**Attachment A**

**Applicable Source Documentation from CCP-AK-LANL-006**

**(On DVD)**

## Attachment A
## Applicable Source Documentation from CCP-AK-LANL-006

| CCP # | Title/ Author | Document No. | Date | LA-UR |
|---|---|---|---|---|
| D007 | Process Acceptable Knowledge Report for Chloride Operations at TA-55 (multiple copies with markup comments), Los Alamos National Laboratory Transuranic Waste Characterization/ Certification Project (TWCP) | | June 21, 2000 | LA-UR-004001 |
| D023 | Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20, TWCP (multiple copies with markup comments) | TWCP-AK-2.1-008,R.2/IC2 | July 26, 2001 | LA-UR-01-2486 |
| D025 | Project 2010 Acceptable Knowledge Report for Debris Waste Streams Containing Pu-239, TWCP | TWCP-AK-2.1-015, R.3 | April 10, 2003 | LA-UR-03-2640 |
| D028 | Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55, TWCP | TWCP-AK-2.1-006, R.2 | May 18, 2001 | LA-UR-01-2558 |
| D029 | Process Acceptable Knowledge Report for Metal Operations Processes at TA-55, TWCP | TWCP-AK-2.1-003 | May 17, 2001 | LA-UR-01-2556 |
| D030_D079 | Process Acceptable Knowledge Report for Special Processing at TA-55, TWCP | TWCP-AK-2.1-007, R.2 | May 18, 2001 | LA-UR-01-2560 |
| D032_D077 | Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55, TWCP | TWCP-AK-2.1-004,R.2 | May 17, 2001 | LA-UR-01-2559 |
| D036 | Process Acceptable Knowledge Report for Nitrate Operations at TA-55, TWCP (multiple copies with markup comments) | TWCP-AK-2.1-005,R.2 | May 17, 2001 | LA-UR-01-2555 |
| D048 | Wastes From Plutonium Conversion and Scrap Recovery Operations, D.C. Christensen et al. | LA-11069-MS | March 1988 | LA-UR-004835 |
| D076 | Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47, TWCP | TWCP-AK-2.1-011,R.0/IC1 | November 5, 2001 | LA-UR-01-4964 |
| D080 | Process Acceptable Knowledge Report for Plutonium-238 | TWCP-AK- | August 7, | LA-UR-01-4200 |

| CCP # | Title/ Author | Document No. | Date | LA-UR |
|---|---|---|---|---|
| | Operations at TA-55, TWCP | 2.1-009,R0 | 2001 | |
| DR036_SD | Acceptable Knowledge Source Document Discrepancy Resolution, LANL List of 291 Nitrate Salt Containers, NCR-LANL-0509-09, R.0, AK6 DR036, R. Fitzgerald (CCP) | NCR-LANL-0509-09, R.0, AK6 DR036, Attach. 1 | January 22, 2013 | |

TWCP-QP-1.1-004,R.6/IC1
Effective Date: 08/23/00

TWCP-03937

9

# RECORDS SUBMITTAL

**INSTRUCTIONS:** This form is prepared by the record source when submitting individual records, batch data reports, or a records package to the RMDC. For records packages, a Table of Contents (TOC) must also be submitted. Each record submitted requires a complete form.

**MANDATORY:** ✓ To the best of my knowledge, the record(s) have no radioactive contamination.
Signature: John Musgrave

**RECORD SOURCE:**
X TWCP ___ WCRRF ___ RAMROD ___ RANT ___ Group
Other: ___

Submittal Date: 9/22/00 Z-Number: 102484 Name/Org.: JOHN MUSGRAVE/C-11

Originator: ROSEMARY GLENN Organization: JOHN HART & ASSOCIATES

**TYPE OF RECORD/ACTION TO BE TAKEN**

X Individual Record ___ Batch data report ___ Records Package (+ TOC)

X New ___ Revision* ___ Addition* ___ Supersedes*

* Record Barcode Number: ___ *Review Cycle (if applicable): ___ Yes ___ No ___ N/A

**RECORD ID NUMBER:** (e.g., memo symbol number, procedure (include revision), deficiency number, batch data report number, unique record identifier if applicable): LA-UR-004001

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**RECORD TITLE, SUBJECT, AND/OR KEYWORDS:**
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✓ Accepted Date: 9/22/00 ___ Return Date: ___

Signature: [signature] Resubmitted: ___
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**(Subject to change prior to scheduled review cycle).**

**Los Alamos National Laboratory**
**Transuranic Waste Characterization/Certification Project**

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR CHLORIDE OPERATIONS AT TA-55

**LA-UR 004001**

**Date: June 21, 2000**

**Waste Generated from Process/Status Codes:**

CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate)

| | | |
|---|---|---|
| Pamela Rogers<br>Site Project Manager (Print Name) | Pamela Rogers<br>Signature | 9/18/00<br>Date |
| M A Gavett<br>Site Project QA Officer (Print Name) | M A Gavett<br>Signature | 9/19/00<br>Date |
| Rosemary T. Glenn<br>Preparer (Print Name) | Rosemary T Glenn<br>Signature | 9-13-00<br>Date |
| Matt J. Riggs<br>Waste Certification Official (Print Name) | Matt J. Riggs<br>Signature | 9/19/00<br>Date |
| Charles L. Foxx<br>Facility Representative (Print Name) | Charles L. Foxx<br>Signature | 9/21/00<br>Date |

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**Attachments**

1 Acceptable Knowledge Summary (1 page)

2 Time Lines—Chloride Operations (1 page)

3 Acceptable Knowledge Roadmap (3 pages)

4 Map of TA-55 (1 page)

5 Process Input/Output Table and List of Feed Materials (6 pages)

6 Simplified Schematic of Chloride Line (1 page)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| CFR | *Code of Federal Regulations* |
| DOE | U.S. Department of Energy |
| EPA | U.S. Environmental Protection Agency |
| LANL | Los Alamos National Laboratory |
| PAFD | process accountability flow diagram |
| PCB | polychorinated biphenyl |
| P/S [code] | process/status [code] |
| RCRA | Resource Conservation and Recovery Act |
| RMDC | Records Management/Document Control |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) |
| SAR | safety analysis report |
| SOP | safe operating procedure |
| TA | technical area |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization/Certification Project |
| WAC | waste acceptance criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |

# DRAFT PROCESS ACCEPTABLE KNOWLEDGE REPORT CHLORIDE OPERATIONS AT TA-55

## INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plan (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

## 1.0 METHODOLOGY OF AK INFORMATION SEARCH

The AK search for the information related to waste streams resulting from chloride operations covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (Cl-1/TWCP-PLAN-0.2.7-001,R.2) (Sampling Plan) that includes information regarding all waste streams

- Review of documents related to the waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 3) (safety analysis reports [SARs], safe operating procedures [SOPs], reports, memos, etc.) (Cl-6 through Cl-22 [all in TWCP-3547])

- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Cl-23 through Cl-27 [all in TWCP-3547])

- Analysis of processes generating waste, including in-process sampling and testing.

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report.

## 2.0 DESCRIPTION OF CHLORIDE OPERATIONS PROCESSES

The following sections describe chloride operations processes, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 2.1 Facility and Mission

The Technical Area (TA)-55 Plutonium Reprocessing facility processes plutonium from residues generated through the defense complex into pure plutonium feedstock. The waste streams generated at the TA-55 Plutonium Reprocessing facility as waste from chloride process operations to reprocess/recover plutonium are entirely defense related (Cl-3/TWCP-614). These waste streams were generated at building PF-4 of the TA-55 plutonium facility. A map of the TA-55 facility is attached to this report (Attachment 4).

### 2.2 Waste Physical Form and Content Description

Wastes generated during chloride operations, primarily debris wastes and wastes entered into the cement fixation process, are covered by this Draft Process Acceptable Knowledge Report for Chloride Operations

at TA-55. They are identified by having the process status codes for chloride operations: CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, and PB; CC applies to both chloride and nitrate operations. General debris waste categories include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape)
- Rubber
- Metal debris (for example, wire, hose clamps, tools)
- Glass debris
- Steel packaging materials

These debris items are contaminated with small amounts of material from chloride operations.

### 2.3 Waste Volume and Time Period of Generation

This report covers waste streams generated from 1982, when the chloride line was first developed, to the present. Wastes generated in the chloride operations have process/status (P/S) codes CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, and PB; CC applies to both chloride operations and nitrate operations. Wastes from the chloride operations have different associated Resource Conservation and Recovery Act (RCRA) codes depending on the time period they were generated. The P/S codes, their time period of generation, and corresponding RCRA codes are shown graphically in Attachment 2, Time Lines—Chloride Operations.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

### 2.4 Waste Stream Generation Process

The following sections describe the generation of waste streams as well as outputs to the nitrate operation.

#### 2.4.1 Overview

Manufacturing and research operations performed at TA-55 in the production of plutonium result in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (Cl-2/TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various Los Alamos National Laboratory (LANL) facilities and other U.S. Department of Energy (DOE) sites. These recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

#### 2.4.2 Process Descriptions

Detailed information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (Cl-2/TWCP-352). In general, TA-55 plutonium recovery processes can be divided into three major process lines:

- Aqueous chloride-based processes
- Aqueous nitrate-based processes
- Pyrochemical operations

This report concerns only the first of these, the aqueous chloride-based process line.

The primary feed sources for the chloride processes are plutonium residues from pyrochemical operations, metal preparation, metal fabrication, analytical laboratory operations (see below), and residues from other DOE facilities. The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal.

As mentioned above, analytical laboratory operations are one feed into the chloride operations. Samples from the various stages of the production of plutonium are sent for chemical (e.g., radiochemical) analyses. After analysis, excess samples that are either an intermediate or direct product having considerable value, and sample residues rich in plutonium, are returned to TA-55 as feedstock for the production of plutonium metals and oxides. The solvents used in some of the analytical analyses do not carry over an RCRA F listing designation because the sample residues are not a solid waste and are considered feedstock.

Chloride operations can be broken down into the following process steps:

- Pretreatment
- Dissolution
- Purification
- Hydroxide Precipitation

Each of these process steps is described below. A complete listing of P/S codes, their descriptions, and their inputs and outputs is found in Attachment 5, along with a list of feed materials into the chloride process. A simplified schematic diagram of chloride operations is found in Attachment 6.

#### 2.4.2.1 Pretreatment (P/S codes CR, PB, PUB)

Pretreatment includes primarily physical processes used to prepare scrap and residues for dissolution. Pretreatment may include sorting, crushing, and/or pulverizing (P/S code CR; see *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* [TWCP-3940]). As materials are received from various areas in TA-55, they are sorted and sent to various other pretreatment processes or directly to dissolution, depending on the physical nature of the scrap or residue, and the amount and type of plutonium associated with the material.

A separate pretreatment procedure is the decladding of plutonium-beryllium sources (P/S codes PB, PUB; Cl-14/TWCP-3547, Cl-20/TWCP-3547, Cl-21/TWCP-3547). The metal is removed from the sources, and is placed into containers with metal from all other PF-4 operations (the metals waste stream; not a chloride operations waste). The Pu-Be sources, after the cladding has been removed, are entered into the chloride line for plutonium recovery along with other materials. The P/S code for the decladding and processing of the Pu-Be sources in the chloride line was PB prior to 1988, and PUB from 1988 to the present.

#### 2.4.2.2 Dissolution (P/S codes CLRD, CX, CXL, CL, LD, CLS)

In general, the dissolution step can be described as the use of hydrochloric acid to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory known at different times as CHM-1, CLS-1, CST-1, and NMT-1. The scrap and residues may include lead, cadmium, mercury, and chromium from feed materials (see Attachment 5), as

well as from the stainless steel and shielding used in the chloride operations equipment (Cl-27/TWCP-3547).

The chloride line was developed in 1982, and operated under P/S code CLRD until 1984; as P/S code CX (along with other more feed-specific codes described below) until 1994; and as P/S code CXL from 1994 to the present.

**NOTE**: After dissolution, if a plutonium-containing solution contained too much iron for the solvent extraction process, it went to +3 ion exchange (not to be confused with the +4 ion exchange as a part of purification) as an intermediate step prior to entering the purification phases of chloride operations.

Some P/S codes were used for dissolution of specific feed materials. CL, used from 1985 to 1990, applied to crucible leaching in HCl. LD, used from 1988 to 1992, applied to the dissolution step for most materials but specifically excluded solutions from the analytical laboratory (CLS-1, etc.). P/S codes MB and MS, 1985–1990, were used for molten salts/pyrochemical salts dissolution only. CLS was used when solutions from the analytical laboratory were the only feed material.

Waste solids from HCl dissolution generally went to cement fixation, but on occasions to debris waste (Cl-26/TWCP-3547). Since analyses have not been performed on these wastes, all are required to carry the RCRA codes for cadmium (D006), chromium (D007), lead (D008), and mercury (D009), due to the presence of these metals in the feedstock and equipment.

#### 2.4.2.3 Purification (P/S codes CX, CS, CSE, SE, CL, CLS, MB, MS, PRR, PB, and PUB)

The purification steps in the chloride line may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the solutions to be purified.

Solvent extraction (P/S codes CSE and SE) has been used in the chloride line since 1985 (Cl-26/TWCP-3547, Cl-27/TWCP-3547). The RCRA-regulated solvent, tetrachloroethylene (F002), was used in the solvent extraction process until 1992. Debris waste from the solvent extraction process up until 1992 therefore carries the EPA code F002, as do liquid wastes absorbed in vermiculite. However, pieces left after filtration in the hydrochloric acid dissolution step are removed from the line prior to solvent extraction, so do not carry the F002 designation (see Attachment 6, Simplified Schematic of the Chloride Line).

Silver nitrate titration was used to determine chloride concentration (also resulting in formation of potassium chromate) in both the solvent extraction and ion exchange processes up until 1992, so the RCRA codes D011 and D006 are applied to all wastes during this time period.

The chloride line was halted from 1992 until 1994. When it resumed operation, non-RCRA-regulated solvents replaced the TCE used in solvent extraction, and silver nitrate titration was no longer performed. P/S code CXL was initiated to denote the newly operational chloride line.

During the operation of the chloride line, some leaching of chromium from the stainless steel equipment, and lead and cadmium from shielding, always occurs, and mercury (from feed materials) is present as well (Cl-27/TWCP-3547). These metals concentrate in the cement-fixated waste from chloride operations, and when analyses have been run on these wastes, they were over RCRA limits (Cl-27/TWCP-3547). Since analyses for these metals have not been performed on debris waste, they are also required to carry the above RCRA codes.

Ion exchange columns (+3 and +4) are used to collect plutonium and separate out impurities such as americium and uranium (P/S codes CX, CXL, and PRR). When discarded, the resins carry the EPA codes D006-D009 for the cadmium, chromium, lead, mercury, and prior to 1994, D011 for silver.

The enriched plutonium solutions from solvent extraction or ion exchange are treated with oxalic acid (oxalate precipitation) (P/S codes CS, CSE, CX, CXL, PB, PUB, and SE), and the resulting plutonium precipitate goes to be calcined (P/S code CC) and eventually to the vault. The liquid solution goes to hydroxide precipitation.

#### 2.4.2.4 Hydroxide Precipitation (P/S codes CLS, CW, PRR)

In this step, the solutions from purification steps are precipitated with potassium, magnesium, or sodium hydroxide. The resulting enriched cakes (greater than economic discard level) go to nitrate operations for further processing (see Time Lines in Attachment 2 for P/S codes and corresponding RCRA codes). The hydroxide cake (lower than economic discard level) fines were cemented until 1995, with large chunks of hydroxide filtrate cakes (lower than economic discard level) placed into containers for disposal. Based on a revision to the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) (WIPP WAC) in 1995, all cake material lower than a revised economic discard level is containerized for disposal as debris waste. Waste caustic liquid meeting the TA-50 waste acceptance criteria (WAC) is disposed through the caustic waste line. P/S code CW was used from 1985 to 1992 for feed materials specifically containing analytical laboratory (CLS-1, etc.) solutions as feed material. Occasionally, solutions from hydroxide precipitation are returned to HCl dissolution for reprocessing (see Attachment 6); RCRA code assignments would then be reflected through other P/S codes.

### 2.4.3 Process Flow Diagrams

A simplified process flow diagram of the TA-55 chloride operations is included as Attachment 6 to this report. Individual process accountability flow diagrams (PAFDs) for the chloride P/S codes are included in the procedures referenced in the AK Roadmap found in Attachment 3.

## 2.5 Material Inputs to the Waste Generation Process

The material inputs to waste from chloride operations are described below.

### 2.5.1 Physical Waste Form Identification

Since items from several different processes are usually combined into one waste drum, the physical waste form of each drum must be determined independently. The physical description of each waste item generated is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form.

For chloride operations, waste consists primarily of debris and cemented waste.

### 2.5.2 Radionuclide Content Identification

The primary plutonium material type inputs for chloride operations at TA-55 are listed in reference Cl-4/TWCP-698. The material type provides the major radionuclide components of the waste and yields an estimated Am-241 content by calculation. However, some of the plutonium recovery processes separate plutonium and americium, so that their ratios may be altered in the outputs from the processes. According to reference CL-5/TWCP-882, waste items from P/S code CXL may be either depleted or enriched in americium depending on whether the source of contamination is the process product or the

process residues; however, in general, the waste will be enriched in americium (Cl-26/ TWCP-3547). Individual waste packages undergo gamma spectroscopy to provide detailed radionuclide characterization information.

### 2.5.3 Chemical Content Identification

The chemical content of waste from the chloride processes is in the form of debris waste, cemented waste, or occasionally pieces of hydroxide cake, which consist primarily of salts such as potassium chloride, sodium chloride, and calcium chloride and are entered into the cement fixation process or debris waste (Cl-26/TWCP-3547). In addition, caustic solutions from hydroxide precipitation are discarded through the waste line to TA-50. A table listing all P/S codes, their descriptions, and their inputs/outputs is provided in Attachment 5.

## 3.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA hazardous waste codes is described below.

### 3.1 F, K, and P Listings

As described in Sections 2.3 and 2.4 of this report, the F002 code is assigned only to debris waste and waste absorbed in vermiculite from the solvent extraction process, up until 1992. After 1994, no F coded waste resulted from chloride operations. No K or P codes are assigned to chloride operations waste.

### 3.2 Toxicity

As outlined in Section 2.3 and 2.4 of this report, all waste from the chloride line from 1982 through 1992 are assigned the toxicity characteristic codes D006, D007, D008, D009, and D011 for cadmium, chromium, lead, mercury, and silver. After 1992, the code for silver (D011) was removed from the waste due to a process change (Cl-23/TWCP-3547).

### 3.3 Corrosivity, Reactivity, and Ignitability

See Section 4.0.

## 4.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

See Section 5.0.

## 5.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

All waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals per 49 *Code of Federal Regulations* (CFR) Section 177.848, and were determined to be in compliance with this requirement.

In addition, since 1987, waste generators sign a statement on the WODF stating that the waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders, or materials other than the indicated matrix."

Also, the Waste Profile Request Forms (used after 1991) include statements that the waste related to chloride operations is not ignitable (flash point >200 F), reactive, or corrosive (not applicable for solid [physical form] waste).

## 6.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN 4 L IN VOLUME, NOR >1% RADIONUCLIDE PYROPHORICS

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume must be obtained from radiography. For pyrophorics, see Section 5.0.

## 7.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs)

No PCBs were introduced into the chloride operations, as documented in the TA-55 procedures.

## 8.0 DETERMINATION OF THE RADIONUCLIDE ISOTOPIC COMPOSITION

See Section 2.5.2.

## 9.0 PACKAGING

Waste packaging information will be addressed in a separate report. The waste packaging report will describe packaging configurations, packaging materials, layers of confinement, and types of inner-layer closure. The report will summarize waste packaging operations applicable to all processes at TA-55.

## ACCEPTABLE KNOWLEDGE SUMMARY

**P/S Codes:** CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate)

**Site:** LANL

**Facility Mission (including defense and non-defense programs):**

The TA-55 Plutonium Reprocessing facility processed Pu-239 from residues generated throughout the defense complex into pure plutonium feedstock. The waste streams from P/S codes CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate) were generated at the TA-55 Plutonium Reprocessing facility from chloride operations for plutonium recovery and purification.

**Description of the waste stream**:

Waste from chloride operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, glass debris, and steel packaging materials, and waste sent for cement fixation.

**Area(s) or building(s) where the waste stream was generated (including operations carried out in those areas)**:

Chloride operations wastes are generated at the PF-4 wing, Room 420, of the TA-55 plutonium facility. Manufacturing and research operations performed at TA-55 in the production of plutonium result in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

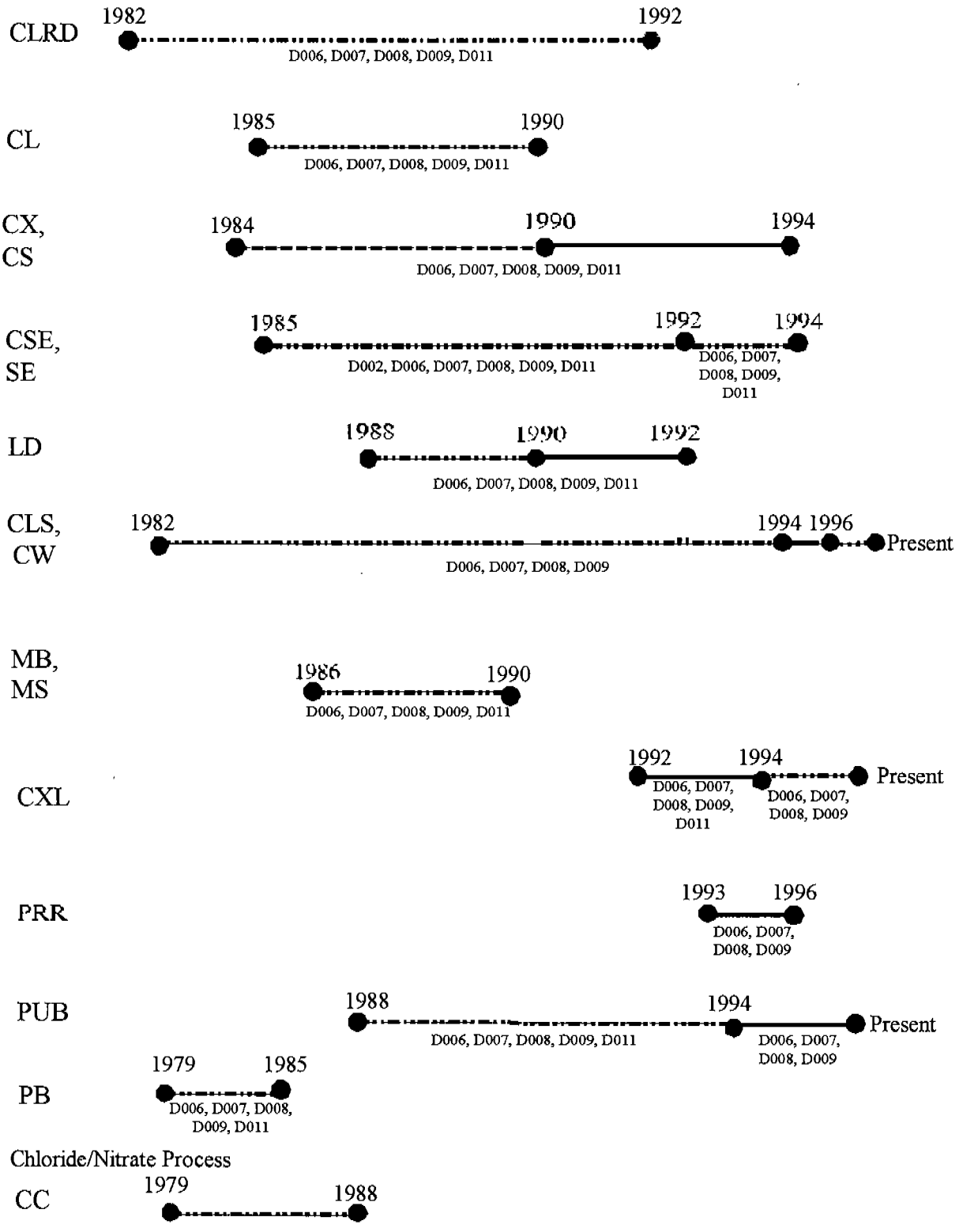
**Waste stream volume and time period of generation**:

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document. The time period of waste generation for chloride operations is from 1982 to the present.

**Waste generating processes and material inputs:**

The primary feed sources for the chloride processes are plutonium residues from pyrochemical operations, metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. Processes include pretreatment, dissolution, purification, and hydroxide precipitation.

## TIME LINES: CHLORIDE OPERATIONS



## TIMELINE EXPLANATION



The P/S code is established in either the P/S diagrams or in both (or all) revisions of the procedures designating the start and end dates (e.g., Rev. 0 to Rev. 1; or Rev. 0 to Rev. 5)



The P/S code is not identified in the procedure, but the process description matches the P/S code and the description in previous or later revisions of the same procedure.



Extrapolate out two(2) years beyond the last procedure to next possible review date.



Time period based on subject matter expert comments.

## ACCEPTABLE KNOWLEDGE ROADMAP

**P/S Codes:** CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate)

Documents are in the TWCP Records Management Center

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-1/TWCP-PLAN-02.7-001, R.2 | b | Waste stream delineation | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-02.7-001,R.2) | Correlations between waste streams from TA-55 with regard to time of generation, waste generating processes, and site-specific facilities | The LANL TRU Waste Characterization Sampling Plan contains information that was extracted from the TRI waste database (CST-14 database). As explained in Section 3 (for retrievably stored waste) and Section 5 (for newly generated waste), the TA-55 controlled database should be used for waste stream characterization. |
| Cl-2/TWCP-352 | b | Description of plutonium recovery processes | Wastes from Plutonium Conversion and Scrap Recovery Operations, LA-11069, March 1988 | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| Cl-3/TWCP-619 | d | All TA-55 waste is defense related | Memo from Doug Sankey. | All TA-55 waste is defense related | None |
| Cl-4/TWCP-698 | b | Gives Material Type compositions | NMT memo WM/EC96-032 | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes |
| Cl-5/TWCP-882 (UCNI) | d | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process status code. Covers time period from 1978 to the present. | Best information available, but it is based on worker recollection because other records are not available. |
| Cl-6/TWCP-3547 | c | Developmental Chloride Solvent Extraction Process | Procedure 462-REC, all revisions | Describes development of chloride line processes | Limited information on wastes |

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-7/TWCP-3547 | c | Recovery and Purification of Pu from Direct Oxide Reduction (DOR) Salts by Chloride Anion Exchange | Procedure 463-REC, all revision | Process descriptions | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-8/TWCP-3547 | c | Hydroxide Precipitation of Chloride Solutions Containing Organic Chemicals | Procedure 467-REC, all revisions | Process descriptions | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-9/TWCP-3547 | c | Dissolution and/or Leaching of Various Materials in HCl | Procedure 470-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-10/TWCP-3547 | c | Oxalate Precipitation of Plutonium from Chloride Solutions | Procedure 471-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-11/TWCP-3547 | c | Chloride Solvent Extraction | Procedure 472-CLO | Process description | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-12/TWCP-3547 | c | Purification and Recovery of Plutonium by Chloride Anion Exchange | Procedure 473-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-13/TWCP-3547 | c | Hydroxide Precipitation of Chloride Waste Streams | Procedure 474-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-14/TWCP-3547 | c | Recovery of Plutonium from Plutonium-Beryllium Neutron Sources | Procedure 476-CLO, all revisions | Process description | Detail only in decladding operation |
| Cl-15/TWCP-3547 | c | Calcination Operation for Aqueous Chloride Processes | Procedure 477-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-16/TWCP-3547 | c | Dicesium Hexachloro Plutonate | Procedure 478-CLO, all revisions | Process description | Additional step of DCHP precipitation used for certain feed material only |
| Cl-17/TWCP-3547 | c | Head End Processing of Aqueous Chloride Plutonium | Procedure 479-CLO, all revisions | Process description | Does not describe where silver nitrate and potassium chromate are disposed of |
| Cl-18/TWCP-3547 | c | Hydroxide Precipitation of the Plutonium in Chloride Waste | Procedure 481-REC, all revisions | Process description | Describes only one portion of chloride line |

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-19/TWCP-3547 | c | Recovery of Plutonium from Hydrochloric CLS-1 Solutions | Procedure 482-REC, all revisions | Process description | Does not address RCRA-regulated solvents |
| Cl-20/TWCP-3547 | c | Decladding of PuBe Neutron Sources | Procedure 482-CLO, all revisions | Process description | Decladding only |
| Cl-21/TWCP-3547 | c | Purification and Recovery of Pu by Chloride Anion Exchange | Procedure 483-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-22/TWCP-3547 | c | Radiochemical Analysis at TA-55 | Procedure 029-CST-1, R02 | Process description | Feed material only; does not address further processing |
| Cl-23/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Jim Foxx 8/31/99 | Answers to questions on Chloride processes | none |
| Cl-24/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Jim Foxx, 9/15/99 | Answers to questions on Chloride processes | none |
| Cl-25/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Jim Foxx, 9/23/99 | Answers to questions on Chloride processes | none |
| Cl-26/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Tim Hayes, 1/12/00 | Answers to questions on Chloride processes | none |
| Cl-27/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Tim Hayes, 6/1/00 | Answers to questions on Chloride processes | none |
| TWCP-3940 | b | Process AK Report on Nitrate Process Operations at TA-55 | Process Acceptable Knowledge for Nitrate Operations at TA-55 | Contains all information located on nitrate processes at TA-55 from 1978 to the present.. | none |

*As defined in TWCP-QP-1.1-021, Section 6.2.4:

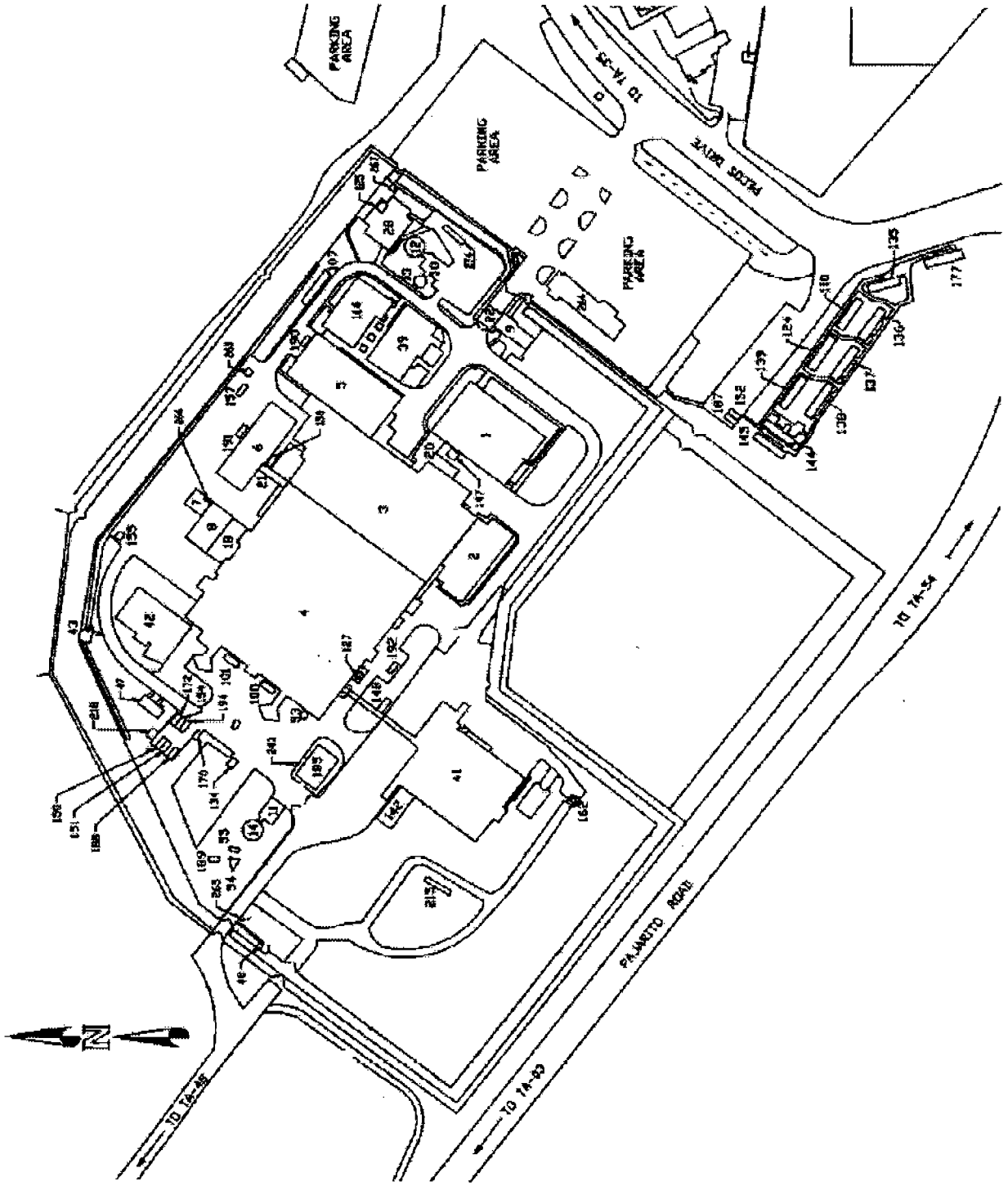
a. Forms intended for use in waste certification

b. Data from controlled databases and published documents

c. Unpublished data

d. Interviews, memos, and letters

**MAP OF TA-55**


PARKING AREA
PARKING AREA
PARKING AREA
SAWYER SOUTH
TO TA-54
PAJARITO ROAD
TO TA-60
TO TA-46
N

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| CC | Calcination | OY | none | Pu oxide to vault; to P/S code OR | none | none | CI-26, PAFD 3/85 |
| CL | Crucible Leach | Crucibles | Hydrochloric acid | Pu-enriched solutions to P/S codes SE or CX (chloride line) (hydroxide cake) for further processing; P/S code SP (nitrate line); vault | 1) Crucible pieces to cement fixation (or on occasion, debris waste)<br><br>2) Debris waste | D006, D007, D008, D009, D011 | CI-26, PAFD 10/86 |
| CLRD | Aqueous Chloride R&D | See Chloride Feed Materials list | Hydrochloric acid, other chemicals depending on R&D projects | Pu-enriched solutions to vault; hydroxide cake | Debris waste | D006, D007, D008, D009, D011 | PAFD 10/90 |
| CLS | Accountable CLS Chloride Solutions | Analytical laboratory sample residues | Magnesium hydroxide, potassium hydroxide, sodium hydroxide | vault; hydroxide cake | Debris waste | D006, D007, D008 | CI-15, CI-20, CI-27 |
| CS | Chloride Solutions | P/S codes CX, various other feed materials (see list) | Oxalic acid, hydroxylamine hydrochloride, potassium fluoride, sodium hydroxide, sodium bicarbonate, bromocresol purple, silver nitrate, potassium chromate, argon gas, aluminum chloride | vault; hydroxide cake | Debris waste | D006, D007, D008, D009, D011 | CI-26, PAFD 11/86 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| CSE | Chloride Solvent Extraction | P/S codes CX, CSE, various other feed materials (see list) | Hydrochloric acid, oxalic acid, hydroxylamine hydrochloride, potassium fluoride, calcium carbonate, sodium hydroxide, sodium bicarbonate, bromocresol purple, silver nitrate, potassium chromate, argon gas, aluminum chloride, TCE, TBP | vault; hydroxide cake | 1) Debris waste<br><br>2) Liquids absorbed in vermiculite<br><br>3) Pieces left after filtration to cement fixation | F002, D006, D007, D008, D009, D011 | Cl-26, Cl-27, PAFD 8/89 |
| CX | Chloride Anion Exchange | P/S codes ST, PTP, PK, PRR, OR, EXT, SS | Hydrochloric acid, oxalic acid, hydroxylamine hydrochloride, potassium fluoride, calcium carbonate, sodium hydroxide, sodium bicarbonate, bromocresol purple, silver nitrate, potassium chromate, argon gas, aluminum chloride, sodium nitrite | P/S codes SP or HCD (nitrate line) (hydroxide cake); Pu oxide to vault; recycle back or continue through chloride process | 1) Pieces left after filtration to cement fixation<br><br>2) Ion exchange resins to cement fixation<br><br>3) Debris waste | D006, D007, D008, D009, D011 | Cl-10, Cl-12, Cl-17, Cl-21, Cl-27 |
| CXL | Experimental Chloride Extraction Line | See Chloride Feed Material list; note no RCRA-regulated solvents used after 1992. | Hydrochloric acid, oxalic acid, calcium carbonate, magnesium hydroxide, potassium hydroxide, sodium hydroxide, bromocresol purple, ferrous chloride, stannous chloride, calcium fluoride, sodium nitrite, cesium chloride, argon gas, aluminum chloride | P/S codes SP, CR, LR, DS, or NR (all nitrate line) (hydroxide cake); recycle back or continue through chloride process; vault | 1) Pieces left after filtration to cement fixation (or occasionally, debris waste)<br><br>2) Ion exchange resins to cement fixation<br><br>3) Debris waste | D006, D007, D008, D009 | Cl-10, Cl-12, Cl-13, Cl-15, Cl-16, Cl-19, Cl-21 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| CW | Caustic Waste | P/S codes CLS, CSE, other chloride solutions | Calcium or sodium or potassium hydroxide | P/S code HCD (nitrate line) (hydroxide cake) or vault | Debris waste | D006, D007, D008, D009 | Cl-26, Cl-27, PAFD 10/86 |
| LD | Chloride Leach & Dissolution | P/S code SS; also see Chloride Feed Materials list | Hydrochloric acid | P/S code CX (chloride line); SP (nitrate line) (hydroxide cake); Pu oxide to vault | 1) Pieces left after filtration to cement fixation (or occasionally, debris waste)<br><br>2) Debris waste | D006, D007, D008, D009, D011 | Cl-26, PAFD 9/88 |
| MB | Nitric Dissolution of Molten Salts | Molten salts | Hydrochloric acid, nitric acid | P/S codes SE or CS (chloride line), LR or CN or PS (nitrate line) (hydroxide cake) | Debris waste | D006, D007, D008, D009, D011 | Cl-26, PAFD 10/86 |
| MS | Molten Salts Purification Dissolution | Molten salts | Hydrochloric acid | P/S code SE (chloride line); Pu oxide to vault; hydroxide cake | Debris waste | D006, D007, D008, D009, D011 | Cl-26, PAFD 6/85 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| PB | Pu-Be Source Recovery | Pu-Be sources | Hydrochloric acid, sodium nitrite, DCHP, oxalic acid, potassium hydroxide, silver nitrate, hydroxylamine hydrochloride, bromocresol purple, sodium bicarbonate, potassium dichromate, hydrofluoric acid, calcium carbonate, stannous chloride, aluminum chloride | P/S codes CXL (recycle back through chloride line); P/S codes HCD, CD (nitrate line) (hydroxide cake) | 1) Metal cladding to metals waste stream<br><br>2) Pieces left after filtration to cement fixation<br><br>3) Debris waste | none<br><br>D006, D007, D008, D009, D011 | Cl-20, Cl-21 |
| PRR | Pyrochemical Residue Recovery | See Chloride Feed Materials list | Hydrochloric acid, oxalic acid, calcium carbonate, magnesium hydroxide, potassium hydroxide, sodium hydroxide, bromocresol purple, argon gas, aluminum chloride | P/S codes CX, CXL (chloride line); P/S code SP (nitrate line) (hydroxide cake), vault | 1) Pieces left after filtration to cement fixation<br><br>2) Ion exchange resins to cement fixation<br><br>3) Debris waste | D006, D007, D008, D009, D011 | Cl-15, Cl-19, Cl-21 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| PUB | Pu/Be Source Recovery | Pu-Be sources | Hydrochloric acid, sodium nitrite, DCHP, oxalic acid, potassium hydroxide, silver nitrate, hydroxylamine hydrochloride, bromocresol purple, sodium bicarbonate, potassium dichromate, hydrofluoric acid, calcium carbonate, stannous chloride, aluminum chloride | P/S codes CXL (chloride line); P/S codes HCD, CD (nitrate line) (hydroxide cake) | 1) Metal cladding to metals waste stream<br><br>2) Pieces left after filtration to cement fixation<br><br>3) Debris waste | none<br><br>D006, D007, D008, D009, D011 | Cl-14, Cl-20, Cl-21 |
| SE | Solvent Extraction | P/S codes PK, LD, CS, PTP | Hydrochloric acid, oxalic acid, hydroxylamine hydrochloride, potassium fluoride, calcium carbonate, sodium hydroxide, sodium bicarbonate, bromocresol purple, silver nitrate, potassium chromate, argon gas, aluminum chloride, TCE, TBP, CMPO | P/S code CS (chloride line), vault; hydroxide cake | 1) Debris waste<br><br>2) Liquids absorbed in vermiculite<br><br>3) Pieces left after filtration to cement fixation | F002, D006, D007, D008, D009, D011 | Cl-26, Cl-27, PAFD 11/86 |

[1] All P/S codes generate routine laboratory debris waste consisting of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated.

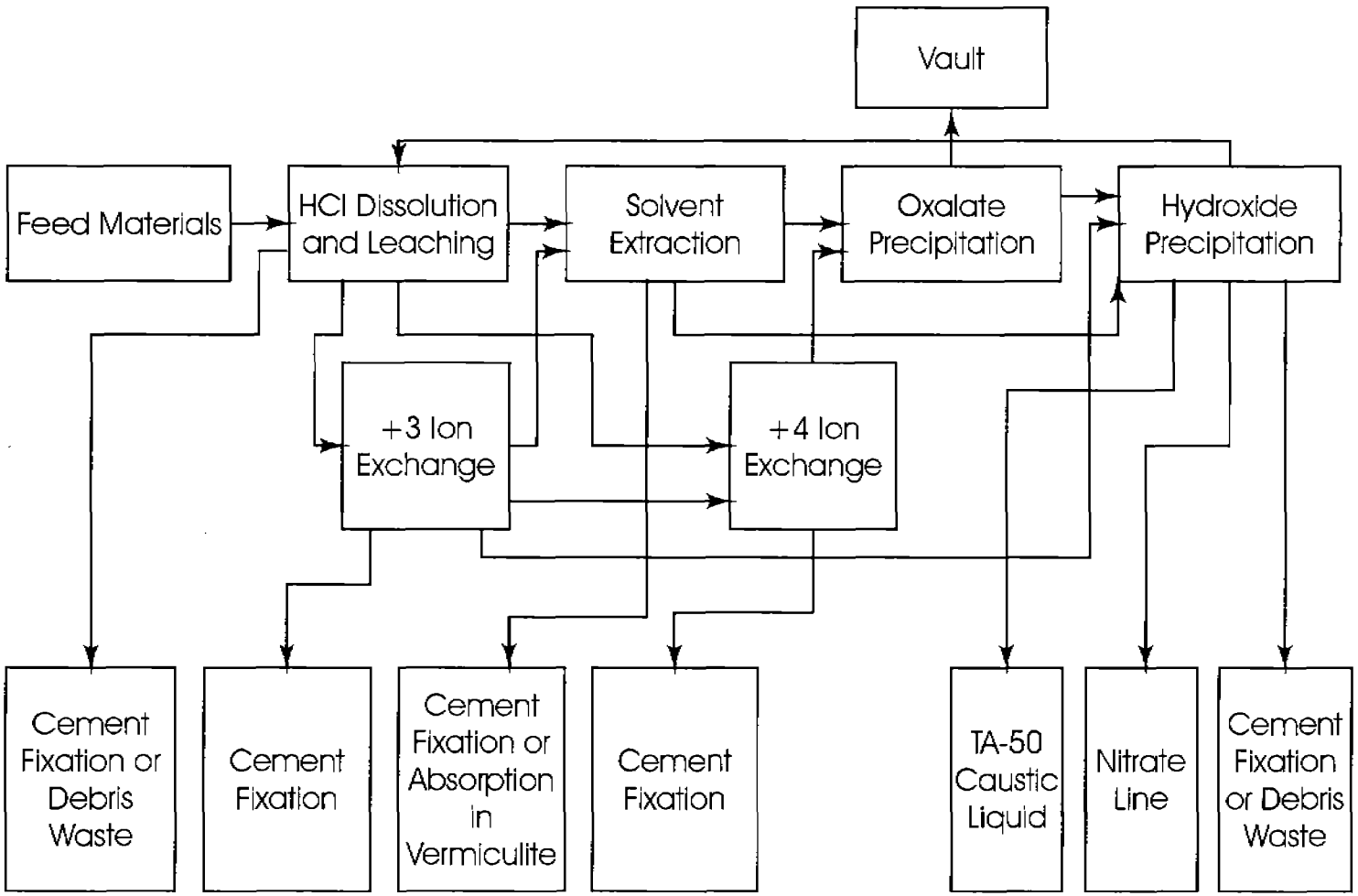
[2] All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other debris waste and are assigned EPA hazardous waste code D008. The D008 code is assigned to the leaded gloves waste stream rather than to each P/S code waste stream.

[3] Refer to the Acceptable Knowledge Roadmap in Attachment 3.

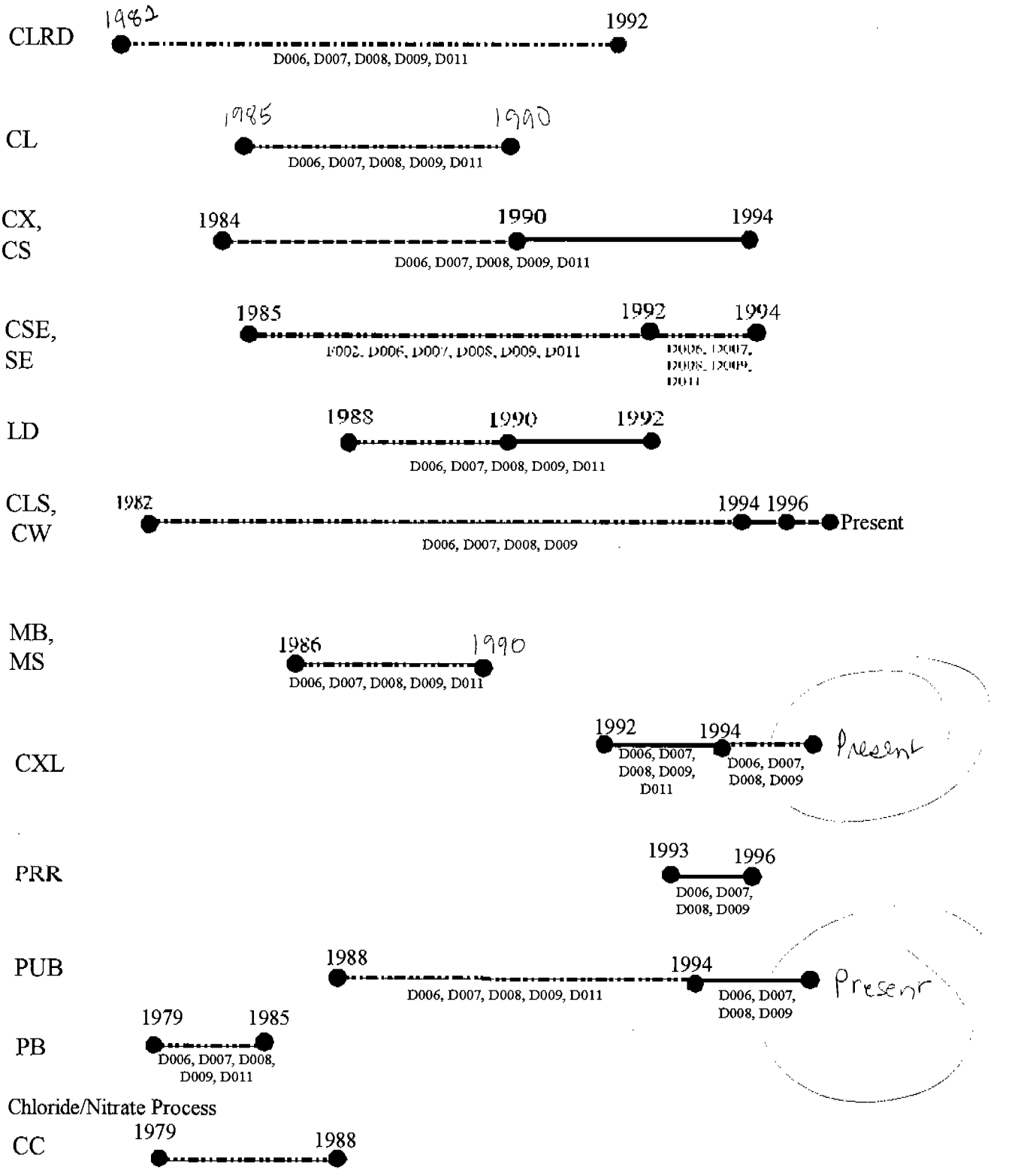
## LIST OF CHLORIDE OPERATIONS FEED MATERIALS

- impure Pu metal
- pyrochemical salts
- crucible pieces (tantalum, magnesium oxide)
- impure metals, including cadmium, mercury, zinc, chromium
- anode heels
- oxides
- hydroxides
- Pu-Be sources and turnings
- stainless steel and/or tantalum residues from decladding of Pu-Be sources
- analytical laboratories (CLS-1, etc.) solutions

Attachment 6. Simplified Schematic of Chloride Line



## TIME LINES: CHLORIDE OPERATIONS



## TIMELINE EXPLANATION



The P/S code is established in either the P/S diagrams or in both (or all) revisions of the procedures designating the start and end dates (e.g., Rev. 0 to Rev. 1; or Rev. 0 to Rev. 5).



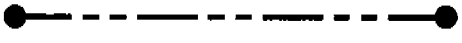
The P/S code is not identified in the procedure, but the process description matches the P/S code and the description in previous or later revisions of the same procedure.



Extrapolate out two (2) years beyond the last procedure to next possible review date.



The P/S code is not identified in the procedure, but the process description matches that of the P/S diagram or P/S code description.



Time period based on subject matter expert comments

**Los Alamos National Laboratory**
**Transuranic Waste Characterization/Certification Project**

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR CHLORIDE OPERATIONS AT TA-55

**LA-UR 004001**

**Date: June 21, 2000**

**Waste Generated from Process/Status Codes:**

CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate)

| | | |
|---|---|---|
| Site Project Manager (Print Name) | Signature | Date |
| Site Project QA Officer (Print Name) | Signature | Date |
| Preparer (Print Name) | Signature | Date |
| Waste Certification Official (Print Name) | Signature | Date |
| Facility Representative (Print Name) | Signature | Date |

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**Attachments**

1 Acceptable Knowledge Summary (1 page)

2 Time Lines—Chloride Operations (1 page)

3 Acceptable Knowledge Roadmap (3 pages)

4 Map of TA-55 (1 page)

5 Process Input/Output Table and List of Feed Materials (6 pages)

6 Simplified Schematic of Chloride Line (1 page)

# DRAFT PROCESS ACCEPTABLE KNOWLEDGE REPORT CHLORIDE OPERATIONS AT TA-55

## INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plan (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

## 1.0 METHODOLOGY OF AK INFORMATION SEARCH

The AK search for the information related to waste streams resulting from chloride operations covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.0) (Cl-1/TWCP-3070) (Sampling Plan) that includes information regarding all waste streams

- Review of documents related to the waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 3) (safety analysis reports [SARs], safe operating procedures [SOPs], reports, memos, etc.) (Cl-6 through Cl-22 [all in TWCP-3547])

- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Cl-23 through Cl-27 [all in TWCP-3547])

- Analysis of processes generating waste, including in-process sampling and testing.

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report.

## 2.0 DESCRIPTION OF CHLORIDE OPERATIONS PROCESSES

The following sections describe chloride operations processes, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 2.1 Facility and Mission

The Technical Area (TA)-55 Plutonium Reprocessing facility processes plutonium from residues generated through the defense complex into pure plutonium feedstock. The waste streams generated at the TA-55 Plutonium Reprocessing facility as waste from chloride process operations to reprocess/recover plutonium are entirely defense related (Cl-3/TWCP-614). These waste streams were generated at building PF-4 of the TA-55 plutonium facility. A map of the TA-55 facility is attached to this report (Attachment 4).

### 2.2 Waste Physical Form and Content Description

Wastes generated during chloride operations, primarily debris wastes and wastes entered into the cement fixation process, are covered by this Draft Process Acceptable Knowledge Report for Chloride Operations

at TA-55. They are identified by having the process status codes for chloride operations: CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, and PB; CC applies to both chloride and nitrate operations. General debris waste categories include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape)
- Rubber
- Metal debris (for example, wire, hose clamps, tools)
- Glass debris
- Steel packaging materials

These debris items are contaminated with small amounts of material from chloride operations.

### 2.3 Waste Volume and Time Period of Generation

This report covers waste streams generated from 1982, when the chloride line was first developed, to the present. Wastes generated in the chloride operations have process/status (P/S) codes CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, and PB; CC applies to both chloride operations and nitrate operations. Wastes from the chloride operations have different associated Resource Conservation and Recovery Act (RCRA) codes depending on the time period they were generated. The P/S codes, their time period of generation, and corresponding RCRA codes are shown graphically in Attachment 2, Time Lines—Chloride Operations.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

### 2.4 Waste Stream Generation Process

The following sections describe the generation of waste streams as well as outputs to the nitrate operation.

#### 2.4.1 Overview

Manufacturing and research operations performed at TA-55 in the production of plutonium result in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (Cl-2/TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various Los Alamos National Laboratory (LANL) facilities and other U.S. Department of Energy (DOE) sites. These recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

#### 2.4.2 Process Descriptions

Detailed information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (Cl-2/TWCP-352). In general, TA-55 plutonium recovery processes can be divided into three major process lines:

- Aqueous chloride-based processes
- Aqueous nitrate-based processes
- Pyrochemical operations

This report concerns only the first of these, the aqueous chloride-based process line.

The primary feed sources for the chloride processes are plutonium residues from pyrochemical operations, metal preparation, metal fabrication, analytical laboratory operations (see below), and residues from other DOE facilities. The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal.

As mentioned above, analytical laboratory operations are one feed into the chloride operations. Samples from the various stages of the production of plutonium are sent for chemical (e.g., radiochemical) analyses. After analysis, excess samples that are either an intermediate or direct product having considerable value, and sample residues rich in plutonium, are returned to TA-55 as feedstock for the production of plutonium metals and oxides. The solvents used in some of the analytical analyses do not carry over an RCRA F listing designation because the sample residues are not a solid waste and are considered feedstock.

Chloride operations can be broken down into the following process steps:

- Pretreatment
- Dissolution
- Purification
- Hydroxide Precipitation

Each of these process steps is described below. A complete listing of P/S codes, their descriptions, and their inputs and outputs is found in Attachment 5, along with a list of feed materials into the chloride process. A simplified schematic diagram of chloride operations is found in Attachment 6.

### 2.4.2.1 Pretreatment (P/S codes CR, PB, PUB)

Pretreatment includes primarily physical processes used to prepare scrap and residues for dissolution. Pretreatment may include sorting, crushing, and/or pulverizing (P/S code CR; see Process Acceptable Knowledge Report for Nitrate Operations). As materials are received from various areas in TA-55, they are sorted and sent to various other pretreatment processes or directly to dissolution, depending on the physical nature of the scrap or residue, and the amount and type of plutonium associated with the material.

A separate pretreatment procedure is the decladding of plutonium-beryllium sources (P/S codes PB, PUB; Cl-14/TWCP-3547, Cl-20/TWCP-3547, Cl-21/TWCP-3547). The metal is removed from the sources, and is placed into containers with metal from all other PF-4 operations (the metals waste stream; not a chloride operations waste). The Pu-Be sources, after the cladding has been removed, are entered into the chloride line for plutonium recovery along with other materials. The P/S code for the decladding and processing of the Pu-Be sources in the chloride line was PB prior to 1988, and PUB from 1988 to the present.

### 2.4.2.2 Dissolution (P/S codes CLRD, CX, CXL, CL, LD, CLS)

In general, the dissolution step can be described as the use of hydrochloric acid to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory known at different times as CHM-1, CLS-1, CST-1, and NMT-1. The scrap and residues may include lead, cadmium, mercury, and chromium from feed materials (see Attachment 5), as

well as from the stainless steel and shielding used in the chloride operations equipment (Cl-27/TWCP-3547).

The chloride line was developed in 1982, and operated under P/S code CLRD until 1984; as P/S code CX (along with other more feed-specific codes described below) until 1994; and as P/S code CXL from 1994 to the present.

**NOTE**: After dissolution, if a plutonium-containing solution contained too much iron for the solvent extraction process, it went to +3 ion exchange (not to be confused with the +4 ion exchange as a part of purification) as an intermediate step prior to entering the purification phases of chloride operations.

Some P/S codes were used for dissolution of specific feed materials. CL, used from 1985 to 1990, applied to crucible leaching in HCl. LD, used from 1988 to 1992, applied to the dissolution step for most materials but specifically excluded solutions from the analytical laboratory (CLS-1, etc.). P/S codes MB and MS, 1985–1990, were used for molten salts/pyrochemical salts dissolution only. CLS was used when solutions from the analytical laboratory were the only feed material.

Waste solids from HCl dissolution generally went to cement fixation, but on occasions to debris waste (Cl-26/TWCP-3547).

### 2.4.2.3 Purification (P/S codes CX, CS, CSE, SE, CL, CLS, MB, MS, PRR, PB, and PUB)

The purification steps in the chloride line may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the solutions to be purified.

Solvent extraction (P/S codes CSE and SE) has been used in the chloride line since 1985 (Cl-26/TWCP-3547, Cl-27/TWCP-3547). The RCRA-regulated solvent, tetrachloroethylene (F002), was used in the solvent extraction process until 1992. Debris waste from the solvent extraction process up until 1992 therefore carries the EPA code F002, as do liquid wastes absorbed in vermiculite. However, pieces left after filtration in the hydrochloric acid dissolution step are removed from the line prior to solvent extraction, so do not carry the F002 designation (see Attachment 6, Simplified Schematic of the Chloride Line).

Silver nitrate titration was used to determine chloride concentration (also resulting in formation of potassium chromate) in both the solvent extraction and ion exchange processes up until 1992, so the RCRA codes D011 and D006 are applied to all ~~the codes listed in this paragraph~~ during this time period.

The chloride line was halted from 1992 until 1994. When it resumed operation, non-RCRA-regulated solvents replaced the TCE used in solvent extraction, and silver nitrate titration was no longer performed. P/S code CXL was initiated to denote the newly operational chloride line.

During the operation of the chloride line, some leaching of chromium from the stainless steel equipment, and lead and cadmium from shielding, always occurs, and mercury (from feed materials) is present as well (Cl-27/TWCP-3547). These metals ~~end up~~ in the cement-fixated waste from chloride operations, and when analyses have been run on these wastes, they were over RCRA limits (Cl-27/TWCP-3547). ~~Therefore, cemented wastes from the chloride line carry the RCRA codes for these metals, except for P/S codes MB and MS since there is no cemented waste from these P/S codes (Cl-26/TWCP-3547).~~

Ion exchange columns (+3 and +4) are used to collect plutonium and separate out impurities such as americium and uranium (P/S codes CX, CXL, and PRR). When discarded, the resins carry the EPA codes D006-D009 for the cadmium, chromium, lead, mercury, and prior to 1994, D011 for silver.

The enriched plutonium solutions from solvent extraction or ion exchange are treated with oxalic acid (oxalate precipitation) (P/S codes CS, CSE, CX, CXL, PB, PUB, and SE), and the resulting plutonium precipitate goes to be calcined (P/S code CC) and eventually to the vault. The liquid solution goes to hydroxide precipitation.

#### 2.4.2.4 Hydroxide Precipitation (P/S codes CLS, CW, PRR)

In this step, the solutions from purification steps are precipitated with potassium, magnesium, or sodium hydroxide. The resulting enriched cakes (greater than economic discard level) go to nitrate operations for further processing (see Time Lines in Attachment 2 for P/S codes and corresponding RCRA codes). The hydroxide cake (lower than economic discard level) fines were cemented until 1995, with large chunks of hydroxide filtrate cakes (lower than economic discard level) placed into containers for disposal. Based on a revision to the *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) (WIPP WAC) in 1995, all cake material lower than a revised economic discard level is containerized for disposal as debris waste. Waste caustic liquid meeting the TA-50 waste acceptance criteria (WAC) is disposed through the caustic waste line. P/S code CW was used from 1985 to 1992 for feed materials specifically containing analytical laboratory (CLS-1, etc.) solutions as feed material. Occasionally, solutions from hydroxide precipitation are returned to HCl dissolution for reprocessing (see Attachment 6); RCRA code assignments would then be reflected through other P/S codes.

### 2.4.3 Process Flow Diagrams

A simplified process flow diagram of the TA-55 chloride operations is included as Attachment 6 to this report. Individual process accountability flow diagrams (PAFDs) for the chloride P/S codes are included in the procedures referenced in the AK Roadmap found in Attachment 3.

## 2.5 Material Inputs to the Waste Generation Process

The material inputs to waste from chloride operations are described below.

### 2.5.1 Physical Waste Form Identification

Since items from several different processes are usually combined into one waste drum, the physical waste form of each drum must be determined independently. The physical description of each waste item generated is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form.

For chloride operations, waste consists primarily of debris and cemented waste.

### 2.5.2 Radionuclide Content Identification

The primary plutonium material type inputs for chloride operations at TA-55 are listed in reference Cl-4/TWCP-698. The material type provides the major radionuclide components of the waste and yields an estimated Am-241 content by calculation. However, some of the plutonium recovery processes separate plutonium and americium, so that their ratios may be altered in the outputs from the processes. According to reference CL-5/TWCP-882, waste items from P/S code CXL may be either depleted or enriched in americium depending on whether the source of contamination is the process product or the process residues; however, in general, the waste will be enriched in americium (Cl-26/ TWCP-3547). Individual waste packages undergo gamma spectroscopy to provide detailed radionuclide characterization information.

### 2.5.3 Chemical Content Identification

The chemical content of waste from the chloride processes is in the form of debris waste, cemented waste, ~~or occasionally~~ pieces of hydroxide cake, which consist primarily of salts such as potassium chloride, sodium chloride, and calcium chloride and are entered into the cement fixation process or debris waste (Cl-26/TWCP-3547). In addition, caustic solutions from hydroxide precipitation are discarded through the waste line to TA-50. A table listing all P/S codes, their descriptions, and their inputs/outputs is provided in Attachment 5.

## 3.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA hazardous waste codes is described below.

### 3.1 F, K, and P Listings

As described in Sections 2.3 and 2.4 of this report, the F002 code is assigned only to debris waste and waste absorbed in vermiculite from the solvent extraction process, up until 1992. After 1994, no F coded waste resulted from chloride operations. No K or P codes are assigned to chloride operations waste.

### 3.2 Toxicity

As outlined in Section 2.3 and 2.4 of this report, ~~cemented wastes and ion exchange resins~~ from the chloride line from 1982 through 1992 are assigned the toxicity characteristic codes D006, D007, D008, D009, and D011 for cadmium, chromium, lead, mercury, and silver. After 1992, the code for silver (D011) was removed from the waste due to a process change (Cl-23/TWCP-3547). ~~An exception for P/S codes MB and MS is described in the sections referenced above, and is shown on the Time Lines in Attachment 2.~~

### 3.3 Corrosivity, Reactivity, and Ignitability

See Section 4.0.

## 4.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

See Section 5.0.

## 5.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

All waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals per 49 *Code of Federal Regulations* (CFR) Section 177.848, and were determined to be in compliance with this requirement.

In addition, since 1987, waste generators sign a statement on the WODF stating that the waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders, or materials other than the indicated matrix."

Also, the Waste Profile Request Forms (used after 1991) include statements that the waste related to chloride operations is not ignitable (flash point >200 F), reactive, or corrosive (not applicable for solid [physical form] waste).

## 6.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN 4 L IN VOLUME, NOR >1% RADIONUCLIDE PYROPHORICS

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume must be obtained from radiography. For pyrophorics, see Section 5.0.

## 7.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs)

No PCBs were introduced into the chloride operations, as documented in the TA-55 procedures.

## 8.0 DETERMINATION OF THE RADIONUCLIDE ISOTOPIC COMPOSITION

See Section 2.5.2.

## 9.0 PACKAGING

Waste packaging information will be addressed in a separate report. The waste packaging report will describe packaging configurations, packaging materials, layers of confinement, and types of inner-layer closure. The report will summarize waste packaging operations applicable to all processes at TA-55.

## ACCEPTABLE KNOWLEDGE SUMMARY

**WSPR No.**

**P/S Codes:** CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate)

**Site:** LANL

**Facility Mission (including defense and non-defense programs):**

The TA-55 Plutonium Reprocessing facility processed Pu-239 from residues generated throughout the defense complex into pure plutonium feedstock. The waste streams from P/S codes CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate) were generated at the TA-55 Plutonium Reprocessing facility from chloride operations for plutonium recovery and purification.

**Description of the waste stream**:

Waste from chloride operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, glass debris, and steel packaging materials, and waste sent for cement fixation.

**Area(s) or building(s) where the waste stream was generated (including operations carried out in those areas)**:

Chloride operations wastes are generated at the PF-4 wing, Room 420, of the TA-55 plutonium facility. Manufacturing and research operations performed at TA-55 in the production of plutonium result in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

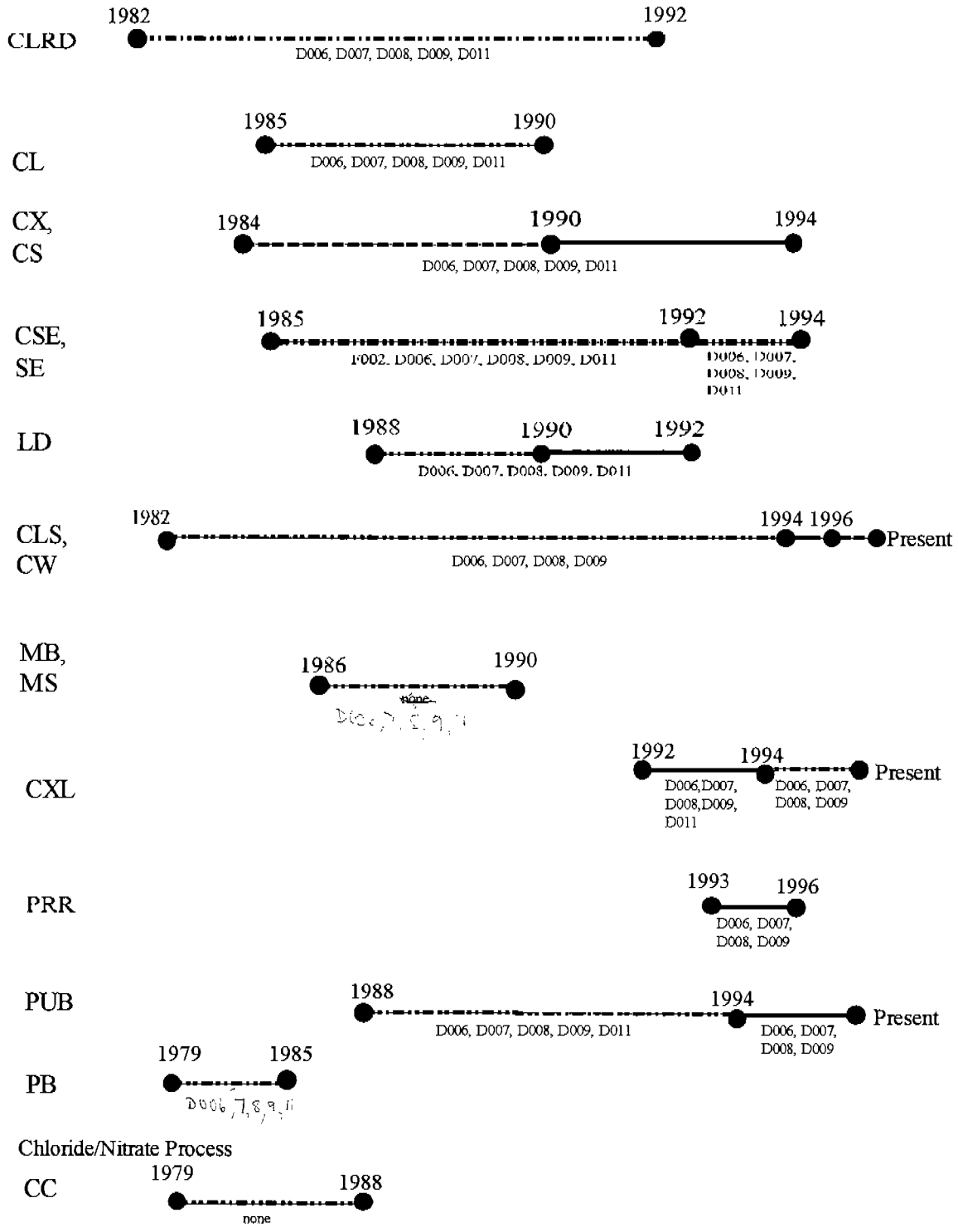
**Waste stream volume and time period of generation**:

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document. The time period of waste generation for chloride operations is from 1982 to the present.

**Waste generating processes and material inputs:**

The primary feed sources for the chloride processes are plutonium residues from pyrochemical operations, metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. Processes include pretreatment, dissolution, purification, and hydroxide precipitation.

## Attachment 2. Time Lines--Chloride Operations



## ACCEPTABLE KNOWLEDGE ROADMAP

**P/S Codes:** CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate)

Documents are in the TWCP Records Management Center

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-1/TWCP-3070 | b | Waste stream delineation | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-02.7-001,R.0) | Correlations between waste streams from TA-55 with regard to time of generation, waste generating processes, and site-specific facilities | The LANL TRU Waste Characterization Sampling Plan contains information that was extracted from the TRI waste database (CST-14 database). As explained in Section 3 (for retrievably stored waste) and Section 5 (for newly generated waste), the TA-55 controlled database should be used for waste stream characterization. |
| Cl-2/TWCP-352 | b | Description of plutonium recovery processes | Wastes from Plutonium Conversion and Scrap Recovery Operations, LA-11069, March 1988 | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| Cl-3/TWCP-619 | d | All TA-55 waste is defense related | Memo from Doug Sankey. | All TA-55 waste is defense related | None |
| Cl-4/TWCP-698 | b | Gives Material Type compositions | NMT memo WM/EC96-032 | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes |
| Cl-5/TWCP-882 (UCNI) | d | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process status code. Covers time period from 1978 to the present. | Best information available, but it is based on worker recollection because other records are not available. |
| Cl-6/TWCP-3547 | c | Developmental Chloride Solvent Extraction Process | Procedure 462-REC, all revisions | Describes development of chloride line processes | Limited information on wastes |

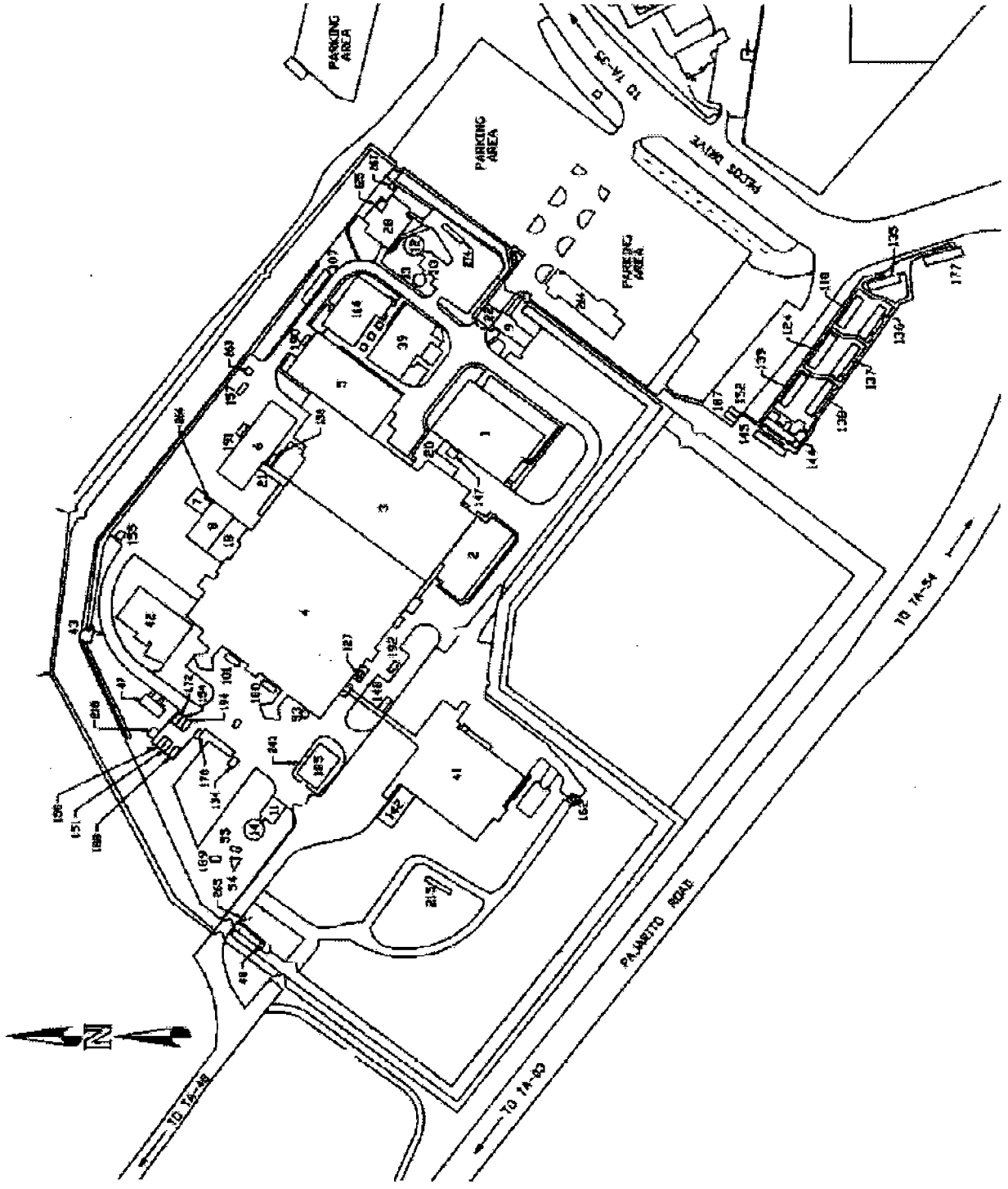
| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-7/TWCP-3547 | c | Recovery and Purification of Pu from Direct Oxide Reduction (DOR) Salts by Chloride Anion Exchange | Procedure 463-REC, all revision | Process descriptions | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-8/TWCP-3547 | c | Hydroxide Precipitation of Chloride Solutions Containing Organic Chemicals | Procedure 467-REC, all revisions | Process descriptions | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-9/TWCP-3547 | c | Dissolution and/or Leaching of Various Materials in HCl | Procedure 470-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-10/TWCP-3547 | c | Oxalate Precipitation of Plutonium from Chloride Solutions | Procedure 471-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-11/TWCP-3547 | c | Chloride Solvent Extraction | Procedure 472-CLO | Process description | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-12/TWCP-3547 | c | Purification and Recovery of Plutonium by Chloride Anion Exchange | Procedure 473-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-13/TWCP-3547 | c | Hydroxide Precipitation of Chloride Waste Streams | Procedure 474-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-14/TWCP-3547 | c | Recovery of Plutonium from Plutonium-Beryllium Neutron Sources | Procedure 476-CLO, all revisions | Process description | Detail only in decladding operation |
| Cl-15/TWCP-3547 | c | Calcination Operation for Aqueous Chloride Processes | Procedure 477-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-16/TWCP-3547 | c | Dicesium Hexachloro Plutonate | Procedure 478-CLO, all revisions | Process description | Additional step of DCHP precipitation used for certain feed material only |
| Cl-17/TWCP-3547 | c | Head End Processing of Aqueous Chloride Plutonium | Procedure 479-CLO, all revisions | Process description | Does not describe where silver nitrate and potassium chromate are disposed of |
| Cl-18/TWCP-3547 | c | Hydroxide Precipitation of the Plutonium in Chloride Waste | Procedure 481-REC, all revisions | Process description | Describes only one portion of chloride line |

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-19/TWCP-3547 | c | Recovery of Plutonium from Hydrochloric CLS-1 Solutions | Procedure 482-REC, all revisions | Process description | Does not address RCRA-regulated solvents |
| Cl-20/TWCP-3547 | c | Decladding of PuBe Neutron Sources | Procedure 482-CLO, all revisions | Process description | Decladding only |
| Cl-21/TWCP-3547 | c | Purification and Recovery of Pu by Chloride Anion Exchange | Procedure 483-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-22/TWCP-3547 | c | Radiochemical Analysis at TA-55 | Procedure 029-CST-1, R02 | Process description | Feed material only; does not address further processing |
| Cl-23/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Jim Foxx 8/31/99 | Answers to questions on Chloride processes | none |
| Cl-24/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Jim Foxx, 9/15/99 | Answers to questions on Chloride processes | none |
| Cl-25/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Jim Foxx, 9/23/99 | Answers to questions on Chloride processes | none |
| Cl-26/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Tim Hayes, 1/12/00 | Answers to questions on Chloride processes | none |
| Cl-27/TWCP-3547 | d | Answers to questions about chloride processes | Interview with Tim Hayes, 6/1/00 | Answers to questions on Chloride processes | none |

*As defined in TWCP-QP-1.1-021, Section 6.2.4:

a. Forms intended for use in waste certification
b. Data from controlled databases and published documents
c. Unpublished data
d. Interviews, memos, and letters

**MAP OF TA-55**


PARKING AREA
PARKING AREA
PARKING AREA
TO TA-54
TO TA-03
TO TA-46
PAJARITO ROAD
N

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| CC | Calcination | OY | none | Pu oxide to vault; to P/S code OR | none | none | Cl-26, PAFD 3/85 |
| CL | Crucible Leach | Crucibles | Hydrochloric acid | Pu-enriched solutions to P/S codes SE or CX (chloride line) for further processing; P/S code SP (nitrate line); vault hydroxide cake | 1) Crucible pieces to cement fixation (or on occasion, debris waste)<br>2) Debris waste | D006, D007, D008, D009, D011<br>~~none~~ | Cl-26, PAFD 10/86 |
| CLRD | Aqueous Chloride R&D | See Chloride Feed Materials list | Hydrochloric acid, other chemicals depending on R&D projects | Pu-enriched solutions to vault; hydroxide cake | ~~1) Cement fixation~~<br>2) Debris waste | D006, D007, D008, D009, D011<br>~~none~~ | PAFD 10/90 |
| CLS | Accountable CLS Chloride Solutions | Analytical laboratory sample residues | Magnesium hydroxide, potassium hydroxide, sodium hydroxide | vault; hydroxide cake | ~~1) P/S code CF for cement fixation~~<br>2) Debris waste | D006, D007, D008 D009<br>~~none~~ | Cl-15, Cl-20, Cl-27 |
| CS | Chloride Solutions | P/S codes CX, various other feed materials (see list) | Oxalic acid, hydroxylamine hydrochloride, potassium fluoride, sodium hydroxide, sodium bicarbonate, bromocresol purple, silver nitrate, potassium chromate, argon gas, aluminum chloride | vault; hydroxide cake | 1) ~~Calcined~~ cake occasionally discarded to cement ~~fixation~~<br>2) Debris waste | D006, D007, D008, D009, D011<br>~~none~~ | Cl-26, PAFD 11/86 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| CSE | Chloride Solvent Extraction | P/S codes CX, CSE, various other feed materials (see list) | Hydrochloric acid, oxalic acid, hydroxylamine hydrochloride, potassium fluoride, calcium carbonate, sodium hydroxide, sodium bicarbonate, bromocresol purple, silver nitrate, potassium chromate, argon gas, aluminum chloride, TCE, TBP | vault ; hydroxide cake | 1) Debris waste<br>2) Liquids absorbed in vermiculite<br>3) Pieces left after filtration to cement fixation | F002<br>~~F002~~<br>D006, D007, D008, D009, D011 | Cl-26, Cl-27, PAFD 8/89 |
| CX | Chloride Anion Exchange | P/S codes ST, PTP, PK, PRR, OR, EXT, SS | Hydrochloric acid, oxalic acid, hydroxylamine hydrochloride, potassium fluoride, calcium carbonate, sodium hydroxide, sodium bicarbonate, bromocresol purple, silver nitrate, potassium chromate, argon gas, aluminum chloride, sodium nitrite | P/S codes SP or HCD (nitrate line); Pu oxide to vault; recycle back or continue through chloride process | 1) Pieces left after filtration to cement fixation<br>2) Ion exchange resins to cement fixation<br>3) Debris waste | D006, D007, D008, D009, D011<br>~~D006~~, ~~D007~~, ~~D008~~, ~~D009~~, ~~D011~~<br>~~none~~ | Cl-10, Cl-12, Cl-17, Cl-21, Cl-27 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| CXL | Experimental Chloride Extraction Line | See Chloride Feed Material list; note no RCRA-regulated solvents used after 1992. | Hydrochloric acid, oxalic acid, calcium carbonate, magnesium hydroxide, potassium hydroxide, sodium hydroxide, bromocresol purple, ferrous chloride, stannous chloride, calcium fluoride, sodium nitrite, cesium chloride, argon gas, aluminum chloride | P/S codes SP, CR, LR, DS, or NR (all nitrate line); recycle back or continue through chloride process; vault | 1) Pieces left after filtration to cement fixation (or occasionally, debris waste)<br><br>2) Ion exchange resins to cement fixation<br><br>3) Debris waste | ~~none~~<br><br>D006, D007, D008 D009<br><br>~~none~~ | Cl-10, Cl-12, Cl-13, Cl-15, Cl-16, Cl-19, Cl-21 |
| CW | Caustic Waste | P/S codes CLS, CSE, other chloride solutions | Calcium or sodium or potassium hydroxide | P/S code HCD (nitrate line) or vault | 1) Debris waste | ~~none~~ D001 D002 | Cl-26, Cl-27, PAFD 10/86 |
| LD | Chloride Leach & Dissolution | P/S code SS; also see Chloride Feed Materials list | Hydrochloric acid | P/S code CX (chloride line); SP (nitrate line); Pu oxide to vault | 1) Pieces left after filtration to cement fixation (or occasionally, debris waste)<br><br>2) Debris waste | D006, D007, D008, D009, D011<br><br>~~none~~ | Cl-26, PAFD 9/88 |
| MB | Nitric Dissolution of Molten Salts | Molten salts | Hydrochloric acid, nitric acid | P/S codes SE or CS (chloride line), LR or CN or PS (nitrate line) | 1) Debris waste | ~~none~~ D006 7 8 9 11 | Cl-26, PAFD 10/86 |
| MS | Molten Salts Purification Dissolution | Molten salts | Hydrochloric acid | P/S code SE (chloride line); Pu oxide to vault | 1) Debris waste | ~~none~~ D006 7 8 9 11 | Cl-26, PAFD 6/85 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| PB | Pu-Be Source Recovery | Pu-Be sources | Hydrochloric acid, sodium nitrite, DCHP, oxalic acid, potassium hydroxide, silver nitrate, hydroxylamine hydrochloride, bromocresol purple, sodium bicarbonate, potassium dichromate, hydrofluoric acid, calcium carbonate, stannous chloride, aluminum chloride | P/S codes CXL (recycle back through chloride line); P/S codes HCD, CD (nitrate line) (hydroxide cake) | 1) Metal cladding to metals waste stream<br>2) Pieces left after filtration to cement fixation<br>3) Debris waste | none<br>D006, D007, D008, D009, D011<br>~~none~~ | Cl-20, Cl-21 |
| PRR | Pyrochemical Residue Recovery | See Chloride Feed Materials list | Hydrochloric acid, oxalic acid, calcium carbonate, magnesium hydroxide, potassium hydroxide, sodium hydroxide, bromocresol purple, argon gas, aluminum chloride | P/S codes CX, CXL (chloride line); P/S code SP (nitrate line), vault (hydroxide cake) | 1) Pieces left after filtration to cement fixation<br>2) Ion exchange resins to cement fixation<br>3) Debris waste | D006, D007, D008, D009, D011<br>D006, D007, D008, D009, D011<br>none | Cl-15, Cl-19, Cl-21 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | Codes[2] | |
| PUB | Pu/Be Source Recovery | Pu-Be sources | Hydrochloric acid, sodium nitrite, DCHP, oxalic acid, potassium hydroxide, silver nitrate, hydroxylamine hydrochloride, bromocresol purple, sodium bicarbonate, potassium dichromate, hydrofluoric acid, calcium carbonate, stannous chloride, aluminum chloride | P/S codes CXL (chloride line); P/S codes HCD; CD (nitrate line) (hydroxide cake) | 1) Metal cladding to metals waste stream<br>2) Pieces left after filtration to cement fixation<br>3) Debris waste | none<br>D006, D007, D008, D009, D011<br>~~none~~ | Cl-14, Cl-20, Cl-21 |
| SE | Solvent Extraction | P/S codes PK, LD, CS, PTP | Hydrochloric acid, oxalic acid, hydroxylamine hydrochloride, potassium fluoride, calcium carbonate, sodium hydroxide, sodium bicarbonate, bromocresol purple, silver nitrate, potassium chromate, argon gas, aluminum chloride, TCE, TBP, CMPO | P/S code CS (chloride line), vault; hydroxide cake | 1) Debris waste<br>2) Liquids absorbed in vermiculite<br>3) Pieces left after filtration to cement fixation | F002<br>~~F002~~<br>D006, D007, D008, D009, D011 | Cl-26, Cl-27, PAFD 11/86 |

[1]All P/S codes generate routine laboratory debris waste consisting of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated.

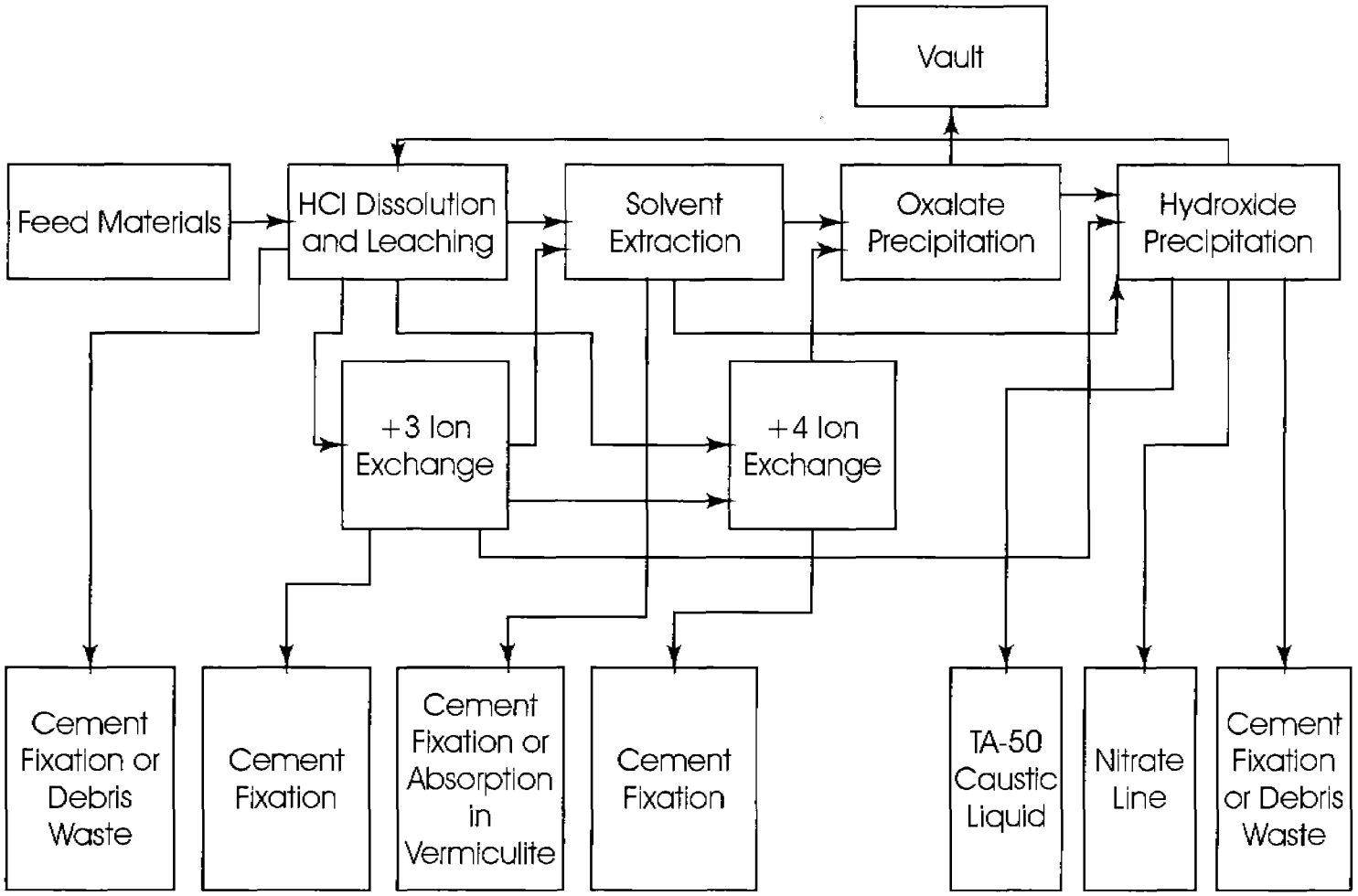
[2] All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other debris waste and are assigned EPA hazardous waste code D008. The D008 code is assigned to the leaded gloves waste stream rather than to each P/S code waste stream.

[3] Refer to the Acceptable Knowledge Roadmap in Attachment 3.

## LIST OF CHLORIDE OPERATIONS FEED MATERIALS

- impure Pu metal
- pyrochemical salts
- crucible pieces (tantalum, magnesium oxide)
- impure metals, including cadmium, mercury, zinc, chromium
- anode heels
- oxides
- hydroxides
- Pu-Be sources and turnings
- stainless steel and/or tantalum residues from decladding of Pu-Be sources
- analytical laboratories (CLS-1, etc.) solutions

Attachment 6. Simplified Schematic of Chloride Line



~~DRAFT~~

**Los Alamos National Laboratory**
**Transuranic Waste Characterization/Certification Project**

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR CHLORIDE OPERATIONS AT TA-55

**LA-UR 0000000**

**Date: 06/21/00**

**Process/Status Codes:**

CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS,
CXL, PRR, PUB, PB, and CC (jointly with nitrate)

chlorideOperations.doc

03 03 04 CONTENTS 2006 1

SECTION PAGE

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CFR Code of Federal Regulations

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| DOE | U.S. Department of Energy |
| EPA | U.S. Environmental Protection Agency |
| LANL | Los Alamos National Laboratory |
| P/S [code] | process/status [code] |
| RCRA | Resource Conservation and Recovery Act |
| RMDC | Records Management/Document Control |
| SAR | safety analysis report |
| SOP | safe operating procedure |
| TA | technical area |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization/Certification Project |
| WAC | waste acceptance criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |

Sampling Plan

# DRAFT ACCEPTABLE KNOWLEDGE ~~SUPPLEMENTAL INFORMATION~~ FOR ~~TA-55~~ CHLORIDE OPERATIONS

## INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plan (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented. ~~This AK supplemental information has been prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021).~~

## 1.0 METHODOLOGY OF AK INFORMATION SEARCH

The AK search for the information related to waste streams resulting from chloride operations covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) (Sampling Plan) that includes information regarding all waste streams
- Review of documents related to the waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 3) (safety analysis reports [SARs], safe operating procedures [SOPs], reports, memos, etc.)
- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap
- Analysis of processes generating waste, including in-process sampling and testing.

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report.

## 2.0 DESCRIPTION OF CHLORIDE OPERATIONS PROCESSES

The following sections describe chloride operations processes, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 2.1 Facility and Mission

The TA-55 Plutonium Reprocessing facility processes plutonium from residues generated through the defense complex into pure plutonium feedstock. The waste streams generated at the TA-55 Plutonium Reprocessing facility as waste from chloride process operations to reprocess/recover plutonium are entirely defense related (TWCP-614). These waste streams were generated at building PF-4 of the TA-55 plutonium facility. A map of the TA-55 facility is attached to this report (Attachment 4).

### 2.2 Waste Physical Form and Content Description

Wastes generated during chloride operations, primarily debris wastes and wastes entered into the cement fixation process, are covered by this Draft Acceptable Knowledge ~~Summary~~ Report. They are identified by having the process status codes for chloride operations: CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB,

MS, CXL, PRR, PUB, and PB; CC applies to both chloride and nitrate operations. General debris waste categories include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape)
- Rubber
- Metal debris (for example, wire, hose clamps, tools)
- Glass debris
- Steel packaging materials

These debris items are contaminated with small amounts of material from chloride operations.

## 2.3 Waste Volume and Time Period of Generation

This report covers waste streams generated from 1982, when the chloride line was first developed, to the present. Wastes generated in the chloride operations have P/S codes CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, and PB; CC applies to both chloride operations and nitrate operations. Wastes from the chloride operations have different associated RCRA codes depending on the time period they were generated. The P/S codes, their time period of generation, and corresponding RCRA codes are shown graphically in Attachment 2, Time Lines—Chloride Operations.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

## 2.4 Waste Stream Generation Process

The following sections describe the generation of waste streams as well as outputs to the nitrate operation.

### 2.4.1 Overview

Manufacturing and research operations performed at TA-55 in the production of plutonium result in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other U.S. Department of Energy (DOE) sites. These recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

### 2.4.2 Process Descriptions

Detailed information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352). In general, TA-55 plutonium recovery processes can be divided into three major process lines:

- Aqueous chloride-based processes
- Aqueous nitrate-based processes
- Pyrochemical operations

This report concerns only the first of these, the aqueous chloride-based process line.

The primary feed sources for the chloride processes are plutonium residues from pyrochemical operations, metal preparation, metal fabrication, analytical laboratory operations (see below), and residues from other DOE facilities. The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal.

As mentioned above, analytical laboratory operations are one feed into the chloride operations. Samples from the various stages of the production of plutonium are sent for chemical (e.g., radiochemical) analyses. After analysis, excess samples that are either an intermediate or direct product having considerable value, and sample residues rich in plutonium, are returned to TA-55 as feedstock for the production of plutonium metals and oxides. The solvents used in some of the analytical analyses do not carry over an RCRA F listing designation because the sample residues are not a solid waste and are considered feedstock.

Chloride operations can be broken down into the following process steps:

- Pretreatment
- Dissolution
- Purification
- Hydroxide Precipitation

Each of these process steps is described below. A complete listing of P/S codes, their descriptions, and their inputs and outputs is found in Attachment 5, along with a list of feed materials into the chloride process. A simplified schematic diagram of chloride operations is found in Attachment 6.

### 2.4.2.1 Pretreatment (P/S codes CR, PB, PUB)

Pretreatment includes primarily physical processes used to prepare scrap and residues for dissolution. Pretreatment may include sorting, crushing, and/or pulverizing (P/S code CR; see Nitrate Operations Report). As materials are received from various areas in TA-55, they are sorted and sent to various other pretreatment processes or directly to dissolution, depending on the physical nature of the scrap or residue, and the amount and type of plutonium associated with the material.

A separate pretreatment procedure is the decladding of plutonium-beryllium sources (P/S codes PB, PUB; references Cl-14, Cl-20, Cl-21). The metal is removed from the sources, and is placed into containers with metal from all other PF-4 operations (the metals waste stream; not a chloride operations waste). The Pu-Be sources, after the cladding has been removed, are entered into the chloride line for plutonium recovery along with other materials. The P/S code for the decladding and processing of the Pu-Be sources in the chloride line was PB prior to 1988, and PUB from 1988 to the present.

### 2.4.2.2 Dissolution (P/S codes CLRD, CX, CXL, CL, LD, CLS)

In general, the dissolution step can be described as the use of hydrochloric acid to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory known at different times as CHM-1, CLS-1, CST-1, and NMT-1. The scrap and residues may include lead, cadmium, mercury, and chromium from feed materials (see Attachment 5), as well as from the stainless steel and shielding used in the chloride operations equipment (reference Cl-27).

The chloride line was developed in 1982, and operated under P/S code CLRD until 1984; as P/S code CX (along with other more feed-specific codes described below) until 1994; and as P/S code CXL from 1994 to the present.

**NOTE**: After dissolution, if a plutonium-containing solution contained too much iron for the solvent extraction process, it went to +3 ion exchange (not to be confused with the +4 ion exchange as a part of purification) as an intermediate step prior to entering the purification phases of chloride operations.

Some P/S codes were used for dissolution of specific feed materials. CL, used from 1985 to 1990, applied to crucible leaching in HCl. LD, used from 1988 to 1992, applied to the dissolution step for most materials but specifically excluded solutions from the analytical laboratory (CLS-1, etc.). P/S codes MB and MS, 1985-1990, were used for molten salts/pyrochemical salts dissolution only. CLS was used when solutions from the analytical laboratory were the only feed material.

Waste solids from HCl dissolution generally went to cement fixation, but on occasions to debris waste (reference Cl-26).

### 2.4.2.3 Purification (P/S codes CX, CS, CSE, SE, CL, CLS, MB, MS, PRR, PB, and PUB)

The purification steps in the chloride line may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the solutions to be purified.

Solvent extraction (P/S codes CSE and SE) has been used in the chloride line since 1985 (references Cl-26, Cl-27). The RCRA-regulated solvent, tetrachloroethylene (F002), was used in the solvent extraction process until 1992. Debris waste from the solvent extraction process up until 1992 therefore carries the EPA code F002, as do liquid wastes absorbed in vermiculite. However, pieces left after filtration in the hydrochloric acid dissolution step are removed from the line prior to solvent extraction, so do not carry the F002 designation (see Attachment 6, Simplified Schematic of the Chloride Line).

Silver nitrate titration was used to determine chloride concentration (also resulting in formation of potassium chromate) in both the solvent extraction and ion exchange processes up until 1992, so the RCRA codes D011 and D006 are applied to all the codes listed in this paragraph during this time period.

The chloride line was halted from 1992 until 1994. When it resumed operation, non-RCRA-regulated solvents replaced the TCE used in solvent extraction, and silver nitrate titration was no longer performed. P/S code CXL was initiated to denote the newly operational chloride line.

During the operation of the chloride line, some leaching of chromium from the stainless steel equipment, and lead and cadmium from shielding, always occurs, and mercury (from feed materials) is present as well (reference Cl-27). These metals end up in the cement-fixated waste from chloride operations, and when analyses have been run on these wastes, they were over RCRA limits (reference Cl-27). Therefore, cemented wastes from the chloride line carry the RCRA codes for these metals, except for P/S codes MB and MS since there is no cemented waste from these P/S codes (reference Cl-26).

Ion exchange columns (+3 and +4) are used to collect plutonium and separate out impurities such as americium and uranium (P/S codes CX, CXL, and PRR). When discarded, the resins carry the EPA codes D006-D009 for the cadmium, chromium, lead, mercury, and prior to 1994, D011 for silver.

The enriched plutonium solutions from solvent extraction or ion exchange are treated with oxalic acid (oxalate precipitation) (P/S codes CS, CSE, CX, CXL, PB, PUB, and SE), and the resulting plutonium precipitate goes to be calcined (P/S code CC) and eventually to the vault. The liquid solution goes to hydroxide precipitation.

#### 2.4.2.4 Hydroxide Precipitation (P/S codes CLS, CW, PRR)

In this step, the solutions from purification steps are precipitated with potassium, magnesium, or sodium hydroxide. The resulting enriched cakes (greater than economic discard level) go to nitrate operations for further processing (see Time Lines in Attachment 2 for P/S codes and corresponding RCRA codes). The hydroxide cake (lower than economic discard level) fines were cemented until 1995, with large chunks of hydroxide filtrate cakes (lower than economic discard level) placed into containers for disposal. Based on a revision to the WIPP WAC in 1995, all cake material lower than a revised economic discard level is containerized for disposal as debris waste. Waste caustic liquid meeting the TA-50 WAC is disposed through the caustic waste line. P/S code CW was used from 1985 to 1992 for feed materials specifically containing analytical laboratory (CLS-1, etc.) solutions as feed material. Occasionally, solutions from hydroxide precipitation are returned to HCl dissolution for reprocessing (see Attachment 6); RCRA code assignments would then be reflected through other P/S codes.

### 2.4.3 Process Flow Diagrams

A simplified process flow diagram of the TA-55 chloride operations is included as Attachment 6 to this report. Individual PAFDs for the chloride P/S codes are included in the procedures referenced in the AK Roadmap found in Attachment 3.

## 2.5 Material Inputs to the Waste Generation Process

The material inputs to waste from chloride operations are described below.

### 2.5.1 Physical Waste Form Identification

Since items from several different processes are usually combined into one waste drum, the physical waste form of each drum must be determined independently. The physical description of each waste item generated is documented on a Waste Origination and Disposition Form (**WODF**) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form

For chloride operations, waste consists primarily of debris and cemented waste.

### 2.5.2 Radionuclide Content Identification

The primary plutonium material type inputs for chloride operations at TA-55 are listed in TWCP-698 (see Attachment 3, AK Roadmap). The material type provides the major radionuclide components of the waste and yields an estimated Am-241 content by calculation. However, some of the plutonium recovery processes separate plutonium and americium, so that their ratios may be altered in the outputs from the processes. According to TWCP-882, waste items from P/S code CXL may be either depleted or enriched in americium depending on whether the source of contamination is the process product or the process residues; however, in general, the waste will be enriched in americium (reference Cl-26). Individual waste packages undergo gamma spectroscopy to provide detailed radionuclide characterization information.

### 2.5.3 Chemical Content Identification

The chemical content of waste from the chloride processes is in the form of debris waste, cemented waste, or occasionally pieces of hydroxide cake, which consist primarily of salts such as potassium chloride, sodium chloride, and calcium chloride and are entered into the cement fixation process or debris waste

(reference Cl-26). In addition, caustic solutions from hydroxide precipitation are discarded through the waste line to TA-50. A table listing all P/S codes, their descriptions, and their inputs/outputs is provided in Attachment 5.

## 3.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA hazardous waste codes is described below.

### 3.1 F, K, and P Listings

As described in Sections 2.3 and 2.4 of this report, the F002 code is assigned only to debris waste and waste absorbed in vermiculite from the solvent extraction process, up until 1992. After 1994, no F coded waste resulted from chloride operations. No K or P codes are assigned to chloride operations waste.

### 3.2 Toxicity

As outlined in Section 2.3 and 2.4 of this report, cemented wastes and ion exchange resins from the chloride line from 1982 through 1992 are assigned the toxicity characteristic codes D006, D007, D008, D009, and D011 for cadmium, chromium, lead, mercury, and silver. After 1992, the code for silver (D011) was removed from the waste due to a process change (reference Cl-23). An exception for P/S codes MB and MS is described in the sections referenced above, and is shown on the Time Lines in Attachment 2.

### 3.3 Corrosivity, Reactivity, and Ignitability

See Section 4.0.

## 4.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

See Section 5.0.

## 5.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

All waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals per 49 Code of Federal Regulations (CFR) Section 177.848, and were determined to be in compliance with this requirement.

In addition, since 1987, waste generators sign a statement on the WODF stating that the waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders, or materials other than the indicated matrix."

Also, the Waste Profile Request Forms (used after 1991) include statements that the waste related to chloride operations is not ignitable (flash point >200 F), reactive, or corrosive (not applicable for solid [physical form] waste).

## 6.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN 4 L IN VOLUME, NOR >1% RADIONUCLIDE PYROPHORICS

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume must be obtained from radiography. For pyrophorics, see Section 5.0.

## 7.0 VERIFICATION THAT THERE ARE NO PCBs

POLYCHLORINATED BIPHENYLS

No PCBs were introduced into the chloride operations, as documented in the TA-55 procedures.

## 8.0 DETERMINATION OF THE RADIONUCLIDE ISOTOPIC COMPOSITION

See Section 2.5.2.

## 9.0 PACKAGING

Waste packaging information will be addressed in a separate report. The waste packaging report will describe packaging configurations, packaging materials, layers of confinement, and types of inner-layer closure. The report will summarize waste packaging operations applicable to all processes at TA-55.

## ACCEPTABLE KNOWLEDGE SUMMARY

**WSPR No.** _____

**P/S Codes:** CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate)

**Site:** LANL

**Facility Mission (including defense and non-defense programs):**

The TA-55 Plutonium Reprocessing facility processed Pu-239 from residues generated throughout the defense complex into pure plutonium feedstock. The waste streams from P/S codes CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate) were generated at the TA-55 Plutonium Reprocessing facility from chloride operations for plutonium recovery and purification.

**Description of the waste stream**:

Waste from chloride operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, glass debris, and steel packaging materials, and waste sent for cement fixation.

**Area(s) or building(s) where the waste stream was generated (including operations carried out in those areas)**:

Chloride operations wastes are generated at the PF-4 wing, Room 420, of the TA-55 plutonium facility. Manufacturing and research operations performed at TA-55 in the production of plutonium result in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

**Waste stream volume and time period of generation**:

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document. The time period of waste generation for chloride operations is from 1982 to the present.

**Waste generating processes and material inputs:**

The primary feed sources for the chloride processes are plutonium residues from pyrochemical operations, metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. Processes include pretreatment, dissolution, purification, and hydroxide precipitation.

PAM: Since this may be a standalone document, should I redefine Acronyms? or spell them out?

**TIME LINES**

## ACCEPTABLE KNOWLEDGE ROADMAP

**P/S Codes:** CLRD, CL, CX, CS, CSE, SE, CLS, CW, MB, MS, CXL, PRR, PUB, PB, and CC (jointly with nitrate)

Documents are in the TWCP Records Management Center

| AK Binder/ TWCP Number | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-1 (TWCP-PLAN-02.7-0001,R.2) √ | b | Waste stream delineation | *LANL TRU Waste Characterization Sampling Plan* (TWCP-PLAN-02.7-0001) | Correlations between waste streams from TA-55 with regard to time of generation, waste generating processes, and site-specific facilities | The LANL TRU Waste Characterization Sampling Plan contains information that was extracted from the TRI waste database (CST-14 database). As explained in Section 3 (for retrievably stored waste) and Section 5 (for newly generated waste), the TA-55 controlled database should be used for waste stream characterization. |
| Cl-2 √ (TWCP-352) | b | Description of plutonium recovery processes | Wastes from Plutonium Conversion and Scrap Recovery Operations, LA-11069, March 1988 | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| Cl-3 not in text (TWCP-~~619~~ 614 should this be 614?) | d | All TA-55 waste is defense related | Memo from Doug Sankey. | All TA-55 waste is defense related | None |
| Cl-4 √ (TWCP-698) | b | Gives Material Type compositions | NMT memo WM/EC96-032 | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes |
| Cl-5 √ (TWCP-882) UCNI | d | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process status code. Covers time period from 1978 to the present. | Best information available, but it is based on worker recollection because other records are not available. |
| Cl-6 √ | c | Developmental Chloride Solvent Extraction Process | Procedure 462-REC, all revisions | Describes development of chloride line processes | Limited information on wastes |

Should UIPP WAC & TA-55 WAC be listed here? How come most of this is not referenced in text?

| AK Binder/ TWCP Number | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-7 | c | Recovery and Purification of Pu from Direct Oxide Reduction (DOR) Salts by Chloride Anion Exchange | Procedure 463-REC, all revision | Process descriptions | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-8 | c | Hydroxide Precipitation of Chloride Solutions Containing Organic Chemicals | Procedure 467-REC, all revisions | Process descriptions | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-9 | c | Dissolution and/or Leaching of Various Materials in HCl | Procedure 470-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-10 | c | Oxalate Precipitation of Plutonium from Chloride Solutions | Procedure 471-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-11 | c | Chloride Solvent Extraction | Procedure 472-CLO | Process description | Describes only one portion of chloride line; does not address use of RCRA-regulated solvents |
| Cl-12 | c | Purification and Recovery of Plutonium by Chloride Anion Exchange | Procedure 473-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-13 | c | Hydroxide Precipitation of Chloride Waste Streams | Procedure 474-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-14 | c | Recovery of Plutonium from Plutonium-Beryllium Neutron Sources | Procedure 476-CLO, all revisions | Process description | Detail only in decladding operation |
| Cl-15 | c | Calcination Operation for Aqueous Chloride Processes | Procedure 477-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-16 | c | Dicesium Hexachloro Plutonate | Procedure 478-CLO, all revisions | Process description | Additional step of DCHP precipitation used for certain feed material only |
| Cl-17 | c | Head End Processing of Aqueous Chloride Plutonium | Procedure 479-CLO, all revisions | Process description | Does not describe where silver nitrate and potassium chromate are disposed of |
| Cl-18 | c | Hydroxide Precipitation of the Plutonium in Chloride Waste | Procedure 481-REC, all revisions | Process description | Describes only one portion of chloride line |

| AK Binder/ TWCP Number | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| Cl-19 ✓ | c | Recovery of Plutonium from Hydrochloric CLS-1 Solutions | Procedure 482-REC, all revisions | Process description | Doe not address RCRA-regulated solvents |
| Cl-20 ✓ | c | Decladding of PuBe Neutron Sources | Procedure 482-CLO, all revisions | Process description | Decladding only |
| Cl-21 ✓ | c | Purification and Recovery of Pu by Chloride Anion Exchange | Procedure 483-CLO, all revisions | Process description | Describes only one portion of chloride line |
| Cl-22 ✓ | c | Radiochemical Analysis at TA-55 | Procedure 029-CST-1, R02 | Process description | Feed material only; does not address further processing |
| Cl-23 ✓ | d | Answers to questions about chloride processes | Interview with Jim Foxx 8/31/99 | Answers to questions on Chloride processes | none |
| Cl-24 ✓ | d | Answers to questions about chloride processes | Interview with Jim Foxx, 9/15/99 | Answers to questions on Chloride processes | none |
| Cl-25 ✓ | d | Answers to questions about chloride processes | Interview with Jim Foxx, 9/23/99 | Answers to questions on Chloride processes | none |
| Cl-26 ✓ | d | Answers to questions about chloride processes | Interview with Tim Hayes, 1/12/00 | Answers to questions on Chloride processes | nonw |
| Cl-27 ✓ | d | Answers to questions about chloride processes | Interview with Tim Hayes, 6/1/00 | Answers to questions on Chloride processes | none |

*As defined in TWCP-QP-1.1-021, Section 6.2.4:

a. Forms intended for use in waste certification
b. Data from controlled databases and published documents
c. Unpublished data
d. Interviews, memos, and letters

**MAP OF TA-55**

# PROCESS INPUTS AND OUTPUTS AND LIST OF FEED MATERIALS

## Chloride Operations Feed Materials

- impure Pu metal
- pyrochemical salts
- crucible pieces (tantalum, magnesium oxide)
- impure metals, including cadmium, mercury, zinc, chromium
- anode heels
- oxides
- hydroxides
- Pu-Be sources and turnings
- stainless steel and/or tantalum residues from decladding of Pu-Be sources
- analytical laboratories (CLS-1, etc.) solutions

**SIMPLIFIED SCHMATIC FLOWCHART OF CHLORIDE LINE**

## Attachment 3 - Acceptable Knowledge Source Document Summary

**Waste Stream Number(s):** LA-CIN01.001, LA-MHD01.001, LA-MIN02-V.001, LA-MIN04-S.001

| **Site(s):** Los Alamos National Laboratory | **Source Document Tracking Number:** D023 |
|---|---|
| **Acceptable Knowledge Documentation Type:**<br>✓ **TRU Waste Management Program Information**<br>✓ **Waste Stream-Specific Information**<br>✓ **Supporting Information** | **Category:**<br>**C - Correspondence**<br>✓ **D - Documents**<br>**M - Miscellaneous**<br>**P - Procedures**<br>**DR - Discrepancy Resolution**<br>**U - Unpublished Documents** |

**Title of Source Document:** TA-55 Plutonium Facility Acceptable Knowledge Report

**Source Document Reference Information (author(s), document and revision number, date, publisher):** TWCP-AK-2.1-008, R.2, 05/14/01, LANL

| AK # [a] | Source Doc. Page # [b] | AK Information Summary |
|---|---|---|
| PR5, WS12 | vii | Table: TA-55 Process/Status Code Index: Contains P/S Code, P/S Name, AK Process Report and Primary Report Section in which P/S Code is Described, and RCRA Listings for Combustible Debris |
| WS1, WS9 | xvi-xxiv | Waste stream Number and Title: TA-55-19, Mixed Combustible Debris WasteTA-55-19A, Mixed Combustible Debris Waste with P120, a subset (I.e. lot) of waste stream TA-55-19TA-55-20, Non-mixed Combustible Debris Waste Waste Matrix Code: S5300 (same for all three) |
| S16 | xvi-xxiv | (See limitation at end of this summary) Maximum Layers of Packaging: 6 (same for all three waste streams) |
| PR6, WS3 | xvi-xxiv | Time Period of Generation: TA-55-19, Mixed Combustible Debris Waste: 1978-present, Waste Stream Volume (as stored): 4173 containers (873 m3) (including lot TA-55-19A) Waste Stream Volume (after repackaging): 850 SWBs, 3873 drums (2390 m3) TA-55-19A, Mixed Combustible Debris Waste with P120: 02/98-06/98, Waste Stream Volume (as stored): 12 containers (2.5 m3) Waste Stream Volume (after repackaging): Not yet determinedTA-55-20, Non-mixed Combustible Debris Waste: 1979-present. Waste Stream Volume (as stored): 281 containers (59 m3)Waste Stream Volume (after repackaging): Not yet determined |
| WS4 | xvi | Waste Generasting Processes: (Same for all three waste streams): Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate TRU wastes. These operations include: Preparation of ultra-pure plutonium metals, alloys, and compounds. Preparation of specific alloys, including casting and machining these materials into specific shapes. Determination of the high-temperature thermodynamic properties of plutonium. Reclamation of plutonium from scrap and residues produced by numerous feed sources. Disassembly of components for inspection and analysisManufacturing of parts on a limited basis |
| PR2, WS7 | xvi-xxiv | Defense Waste Status (same for all three waste streams): Defense-related transuranic (TRU) waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| WS12 | xvi-xxiv | RCRA CharacterizationTA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.F001, F002, F003, F005, D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040. TA-55-19A has the same codes and also P120 |

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## Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

| Site(s): Los Alamos National Laboratory | | Source Document Tracking Number: D023 |
|---|---|---|
| **AK # [a]** | **Source Doc. Page # [b]** | **AK Information Summary** |
| | | (for vanadium pentoxide). |
| WS11 | xvi-xxiv | Radionuclide Content: These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptuniump237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 and protactinium-231 may be present because of their widespread presence as contaminants in TA-55 operations. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium. |
| WS5 | xxv | See Waste Generation Summary Diagram |
| WS12 | vii-viii | Pg vii contains a table with the TA-55 process/status code index, including the RCRA listings for combustible debris. |
| WS8, WS12 | All | Chemicals identified in report: hydrochloric acid, nitric acid, calcium fluoride, hydrofluoric acid, salts. Acids used in TA-55 are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, phorporic acid, stearic acid, sulfuric acide an dsuperacides. Bases used in TA-55 are calciumhydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. Perschloric acid solutions were sent to cement fixation. Free liquids are absorbed on vermiculite.<br><br>Table 5 on pg 35 contains a list of the use of RCRA-regulated inorganic chemicals in the TA-55 processes<br><br>Table 6 on pg 37 contains a liste of the use of RCRA-regulated organic chemicals in TA-55 processes.. |
| WS8, WS9 | 23 | Table 1 contains a listing of feed materials for processes contributing to waste streams TA-55-19 and TA-55-20 including presence of RCRA-regualted substanced and P/S codes. |
| WS11 | 29 | Table 4 contains a listing of secondary radionuclides in TA-55 TRU Waste. |

**Source Document Data Limitations (if any):**

1. It is not evident that the three waste streams described in this document are similar, the same, or different from the two waste streams described in this source document database.
2. This document has numerous handwriten changes and the souce is unknown

**Acceptable Knowlege Expert:**

Amy Johns — Amy Johns — Date: 1/14/2009

Print /Sign

[a] Obtain from Acceptable Knowledge Documentation Checklist
[b] For microfilm or microfiche, identify box, tape, reel number and location.

## Attachment 3 - Acceptable Knowledge Source Document Summary

**Waste Stream Number(s):** LA-CIN01.001, LA-MHD01.001, LA-MIN02-V.001

| **Site(s):** Los Alamos National Laboratory | **Source Document Tracking Number:** D023 |
|---|---|
| **Acceptable Knowledge Documentation Type:**<br>☑ TRU Waste Management Program Information<br>☑ Waste Stream-Specific Information<br>☑ Supporting Information | **Category:**<br>☐ C - Correspondence<br>☑ D - Documents<br>☐ M - Miscellaneous<br>☐ P - Procedures<br>☐ DR - Discrepancy Resolution<br>☐ U - Unpublished Documents |

**Title of Source Document:** TA-55 Plutonium Facility Acceptable Knowledge Report

**Source Document Reference Information (author(s), document and revision number, date, publisher):** TWCP-AK-2.1-008, R.2, 05/14/01, LANL

| AK # [a] | Source Doc. Page # [b] | AK Information Summary |
|---|---|---|
| PR5, WS12 | vii | Table: TA-55 Process/Status Code Index: Contains P/S Code, P/S Name, AK Process Report and Primary Report Section in which P/S Code is Described, and RCRA Listings for Combustible Debris |
| WS1, WS9 | xvi-xxiv | Waste stream Number and Title: TA-55-19, Mixed Combustible Debris WasteTA-55-19A, Mixed Combustible Debris Waste with P120, a subset (I.e. lot) of waste stream TA-55-19TA-55-20, Non-mixed Combustible Debris Waste Waste Matrix Code: S5300 (same for all three) |
| S16 | xvi-xxiv | (See limitation at end of this summary) Maximum Layers of Packaging: 6 (same for all three waste streams) |
| PR6, WS3 | xvi-xxiv | Time Period of Generation: TA-55-19, Mixed Combustible Debris Waste: 1978-present, Waste Stream Volume (as stored): 4173 containers (873 m3) (Including lot TA-55-19A) Waste Stream Volume (after repackaging): 850 SWBs, 3873 drums (2390 m3) TA-55-19A, Mixed Combustible Debris Waste with P120: 02/98-06/98, Waste Stream Volume (as stored): 12 containers (2.5 m3) Waste Stream Volume (after repackaging): Not yet determinedTA-55-20, Non-mixed Combustible Debris Waste: 1979-present. Waste Stream Volume (as stored): 281 containers (59 m3)Waste Stream Volume (after repackaging): Not yet determined |
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## Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

| Site(s): Los Alamos National Laboratory | | Source Document Tracking Number: D023 |
|---|---|---|
| **AK # [a]** | **Source Doc. Page # [b]** | **AK Information Summary** |
| | | (for vanadium pentoxide). |
| WS11 | xvi-xxiv | Radionuclide Content: These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptuniump237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 and protactinium-231 may be present because of their widespread presence as contaminants in TA-55 operations. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium. |
| WS5 | xxv | See Waste Generation Summary Diagram |
| WS12 | vii-viii | Pg vii contains a table with the TA-55 process/status code index, including the RCRA listings for combustible debris. |
| WS8, WS12 | All | Chemicals identified in report: hydrochloric acid, nitric acid, calcium fluoride, hydrofluoric acid, salts. Acids used in TA-55 are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, phorporic acid, stearic acid, sulfuric acide an dsuperacides. Bases used in TA-55 are calciumhydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. Perschloric acid solutions were sent to cement fixation. Free liquids are absorbed on vermiculite.<br><br>Table 5 on pg 35 contains a list of the use of RCRA-regulated inorganic chemicals in the TA-55 processes<br><br>Table 6 on pg 37 contains a liste of the use of RCRA-regulated organic chemicals in TA-55 processes.. |
| WS8, WS9 | 23 | Table 1 contains a listing of feed materials for processes contributing to waste streams TA-55-19 and TA-55-20 including presence of RCRA-regualted substanced and P/S codes. |
| WS11 | 29 | Table 4 contains a listing of secondary radionuclides in TA-55 TRU Waste. |

**Source Document Data Limitations (if any):**

1. It is not evident that the three waste streams described in this document are similar, the same, or different from the two waste streams described in this source document database.
2. This document has numerous handwriten changes and the souce is unknown

**Acceptable Knowlege Expert:**

Sheri Nance / Sheri Nance Date: 1/4/08

Print /Sign

[a] Obtain from Acceptable Knowledge Documentation Checklist
[b] For microfilm or microfiche, identify box, tape, reel number and location.

LA-UR-01-2486



# INTERIM CHANGE REQUEST

| ☑ TWCP ☐ WRR ☐ Other<br>If Other, please identify: _____ | IC Number: 2 |
|---|---|
| **Person Requesting this Interim Change:** June Fabryka-Martin | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20 | **Document No./Revision:** TWCP-AK-2.1-008,R.2 |
| **Effective Date of Current Document:** 07/26/01 | **Document Preparer:** John Musgrave |

| CHANGE INFORMATION: Please ensure the following changes are made: | | |
|---|---|---|
| Section/Page | Change: | Reason/Justification: |
| Section 2.0 | Insert Note following the first bullet in Section 2.0:<br>NOTE: The primary sources of waste generator information presented in the AK Information Summary are:<br>• the "Los Alamos National Laboratory Transuranic Waste Database" maintained by the Facility Waste Operations (FWO) – Integrated Information Management (IIM) group for all TRU waste in storage at TA-54, in accordance with AP-SWO-006;<br>• the TA-55 Waste Management System (WMS) database described in QA-TP-WMS-000.001 and in Section 7.2 of the *TA-55 Transuranic Waste Interface Document* (TWID); and<br>• archived older versions of the TA-55 WMS database (TWCP-6988). | Respond to CBFO audit comments, by improving traceability to AK data sources. |
| Attachment 1 | Insert new references to AK Roadmap (see attached page) | |
| **Date changes submitted:** 10/25/01 | | **Desired effective date for changes:** 10/26/01 |

| INTERIM CHANGE APPROVAL | | | |
|---|---|---|---|
| Document Preparer: John Musgrave | | Reviewer (if applicable): | |
| Signature: John Musgrave | Date: 10/25/01 | Signature: | Date: |
| Site Project QA Officer: Lawrence A. Souza | | LAAO (if implementing WAP requirements): | |
| Signature: | Date: 10/25/01 | Signature: | Date: |
| ☑ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | | Do changes affect WAP data collection, data quality, or performance criteria?<br>☐ Yes ☑ No<br>If yes, date of CBFO approval: _____<br>(documentation attached) | |
| Site Project Mgr/Line Mgr: P Rogers | | | |
| Signature: Pamela Rogers | Date: 10/25/01 | | |
| USQ Screener (if applicable): NA | | | |
| Signature: Greg Berghust | Date: 10-29-01 | | |
| **NOTE:** Changes can be designated on the document and attached to this form. | | | |
| **Effective date for this interim change:** 11/02/01 | | | |

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| AP-SWO-006, R.3.1 | A | Describes how the TRU Waste Storage Record (TWSR) is prepared, reviewed, submitted, and entered into a TRU waste database | *Review and completion of the TWSR* | Section 8.6 describes how waste generator information submitted on the TWSR, as well as other receipt and storage information, is entered into the LANL TRU Waste Database for TRU waste stored at TA-54. | Does not contain any data. No detailed discussion of changes made in this procedure since it was first issued in June 1994 as DOP-CST17G-003,R.0. The current procedure listed here was issued April 2001. |
| NMT7-AP-TA55-018, R3 | A | Contains waste generator information required by the LANL TRU Waste Certification Plan | *TA-55 Transuranic Waste Interface Document* (TWID) | Contains information on waste characterization, waste packaging configurations, and TRUCON codes for newly-generated TA-55 waste. Describes how waste generator information in the TA-55 Waste Management System (WMS) database is certified and maintained for waste generated at the TA-55 facility. Contains information on current and projected waste stream volumes. | Does not contain data on specific waste containers. Does not contain information for legacy waste generated prior to this document's approval. Periodically updated by TA-55. |
| QP-TP-WMS-000.001 | B | Compilation of TA-55 waste generator information, for individual waste containers. | TA-55 Waste Management System (WMS) | Certified and current database of waste container identifiers, waste codes (e.g., IDC, RSWD, EPA HWNs), assay results, packaging dates, waste material content and generating processes for TA-55 wastes. | Controlled access, continually being updated |
| TWCP-6988 | B | Compilation of TA-55 waste generator information, for individual waste containers. | *Archived generator's databases 95DRUM and 95ncdrum.* | Database of waste container identifiers, waste codes (e.g., IDC, RSWD, EPA HWNs), assay results, packaging dates, waste material content and generating processes for TA-55 wastes. | Archive of previous version of the TA-55 WMS; may not contain latest corrections. |

# INTERIM CHANGE REQUEST

| ☑ TWCP ☐ WRR ☐ Other<br>If Other, please identify: _____ | IC Number: 1 |
|---|---|
| **Person Requesting this Interim Change:** June Fabryka-Martin | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20 | **Document No./Revision:** TWCP-AK-2.1-008,R.2 |
| **Effective Date of Current Document:** 05/14/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| iii | Revise section 8.1 title: "F, K, and P Listings" | No applicable U listings |
| iv | List "Attachment 6, Drum List for Waste Stream Lot TA-55-19A (1 page)" | New attachment |
| vi | Delete U from list of acronyms | Not used in report |
| xvii, xxi | Delete bullet about U213 (tetrahydrofuran) | No evidence for presence of tetrahydrofuran in TA-55 TRU waste |
| 3.2.2 / p. 7 | Delete "usually" | Editorial correction |
| 3.4 / p. 8 | Add "(Attachment 6)" to end of NOTE | New attachment lists drums of combustible debris waste to which HWN P120 is applicable |
| 3.6.3.1 / p. 30 | Add to beginning of first bullet, "D001 (oxidizer), " | Editorial correction |
| 3.6.3.1 / p. 31 | Add to beginning of top bullet, "D001," | Editorial correction |
| Table 6 / p. 38 | Replace comment about Tetrahydrofuran: "U213 is not applicable to the use of this chemical because there is no evidence of a spill or of spill residues entering TA-55 TRU waste streams." | No evidence for presence of tetrahydrofuran in TA-55 TRU waste |
| 8.1 / p. 41 | Revise section 8.1 title: "F, K, and P Listings" | No applicable U listings |
| 8.1 / p. 42 | Delete paragraph about U213 | No evidence for presence of tetrahydrofuran in TA-55 TRU waste |
| 12.0 / p. 49 | Revise text about PCBs | Document disposal path for waste items which may contain PCBs, and required check for such items during RTR |

| | | |
|---|---|---|
| 14.1 / p. 52 | Add new bullet: On average, the drums contain 92 wt. % combustible debris waste, 5 wt. % metal debris waste, and 3 wt. % packaging material. | To confirm the classification of these waste streams as combustible debris |
| 14.4 / p. 59 | Delete last bullet about tetrahydrofuran | Information is not relevant |
| 15.0 | List TWCP-DTP-1.2-008 as new reference | Reference discusses required check for PCB-containing items during RTR |
| New Attachment 6 | Add "Attachment 6, Drum List for Waste Stream Lot TA-55-19A" | New attachment lists drums of combustible debris waste to which HWN P120 is applicable |
| Attachment 1 | Add TWCP-3568 (N-74 and N-82) and TWCP-5372 to AK Roadmap | References are cited in Section 12 and Attachment 6 |

**Date changes submitted:** 05/15/01 | **Desired effective date for changes:** 05/18/01

**INTERIM CHANGE APPROVAL**

| | |
|---|---|
| Document Preparer: John Musgrave | Reviewer (if applicable): June Fabryka-Martin |
| Signature: John Musgrave Date: 5/15/01 | Signature: June Fabryka-Martin Date: 5/15/01 |
| Site Project QA Officer: MA Gavett | LAAO (if implementing WAP requirements): |
| Signature: MA Gavett Date: 5/15/01 | Signature: Date: |
| ☒ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | Do changes affect WAP data collection, data quality, or performance criteria? |
| Site Project Mgr/Line Mgr: Pam Rogers | ~~☒ Yes~~ ☒ No 7/25/01 |
| Signature: Pamela Rogers Date: 5/15/01 | If yes, date of CBFO approval: _____ (documentation attached) |
| USQ Screener (if applicable): Not applicable | |
| Signature: Date: | |

**NOTE:** Changes can be designated on the document and attached to this form.

**Effective date for this interim change:** 07/26/01

## ATTACHMENT 6. DRUM LIST FOR WASTE STREAM LOT TA-55-19A

A review of TA-55 data bases of waste items packaged into drums (TWCP-5086) and the Sampling Plan (TWCP-PLAN-0.2.7-001,R.3) identified the following twelve 55-gallon drums that contained combustible debris generated by P/S codes SD and SS and that were closed between February 1, 1998 and December 31, 1998 (TWCP-5372).

| Drum Identifier | P/S Codes of Waste Items (TWCP-5086) | Packaging Date (Sampling Plan,R.3) |
|---|---|---|
| LA00000056873 | ED, RFX, SS, TDC | 04/13/98 |
| LA00000056876 | CXL, ED, EV, ME, SS | 05/12/98 |
| LA00000056887 | SS | 06/09/98 |
| LA00000056902 | BC, MA, SS, TDC | 09/29/98 |
| LA00000056924 | SS | 07/13/98 |
| LA00000056930 | SS | 08/17/98 |
| LA00000057121 | BM, FF, SS | 08/31/98 |
| LA00000057137 | CXL, SS, TDC | 09/29/98 |
| LA00000057164 | SS | 10/28/98 |
| LA00000057737 | FF, SS | 12/01/98 |
| LA00000057755 | ATL, BM, CXL, MA, SS, TIGR, XO | 11/24/98 |
| LA00000057766 | SS | 11/24/98 |

Replacement text for Section 12.0:

No PCBs were introduced into the nitrate operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in lists of process inputs documented in the TA-55 process AK reports.

- In the cement fixation process (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs.

- All transformers known to contain PCBs have been tracked from initiation of operations of TA-55 in 1978. When any transformer oil is drained, the oil is handled by a subcontractor who is wholly responsible for its disposal; this oil does not enter the LANL disposal operations (TWCP-3568/N-82).

- Ballast in fluorescent light fixtures could contain PCBs, but at TA-55 these light fixtures are outside the gloveboxes and hence would not enter the TRU waste stream.

- Oil-filled capacitors are not known to have been used in TA-55 gloveboxes.

In addition, if the possibility exists for the waste to contain PCBs, RTR operators are required to check for indications of PCB-containing materials or PCB-contaminated materials. If there is reason to suspect that an item may contain PCBs (based on AK, operator training, or previous operator experience), then the operator submits a PWR and places a hold tag on the waste container (Section 6.6.6 and Table 3 in TWCP-DTP-1.2-008).

Add to Section 15.0:

*Performing Nondestructive Testing Using the Mobile Real-Time Radiography System* (TWCP-DTP-1.2-008)

New references to add to Attachment 1:

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP -3568 /N-74 | C | Chemical list; process description (P/S code CF) | Organic Liquid Emulsification, TRU-NMT2-DP-13, R00; TRUWM-TA55-DP-13-R00; 8/30/93 through 9/30/94 | Emulsifying waste oil and other organic liquids for cement fixation. | None |
| TWCP -3568 /N-82 | C | Clarification of specific processes within the nitrate operations at TA-55 | Jim Foxx, SME, response to comments received on the draft Acceptable Knowledge Summary Report for TA-55 Nitrate Operations, 2/25/00 | Resolutions to the questions and issues raised by Pam Rogers during her review of the Acceptable Knowledge Summary Report for TA-55 Nitrate Operations, 2/25/00 | Information is based on SME knowledge. |
| TWCP -5372 | D | Applicability of P120 to waste generated by P/S codes SD and SS | Interview with Jim Foxx (TA-55 SME) on May 7, 2001 | Vanadium pentoxide was used between February 1998 and June 1998. SME information indicates that waste from this work would have been packaged into containers that were closed by the end of December 1998. | None |

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-01-2486)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19, Lot TA-55-19A, and TA-55-20

**EFFECTIVE DATE:** 05/14/01

**NEXT REVIEW DATE:** 05/14/03

**DOCUMENT PREPARER:**

John Musgrave — 5/7/01

JOHN MUSGRAVE — DATE

**APPROVALS:**

Irene Fabyan-Martin — 5/7/01

INDEPENDENT TECHNICAL REVIEWER/EDITOR — DATE

Mavis R Lo — 5/10/01

SITE PROJECT MANAGER — DATE

Sandy Wander — 5/11/01

WASTE CERTIFICATION OFFICIAL — DATE

[signature] — 5/14/01

SITE PROJECT QA OFFICER — DATE

Charles L. Foxx — 5/7/01

FACILITY REPRESENTATIVE — DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 08/31/00 | — | New report (TWCP-03844) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 1/IC1 | 12/15/00 | Acceptable Knowledge Summary | To clarify segregation of containers in TA-55-19A |
| 2 | 05/14/01 | All | To respond to CBFO reviewer comments, update with new AK information, and add new section on AK confirmation |
| 2/IC1 | 07/26/01 | All | Respond to auditor comments |
| 2/IC2 | 11/02/01 | Section 2, Attachment 1 | Respond to CBFO audit comments, by improving traceability to AK data souces. |

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**Attachments**

1 Acceptable Knowledge Roadmap (16 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Simplified Process Flow Diagrams (8 pages)
4 Waste Generator Forms for TRU Waste (6 pages)
5 Chemical Waste Disposal Request Form (1 page)
6 Drum List for Waste Stream Lot TA-55-19A (1 page)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| ARIES | Advanced Recovery and Integrated Extraction System |
| CBFO | Carlsbad Field Office |
| CFR | *Code of Federal Regulations* |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| C–N–O | carbon–nitrogen–oxygen |
| CSMO | Central Scrap Management Office |
| DBBP | dibutyl butylphosphonate |
| DCHP | dicesium hexachloroplutonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | Chemical symbol for Fluoride, or RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| ICP | Inductively coupled plasma |
| ID | item identification |
| IDC | item description code |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| M | molar |
| MCDOR | multicycle direct oxide reduction |
| MDL | Method detection limit |
| MEGAS | Multiple Energy Gamma Assay System |
| MSE | molten-salt extraction |
| MT | material type |
| NDA | nondestructive assay |
| NIOSH | National Institute for Occupational Safety and Health |
| NMT | Nuclear Material Technology |
| P | Chemical symbol for Phosphorus, or RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF | Plutonium Facility |
| ppm | part per million |

| | |
|---|---|
| ppmv | part per million, on a volume basis |
| PRQL | program required quantitation limit |
| P/S | process/status [code] |
| PuBe | plutonium–beryllium |
| PVDF | polyvinyldienefluoride (also known as Kynar) |
| PWR | prohibited wasted report |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| RSWD | radioactive solid waste disposal |
| RTR | real-time radiography |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) |
| SME | subject matter expert |
| SOP | safe operating procedure |
| TA | technical area |
| TBP | tributyl phosphate |
| TOPO | trioctylphosphine oxide |
| TRU | transuranic |
| TRUCON | TRUPACT-II Content Code |
| TRUPACT-II | Transuranic Waste Transporter-Model II |
| TWBIR | Transuranic Waste Baseline Inventory Report |
| TWCP | Transuranic Waste Characterization/Certification Project |
| $UCL_{90}$ | 90% Upper Concentration Limit |
| UCNI | unclassified controlled nuclear information |
| VE | visual examination |
| VOC | volatile organic compound |
| WAC | Waste Acceptance Criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request form |
| XES | X-ray energy spectroscopy |

# TA-55 PROCESS/STATUS CODE INDEX

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| AC | Actinide chemistry, R&D | Miscellaneous Operations | 3.5.3, Att. 4 | D007, D009, D011, D018, D022, D038, F002, F005 |
| AC1 | Actinide chemistry, R&D | Miscellaneous Operations | 3.5.3, Att. 4 | D007, D009, D011, D018, D022, F002, F005 |
| AC2 | Actinide chemistry, R&D | Miscellaneous Operations | 3.5.3, Att. 4 | D007, D009, D011, D018, D022, D038, F002, F005 |
| AC3 | Actinide chemistry, R&D | Miscellaneous Operations | 3.5.3, Att. 4 | |
| ACC | Ammonium chloride conversion | Special Processing | 3.5.8, Att. 4 | |
| ACD | Cascade dissolver | Special Processing | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 |
| ACL | Analytical chemistry laboratory | Miscellaneous Operations | 3.5.4, Att. 4 | D007, D009 |
| AD | Actinide processing demonstration | Miscellaneous Operations | 3.5.1, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| AL | Ash leach | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 |
| AO | Assembly operation | Metal Operation Processes | 3.5.3, Att. 4 | |
| AO | Americium processing calcination | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| AP | Americium purification | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | D007, D009 |
| APD | Actinide processing demonstration | Miscellaneous Operations | 3.5.7, Att. 4 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| ARI | ARIES | Metal Operation Processes | 3.5.3, Att. 4 | |
| AS | Anode heel dissolution | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D006, D007, D008, D011 |
| AT | Ash testing | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 |
| ATL | Advanced test line for actinide separation RD&D | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 |
| AX | Solution assay | Miscellaneous Operations | 3.5.3, Att. 4 | D007, D009 |
| BA | Basement isopress | Metal Operation Processes | 3.5.2, Att. 4 | |
| BAC | Bacterial decomposition of cellulose items | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |
| BC | Physical properties | Metal Operation Processes | 3.5.2, Att. 4 | |
| BF | Unknown name for P/S code | Nitrate Operations | 3.5.6, Att. 4 | D006, D007, D008, D011 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| BL | Blending | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | |
| BM | Burning metal | Nitrate Operations | 3.5.1, Att. 4 | |
| BT | Burst testing | Metal Operation Processes | 3.5.3, Att. 4 | |
| BU | Button burning | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | D006, D007, D008, D011 |
| CA | Casting | Metal Operation Processes | 3.5.2, Att. 4 | |
| CC | Calcination | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| CD | Hydroxide cake dissolution | Nitrate Operations | 3.5.2, Att. 4 | D006, D007, D008, D009, D011 |
| CF | Cement fixation | Nitrate Operations | 3.5.5, Att. 4 | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 |
| CH | Characterization | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| CK | RD&D volatile fluoride Pu recovery | Miscellaneous Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| CL | Crucible processing | Chloride Operations | 3.5.2, 3.5.3, Att. 4 | D007, D008, D009 |
| CLRD | Aqueous chloride R&D | Chloride Operations | 3.5.2, Att. 4 | D007, D008, D009 |
| CLS | Accountable CLS chloride solutions | Chloride Operations | 3.5.2, 3.5.3, 3.5.4, Att. 4 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| CN | C-N-O analysis | Metal Operation Processes | 3.5.1, Att. 4 | |
| CO | Comminution | Metal Operation Processes | 3.5.1, Att. 4 | |
| COD | Chlorinated oxide dissolution | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |
| COL | Chlorinated oxide leach | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D005 |
| CPOD | Catalyzed electrochemical plutonium oxide dissolver | Nitrate Operations | 3.5.2, Att. 4 | D011 |
| CR | Crushing and pulverizing | Nitrate Operations | 3.5.1, Att. 4 | |
| CRD | Chlorination/reduction RD&D | Pyrochemical Processes | 3.5, Att. 4 | |
| CS | Chloride solutions | Chloride Operations | 3.5.3, Att. 4 | D007, D008, D009 |
| CSE | Chloride solvent extraction | Chloride Operations | 3.5.3, Att. 4 | D007, D008, D009, D039, F002 |
| CT | Compatibility testing | Metal Operation Processes | 3.5.1, Att. 4 | |
| CV | RD&D experimental chlorination processes | Miscellaneous Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D009, D011, D019 |
| CW | Caustic waste | Chloride Operations | 3.5.4, Att. 4 | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| CX | Chloride anion exchange | Chloride Operations | 3.5.2, 3.5.3, 3.5.4, Att. 4 | D007, D008, D009, D011 |
| CXL | Experimental chloride extraction line | Chloride Operations | 3.5.2, 3.5.3, Att. 4 | D007, D008, D009 |
| DA | Alloy development Pu items | Metal Operation Processes | 3.5.2, Att. 4 | F002 |
| DF | DS furnace and oxide preparation | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| DO | Dissolution of oxide | Special Processing | 3.5.3, 3.5.5, 3.5.7, Att. 4 | D007, D011 |
| DOP | Detector oxide preparation | Metal Operation Processes | 3.5.2, Att. 4 | D008 |
| DP | Dry processing | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | |
| DS | Ion exchange | Nitrate Operations | 3.5.3, Att. 4 | D006, D007, D008, D009, D011 |
| DT | John Ward R&D | Metal Operation Processes | 3.5.2, Att. 4 | |
| ED | Cascade dissolver | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 |
| EDC | Electrolytic decontamination | Miscellaneous Operations | 3.5.8, Att. 4 | D007 |
| EL | Element loading | Metal Operation Processes | 3.5.1, Att. 4 | D040 |
| ELW | Experimental laser welding | Metal Operation Processes | 3.5.3, Att. 4 | |
| EM | Electron microscopy | Metal Operation Processes | 3.5.2, Att. 4 | |
| EOC | Experimental oxide characterization | Miscellaneous Operations | 3.5.5, Att. 4 | D007, D009 |
| ER | Electrorefining | Pyrochemical Processes | 3.5.4, Att. 4 | D006, D008 |
| ETD | Experimental thermal decomposition | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | D005, D006, D007, D008, D011 |
| EV | Evaporator | Nitrate Operations | 3.5.4, Att. 4 | D006, D007, D008, D009, D011 |
| EVAC | Evacuation and bake out | Metal Operation Processes | 3.5.3, Att. 4 | |
| EXT | Extraction RD&D | Miscellaneous Operations | 3.5.6, Att. 4 | D005, D006, D007, D008, D009, D011 |
| FA | Americium processing | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| FC | Canning | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| FDL | FOOF demonstration loop | Miscellaneous Operations | 3.5.2, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| FF | Fuel fabrication | Metal Operation Processes | 3.5.1, Att. 4 | D022, D040 |
| FLU | Fluorination RD&D | Miscellaneous Operations | 3.5.2, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| FSPF | Special furnace operations | Metal Operation Processes | 3.5.3, Att. 4 | |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| FX | Cement to drum | Nitrate Operations | 3.5.6, Att. 4 | D006, D007, D008, D009, D011 |
| GI | Pellet grinding & inspection | Metal Operation Processes | 3.5.1, Att. 4 | |
| GMS | Open gradient magnetic separation | Nitrate Operations | 3.5.1, Att. 4 | |
| HC | Calcination | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| HCD | Hydroxide cake dissolution | Nitrate Operations | 3.5.2, Att. 4 | D006, D007, D008, D009, D011 |
| HD | Hydroxide cake dissolution | Nitrate Operations | 3.5.2, Att. 4 | D006, D007, D008, D009, D011 |
| HG | Pu removal by mercury | Metal Operation Processes | 3.5.2, Att. 4 | |
| HGMS | High gradient magnetic separation | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | D006, D007, D008, D009, D011 |
| HP | Cement fixation | Nitrate Operations | 3.5.5, Att. 4 | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 |
| HRA | Hanford Reservation Material | Nitrate Operations | 3.5.6, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| HRS | High resolution spectroscopy | Miscellaneous Operations | 3.5.5, Att. 4 | |
| IA | Impure americium holding for discard | Nitrate Operations | 3.5.5, 3.5.6, Att. 4 | D006, D007, D008, D009, D011 |
| IAM | Inspection and measurement | Special Processing | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 |
| IB | Matrix study of pyrochemical salts | Miscellaneous Operations | 3.5.6, Att. 4 | D005, D006, D007, D008, D009, D011 |
| ICP | ICP-AES analysis | Miscellaneous Operations | 3.5.4, Att. 4 | D007, D009 |
| ID | Immersion density | Metal Operation Processes | 3.5.1, Att. 4 | |
| IE | Isotope enrichment | Miscellaneous Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| IN | Inspection | Metal Operation Processes | 3.5.2, Att. 4 | |
| IS | Incinerator | Nitrate Operations | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 |
| ITF | Impact test facility | Metal Operation Processes | 3.5.2, Att. 4 | |
| ITF4 | Impact test facility | Metal Operation Processes | 3.5.2, Att. 4 | |
| ITF7 | Impact test facility | Metal Operation Processes | 3.5.2, Att. 4 | |
| IX | Ion exchange | Special Processing | 3.5.2, Att. 4 | D006, D007, D008, D009, D011 |
| JA | Gas isostatic press | Metal Operation Processes | 3.5.2, Att. 4 | |
| KBTF | Kolsky bar test facility | Metal Operation Processes | 3.5.3, Att. 4 | D008 |
| LC | Uranium plutonium processing | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| LD | Chloride leach & dissolution | Chloride Operations | 3.5.2, Att. 4 | D007, D008, D009 |
| LG1 | Non combustible leach | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D006, D008 |
| LG2 | Hydroxide cake dissolution | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D006, D007, D008, D009, D011 |
| LI | XF6 experimental measurements | Miscellaneous Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| LIBS | Laser-induced breakdown spectroscopy system | Miscellaneous Operations | 3.5.5, Att. 4 | |
| LR | Ion exchange | Nitrate Operations | 3.5.3, Att. 4 | D006, D007, D008, D009, D011 |
| MA | Machining | Metal Operation Processes | 3.5.2, Att. 4 | D035, D040, F001, F005 |
| MAG | Magnetic separation | Nitrate Operations | 3.5.1, Att. 4 | |
| MAS | RD&D experimental processes | Nitrate Operations | 3.5.1, Att. 4 | |
| MB | Nitric dissolution of molten salts | Chloride Operations<br>Nitrate Operations | 3.5.2, Att. 4<br>3.5.2, 3.5.6, Att. 4 | D007, D008, D009 |
| MBC | Crystal | Metal Operation Processes | 3.5.3, Att. 4 | |
| ME | Metallography | Miscellaneous Operations | 3.5.10, Att. 4 | D007, D040, F003 |
| MELL | Mediated electro-oxidation of LLW | Nitrate Operations | 3.5.2, Att. 4 | D006, D007, D008, D009, D011 |
| MF | Metals furnace | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | |
| ML | Non-Pu metal leach | Nitrate Operations | 3.5.2, Att. 4 | D006, D008 |
| MO | Metal oxidation, room 429 | Pyrochemical Processes | 3.5.9, Att. 4 | |
| MOX | Mixed oxide fuel production | Metal Operation Processes | 3.5.1, Att. 4 | |
| MP | Metal preparation | Pyrochemical Processes | 3.5.1, Att. 4 | |
| MPD | Cascade dissolver | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 |
| MS | Molten salts purification dissolution | Chloride Operations | 3.5.2, Att. 4 | D007, D008, D009 |
| MW | Metal working | Metal Operation Processes | 3.5.2, Att. 4 | |
| NC | Noncombustible leach | Nitrate Operations | 3.5.2, Att. 4 | D006, D008 |
| NCD | Nonconfirming drums | Miscellaneous Operations | 3.5.9, Att. 4 | |
| NEPTUNIUM | Neptunium | Pyrochemical Processes | 3.5.10, Att. 4 | |
| NL | Noncombustible leach | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D006, D008 |
| NR | Nitrate recovery | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |
| OB | Oxide blending | Metal Operation Processes | 3.5.1, Att. 4 | |
| OD | Oxide dissolution | Nitrate Operations | 3.5.2, Att. 4 | D006, D007, D008 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| OH | Hydroxide precipitation | Nitrate Operations | 3.5.1, 3.5.3, Att. 4 | D006, D007, D008, D009, D011 |
| OM | Oxygen to metal ratio determination | Metal Operation Processes | 3.5.1, Att. 4 | |
| OR | Direct oxide reduction | Pyrochemical Processes | 3.5.2, Att. 4 | |
| OY | Oxalate precipitation | Nitrate Operations | 3.5.1, 3.5.3, Att. 4 | |
| PA | Passivation | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | |
| PAF | Passivation furnaces | Nitrate Operations | 3.5.1, Att. 4 | |
| PB | Pu-beryllium source recovery | Chloride Operations | 3.5.1, Att. 4 | D007, D008, D009 |
| PCH | Plasma chemistry | Metal Operation Processes | 3.5.2, Att. 4 | D007 |
| PD | Pit disassembly | Metal Operation Processes | 3.5.2, Att. 4 | |
| PE | Sputtering process | Metal Operation Processes | 3.5.2, Att. 4 | D004 |
| PF | Plutonium surfaces | Metal Operation Processes | 3.5.2, Att. 4 | |
| PH | Thermal hydride/dehydride | Metal Operation Processes | 3.5.2, Att. 4 | |
| PI | Preparation of isotopes | Special Processing | 3.5.4, Att. 4 | |
| PIG | Welding | Metal Operation Processes | 3.5.3, Att. 4 | |
| PK | Pickling and nitrate holding | Pyrochemical Processes | 3.5.11, Att. 4 | D006, D007, D008, D011 |
| POSM | Processing out-of-specification material | Special Processing | 3.5.3, Att. 4 | D007, D011 |
| PPD | Pu pellet dissolution | Special Processing | 3.5.11, Att. 4 | |
| PR | Peroxide precipitation | Nitrate Operations | 3.5.3, Att. 4 | |
| PRR | Pyrochemical residue recovery | Chloride Operations | 3.5.3, 3.5.4, Att. 4 | D007, D009 |
| PS | Peroxide precipitation of MSE salts | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |
| PT | Plutonium-thorium separation | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D007 |
| PTP | Plutonium trichloride preparation | Pyrochemical Processes | 3.5.12, Att. 4 | D019 |
| PTS | RD&D pretreatment study | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | D005, D006, D007, D008, D011 |
| PUB | Pu/Be source recovery | Chloride Operations | 3.5.1, Att. 4 | D007, D008, D009 |
| PX | Pyrochemical R&D | Special Processing | 3.5.6, 3.5.7, 3.5.8, 3.5.9, 3.5.10, Att. 4 | D006, D008, D019 |
| RA | Recovery of anodes | Pyrochemical Processes | 3.5.6, Att. 4 | |
| RAP | Research alloy preparation | Metal Operation Processes | 3.5.3, Att. 4 | |
| RAP2 | Research alloy preparation | Metal Operation Processes | 3.5.3, Att. 4 | |
| RASS/RSS | Raman spectroscopy system | Miscellaneous Operations | 3.5.5, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| RB | Roasting and blending | Nitrate Operations | 3.5.3, Att. 4 | |
| RBJ | Roasting and blending Jr | Nitrate Operations | 3.5.3, Att. 4 | |
| RC | Rotary calciner | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | D005, D006, D007, D008, D011 |
| RCM | Rich column material ion exchange | Nitrate Operations | 3.5.3, Att. 4 | |
| RD | Repackaging into retrievable drums | Miscellaneous Operations | 3.5.9, Att. 4 | |
| RFX | Ion exchange | Nitrate Operations | 3.5.3, Att. 4 | |
| RL | Radiochemical coating | Metal Operation Processes | 3.5.2, Att. 4 | |
| RM | Reduction to metal | Special Processing | 3.5.4, 3.5.6, 3.5.7, 3.5.8, 3.5.9, Att. 4 | |
| RO | Oil recovery | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | D006, D008, D040 |
| RR | Ion exchange | Nitrate Operations | 3.5.3, Att. 4 | D006, D007, D008, D009, D011 |
| RS | Pellet sintering | Metal Operation Processes | 3.5.1, Att. 4 | |
| SA | Super acid RD&D | Miscellaneous Operations | 3.5.3, Att. 4 | D007, D009, D018, D038, F002, F003, F005 |
| SB | Scrap burning | Special Processing | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 |
| SBB | Ca/Al scrubbing RD&D | Special Processing | 3.5.9, Att. 4 | |
| SC | Cascade dissolver, G437 | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 |
| SCB | Chlorination Ca/Al scrubbing RD&D | Pyrochemical Processes | 3.5.2, Att. 4 | |
| SD | Salt distillation | Pyrochemical Processes | 3.5.5, Att. 4 | P120 |
| SE | Solvent extraction | Chloride Operations | 3.5.3, Att. 4 | D007, D008, D009, D039, F002 |
| SL | Scrap leaching | Special Processing | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 |
| SMP | SP mounting preparation | Miscellaneous Operations | 3.5.5, Att. 4 | |
| SO | Super oxidizer, FOOF program | Miscellaneous Operations | 3.5.2, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | Scrap dissolution, G438 | Nitrate Operations | 3.5.2, Att. 4 | D007 |
| SRL | Special recovery line | Metal Operation Processes | 3.5.2, Att. 4 | |
| SS | Salt stripping | Pyrochemical Processes | 3.5.3, 3.5.4, 3.5.5, 3.5.7, 3.5.8, Att. 4 | D006, D008, P120 |
| SSD | Special scrap dissolution | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D006, D007, D008 |
| SSMD | SS material development | Pyrochemical Processes | 3.5, Att. 4 | D009 |
| STF | Standard fabrication | Miscellaneous Operations | 3.5.6, Att. 4 | D007 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| SX | Americium processing silicon removal | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| TDC | Thermal decomposition of cellulose items | Nitrate Operations | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 |
| TIGR | Thermally induced gallium removal | Metal Operation Processes | 3.5.3, Att. 4 | |
| UA | Uranium fabrication | Metal Operation Processes | 3.5.2, Att. 4 | |
| UPS | Uranium/plutonium separation | Nitrate Operations | 3.5.2, Att. 4 | |
| US | Uranium separation for solid solution feed | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |
| US2 | Uranium separation for non-solid solutions feed | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |
| VC | Variable CSMO scrap dissolution | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D006, D008 |
| VD | Vapor degreaser and sand blasting | Metal Operation Processes | 3.5.2, Att. 4 | |
| VP1 | CSMO scrap dissolution | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | D009 |
| VP2 | Polycube processing | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | |
| VP3 | Hydroxide precipitation | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | D009 |
| VS | Confirmation, inspection & sampling | Miscellaneous Operations | 3.5.5, Att. 4 | |
| VU | Vessel unloading | Special Processing | Att. 4 | D005, D008 |
| VUL | Vessel unloading | Nitrate Operations | 3.5.1, Att. 4 | D005, D008 |
| WE | Welding | Metal Operation Processes | 3.5.2, Att. 4 | |
| WLT | Welding leak test | Metal Operation Processes | 3.5.3, Att. 4 | |
| WM | Waste management | Miscellaneous Operations | 3.5.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| X0 | Inactive or unspecified P/S material | Miscellaneous Operations | 3.5.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-ray energy spectroscopy | Miscellaneous Operations | 3.5.5, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| XO | Inactive or unspecified P/S material | Miscellaneous Operations | 3.5.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XP | RD&D experimental processes | Miscellaneous Operations | 3.5.4, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| ZD | Scrap oxide dissolution | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Metal Operation Processes (TWCP-AK-2.1-003,R.2), Miscellaneous Operations (TWCP-AK-2.1-004,R.2), Nitrate Operations (TWCP-AK-

2.1-005,R.2), Pyrochemical Processes (TWCP-AK-2.1-006,R.2), and Special Processing (TWCP-AK-2.1-007, R.2)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19, Mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1978–present |
| **Defense Waste Status:** | Defense-related transuranic (TRU) waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 4173 containers (873 $m^3$) (including lot TA-55-19A) |
| **Waste Stream Volume (after repackaging):** | 850 SWBs, 3873 drums (2390 $m^3$) |

### Facility Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

### Waste Generating Processes

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate TRU wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040

- Drums containing waste generated from P/S codes SD and SS between 02/98 and 06/98 are segregated as a subset of TA-55-19 due to the potential presence of vanadium pentoxide (EPA HWN P120). (See separate AK summary for waste stream lot TA-55-19A).

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 and protactinium-231 may be present because of their widespread presence as contaminants in TA-55 operations. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3)

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19A

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19A, Mixed Combustible Debris Waste with P120<br><br>**NOTE:** This is a subset (i.e., lot) of waste stream TA-55-19. It is distinguished from TA-55-19 only insofar as the waste has the potential to include vanadium pentoxide (EPA HWN P120). |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 02/98–06/98 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 12 containers (2.5 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate TRU wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

TA-55-19A is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005

- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 and protactinium-231 may be present because of their widespread presence as contaminants in TA-55 operations. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3)

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-20

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-20, Non-mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-T16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1979–present |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 281 containers (59 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

### Facility Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

### Waste Generating Processes

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate TRU wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds

- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

No HWNs apply to containers in waste stream TA-55-20.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 and

protactinium-231 may be present because of their widespread presence as contaminants in TA-55 operations. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3)

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

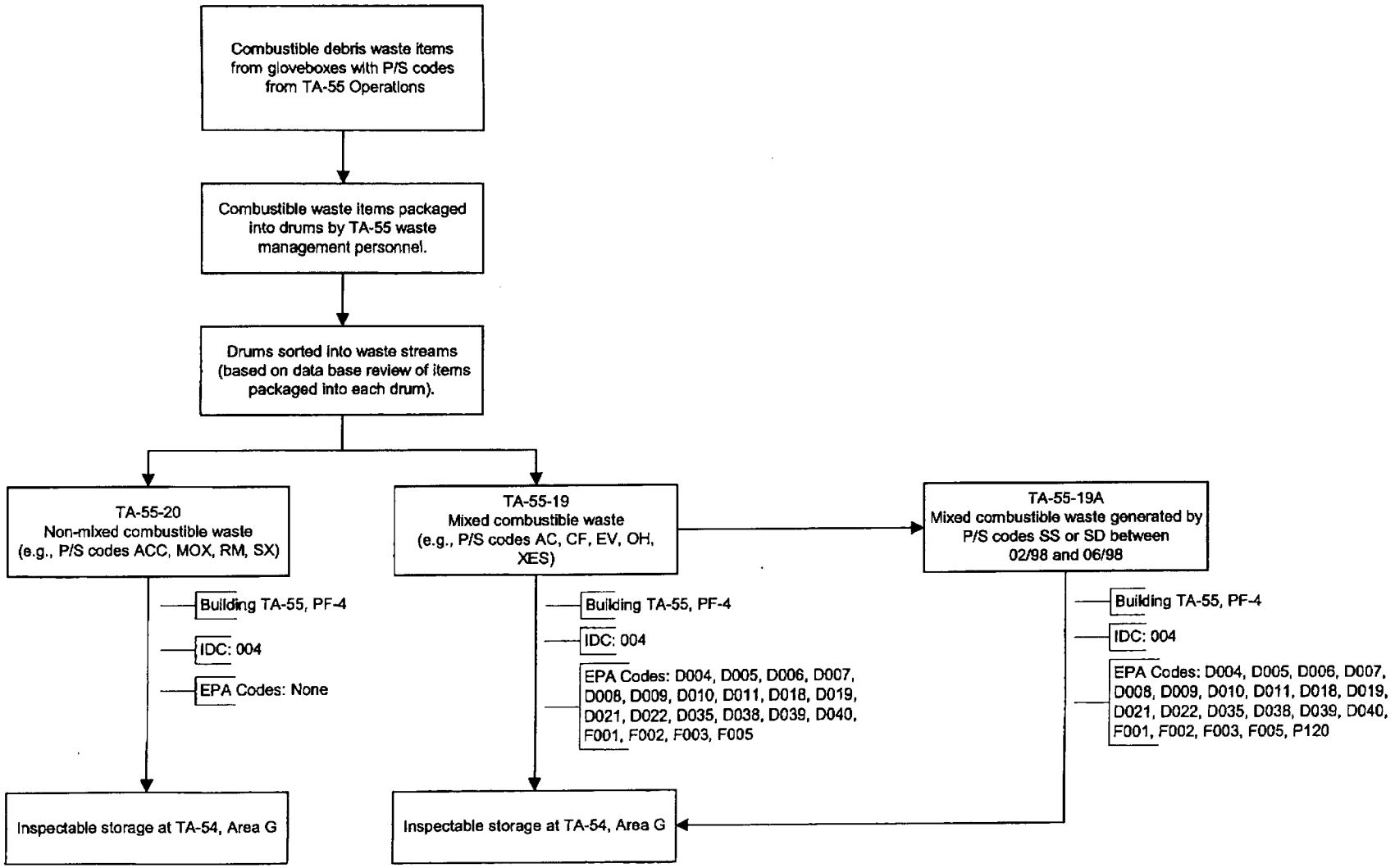
*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

## WASTE GENERATION SUMMARY DIAGRAM



# ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR WASTE STREAMS TA-55-19, LOT TA-55-19A, AND TA-55-20

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK information and provides guidelines on how AK should be obtained and documented.

This AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the Plutonium Facility at Technical Area (TA) 55, one of the TRU waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides technical support for assignment of specific waste containers to the waste stream.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to waste streams TA-55-19 (including lot TA-55-19A) and TA-55-20 covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) (Sampling Plan) that includes information regarding all waste streams, including TA-55-19 and TA-55-20

  **NOTE:** The primary sources of waste generator information presented in the AK Information Summary are:

  - The "Los Alamos National Laboratory Transuranic Waste Database" maintained by the Facility Waste Operations (FWO)-Integrated Information Management (IIM) group for all TRU waste in storage at TA-54, in accordance with AP-SWO-006
  - The TA-55 Waste Management System (WMS) database described in QA-TP-WMS-000.001 and in Section 7.2 of the *TA-55 Transuranic Waste Interface Document* (TWID)
  - Archived older versions of the TA-55 WMS database (TWCP-6988)

- Review of documents related to the waste generation and waste management activities at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1)

- Interviews with personnel involved with waste generation and waste management at TA-55 as documented in process AK reports listed in the Acceptable Knowledge Roadmap (Attachment 1)

- Review of process AK reports for TA-55 processes (as discussed below)

- Analysis of processes generating waste, as discussed in the process AK reports and in this report

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that are referenced in this summary report. Unclassified Controlled Nuclear Information (UCNI) is reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK summary report is based on detailed information compiled in a set of closely related reports about TRU waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six operational areas. The multiple processes in each area are described in detail in the following six process AK reports:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

The process AK reports contain information on over 175 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. For example, the nitrate operations report (*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005,R.2]) covers waste generation processes and

characteristics for over 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generator records. However, as described in section 3.2, TA-55 TRU waste items have always been segregated and packaged into waste containers based on the physical form and material type content of the waste, without regard to process of origin (i.e., P/S code). In order to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number), separate AK reports have been prepared for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in the process AK reports.

This AK summary report summarizes AK information specific to the combustible debris waste streams TA-55-19 (including waste stream lot TA-55-19A) and TA-55-20.

## 3.0 DESCRIPTION OF THE WASTE STREAM

### 3.1 Facility and Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

The combustible waste streams TA-55-19 and TA-55-20 were generated at the TA-55 Plutonium Facility (Building PF-4) as debris waste from process operations and glovebox maintenance involved in plutonium recovery. For this reason, the waste streams are defense related. However, waste also was produced from "special process" and research-related activities. These wastes were not segregated until 1998, but rather were commingled in the final waste containers to such an extent that segregation is not possible on the basis of waste generating process or glovebox location (TWCP-887). The waste was also co-mingled with room trash related to these same operations (both defense and non-defense), which was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site assay results showed it exceeded the low-level waste threshold value (TWCP-816).

A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process of origin. Relevant details of these planning and implementation documents are summarized in this section, to provide background information to support the process used by TWCP to assign TA-55 waste containers to specific waste streams. Waste stream assignment is made on the basis of waste generator information compiled in the TWCP waste container data base, which comprises the bulk of the Sampling Plan. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, which are key factors in the evaluation of the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents in that drum.

3.2.1 Waste Packaging at TA-55

Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged by this team. Materials are considered waste only when they have been received and processed by the waste management team. Waste segregation schemes used by this team have evolved since operations began at the Plutonium Facility in 1978.

In 1978, the standard operating procedure for waste management at TA-55 stated the guiding philosophy of minimizing the amount of waste generated and minimizing the plutonium content of that waste (TWCP-3943). Discard Limits (DL) for plutonium in various types of waste matrices were established by the waste-generating group, and approved by the LANL division office and the DOE Albuquerque Operations Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of plutonium) into classes such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. All liquids, including oils, were required to be sent to recovery operations

for processing. Liquids were explicitly prohibited from any container of solid waste materials.

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific processes and waste streams. TA-55 prepared an attachment in March 1987 for contact-handled combustible and noncombustible solid waste (TWCP-701), defined as follows:

- Combustible waste forms included materials that could be reduced to an ash if desired but that did not require further processing to meet the WIPP WAC (TWCP-701). (This definition is still current.) Subcategories included plastic-base, cellulose-base and miscellaneous (graphite and graphite crucibles). It was acceptable for the combustible waste stream to include some unspecified "small" fraction of noncombustible solids such as scrap metals.

- Noncombustible waste forms included materials that could not be reduced to ash but that did meet the WIPP WAC without further processing (TWCP-701). The two subcategories were metals and non-metals. The non-metal wastes included glass, fiberglass heating mantles, porcelain crucibles, ceramic furnace tube inserts, and leaded glovebox gloves. It was acceptable for the noncombustible waste stream to include some unspecified "small" fraction of combustible solids, and that could be contained in plastics. For WIPP purposes, any waste forms that were chemically compatible and that met the WAC, could be combined into a single waste container.

In 1995, a new TRU Waste Certification Plan was adopted, including a new attachment that formalizes how the TA-55 waste management team currently segregates newly generated wastes into waste streams (TWCP-700). Waste materials are segregated:

- by radioisotope, to meet nondestructive assay (NDA) and gas generation requirements

- by material matrix, to meet NDA and TRUCON requirements

- by hazardous constituents, to meet RCRA and Department of Transportation (DOT) requirements

Combustible waste forms include plastic base and cellulose base (TRUCON code 116), but graphite waste was moved to the

noncombustible category. Noncombustible debris waste forms are broken down to a finer level of classification than had previously been used:

- metals (TRUCON code 117)
- glass (TRUCON code 118)
- HEPA filters (TRUCON code 119)
- leaded gloves (TRUCON code 123)
- salts (TRUCON code 124)
- graphite (TRUCON code 115)

In addition, each major waste form includes provisions for small quantities of unspecified waste with similar properties. This provision is necessary to allow for infrequently encountered waste items.

### 3.2.2 Waste Stream Delineation for TA-55

From the beginning of operations at TA-55, the physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for waste items was sometimes also documented on this form. Starting in 1987, the TA-55 Plutonium Facility began its current system of tracking waste items both by the process from which they originated as well as by their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item (although recording of P/S codes was inconsistent until about 1990). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel. Both the WODF and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- First by radioisotope content (Pu-238 or Pu-239 material type)
- Then by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

Waste stream delineation was performed using waste generator information (such as the WODF and DWLS) that has been compiled in an electronic data base that is part of the Sampling Plan. Because waste items from several different P/S codes were combined into each waste drum, a special sort on the P/S code of each waste item in a drum was necessary to determine if the drum contained all non-mixed items, some or all mixed-waste items, or a special case item (such as an item from P/S code SS carrying the EPA Hazardous Waste Number (HWN) P120). If the P/S code information was missing for any item in a waste drum (as was the case for many older wastes), that drum was conservatively assigned to the mixed-waste stream. Fortunately, the special case wastes carrying the HWN P120 were generated relatively recently, such that the data base records for those items are complete.

### 3.2.3 Waste Container Labeling

The net effect of the waste packaging system used at TA-55 is that several HWNs are conservatively assigned to individual waste streams for the purposes of WIPP disposal, because the WIPP WAP requires HWN assignment on a waste stream rather than a waste container basis. For the purposes of generator and on-site storage, however, LANL labels waste on a container by container basis. Thus, the hazardous labels on containers in storage at LANL should not be expected to correspond to the HWNs assigned to the waste stream through this AK summary report. Hazardous labels are updated to meet WIPP disposal requirements just before loading waste containers into the Transuranic Package Transporter-Model II (TRUPACT-II) for shipping to the WIPP.

## 3.3 Waste Physical Form and Content Description

The TA-55-19 and TA-55-20 waste streams are defined as combustible debris waste streams (Sampling Plan, Appendix D), with TA-55-19 being a mixed-waste stream and TA-55-20 its non-mixed counterpart. TA-55-19A is a small substream lot, distinguished from TA-55-19 by the addition of HWN P120. Both of these waste streams include paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape, gloves, plastic vials, polystyrene, Tygon tubing, polyvinyl chloride plastic, Teflon products, Plexiglas, and dry box gloves

(unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (scrap metal, metal lids, and clothing zippers) (Sampling Plan, Appendix D).

Leaded gloves are also generated as process waste in TA-55 operations. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams, including TA-55-19. Between 1987 and May 1992, leaded gloves began to be segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste were ever incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

## 3.4 Waste Volume and Time Period of Waste Generation

The following information is from Appendix D of the Sampling Plan (R.3). These inventories are expected to change because the Sampling Plan is continually updated as new waste information is obtained.

- TA-55-19 includes 4173 containers (873 cubic meters), that were generated from 1978 to the present time.

  **NOTE:** Waste stream lot TA-55-19A is a subset of TA-55-19 that contains 12 containers (2.5 $m^3$) with waste items generated from P/S codes SD and SS between February and June 1998 (Attachment 6).

- TA-55-20 includes 281 containers (59 cubic meters), that were generated from 1979 to the present time.

## 3.5 Waste Stream Generation Processes

### 3.5.1 Overview

The TA-55-19 and TA-55-20 combustible debris waste streams were generated from combustible materials used in processes to recover plutonium from residues, metal fabrication, and research and development (R&D) activities. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds
- Preparing (on a large scale) specific alloys, including casting and machining these materials into specific shapes

- Determining high-temperature thermodynamic properties of plutonium
- Reclaiming plutonium from scrap and residues produced by numerous feed sources
- Disassembling components for inspection and analysis
- Manufacturing of parts on a limited basis
- Processing mixtures of plutonium and uranium oxides for reactor fuels.

The manufacturing and research operations performed at TA-55 in the recovery of plutonium results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scrap generated from operations at various LANL, other U.S. Department of Energy (DOE) facilities, and commercial radioactive sources. These recovery operations, along with associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Plutonium processing operations generate contaminated combustible waste from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber- and Teflon-based products (such as rubber gloves, Teflon tape, gaskets, stoppers, etc.) used in operations

### 3.5.2 Process Flow Diagrams

Detailed information about the TA-55 plutonium recovery processes can be found in the process AK reports. For purposes of the AK search, and to allow convenient referral to and referencing of the process AK reports in this waste stream AK summary report, the processes have been divided into six major areas:

- Chloride Operations (TWCP-AK-2.1-002)
- Nitrate Operations (TWCP-AK-2.1-005)

- Miscellaneous Operations (TWCP-AK-2.1-004)
- Special Processing (TWCP-AK-2.1-007)
- Metal Operation Processes (TWCP-AK-2.1-003)
- Pyrochemical Processes (TWCP-AK-2.1-006)

Generalized flow diagrams for these six operational areas are presented as Attachment 3 and indicate P/S codes for the various processes. The full block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

The following subsections describe the processes that generated debris waste assigned to the TA-55-19 and TA-55-20 waste streams. The potential for RCRA-regulated constituents to be present due to feed materials and chemical use in these processes is summarized in Sections 3.6.1 and 3.6.3. The applicability of EPA HWNs as a result of this potential is specified in Section 8.

### 3.5.3 Chloride Operations

P/S codes CL, CLRD, CLS, CS, CSE, CW, CX, CXL, LD, MB, MS, PB, PRR, PUB, and SE

A detailed description of chloride operations can be found in *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002).

The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The primary feed sources are plutonium residues from pyrochemical operations, plutonium-beryllium (PuBe) neutron sources, analytical laboratory solutions, and residues from other DOE facilities. Chloride operations can be broken down into the following process steps:

- Pretreatment
- Dissolution
- Purification
- Hydroxide precipitation

Pretreatment may include sorting, crushing, and/or pulverizing feed materials prior to being fed into later steps of chloride operations. A separate pretreatment procedure is the decladding of plutonium-beryllium sources. The PuBe metal alloy is removed from the sources, which are then entered into the chloride line for plutonium recovery along with other materials.

In the dissolution step, hydrochloric acid is used to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory. Enriched solutions undergo further purification (see next paragraph), and solid wastes are discarded as debris waste or sent to cement fixation in nitrate operations (Section 3.5.4).

Purification steps may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and separate out impurities. Enriched solutions may be further treated with oxalic acid to precipitate plutonium oxalate, which is converted to plutonium oxide.

In the hydroxide precipitation step, plutonium in filtrate solutions from purification steps is precipitated with potassium, magnesium, or sodium hydroxide. Heavy metals are concentrated in the plutonium-rich hydroxide cakes and derive from one or more of the following: (a) feed materials that consist of or contain these metals; (b) leaching of chromium from stainless-steel equipment components; or (c) the use of silver salt (until 1994) as an indicator of chloride content. The resulting Pu-enriched hydroxide cakes become feed material for nitrate operations, and liquid meeting the TA-50 WAC is sent to the RLWTF using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

### 3.5.4 Nitrate Operations

P/S codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride operations), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following process steps:

- Pretreatment
- Dissolution
- Purification
- Evaporation
- Cement fixation

Pretreatment primarily includes physical processes used to separate scrap and residues for the next step—dissolution. It may include calcination, caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing, distillation, filtering of liquids or oils, incineration, magnetic separation, passivation, scraping, or sorting. After pretreatment, solids are sent to dissolution if plutonium concentrations are above the DL and to solid waste packaging (at the present time) or to cement fixation (in the past) if concentrations are below the DL. Liquids are sent to purification if plutonium concentrations are above the DL and to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) if they meet the TA-50 RLWTF WAC or to evaporation and cement fixation; otherwise, they are further treated until they meet that WAC.

Dissolution includes various steps that generate plutonium nitrate solutions for feed to purification. Primary chemicals used in dissolution are nitric acid, calcium fluoride, and/or hydrofluoric acid. Filtered solids are returned to the dissolution process until plutonium concentrations are below the DL, then sent to cement fixation for disposal. Debris items are disposed after removal of plutonium contamination above the DL. Plutonium-bearing solutions are sent to purification.

Purification consists of ion exchange and precipitation processes. The ion exchange processes use resin-filled columns to collect plutonium, which binds to the resin while impurities flow through the columns; an eluting agent is then used to release purified plutonium in solution. The enriched solutions are then sent to oxalate precipitation. Calcination of the oxalate converts the plutonium to oxide form. The depleted liquids are sent to the evaporator or the RLWTF, and the calcined plutonium oxides are sent to the vault.

The evaporator processes plutonium-poor liquids in order to re-concentrate plutonium, if possible, or to reduce the volume of liquid waste. Evaporator bottoms are either sent back to ion exchange or discarded to cement fixation, depending on their plutonium content. Heavy metals that may be present are concentrated in this process.

In the cement fixation step, wastes with low plutonium concentrations are collected and immobilized in cement. Most of the wastes generated under these processes (P/S codes CF, HP, and IA) are classified as

cemented wastes and would not normally be part of the debris waste streams.

3.5.5 Miscellaneous Operations

P/S codes AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

A detailed description of miscellaneous operations can be found in *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004).

R&D projects at TA-55 include an array of activities involving applied techniques and methods designed to study and improve processes associated with the purification, separation, extraction, recovery, and characterization of actinides (primarily plutonium) from various matrices. General types of miscellaneous processes are described below.

*Extraction/Separation Studies.* A series of similar actinide extraction, separation, and characterization R&D studies involved processing of actinide hydroxide cakes from chloride and nitrate operations, development of sensors and instrumentation for online chemical analysis, and purification process development. The process R&D activities were of a non-routine developmental nature involving research, process development, small scale "trouble-shooting," and occasionally preparation of various isotopes and isotopic mixtures of plutonium, uranium, americium, and neptunium.

*Halogenation Studies.* A variety of R&D efforts used fluorinating agents to fluorinate samples containing plutonium residues. A gas flow loop was used to pass a fluorinating agent through a gas-solid reactor where plutonium in the solid residue reacted chemically to form solid $PuF_4$ or gaseous $PuF_6$. Gaseous $PuF_6$ was trapped in a cold trap, distilled, and reduced to $PuF_4$. Separation operations involving experimental chlorination processes were similar to the fluorination procedures. A gas loop was used to flow carbon tetrachloride and perchlorocarbons through a gas-solid reactor to chlorinate plutonium oxides to form recoverable plutonium compounds.

*Non-Aqueous Dissolution/Extraction Operations.* Non-aqueous dissolution/extraction operations included the dissolution of actinide compounds and actinide-containing matrices in superacid media. The superacid solutions were evaporated to leave solid products that were analyzed by a variety of methods. The study of the organometallic chemistry of uranium and thorium in non-aqueous solvents consisted of

a variety of small-scale organoactinide operations involving fundamental research of the synthesis in non-aqueous media of new actinide compounds, their characterization and reaction chemistry, and application to existing actinide processing technology. Other operations comprised a broad range of laboratory activities in support of fundamental and applied actinide chemistry research, including preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation.

*Analytical Operations.* This category covers all analytical techniques performed in Room 124 of the Plutonium Facility. Processes involve analysis of plutonium and americium, RCRA metals, and trace metals. Originators provide samples, which are prepared for further analyses, such as inductively-coupled plasma (ICP) and X-ray energy spectroscopy (XES). Unused liquid samples are returned to the originator, sent to radiochemistry for counting, or sent to recovery operations.

*R&D Efforts.* Several small-scale R&D efforts primarily focused on plutonium recovery included the following activities:

- Fluoride sintering of $PuO_2$ took advantage of the presence of fluoride to aid the formation of a sintered mass of $PuO_2$ powder at temperatures above 700 °C.

- Chlorination of Pu oxides involved oxides with tantalum chips from Rocky Flats Environmental Technology Site (RFETS). Chlorination was used to recover plutonium from potassium chloride and sodium chloride matrices.

- Processing of molten-salt extraction (MSE) salts generated at LANL and RFETS.

- Recovery of plutonium from ash involving plutonium/thorium oxide mixtures.

- Processing of neptunium oxide and metal was performed to remove the protactinium daughter in order to use the neptunium for NDA standards.

*Measurement/Detection Operations and Studies.* P/S code VS involves the inspection of oxides and metals. Materials are retrieved from the vault, brought to the glovebox, inspected and sampled if necessary, then repackaged and returned to the vault. Assay methods include XES, laser based spectroscopy, and other spectroscopic techniques. Electron

microscopy may be conducted on actinide samples in the future. In addition to elemental and isotopic analyses, other measurement studies are designed to calculate the surface area and pore size distribution of a sample and to analyze its surface characteristics.

*Pyrochemical Matrix Studies.* A pyrochemical matrix study was conducted from 1986-1992 and involved rod milling prior to screening. This process had two objectives: (1) blending of large batches of homogeneous plutonium metal oxides for pyrochemical operations, and (2) dissolution of plutonium metal oxides for nitrate operations. The process changed in August 1992 when a need developed to blend oxides to provide feed material for making NDA standards. In February 1995 the process again changed, with the objective of determining the effect of pyrochemical salt matrices on the accuracy of NDA measurements. Process activities involved crushing, pulverizing, blending, roasting, and sieving pyrochemical salts. The results were used to determine handling and processing of the salts and to correct bias measurements. The feed material consisted of high-purity oxides to use in the fabrication of standards for use at LANL and throughout the DOE complex.

*Hydrothermal Processing.* The hydrothermal processing procedure involves the reaction of aqueous/organic mixtures, pure organic liquids, or contaminated combustible solids (e.g., ion exchange resins, plastic filters, and cellulose rags) under supercritical conditions (i.e., high temperature and pressure). Feed streams include, but are not limited to, carbon tetrachloride, tributyl phosphate, and organic solvents. Process effluents are gases, liquids, and salts. Organic components are oxidized to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

*Electrochemistry Experiments.* Electrochemistry methodologies were designed to decontaminate items, replace processes that produce large amounts of waste, or enhance chemical reactions. The process involved uranium decontamination of disassembled weapon components from various sites with various levels of plutonium surface contamination. The operation was strictly an aqueous process in which an alkaline solution was reacted with the components to precipitate uranium. Significant amounts of metal could be stripped in a short period. The solution containing the precipitated uranium salts was then dried for mass balance.

*Metallography.* The purpose of the metallography operation is to characterize the microstructure of metallic or ceramic pieces to verify and establish the quality and effectiveness of welds. Materials examined

consist of plutonium and uranium carbides, nitrides, and oxides, as well as zirconium and tantalum alloys, and stainless steel. Metal pieces (pellets) are cut with a diamond saw. Ceramic pieces are subjected to grinding with standard metal grinding media (e.g., papers impregnated with silicon carbides and diamond). The materials are polished with several different chemical compounds.

*Waste Management Operations.* P/S code RD was used in Room 432 from 1984–1986. It allowed for tracking of demonstration drums (one drum each year) that were packaged and prepared in accordance with the TA-55 Attachments to the Certification Plan (TWCP-701) to meet the WIPP requirements at that time. Packaging of these drums did not of itself result in the generation of TRU waste. The waste drums that were packaged contained non-mixed TRU waste.

Operations under P/S code NCD occurred from April 1989 – April 1991 in Room 432. This P/S code was established to provide a mechanism for dealing with TRU drums that did not confirm specifications (e.g., recorded weight or nuclear material content). Non-confirming drums were temporarily set aside until such time as personnel could reprocess them under P/S code WM to correct the nonconfirming condition. After April 1991, nonconfirming drums were dealt with immediately, and P/S code NCD was no longer needed.

P/S code WM is currently limited to waste that arises from the TRU solid waste management operation in Room 432. This situation has been the case since the beginning of 1993. Room trash boxes from Building PF-4 have always been handled as low-level waste; however, the boxes were assayed to verify contamination levels and any that were determined to be TRU waste were diverted to Room 432 for repackaging as such. From May 1987 through 1992, these boxes were created as P/S code XO or X0. These codes were changed to P/S code WM after 1992. Additional controls were placed on room trash after 1992. Trash was assayed with the Multiple Energy Gamma Assay System (MEGAS). When a container was rejected because of MEGAS data, the rejected container was returned to the originator for removal of any "hot" item(s). This process also allowed greater control to prevent discarding regulated materials (e.g., RCRA constituents) in room trash.

P/S code X0 was designated for waste materials that could not be associated with a specific room, such as a hallway, mezzanine offices, rest rooms, change rooms, basement, pump rooms, and trolleys. The waste from all these areas, except the pump rooms and trolleys, would be low-level waste and no RCRA constituents would be associated with the waste items.

P/S code XO indicated waste materials that were generated within specific rooms but could not be associated with an individual P/S code in that room.

3.5.6 Special Processing

P/S codes ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

A detailed description of special processing is found in *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007).

Special Processing includes processing operations for Material Type (MT) 42, and R&D activities for MT 52. (See Section 3.6.2 and Table 2 for descriptions of plutonium material types.) Because processing MT 42 is a smaller-scale version of the recovery processes used for MT 52, MT 42 processing has five main recovery steps:

- Head-end operations
- Nitrate ion exchange operations
- Chloride ion exchange operations
- Separation and purification by precipitation
- Pyrochemical processes

Only head-end operations and separation by purification and precipitation are covered here, since chloride ion exchange operations, nitrate ion exchange operations, and pyrochemical processes are covered briefly in Sections 3.5.3, 3.5.4, and 3.5.8, respectively.

Head-end operations leach tools, labware, crucibles, rags, etc., in nitric acid to remove recoverable plutonium. Plutonium oxide is typically calcined as part of head-end operations.

Separation and purification by precipitation is a method of plutonium removal from aqueous solutions. The most common precipitation methods utilize oxalate, hydroxide, and peroxide anions. By selectively precipitating the plutonium, many of the metals remain in solution, thereby purifying the plutonium.

All wastes generated by MT 52 R&D operations are replicated for MT 42 but carry different P/S codes to differentiate and identify the radionuclide content of the waste. Outputs from Special Processing include high purity metal for casting and machining.

3.5.7 Metal Operation Processes

P/S codes AO, ARI, BA, BC, BT, CA, CN, CO, CT, DA, DOP, DT, EL, ELW, EM, EVAC, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT

A detailed description of metal operation processes is found in *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003).

The processes included in metal operations can be divided into three groups

- on-going metal operations
- developmental metal operations
- reactor fuel development

The main goal of metal processes is to take the high purity metal produced by pyrochemical operations and produce shaped metal pieces. On-going metal operation processes include various R&D activities, alloy development, casting of metals, welding, coating, and machining/metalwork on various metals. Developmental metal operations include the Advanced Recovery and Integrated Extraction System (ARIES) project, assembly operations, burst testing of shells, experimental laser welding, furnace operations, and various other experimental activities. In reactor fuel development, enriched uranium oxide, depleted uranium oxide, and/or plutonium oxide feeds are blended and mixed with graphite, and various operations are performed to convert the feed material into pellets that can be used for fuel. Testing and R&D are done on the fuel pellets.

3.5.8 Pyrochemical Processes

P/S codes CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

A detailed description of pyrochemical processes is found in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006).

Pyrochemical processes include metal preparation, metal purification, and ancillary metal production operations. Pyrochemical process outputs are most often high-purity metal feed materials for metal operations.

3.5.8.1 Metal preparation processes include the following:

*Metal Preparation Line*. The metal preparation line produces plutonium metal from fluoride salts. Hydrogen fluoride gas reacts with plutonium oxides obtained from calcination of oxalate or peroxide precipitates from the aqueous nitrate or chloride process lines. The plutonium compound is further reacted with various chemicals to produce plutonium metal, which can then be recovered as a small globule, or button, by breaking the crucible.

*Direct Oxide Reduction (DOR)*. In the single pass DOR process, plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$), or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible. After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which is sometimes recovered by addition of fresh salt plus additional calcium metal.

*Multiple-Cycle Direct Oxide Reduction (MCDOR)*. To minimize the salt waste, the MCDOR process was started, in which the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated.

3.5.8.2 Metal purification processes include the following:

*Molten Salt Extraction (MSE)*. MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (TWCP-352). This process is employed only if the americium content is greater than 1000 ppm. In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible, and heated to 750 °C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. Ninety percent

of the americium and ten percent of the plutonium are transferred from the feed metal to the salt. After cooling, the salt and metal are mechanically separated. The salts are transferred to the salt stripping process.

*Electrorefining (ER).* The ER process takes impure metal from the MSE and MCDOR (DOR) processes and produces high purity plutonium metal. Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$. After the anode and salt melt, current is applied to the system, and plutonium at the anode is oxidized to plutonium ions, that travel to the cathode and are reduced back to the metal state. Impurities in the original plutonium anode that are less electroactive than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities more electroactive than plutonium (including barium) remain in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. Anode heels were sent to pyroredox from 1984 to 1986. Currently, salts are sent to chloride operations or carbonate oxidation/distillation.

From 1987 to 1989, secondary solvent metals such as cadmium, bismuth, lead, and gallium were added to experimental studies of the ER process.

3.5.8.3 Ancillary metal production operations include the following:

*Salt Stripping.* The MSE and ER salts are further treated by salt stripping, oxygen sparging or carbonate oxidation, and salt distillation. The salt stripping process treats the residue by melting and stirring the salt with calcium metal in a magnesium oxide crucible at 850°C. This treatment reduces the plutonium in the salt to metal and allows the metal to coalesce for physical removal and recovery. After cooling, the crucible is broken and the metal physically separated and recycled to the ER process or burned to oxide and sent back through aqueous recovery. The crucible shards are leached in hydrochloric acid, then discarded.

Oxygen sparging and carbonate oxidation (since 1996) are used to ensure that any plutonium, americium, or metallic sodium or potassium left in the salts are converted to nonpyrophoric oxide forms.

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping process from February to June 1998. Wastes that potentially contain this chemical (HWN P120) are segregrated into waste stream lot TA-55-19A (see Section 4.0).

*Salt Distillation.* Salt distillation allows the recovery of plutonium oxide from the chloride salt and produces purified chloride salt for reuse.

*Pyroredox.* The pyroredox operation was used to recover plutonium from spent anode heels in the mid- to late 1980s. The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements more electroactive than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements less electroactive than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded. The metal phase containing zinc was placed in the vault or further treated, and the plutonium eventually was routed back to ER.

*Ingot Casting.* Metal is melted in a MgO crucible to cast the ingot.

*Metal Coalescence.* Metal coalescence is used for plutonium turnings to coalesce the turnings into a metal button. Calcium metal and $CaCl_2$ are added to a MgO crucible along with the turnings and melted.

*Metal Oxidation.* Small pieces of metal remaining on furnace or crucible surfaces are collected for conversion to the oxide phase. These metal pieces are placed in a furnace for the conversion process. The oxide is then transferred to the vault.

*Neptunium.* Neptunium residues stored in the vault were processed in 1993.

*Pickling.* Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. After a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts so it becomes necessary to leach the plutonium from

these items. In addition, after calcium metal reduction processes such as metal preparation, direct oxide reduction, and molten salt extraction, plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals.

*Plutonium Trichloride Preparation.* An intermediate process in Pu metal production prepared plutonium trichloride by bubbling a carrier gas (chlorine) through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500 °C–600 °C before being absorbed in a 5–6 M (molar) potassium hydroxide solution. The carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991. Feed material was high purity oxides from the vault or from other P/S codes. The product plutonium trichloride was reduced to metal by the MSE or ER processes.

## 3.6 Material Inputs to the Waste Generation Processes

Material inputs to the waste generation processes derive from four general sources: (a) feed materials, (b) associated nuclear material types, (c) chemical use, and (d) ancillary material inputs such as those related to the use of laboratory equipment and materials and glovebox maintenance activities.

### 3.6.1 Feed Materials Identification

The feed materials for TA-55 processes that generate waste in waste streams TA-55-19 and TA-55-20 consist of the general types of materials listed in Table 1. These feed materials are obtained either from the storage vault, as process outputs from various P/S codes, or from sources outside TA-55, including other DOE facilities.

These feed materials fall into four general categories:

- pure Pu metal to be recycled from pits and sealed sources or to be reworked into desired shapes or chemical forms
- intermediate Pu products in purification processes, in the form of solutions, oxides, hydroxides, salts, anode heels, etc.
- a wide variety of matrices contaminated with Pu above the DL, such as ash, salts, equipment, and solutions
- experimental R&D feed materials

**Table 1. Feed Materials for Processes Contributing to Waste Streams TA-55-19 and TA-55-20**

| Feed Material | Potential Presence of RCRA-Regulated Substances* | P/S Codes, Listed by Process |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• CLS-1 solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (Cl-25/TWCP-3547). | Chloride operations: CLS, CW, (analytical laboratory solutions from LANL Group CLS-1); CSE, CXL, SE (other solutions)<br>Miscellaneous operations: ACL, ICP<br>Nitrate operations: CF, HP |
| Anode heels | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), chromium (D007), lead (D008), and silver (D011). Heavy metals arsenic (D004), mercury (D009), and selenium (D010) are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | Nitrate operations: AS, BF, BU<br>Pyrochemical processes: RA |
| Ash from P/S codes ETD, IS, SB, TDC, or from other DOE facilities | Usually suspect contaminated with barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic (D004), mercury (D009), and selenium (D010) metals are volatilized at high temperatures if present in the oxide and chloride forms. | Miscellaneous operations: CK, CV, FDL, FLU, SO, XP<br>Nitrate operations: AL, AT, ATL, ED, HGMS, HRA, IS, MPD, PTS, RC, SC<br>Special processing: ACD, IAM, SB, SL |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | Chloride operations: CL<br>Nitrate operations: MAS, SC<br>Special processing: ACD, SL |
| Disassembled weapons components (pit diassembly) | High-purity Pu and U material types, no RCRA substances present | Metal operation processes: ARI, CA, PH, SRL<br>Miscellaneous operations: EDC<br>Nitrate operations: BM, RB, RBJ |

| Feed Material | Potential Presence of RCRA-Regulated Substances* | P/S Codes, Listed by Process |
|---|---|---|
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity; may or may not contain RCRA substances | Miscellaneous operations: AD, CV, EXT, HRS, RASS, SA, XES, XP<br>Nitrate operations: MAS |
| Hydroxide cakes (process output from P/S codes CLS, CW, CXL, DO, POSM, PRR) | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), lead (D008), mercury (D009), silver (D011), and possibly chromium (D007) | Miscellaneous operations: AD<br>Nitrate operations: CD, HCD, HD, LG2<br>Special processing: DO, POSM |
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters) | May be contaminated with RCRA-regulated heavy metals silver (D011), cadmium (D006), mercury (D009), lead (D008), and possibly chromium (D007) | Miscellaneous operations: APD<br>Nitrate operations: ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD<br>Pyrochemical processes: PK (hardware, metal, anode chips from other P/S codes)<br>Special processing: ACD, DO, SB, SL |
| MSE salts | Typically fairly pure, suspect contaminated with barium (D005) | Chloride operations: MB, MS<br>Miscellaneous operations: XP<br>Nitrate operations: MB, PS |
| Neptunium residues from vault | No RCRA-regulated substances | Pyrochemical processes: Neptunium (only active in 1993) |
| Pu chlorides and fluorides | Variable purity; may or may not contain RCRA substances | Miscellaneous operations: FDL, SO<br>Pyrochemical processes: ER, SD, SS<br>Special processing: RM |
| Pu metal or metal alloy from vault or from various P/S codes | High purity, no RCRA-regulated substances, unless noted otherwise | Metal operation processes: AO, ARI, BC, BT, CA, DA, ELW, EVAC, FSPF, ITF, ITF4, JA, KBTF, MA, MBC, MW, PCH (variable purity), PD, PE, PF, PH, RL, SRL, VD, WE, WLT<br>Miscellaneous operations: AC, AC1, AC2, EXT, LIBS, ME, SA, SMP, VS<br>Nitrate operations: ATL, BM, BU, MF, PAF, VP1<br>Pyrochemical processes: CRD (variable purity), MO, SCB, SS, |

| Feed Material | Potential Presence of RCRA-Regulated Substances* | P/S Codes, Listed by Process |
|---|---|---|
| | | SSMD<br>Special processing: ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |
| Pu oxalates | Typically fairly pure, no RCRA substances present | Nitrate operations: CC, DF, HC |
| Pu oxides | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals cadmium (D006) chromium (D007), and lead (D008)<br>High purity oxides from P/S codes CA, DO, and MA, and from the vault; may or may not contain RCRA substances | Metal operation processes: DOP (high-purity Pu and other radionuclides as oxides)<br>Miscellaneous operations: CK, CV, EOC, EXT, FDL, FLU, IB, IE, LI, LIBS, SO, STF, VS, XP<br>Nitrate operations: ATL, BL, CH, CPOD, DP, ED, FC, HRA, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2<br>Pyrochemical processes: MP (generally high purity), OR (variable purity), PTP<br>Special processing: DO, PI, PX, POSM, RM |
| Pu-Be sources | High purity constituents, no RCRA-regulated substances | Chloride operations: PB, PUB |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than barium (D005) are present | Chloride operations: MB, MS, PRR<br>Miscellaneous operations: EXT, IB<br>Nitrate operations: COD, COL, MB<br>Special processing: DO |
| Reactor fuel pellets | High purity Pu and U material types, no RCRA-regulated substances | Metal operation processes: ME |
| Stainless steel and/or tantalum residues from decladding of Pu-Be sources | High purity metals, potential leaching of chromium (D007) from stainless steel if subjected to strong acid | Chloride operations: PUB |

* The information in this column is highly generalized. Applicability of specific HWNs to a process as a result of the feed material must be determined on a case-by-case basis because the presence and fate of contaminants is time and function dependent. These aspects are discussed in the process AK reports.

3.6.2 Radionuclide Content Identification

The primary Pu material type inputs for TA-55 processes are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers (see Section 14). The results of these calculations are tabulated in the last three columns of Table 2. The calculations assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides will be present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material:

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present in minor amounts in most debris waste from processes at TA-55.
- In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposely contain uranium. The primary uranium material type inputs for reactor fuel development activities and for pit disassembly at TA-55 are listed in Table 3.
- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239.

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope (Wt. %) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

**Table 3. Average Isotopic Content of Uranium Material Types and Enrichments (Wt. %)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Source: TWCP-698

- U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2).

- Protactinium (Pa)-231, the decay-chain daughter of U-235, is expected to be present in trace amounts in some TA-55 wastes due to its widespread presence as a contaminant in TA-55 operations (TWCP-5164, TWCP-5165).

- Cs-137 is a product of the spontaneous fission of Pu-238, Pu-239 and especially Pu-240, as well as a trace contaminant in purified plutonium from the production reactors (TWCP-5164, TWCP-5165). In the latter case the remaining Cs could be on the order of 0.5 ng/g Pu. In the former instance the formation of Cs-137 due to spontaneous fission would lead to about 0.4 pg/g Pu in plutonium that is 10 years old. Because Cs-137 due to spontaneous fission is about a factor of a thousand less than that due to residual contamination from the original separation on the production fuel, the latter is the dominant source of Cs in TA-55 waste.

In general no correlation is expected to be seen among the different radioelements, Pu, Np, U, Pa or Am. The differences in valence states and chemical affinities among these elements is expected to result in substantial fractionation during several TA-55 processes, including ion exchange, solvent extraction, hydroxide precipitation, and dissolution.

Secondary radionuclides are also present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memorandum according to P/S code (TWCP-882, amended by TWCP-5166), as summarized in Table 4. This list includes Am-241, Am-243, cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Th-230, Th-232, U-233, U-235, and U-238.

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of a radioassay instrument to use for optimal results. Cm-244 was introduced in TA-55 operations in P/S code DOP, which started in 1988 (TWCP-5165). Material outputs from this process sometimes were sent to P/S codes IS or WE. Cm-244 could also be part of debris waste under P/S code CA because both operations took place in the 300 Wing of PF-4. Because only one room in this area is available for bagouts, TRU waste from P/S codes DOP and CA were sometimes combined. In addition, because rags

**Table 4. Secondary Radionuclides in TA-55 TRU Waste**

| Secondary Radionuclide | P/S Code Generating Waste |
|---|---|
| Americium-241 | AO, AP, CA, CD, CF, CLX, CXL, DOP, EV, FA, HCD, HD, HP, IA, LR, MA, OH, PI, PR, PRR, PS, SS, SX, WE, XP; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Pu-241 decay. Waste could be either depleted or enriched in Am depending upon whether the source of contamination is the process product or the process residues. |
| Americium-243 | BC, CA, DOP, JA, MA, PH, PI, SS, WE |
| Cerium-144 | DOP, WE |
| Curium-244 | DOP, IS (Mar-Apr 1987), WE |
| Neptunium-237 | ATL, BC, CA, CF, DOP, ED, EV, IS, JA, MA, Neptunium, PI, RB, RFX, WE; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Am-241 decay |
| Protactinium-231 | BC (1989), JA (1989), WE |
| Plutonium-238 | TDC |
| Plutonium-241 | EV, IS, TDC |
| Thorium-232 | CF, DOP, PT, WE |
| Thorium-232 enriched with Thorium-230 | BC, JA, WE |
| Uranium-233 | DOP, WE |
| Uranium-235 or enriched uranium | CN, FF, GI, MW, OB, PD, PI, RS, SRL, UA; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |
| Uranium-238 or depleted uranium | BC, CN, FF, GI, JA, LC, MW, OB, PD, RC, RS, SRL, UA, UPS, US, WE,; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |

Sources: TWCP-882, TWCP-5166, TWCP-AK-2.1-003, TWCP-AK-2.1-005

from DOP were sent to IS, Cm-244 could be present in the ash produced by this operation, which is then processed through nitrate aqueous recovery operations. Some unknown fraction of the Cm-244 could ultimately end up in the evaporator bottoms, which are then immobilized in cement in P/S code CF. In any case, however, Cm-244 is not expected to be present in any waste generated before 1988.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The assay results are summarized in Section 14.2.

3.6.3 Chemical Content Identification

Chemical contents of process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from subject matter expert (SME) input. Individual process AK reports contain detailed assessments of these chemical inputs and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

3.6.3.1 *Acids and bases.* Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, phosporic acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D001 (oxidizer), D002 (corrosivity), and D003 (reactivity) do not apply to the solid debris waste because there are no free liquids in this waste.

- D001, D002, and D003 also do not apply despite the possible production of perchlorate salts in perchloric acid solutions because:

- Perchloric acid solutions are sent to cement fixation.
- Perchlorate salts used in P/S code FF were sent to cement fixation (TWCP-5158).
- Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded.

- Formic acid and hydrofluoric acid are listed in Appendix VIII of 40 CFR Part 261, for their corrosive and toxic characteristics, with EPA HWNs U123 and U134. However, these HWNs are not applicable to the manner in which these chemicals were used in the processes covered by this report.

- None of the acids or bases are F, K or P-listed chemicals

3.6.3.2 *Gases and cryogenic fluids.* The following gases and cryogenic fluids used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation:

- Argon
- Carbon dioxide
- Chlorine
- Dioxygen difluoride (foof)
- Halogen fluorides
- Hexafluoroethane
- Hydrogen chloride
- Krypton fluoride
- Methane
- Nitrogen (gas)
- Nitrogen (liquid)
- Perfluoropropane
- Tetrafluoromethane

The following gases used in the TA-55 processes are identified in Appendix VIII of 40 CFR Part 261 as having hazardous characteristics. The chemical name is followed by the listed EPA HWN and the P/S codes in which the gas is used:

- Fluorine (P056) is used in P/S codes CV, FDL, FLU, PI, SO

- Hydrogen fluoride (U134) is used in P/S codes MP, PI

- Nitrogen dioxide (P078) is used in P/S code HRS
- Phosgene gas (P095) is used in P/S code PTP

No EPA HWNs are applicable to the use of these gases in the TA-55 processes. Compressed gas cylinders are kept outside of the gloveboxes; most are even outside the building, and the gases are plumbed into the glovebox (TWCP-4164). Thus, the gas cylinders are not discarded with TRU wastes. Additional reasons the HWNs are not applicable are as follows:

- D002 (corrosivity) does not apply to the use of hydrogen fluoride because there are no free liquids in the solid TRU waste.
- D003 (reactivity) does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution.
- P056 (fluorine), P078 (nitrogen dioxide) and P095 (phosgene) are not applicable to the listed TA-55 processes because of the manner in which these gases are used in the processes covered by this report.
- Hydrogen fluoride (U134) is listed in Appendix VIII of 40 CFR Part 261 for its corrosive and toxic characteristics. However, this code is not applicable to the manner in which this gas is used in the processes covered by this report.

3.6.3.3 *Metals*. The following metals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII of that regulation: bismuth, bismuth-tin alloy, calcium, copper wool, gallium (metal, oxide or salt), gold, lanthanides, lutetium, niobium +1 percent zirconium metal, platinum, platinum-rhodium alloy, tantalum (metal, alloy, oxide or salt), titanium, uranium powder (depleted), vanadium, and zirconium alloy.

Several metals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. The bullets below list the chemical name, its listed EPA HWN, the P/S codes in which

the metal is used, and the applicability of the EPA HWNs for use of these metals in the TA-55 processes:

- Alkaline earth metals (D003) were used in P/S codes AC, AC1 and AC2; it is possible that one or more of these were pyrophoric. However, EPA HWN D003 does not apply to P/S codes AC, AC1, or AC2 because the metals are consumed or oxidized before discarding.

- Arsenic (D004) was used in P/S code PE between 1984 and 1985, and EPA HWN D004 is applicable to P/S code PE during this period.

- Cadmium (D006) applies to a limited number of anode heels produced in P/S codes ER, PX, and SS using cadmium as a solvent.

- Lead (D008) was used in P/S codes DOP, ER, KBTF, PX, and SS. For combustible debris waste, EPA HWN D008 is applicable to P/S codes DOP, KBTF, and PX. For P/S codes ER and SS, D008 is only applicable to the metal waste.

- Tin-lead (D008) solder was used in sensors in P/S code BT, but D008 is only applicable to the metal waste from this P/S code, and not to the combustible debris waste.

- Mercury (D009) applies to P/S code SSMD, in which it was used for about one week in the summer of 1994.

- Nickel powder was used in P/S code CO as a sintering aid. This metal is listed in Appendix VIII but no HWN is given.

- Sodium (D003) was used in P/S code EL. However, D003 does not apply in this case because excess Na is dissolved in Dowanol 80.

- Stainless steel (contains chromium, D007) was used in P/S code WE. However, EPA HWN D007 does not apply in this case. There is no potential to leach chromium because stainless steel is not exposed to strong acids in P/S code WE.

3.6.3.4 *Inorganic chemicals.* The following inorganic chemicals used in the TA-55 processes are not identified as having hazardous

characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: aluminum chloride, aluminum fluoride, aluminum nitrate, aluminum oxide, ammonium chloride, antimony pentafluoride, bromine, calcium carbonate, calcium chloride, calcium fluoride, calcium nitrate, cerium nitrate, cesium chloride, cobalt nitrate, dicesium hexachloroplutonate (DCHP), ferric ammonium sulfate hydrate, ferric nitrate, ferrous ammonium sulfate, ferrous chloride, ferrous sulfamate, graphite, gypsum cement, hydrogen peroxide, hydroxylamine chloride, hydroxylamine hydrochloride, hydroxylamine nitrate, iodine, lanthanum nitrate, lithium chloride, magnesium chloride, magnesium oxide, magnesium perchlorate, molybdenum oxide, phosphates, Portland cement, potassium chloride, potassium fluoride, potassium permanganate, potassium thiocyanate, silicone lubricant, sodium bicarbonate, sodium carbonate, sodium chloride, sodium chlorite, sodium citrate retarder, sodium dithionate, sodium nitrate, sodium nitrite, sodium oxalate, sodium sulfate, sodium tetraborate, stannous chloride, thorium oxide, uranium oxide (depleted), zinc chloride, zinc stearate, and zirconium carbide. Some processes indicated the use of nitrate, chloride, carbonate, bicarbonate, oxalate, and nitrite salts of sodium, potassium, lithium, magnesium, calcium, and iron.

Several inorganic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 5 lists these chemicals, their HWN, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

3.6.3.5 *Organic chemicals.* The following organic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, Citrapeel, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), diethyl oxalate, dihexyl

**Table 5. Use of RCRA-Regulated Inorganic Chemicals in TA-55 Processes**

| Inorganic Chemicals and P/S Codes in Which They Were Used | RCRA D-Listings and P-Listings Due to Metals Used in the Processes |
|---|---|
| Hydrogen peroxide | D001 (ignitability—oxidizer) and D003 (reactivity) do not apply to the use of hydrogen peroxide because there are no free liquids in the TRU solid waste |
| Lead hydroxide, oxide, or nitrate (P/S code AD) | D008 (lead) applies to P/S code AD. |
| Magnesium perchlorate (P/S code FF) | D001 (oxidizer) does not apply to the use of this chemical in P/S code FF because it was sent to cement fixation (TWCP-5158). |
| Mercuric nitrate (P/S codes VP1 and VP3) | D009 (mercury) applies to P/S codes VP1 and VP3. Mercuric nitrate is used as a catalyst in P/S code VP1; the hydroxide cake produced in VP1 is processed in P/S code VP3. |
| Potassium dichromate (P/S codes AD, CS, CSE, DO, and SE) | D007 (chromium) applies to P/S codes AD, CS, CSE, DO, and SE because of the use of potassium dichromate as a titration endpoint indicator until end of 1993. The solution and precipitates were processed by hydroxide precipitation under the same codes. The chromium was incorporated as a contaminant in the hydroxide cakes. |
| Silver nitrate and other silver salts (P/S codes AC1, CPOD, CS, CSE, DO, SE) | D011 (silver) applies to P/S codes CW and CX due to the use of silver nitrate for chloride titrations under P/S codes CS, CSE and SE until 1993. The solution and precipitates were processed by hydroxide precipitation under P/S codes CW and CX. Silver was incorporated as a contaminant in the hydroxide cakes.<br><br>D011 (silver) applies to P/S code CPOD due to the use of silver nitrate as a catalyst from 1990 to 1994. D011 (silver) applies to P/S code AC1 due to the use of silver salts. |
| Sodium chromate (P/S code PT) | D007 (chromium) applies to P/S code PT due to the use of sodium chromate in the separation of thorium from plutonium and americium. |
| Uranium nitride, depleted (P/S code FF) | D003 (reactivity) does not apply to the use of uranium nitride in P/S code FF. Although this chemical is pyrophoric, its disposal in an oxidizing environment eliminates this characteristic because it is converted to uranium oxide. Uranium nitride is oxidized in the passivation furnace (P/S code PA) prior to discard. |
| Vanadium pentoxide (P/S code SD and SS) | P120 (vanadium pentoxide) applies to waste generated under P/S code SD from February to March 1998, and under P/S code SS from May 27, 1998 to June 10, 1998. |

n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), di-isopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride, ion exchange resin, isopropanol, kerosene, Metalprep 79 (phosphoric acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl di-isobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, Organicstrip, perchlorocarbons (unspecified), phenolphthalein, phosphate buffer solution, phosphine oxide compounds, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, Vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 6 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

D001 (ignitability) and D003 (reactivity) do not apply to wastes in waste stream TA-55-19 (including TA-55-19A) despite the use of spent non-halogenated solvents (HWN F003) for the following reasons:

- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for plutonium.

- Solutions containing spent solvents and above the DL for plutonium are further treated by aqueous recovery processes as part of routine chloride and nitrate operations. Aqueous recovery involves dissolving any solid plutonium in hydrochloric or nitric acid, followed by ion exchange to extract the plutonium. The processed

## Table 6. Use of RCRA-Regulated Organic Chemicals in TA-55 Processes

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Acetone (P/S codes FF, ME, and MOX) | • F003 applies to P/S code ME because it may have been used in the glovebox for cleaning.<br>• F003 does not apply to P/S code FF or MOX because it was only used outside the glovebox. |
| Acetonitrile (P/S code AC2) | • U003 does not apply due to the manner in which this chemical is used in P/S code AC2 (Appendix VIII chemical). |
| Benzene (P/S codes AC, AC1, AC2, and SA) | • D018 (benzene) applies to P/S codes AC, AC1, AC2, and SA<br>• F005 applies to P/S codes AC, AC1, AC2, and SA, in which benzene was used as a solvent |
| Carbon tetrachloride (P/S codes AD, CV, PTP, and PX) | • D019 (carbon tetrachloride) applies to P/S codes AD, CV, PTP and PX. This chemical was used in PTP between 1/87 and 6/89.<br>• F002 does not apply to P/S codes AD, CV, PTP, or PX because it was not used as a solvent or for degreasing. |
| Chloroform (P/S codes AC, AC1, AC2, APD, FF, and XO) | • D022 (chloroform) applies to P/S codes AC, AC1, AC2, APD, FF and XO. Concentrations in P/S code FF are expected to be below RCRA threshold because freeze-drying should have removed most, if not all, of the residual chloroform before the microspheres were taken into the glovebox for sintering. |
| Diethyl ether (P/S code SA) | • F003 applies to P/S code SA because of solvent use. |
| Freon and Freon TF (P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | • F002 applies to P/S codes DA, MA and XO.<br>• F002 does not apply to P/S codes CA, MW, PD, SCB, SRL, UA, VD and WE. Although Freon TF is used as a solvent to clean metal parts, the parts are routinely air-dried to avoid the need for cellulosic wipes.<br>• F002 does not apply to P/S code PF because Freon was used as a coolant for a cutting saw, not as a solvent. |
| Methanol (P/S codes AD and SO) | • F003 applies to P/S code AD because it may have been used for cleaning inside the glovebox.<br>• F003 does not apply to P/S code SO because it was used in a cold trap outside the glovebox. |
| Methylene chloride (P/S code AC1) | • F002 applies to P/S code AC1 because this chemical was used as a solvent (MA) and a paint stripper (XO). |
| Methyl ethyl ketone (P/S codes MA and XO) | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO.<br>• F005 applies to P/S codes MA and XO, in which methyl ethyl ketone was used as a solvent (MA and XO). |
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA.<br>• F005 applies to P/S codes AC, AC2 and SA, in which pyridine was used as solvent. |

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Tap Magic (contains 1,1,1 trichloroethane) (P/S code MA) | • F002 does not apply to P/S code MA because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |
| Tetrachloroethane (not used) | • No RCRA codes apply to tetrachloroethane, an Appendix VIII chemical. Although it is listed on the chemical inventory for metal operations, it was never used in glovebox operations. |
| Tetrachloroethylene (P/S codes AD, APD, CSE, CV and SE) | • D039 (tetrachloroethylene) applies to P/S codes AD, APD, CSE and SE in which it was used until 1992.<br>• D039 does not apply to P/S code CV because it was used as a coolant outside the glovebox.<br>• F002 applies to P/S codes AD, APD, CSE and SE. Its use as a solvent in P/S code CSE and SE ended in 1992.<br>• F002 does not apply to P/S code CV because it was only used as a coolant outside the glovebox. |
| Tetrahydrofuran (P/S codes AC, AC2, and SA) | • U213 is not applicable to the use of this chemical because there is no evidence of a spill or of spill residues entering TA-55 TRU waste streams. |
| Toluene (P/S codes AC, AC2 and SA) | • F005 applies to P/S codes AC, AC2 and SA because toluene was used as a solvent. |
| Trichloroethylene (P/S codes CK, EL, FF, MA, ME, and XO) | • D040 (trichloroethylene) applies to P/S codes EL, FF, MA, ME, and XO.<br>• D040 does not apply to P/S code CK because this chemical was used as a coolant outside the glovebox.<br>• F001 applies to P/S code MA, in which trichloroethylene was used as a degreaser during final cleaning of metal parts from 1979 to 1992, resuming again in February 2000.<br>• F002 does not apply to P/S codes EL or FF, in which it was used as a lubricant for a cutting saw, not as a solvent. |

solutions are below the DL for plutonium and are either sent to the RLWTF or to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, a waste form for which ignitability is not a concern.

- Rags, if contaminated with spent solvents and above the DL for plutonium, are thermally decomposed, which destroys any organic component.

- Although contaminated rags that are below the DL for plutonium are discarded as combustible debris, headspace gas analyses support the expectation that the solvents are below the limits established by the WIPP WAC (see Section 14.4).

- In addition, 100 percent of the waste containers are subjected to headspace gas analysis. Any container showing values over 500 ppm total flammable volatile organic compounds (VOCs) is prohibited from being shipped to the WIPP. (For comparison, the explosive limit for acetone is 25,000 ppm.)

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

Waste containers in a waste stream are characterized as a campaign, in which the targeted group of waste containers to be characterized are selected based on criteria such as availability of the waste containers, waste loading level, availability of waste generator records, and hazardous waste numbers. TA-55-19A is one subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which consists of 12 drums, is identical to the rest of the waste stream except for the possibility that the drums may contain vanadium pentoxide (EPA HWN P120), which was used only between 02/01/98 and 06/10/98 in two specific P/S codes. To be conservative, drums were assigned to this lot if they were closed as late as the end of 1998.

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

Waste streams TA-55-19 and TA-55-20 have been discussed together in this AK Summary Report. These waste streams are similar in physical form and waste material content. They differ only in that TA-55-19 is assigned EPA HWNs based on P/S code information, whereas TA-55-20 contains non-mixed waste.

Other waste streams resulting from the same plutonium processing activities at TA-55 but differing in physical form and waste matrix code are listed in the Sampling Plan. These include waste streams for more specific types of waste such as metal debris, glass,

graphite, HEPA filters, and cemented waste, as well as less specific waste streams such as combustible/noncombustible debris.

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

The waste matrix code S5300 is assigned to the waste streams TA-55-19 and TA-55-20 based on waste generation practices described in the TA-55 Waste Management Procedure, 1996 (TWCP-351), description of past segregation practices (TWCP-701, Section 2.1, page 4 of 43), and TA-55 process AK reports (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007). A more detailed waste matrix code cannot be assigned to the TA-55-19 and TA-55-20 waste streams because TA-55 waste management personnel did not segregate plastic waste from cellulosic waste.

The following codes also apply to waste streams TA-55-19 and TA-55-20 from the *Waste Isolation Pilot Plant Transuranic Waste Baseline Inventory Report* (CAO-94-1005) (TWBIR), the *TRUPACT II Content Code (TRUCON)* (DOE/WIPP-89-004/Rev.13), the Radioactive Solid Waste Disposal (RSWD), and the Item Description Code (IDC) (Sampling Plan).

- TWBIR LA-M16 (TA-55-19) and LA-T16 (TA-55-20)
- TRUCON LA 116A, LA 116B, LA 116C, LA 116D, LA 116E, LA 116F, LA 116H, LA 116I
- RSWD A14, A15, A16, A17, A18, A60
- IDC 004 (combustible waste)

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

The TA-55 Plutonium Facility generates contaminated combustible debris waste primarily from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, old bag-out stubs, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber and Teflon-based products such as rubber gloves, Teflon tape, gaskets, stoppers, etc. used in the operations

The following waste material parameter codes (WMP) are assigned to waste streams TA-55-19 and TA-55-20 based on this information and knowledge of waste generation practices described in the TA-55 Waste Management Procedures (see Section 3.2):

- Cellulosics
- Plastics (waste materials)
- Rubber
- Steel (packaging materials)
- Plastics (packaging materials)
- Iron-based metals/alloys (less than 5 percent by volume)

These WMP codes have been verified with WIPP-compliant waste characterization data from real-time radiography and visual examination (Section 14).

## 8.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

**NOTE:** Although the applicability of several of the EPA HWNs discussed below are time-dependent, the period of HWN applicability should generally be extended to two years following cessation of the use of a given listed chemical, unless AK information is available to restrict the applicability to a shorter time period. This recommendation is based on the observation that a single waste container may stay open for several months, and contain waste items generated over a span of time constituting a year or more (TWCP-5086).

### 8.1 F, K, and P Listings

No K-listings apply to any of the debris waste generated by the P/S codes covered by this report.

The following P/S codes require HWN assignments due to the presence or use of F-listed chemicals. In many cases, the applicability of the HWN is limited to waste generated during a specific period, as discussed in the appropriate process AK report.

| | |
|---|---|
| • AC, AC1, AC2, AC3 | F002, F005 |
| • AD | F002, F003 |
| • APD | F002, F003 |
| • CF | F002, F003 |
| • CLS | F002, F003 |
| • CSE | F002 |
| • CW | F002, F003 |
| • DA | F002 |
| • HP | F002, F003 |
| • MA | F001, F005 |
| • SA | F002, F003, F005 |
| • SE | F002 |
| • WM | F001, F002, F005 (No F-listings apply after 1993) |
| • X0, XO | F001, F002, F005 |

In addition, debris waste generated under P/S codes SD and SS between 02/01/98 and 06/10/98 is assigned EPA HWN P120 (vanadium pentoxide). To be conservative, this HWN is assigned to waste containers with packaging dates extending to the end of December 1998.

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 (including lot TA-55-19A) is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses for containers assigned to waste stream TA-55-19 (Section 14.4).

8.2 Toxicity Listings

TA-55-19 (including TA-55-19A) is conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040.

TA-55-20 has no D-listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, ITF7, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RA, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD.

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

| | |
|---|---|
| AC | D007, D009, D011, D018, D022, D038 |
| AC1 | D007, D009, D011, D018, D022 |
| AC2 | D007, D009, D011, D018, D022, D038 |

| | |
|---|---|
| ACD | D005, D006, D007, D008, D011 |
| ACL | D007, D009 |
| AD | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039 |
| AL | D005, D006, D007, D008, D011 |
| AP | D007, D009 |
| APD | D007, D008, D009, D019, D021, D022, D039 |
| AS | D006, D007, D008, D011 |
| AT | D005, D006, D007, D008, D011 |
| ATL | D005, D006, D007, D008, D011 |
| AX | D007, D009 |
| BF | D006, D007, D008, D011 |
| BU | D006, D007, D008, D011 |
| CD | D006, D007, D008, D009, D011 |
| CF | D007, D008, D009, D011, D019, D021, D022, D039 |
| CK | D005, D006, D007, D008, D009, D011 |
| CL | D007, D008, D009 |
| CLRD | D007, D008, D009 |
| CLS | D007, D008, D009, D019, D021, D022, D039 |
| COL | D005 |
| CPOD | D011 |
| CS | D007, D008, D009 |
| CSE | D007, D008, D009, D039 |
| CV | D005, D006, D007, D008, D009, D011, D019 |
| CW | D007, D008, D009, D011, D019, D021, D022, D039 |
| CX | D007, D008, D009, D011 |
| CXL | D007, D008, D009 |
| DO | D007, D011 (no D-listed chemicals used after 1993) |
| DOP | D008 |
| DS | D006, D007, D008, D009, D011 |
| ED | D005, D006, D007, D008, D011 |
| EDC | D007 |
| EL | D040 |
| EOC | D007, D009 |
| ER | D006, D008 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |
| EXT | D005, D006, D007, D008, D009, D011 |
| FDL | D004, D005, D006, D007, D008, D009, D010, D011 |
| FF | D022, D040 |
| FLU | D004, D005, D006, D007, D008, D009, D010, D011 |

| | |
|---|---|
| FX | D006, D007, D008, D009, D011 |
| HCD | D006, D007, D008, D009, D011 |
| HD | D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| HRA | D004, D005, D006, D007, D008, D009, D010, D011 |
| IA | D006, D007, D008, D009, D011 |
| IAM | D005, D006, D007, D008, D011 |
| IB | D005, D006, D007, D008, D009, D011 |
| ICP | D007, D009 |
| IE | D005, D006, D007, D008, D009, D011 |
| IS | D005, D006, D007, D008, D011 |
| IX | D006, D007, D008, D009, D011 |
| KBTF | D008 |
| LD | D007, D008, D009 |
| LG1 | D006, D008 |
| LG2 | D006, D007, D008, D009, D011 |
| LI | D005, D006, D007, D008, D009, D011 |
| LR | D006, D007, D008, D009, D011 |
| MA | D035, D040 |
| MB | D007, D008, D009 |
| ME | D007, D040 |
| MELL | D006, D007, D008, D009, D011 |
| ML | D006, D008 |
| MPD | D005, D006, D007, D008, D011 |
| MS | D007, D008, D009 |
| NC | D006, D008 |
| NL | D006, D008 |
| OD | D006, D007, D008 |
| OH | D006, D007, D008, D009, D011 |
| PB | D007, D008, D009 |
| PCH | D007 |
| PE | D004 (1984–1985) |
| PK | D006, D007, D008, D011 |
| POSM | D007, D011 |
| PRR | D007, D009 |
| PT | D007 |
| PTP | D019 |
| PTS | D005, D006, D007, D008, D011 |
| PUB | D007, D008, D009 |
| PX | D006, D008, D019 |

| | |
|---|---|
| RASS/RSS | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RC | D005, D006, D007, D008, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SA | D007, D009, D018, D038 |
| SB | D005, D006, D007, D008, D011 |
| SC | D005, D006, D007, D008, D011 |
| SE | D007, D008, D009, D039 |
| SL | D005, D006, D007, D008, D011 |
| SO | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | D007 |
| SS | D006, D008 |
| SSD | D006, D007, D008 |
| SSMD | D009 (D-listed chemicals only used from 06/94 to 08/94) |
| STF | D007 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1, VP3 | D009 (D-listed chemical only used from 09/85 to 10/85) |
| VU, VUL | D005, D008 |
| WM | D007, D008, D009, D022, D035, D040 (D-listings are not applicable after 1993) |
| X0, XO | D007, D008, D009, D022, D035, D040<br>**NOTE:** The same set of HWNs have been assigned to P/S codes WM, X0, and XO in order to be conservative, as discussed in *Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004,R.2, Section 3.5.10). |
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." The waste streams covered by this AK report have no listings for corrosivity, reactivity, or ignitability. Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the

new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests (see Attachment 5), introduced in June 1980, included check boxes that the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments for TA-55 (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF (see Attachment 4, pp. 4 and 5) documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in waste, explosives were altogether prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. In case of a misfire or unconsumed explosives, a procedure is in place at TA-55 to ensure that explosives do not enter the waste stream (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids. Controls on reactive wastes are discussed in Section 3.6.3.

Controls have also been in place to ensure the exclusion of ignitable constituents. D001 does not apply to wastes in these waste streams despite the use of spent non-halogenated solvents (HWN F003) for the following reasons:

- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for plutonium.

- If above the DL, the solutions are sent to aqueous processes as part of chloride or nitrate operations. Aqueous recovery steps include dissolution of any solid plutonium

in hydrochloric or nitric acid, followed by plutonium recovery by ion exchange. The solutions are then below the DL and are either sent to the RLWTF or to the evaporator.

- Rags that are above the DL for plutonium are thermally decomposed, which destroys any organic component.

- Rags that are below the DL for plutonium are discarded as combustible debris, but headspace gas analyses support the contention that the solvents are below the limits established by the WIPP WAC (Section 14.4).

- Finally, 100 percent of the drums are subjected to headspace gas analysis, and drums showing over 500 ppm total flammable VOCs are prohibited from being shipped to the WIPP. (This limit is quite conservative. For comparison, the explosive limit for acetone by itself is 25,000 ppm.)

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed onto vermiculite and discarded in an appropriate waste stream and containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the TRUPACT-II shipping containers. Section 9.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste item specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from TA-55. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

A chemical compatibility analysis was performed for TRUCON codes 116/216 (combustible waste) which indicated that all chemicals and the waste matrix were compatible at levels greater than trace amounts (*Content Code Assessments for LANL*

*TRUCON Codes* [DOE/WIPP-89-004]). During the process AK search, additional chemicals were identified that necessitated a new compatibility analysis, which is underway at the present time.

## 11.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

The effectiveness of administrative and procedural controls on the prohibition of pyrophorics in TRU waste has been verified through testing. For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the RFETS (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Chemical Waste Disposal Requests dated as early as June 1980 included boxes that were required to be checked if the waste contained pyrophoric, flammable, corrosive, or explosive materials (see Attachment 5, Chemical Waste Disposal Request).

In addition, for wastes generated after the implementation of the 1987 Certification Plan, Generator Attachments, associated waste packaging procedures, and quality assurance systems, the waste generator has signed a statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The TA-55 Attachment to the Certification Plan describes how these restrictions were verified by waste management personnel (TWCP-701, Sections 3.8.5 through 3.8.7).

## 12.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the nitrate operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in lists of process inputs documented in the TA-55 process AK reports.

- In the cement fixation process (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs.

- All transformers known to contain PCBs have been tracked from initiation of operations of TA-55 in 1978. When any transformer oil is drained, the oil is handled by a subcontractor who is wholly responsible for its disposal; this oil does not enter the LANL disposal operations (TWCP-3568/N-82).

- Ballast in fluorescent light fixtures could contain PCBs, but at TA-55 these light fixtures are outside the gloveboxes and hence would not enter the TRU waste stream.

- Oil-filled capacitors are not known to have been used in TA-55 gloveboxes.

In addition, if the possibility exists for the waste to contain PCBs, RTR operators are required to check for indications of PCB-containing materials or PCB-contaminated materials. If there is reason to suspect that an item may contain PCBs (based on AK, operator training, or previous operator experience), then the operator submits a PWR and places a hold tag on the waste container (Section 6.6.6 and Table 3 in TWCP-DTP-1.2-008).

## 13.0 DETERMINATION OF THE MAXIMUM NUMBER OF CONFINEMENT LAYERS PERMITTED FOR WASTE PACKAGING

Waste streams TA-55-19 and TA-55-20 are primarily generated from operations performed in gloveboxes. The waste material is placed directly into bag-out bags (also called inner bags) through an opening in the glovebox where the bag is attached, and the bag is then closed and detached from the glovebox. Waste streams TA-55-19 and

TA-55-20 may also be generated from "hot jobs" outside of the glovebox, such as valve changes, or from decontamination of spills or other releases. In these cases, the waste is placed directly into one (or possibly more) inner bag at the work area. The maximum number of confinement layers in any case is six (TWCP-816). This upper limit has been confirmed by RTR and VE data (Section 14).

A minor source of waste streams TA-55-19 and TA-55-20 is room trash that was originally considered low-level waste, which is collected in plastic bags inside cardboard boxes. Occasionally when assayed, these boxes are determined to be TRU waste. These boxes may be sorted to remove the "hot" item, or the whole box may be bagged and sent to the TRU packaging area for placement in drums containing waste streams TA-55-19 or TA-55-20, as appropriate. When this occurs, the P/S code WM is assigned to the waste. Due to the additional layers of plastic that are present when this operation occurs, drums with the P/S code WM are assumed to contain up to two more layers of internal packaging than other drums.

Waste drum packaging procedures for waste streams TA-55-19 and TA-55-20 have been modified several times since the beginning of operations at TA-55. TRUCON Code assignments made by the waste generator are compiled in the Sampling Plan; however, when TRUCON codes are absent, they will be assigned to the waste container in accordance with the default packaging configurations and associated TRUCON codes shown in Table 7 that reflect the packaging protocols in effect during different periods of time at TA-55 (TWCP-816).

AK information has been compared with visual examination data for about 22 containers in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). In two cases, the number of layers of packaging observed during visual examination was greater than the number of layers reported by the waste generator, and an incorrect TRUCON code was assigned by the waste generator (Section 14.2). It is possible that the extra plastic layers were breached—in which case they would not be confining layers—but that the VE inspection did not note this fact. However, the conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution. Consequently, the most conservative TRUCON code is assigned to each waste container in waste streams TA-55-19 and TA-55-20, in accordance with the following guidance:

a) The default TRUCON code from Table 7 is assigned if the waste generator has not assigned a TRUCON code.

b) The TRUCON code assigned by the waste generator is used only if it has been positively confirmed by RTR or VE data.

c) If no VE data are available, and if the RTR data are indeterminate, then the default TRUCON code is assigned to the container.

**Table 7. Maximum Layers of Confinement to Be Used for TA-55-19 and TA-55-20 Waste Containers in the Absence of More Specific Waste Characterization Data**

| Time Frame | P/S Code | Layers of Confinement[a] | TRUCON Code |
|---|---|---|---|
| 01/78–05/87 | All | Maximum of 6 layers:<br>• up to 4 inner bags<br>• up to 2 liner bags<br>• all bag closures by either twist & tie; or twist, tie & tape | LA 116 I |
| 05/87–12/97[b] | All except WM, XO, X0 | Maximum of 4 layers:<br>• up to 2 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded<br>**NOTE:** Folded and taped bags and folded bags do not constitute layers of confinement | LA 116 A |
| 05/87–present | WM, XO, X0 | Maximum of 6 layers:<br>• up to 4 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded<br>**NOTE:** Folded and taped bags and folded bags do not constitute layers of confinement | LA 116 I |
| 01/98–present | All except WM, XO, X0 | Maximum of 1 layer:<br>• 1 carbon-filter vented inner bag (if initial bag is breached, bag is placed in second bag and first bag is slit open), closed by either twist & tie; or twist, tie & tape<br>• 2 liner bags, folded, no closure | LA 116 E |

[a] Layers of confinement for these TRUCON Codes are defined in DOE/WIPP-89-004.

[b] In Rev 1 of this AK report, LA116A was applicable from 5/87 until 1/97. Its applicability was extended to the end of 1997 in Rev 2 (the current revision) because of inconsistencies found during reconciliation of VE data (Section 14.2).

This guidance only applies to retrievably stored waste. It is assumed that newly generated waste packaged under procedures approved by TWCP and CBFO are assigned correct TRUCON codes.

## 14.0 CONFIRMATION OF AK INFORMATION FOR THE WASTE STREAM

Characterization data acquired by WAP-compliant activities provide a means to confirm AK information. Radiography, radioassay, and headspace gas analysis are conducted on all retrievably stored containers of debris waste, and VE is being conducted on at least 50 containers from waste streams TA-55-19 and TA-55-20. Relevant aspects of the data produced by these activities are summarized in the sections below, focusing on the extent to which the data confirm AK information.

### 14.1 Radiography Data

Radiography data are examined to confirm AK information about WMC assignments, layers of packaging, absence of prohibited items, and relative volumes or weights of waste matrix parameters for a waste stream. The WMC for waste streams TA-55-19 and TA-55-20 is S5300 (combustible debris). Thus far, 265 containers, or about 6 percent of the 4454 containers in these two waste streams (Sampling Plan, Revision 3), have undergone RTR, with the data contained in WIPP-compliant batch data reports. The following observations are made from an examination of these data, as summarized in Tables 8 and 9:

- confirmation of WMC S5300 for 98.9 percent of the drums examined
- identification of WMC discrepancies for 3 containers (1.1 percent of the drums examined), which must be reassigned to other waste streams
- identification of potentially sealed containers > 4 liters in 13 percent of the drums, for which PWRs were submitted
- confirmation of the absence of any other prohibited item or condition requiring a PWR
- confirmation of 4 or fewer packaging layers for 52 percent of the drums; plastic packaging layers for the remaining 48 percent were indeterminate due to the large number of horsetails present in the drums
- confirmation of the waste stream description
- 97 percent of the drums contain more than 75 wt.% combustible waste
- 86 percent of the drums contain less than 5 wt.% metal waste, and 94 percent contain less than 10 wt.% metal waste.
- On average, the drums contain 92 wt.% combustible debris, 5 wt.% metal debris waste, and 3 wt.% packaging material.

**Table 8. RTR Data for Waste Streams TA-55-19 and TA-55-20**

| Evaluated Waste Characteristic | Number of Drums | | | |
|---|---|---|---|---|
| WIPP-compliant RTR data | | | | |
| • TA-55-19 | 245 | out of | 4173 | 6% of waste stream |
| • TA-55-20 | 20 | out of | 281 | 7% of waste stream |
| WMC discrepancies | | | | |
| • TA-55-19 | 3 | out of | 245 | 1% of drums examined |
| • TA-55-20 | 0 | out of | 20 | 0% of drums examined |
| *Excluding drums with confirmed WMC discrepancy* | | | | |
| Free liquids (no PWR required; all <1" of container or <1% of drum) | 34 | out of | 262 | 13 % of drums examined |
| Sealed containers > 4L (PWR required) | 31 | out of | 262 | 13 % of drums examined |
| Pressurized containers | 0 | out of | 262 | 0 % of drums examined |
| Unpunctured liner | 0 | out of | 262 | 0 % of drums examined |
| Other prohibited items | 0 | out of | 262 | 0 % of drums examined |
| *Excluding drums with PWRs* | | | | |
| Proportion of combustible waste in drum (wt. %) | | | | |
| • Less than 25 | 0 | out of | 231 | 0 % of drums examined |
| • 25 to 50 | 1 | out of | 231 | < 1 % of drums examined |
| • 50 to 75 | 7 | out of | 231 | 3 % of drums examined |
| • More than 75 | 223 | out of | 231 | 97 % of drums examined |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835, 5110, 5121, 5147; RTR batch data report awaiting review and approval by Carlsbad Field Office (CBFO): LA01-RTR-006.

**Table 9. RTR Packaging Data for Waste Streams TA-55-19 and TA-55-20**

| Maximum Number of Layers | Metal Layers | Plastic Layers | Number of Drums | | |
|---|---|---|---|---|---|
| Less than or equal to 1 | 0 | 1 | 2 | out of 231 | 1% of drums |
| Less than or equal to 2 | 0 | 2 | 21 | out of 231 | 9% of drums |
| Less than or equal to 3 | 0 | 3 | 95 | out of 231 | 41% of drums |
| Less than or equal to 4 | 1 | 3 | 2 | out of 231 | 1% of drums |
| Less than or equal to 5 | None observed | | 0 | out of 231 | 0% of drums |
| Less than or equal to 6 | None observed | | 0 | out of 231 | 0% of drums |
| **Number of Layers Indeterminant** due to number of plastic horsetails: | 0 | Indeter | 109 | | |
| | 1 | Indeter | 2 | | |
| | Subtotal | | 111 | out of 231 | 48% of drums |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835, 5110, 5121, 5147; RTR batch data report awaiting review and approval by CBFO: LA01-RTR-006.

**NOTE:** TA-55 waste generators followed guidance that metal cans used to contain debris were to be considered as packaging, and not as waste. This may account for the drums of combustible debris that were estimated by RTR to contain more than the expected 5 wt.% metal waste.

Changes in waste stream assignment because of characterization data are documented in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064).

AK information resolved an apparent WMC discrepancy for several drums in waste stream TA-55-19 which contained material identified as metal by the RTR operator, thereby leading to an apparent WMC of S5110 (for metal debris) (TWCP-3288, 3289, 3290, 3291, 4190). After reviewing with the generator how these drums were packaged, the generator determined that these drums were packaged with very dense in-house fabricated plastic material called polyvinyldienefluoride (PVDF, also known as Kynar) used to line gloveboxes and build equipment in chloride operations starting in about 1988 (TWCP-5157, TWCP-5169). Hence, the WMC S5300 was correct. As a result of this AK information, a sample of Kynar was added to one of the test drums used in the RTR operations.

14.2 Visual Examination Data

VE data are used to confirm AK information on waste stream descriptions, WMC, the absence of prohibited items, the number and type of confining layers, and the relative volumes and weights of waste matrix parameters. AK packaging and WMC information have been evaluated by VE for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). These 22 drums were packaged between 11/85 and 8/97 (Sampling Plan). P/S codes are available for the waste items packaged in these drums, as documented in radioassay batch data reports (TWCP-4024, TWCP-4025, TWCP-4052, TWCP-4158, TWCP-4303) and waste generator records (TWCP-5086). (The codes for these drums are listed in Table 11, which is discussed in Section 14.3). VE results are summarized in Table 10, from which the following observations are made:

- VE confirmed the AK WMC for all of these drums, reporting WMC S5300 (Organic Debris) for 8 drums, and S5310 (Plastic/Rubber Debris) for 14 drums.

- The maximum number of confining layers observed by VE was five (for one drum), consistent with AK information indicating that the number of layers is six or less (TWCP-816; also Table 7 of this report).

  **NOTE:** RTR data for the number of plastic layers in this particular drum were indeterminate.

**Table 10. VE Data for Waste Streams TA-55-19 and TA-55-20**

| Characterization Data | Number of Containers | | | | Comments |
|---|---|---|---|---|---|
| | AK[a] | | RTR | VE | |
| Waste Matrix Code | | | | | |
| S5000 | — | | — | — | Positive confirmation of AK WMC by RTR and VE for 22 drums |
| S5300 | 22 | | 22 | 8 | |
| S5310 | — | | — | 14 | |
| Maximum number of layers and associated TRUCON codes | Default[a] | Assigned in SP | b | | Number of confining layers<br>• AK and VE match for 3 drums<br>• AK more conservative than VE for 14 drums<br>• AK from waste generator was less conservative than VE for 5 drums |
| 0 LA116G | — | — | | — | |
| 1 LA116C, E, F | — | 6 | | 2 | |
| 2 LA116B, D | — | — | | 2 | |
| 3 None | — | — | | 9 | |
| 4 LA116A | 4 | 4 | | 8 | |
| 5 LA116H | — | — | | 1 | |
| 6 LA116J | 8 | — | | — | |

SP—Sampling Plan (Rev 3)

Notes:

[a] AK information for WMC and TRUCON code assignments is from the Sampling Plan, Rev 3. If no TRUCON code was assigned, then the default code was determined from Table 6 in TWCP-AK-2.1-008 (Rev. 1), using AK information on packaging dates and P/S codes as documented in the Sampling Plan.

[b] RTR data indicated no metal packaging layers for any of these drums, which was consistent with AK information and confirmed by VE. The number of plastic packaging layers was indeterminate by RTR except for one drum with three layers, which was consistent with the default TRUCON code and confirmed by VE (TWCP-4393).

Data sources: VE batch data reports TWCP-3947, 3948, 3949, 3950, 3951, 4022, 4326, 4327, 4392, 4393, 4394, 4427, 4800, 5077, 5083, 5084, 5085, 5112, 5115, 5120, 5173; VE batch data report in Project-level review: LA00-3.4.1-005.

## Table 11. Radioassay Data for Waste Streams TA-55-19 and TA-55-20

| Radionuclide Characteristics | Number of Drums | Comments |
|---|---|---|
| Pu isotopic fractions | | Dominant isotope is Pu239 in all drums |
| • Pu238 / total Pu | 22 | 0.010 to 0.069 wt % |
| • Pu239 / total Pu | 22 | 91.1 to 94.1 wt % |
| • Pu240 / total Pu | 22 | 5.7 to 8.5 wt % |
| • Pu241 / total Pu | 22 | 0.14 to 0.32 wt % |
| • Pu242 / total Pu | 22 | 0.009 to 0.055 wt % |
| Material type | | |
| • MT52 | 19 | |
| • MT53 | 2 | |
| • MT52/53 mix | 1 | |
| Total Pu mass, expressed as ratio of AK data to NDA data | | AK data from Sampling Plan (Rev 3)<br>AK/NDA ratios range from 0.6 to 1.4 |
| • AK/NDA < 0.7 | 1 | |
| • 0.7 < AK/NDA < 1.3 | 17 | |
| • AK/NDA > 1.3 | 4 | |
| Other actinides present at detectable levels (uncertainties ≤ 21.5%)* | | *Range of ratios of nuclide to total Pu*<br>Measured ratios / Calculated upper bound (Table 2) |
| • Am241 | 22 | $1 \times 10^{-3}$ to $9 \times 10^{-3}$ / $2 \times 10^{-3}$ to $3 \times 10^{-3}$ |
| • Am243 | 22 | $4 \times 10^{-7}$ to $4 \times 10^{-6}$ / Not applicable |
| • Np237 | 22 | $2 \times 10^{-4}$ to $1 \times 10^{-2}$ / Not applicable |
| • U234 | 21 | $7 \times 10^{-3}$ to $6 \times 10^{-2}$ / $2 \times 10^{-5}$ to $2 \times 10^{-5}$ |
| • U235 | 5 | $3 \times 10^{-3}$ to $5 \times 10^{-2}$ / $9 \times 10^{-4}$ to $1 \times 10^{-3}$ |
| • U238 | 0 | No measurable U238 / Not applicable |
| Other radionuclides present at detectable levels (uncertainties ≤ 21.5%)* | | Th232 is not detectable by the methods used |
| • Cs137 | | |
| • Pa231(uncertainty <21.5%) | 16 | |
| • No other detectable nuclides | 9 | |
| | 2 | |
| Ratio of measured ratio (Am241/Total Pu) to calculated upper bound (0.002, Table 2) | | |
| • Ratio < 1 | 2 | Am241 could be from decay of Pu241 |
| • 1 < ratio < 2 | 7 | Process waste probably enriched in Am241 |
| • 2 < ratio < 3 | 7 | Process waste enriched in Am241 |
| • Ratio > 3 | 6 | Process waste enriched in Am241 |
| P/S codes for waste items present in these drums (TWCP-5086). The number of drums containing waste items from each code is given in parentheses, if more than one. | | |
| • Chloride operations | CSE, CW, CX (3), CXL (7), MB, MS | |
| • Metal operations | CA (2), FF, MA, MW, PH, SRL | |
| • Miscellaneous operations | AD (2), CV, IB (5), ME, WM (3), XP | |
| • Nitrate operations | ATL, BM (4), COD, DS (3), ED (7), EV (4), HCD, LR (4), MAG, NC (6), NL (2), OD, PR (2), RBJ, RR (2), SC (8), SP (4), SSD | |
| • Pyrochemical operations | ER (3), MO, OR (3), SS (3) | |
| • Special processing | None | |

NDA—nondestructive assay

Data sources: Radioassay batch data reports TWCP-4009, 4023, 4024, 4025, 4052, 4078, 4158, 4159, 4212, 4225, 4226, 4303; and Sampling Plan (Rev 3). P/S codes from TWCP-5086 and TWCP-5163.

*The rationale for this MDL cut off (21.5% uncertainty) is given in TWCP-2130.

- No closed liners were found by VE, which confirmed AK and RTR information.

- For 5 drums, the number of confinement layers observed during VE (2 to 4) was greater than the number of layers associated with the TRUCON code assigned for these drums by the waste generator (LA116C, 1 layer).

- For 4 of the above drums, the default AK value (LA116E, 1 layer) would also have been less conservative than the VE findings. All 4 had been packaged after January 1997 such that no more than 1 layer was expected (Table 7).

**NOTE:** As a result of this discrepancy in packaging layers, Table 7 was revised to extend the period of applicability of LA116A (4 layers of packaging) to the end of 1997.

A conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution, at least with respect to waste containers packaged in 1997 when TA-55 personnel were transitioning from one packaging procedure to another.

14.3 Radioassay Data

Radioassay data are examined to confirm AK information on plutonium material type and mass, the presence of other radionuclides contributing to the total drum activity, and evidence for fractionation of other actinides (e.g., uranium, americium) relative to plutonium during material processing. Table 11 summarizes information relevant to these evaluations for the 22 drums from TA-55-19 and TA-55-20 that have undergone VE. These data confirm the following AK information:

- The dominant isotope in all drums is Pu239

- The material type is MT52 or MT53 for all drums

- All these drums qualify as TRU waste

- AK information on total mass of plutonium in each drum is within 30 percent of the TWCP assay value for 17 drums (77 percent). AK mass for the remaining five drums (23 percent) is within 40 percent of the TWCP assay value.

- As indicated by AK information, all drums contain low but detectable quantities of Am-241, Am-243, and Np-237. A significant proportion also contains Cs-137 and Pa-231.

- No U-236 or U-238 was detected, confirming AK information that uranium is not expected to be present in process waste generated under the P/S codes listed as the source of waste in these drums

- U-235 is present only at trace levels in 5 drums

- In 20 drums (91 percent), Am-241 and U-234 are enriched beyond what would be predicted if they were present solely due to the decay of their precursors in the source plutonium, indicating that significant fractionation of americium and uranium from plutonium occurs during processing operations

14.4 Headspace Gas Data

Headspace gas data are examined to confirm AK information about the presence or absence of hazardous constituents in a given waste stream, and the assignment of each drum to the appropriate mixed or nonmixed waste stream. Table 12 summarizes VOC target analyte concentrations for headspace gas samples from 55 containers assigned to waste stream TA-55-19. (No approved data are yet available for drums from waste stream TA-55-20.) These data confirm the AK information:

- Altogether, 13 different VOCs were detected in these drums. All are documented as having been present or used in TA-55 processes contributing to waste stream TA-55-19, and HWNs have already been assigned to this waste stream for these constituents.

- Only one VOC, methylene chloride, had a 90% Upper Concentration Limit ($UCL_{90}$) value that was above its program required quantitation limit (PRQL).

- Four VOCs—acetone, 1,1,2-trichloro-1,2,2-trifluoroethane, methyl ethyl ketone, and toluene—had $UCL_{90}$ values below the PRQL but were present in at least one drum at a concentration above the PRQL.

- One VOC (methanol) had a mean concentration above its Method Detection Limit (MDL) but no concentrations above the PRQL.

- Seven VOCs had mean concentrations below their MDL, but were present in at least one drum at a concentration above the MDL.

- All other target analyte VOCs were below the MDL.

- No Tentatively Identified Compounds (TICs) were detected.

**Table 12. Headspace Gas Data for Target Analytes in Waste Stream TA-55-19**

| ANALYTE | MDL (ppmv) | PRQL (ppmv) | No. of Samples Analyzed | No. of Samples Above MDL | No. of Samples Above PRQL | VOC Concentrations (ppmv) | | | EPA HWN |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | $UCL_{90}$* | Maximum | AssignedAK |
| Benzene | 1.96 | 10 | 55 | 4 | 0 | 1.2 | 1.8 | 5 | F005, D018 |
| Bromoform | 2.27 | 10 | 55 | 0 | 0 | 1.1 | 1.1 | — | — |
| Carbon Tetrachloride | 2.00 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 3 | D019 |
| Chlorobenzene | 1.93 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 2 | F002, D021 |
| Chloroform | 1.85 | 10 | 55 | 4 | 0 | 1.0 | 1.4 | 3 | D022 |
| 1,1-Dichloroethane | 1.78 | 10 | 55 | 2 | 0 | 1.0 | 1.9 | 4 | — |
| 1,2-Dichloroethane | 2.40 | 10 | 55 | 0 | 0 | 1.2 | 1.2 | — | — |
| 1,1-Dichloroethene | 2.74 | 10 | 55 | 0 | 0 | 1.4 | 1.4 | — | — |
| Cis-1,2-Dichloroethylene | 2.06 | 10 | 55 | 0 | 0 | 1.0 | 1.0 | — | — |
| Ethyl Benzene | 1.72 | 10 | 55 | 0 | 0 | 0.9 | 0.9 | — | F003 |
| Ethyl Ether | 1.30 | 10 | 55 | 0 | 0 | 0.65 | 0.65 | — | F003 |
| Methylene Chloride | 1.97 | 10 | 55 | 11 | 8 | 8.7 | 18.1 | 100 | F002 |
| 1,1,2,2-Tetrachloroethane | 1.62 | 10 | 55 | 0 | 0 | 0.8 | 0.8 | — | — |
| Tetrachloroethene | 1.44 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | — | F002, D039 |
| Toluene | 1.67 | 10 | 55 | 33 | 11 | 6.5 | 8.5 | 51 | F005 |
| 1,1,2-Trichloro 1,2,2-trifluoroethane (Freon-113) | 1.79 | 10 | 55 | 1 | 1 | 1.7 | 1.7 | 44 | F002 |
| 1,1,1-Trichloroethane | 1.82 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 4 | — |
| Trichloroethene | 1.31 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | 6.0 | F002, D040 |
| m-Xylene and p-xylene | 3.62 | 10 | 55 | 0 | 0 | 1.8 | 1.8 | — | F003 |
| o-Xylene | 1.90 | 10 | 55 | 0 | 0 | 0.95 | 0.95 | — | F003 |
| Acetone | 16.12 | 100 | 55 | 31 | 13 | 69.7 | 91.2 | 410 | F003 |
| Butanol | 8.78 | 100 | 55 | 1 | 0 | 4.8 | 4.8 | 29 | — |
| Methanol | 11.42 | 100 | 55 | 10 | 0 | 14.6 | 24.3 | 84 | F003 |
| Methyl ethyl ketone | 18.42 | 100 | 55 | 4 | 0 | 10.1 | 12.6 | 23 | F005, D035 |
| Methyl isobutyl ketone | 16.05 | 100 | 55 | 0 | 0 | 8.0 | 8.0 | — | — |

Source: TWCP-4722; VOC target analyte list for debris waste from WIPP WAP, Table B3-2.

ppmv, part per million by volume; MDL, Method Detection Limit; PRQL, Program Required Quantitation Limit; UCL90, 90% Upper Concentration Limit

— Not applicable

* For samples with concentrations below the MDL, $UCL_{90}$ concentrations are calculated by assuming concentrations were one-half of the MDL values as determined in the MDL study dated 6/19/00 (TWCP-3248).

These results are consistent with AK information summarized in this waste stream report, insofar as all of the VOCs that were detected are known to have been present in TA-55 operations. The data confirm that assignment of these HWNs based on AK information is conservative.

Table 13 summarizes concentrations of potentially flammable VOCs, hydrogen, and methane for headspace gas samples from the same 55 containers as are included in Table 12. All were below the WIPP WAC limits. The average concentration of potentially flammable VOCs for this set of 55 drums was 128 ±101 ppmv, with a maximum of 473 ppm (TWCP-4722). No methane was detected in any of the drums, and hydrogen concentrations were lower by more than an order of magnitude than the WAC limit of 5 percent.

In conclusion, the headspace gas data confirm the presence of VOCs in waste stream TA-55-19. All VOCs present were expected based on AK. However, no correlation is seen between the presence and absence of a specific VOC and its documented use in a process known to have contributed waste placed in a particular drum. For example, about 60 percent of the containers show measurable concentrations of acetone and/or toluene in the headspace gas, and 20 percent contain methylene chloride, but less than half of the drums in which these chemicals are present contain waste items generated by activities that were known to have used these chemicals. Because acetone, toluene, and methylene chloride are present as solvents used in the manufacturing of plastics, the presence of these constituents in headspace gases in drums without any other known source of these VOCs is attributed to (1) off-gassing of constituents in the tape and plastic bags used to package waste items, and (2) radiolytic degradation of the plastic, rubber, tape, Tygon, and similar items in the waste (TWCP-2102).

## 15.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, Segregation of hazardous materials
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (Attachment B, Waste Analysis Plan)
- *NIOSH Pocket Guide to Chemical Hazards* (1997). National Institute for Occupational Safety and Health (NIOSH) Publication #97-140.
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)

**Table 13. Headspace Gas Data for Flammable VOCs, Hydrogen and Methane in Waste Stream TA-55-19**

| ANALYTE | Lower Explosive Limit (LEL) | No. of Samples Analyzed | No. of Samples Above MDL | Maximum Measured Concentration (ppmv) | Evidence for Presence of Gas in Waste | |
|---|---|---|---|---|---|---|
| | | | | | Gas Data | AK |
| Acetone | 2.5% | 55 | 31 | 410 | X | X |
| Benzene | 1.2% | 55 | 4 | 5 | X | X |
| Butanol | 1.4% | 55 | 1 | 29 | X | X |
| Chlorobenzene | 1.3% | 55 | 1 | 2 | X | X |
| Cyclohexane | 1.3% | 55 | 0 | — | — | — |
| 1,1-Dichloroethane | 5.4% | 55 | 2 | 4 | X | — |
| 1,2-Dichloroethane | 6.2% | 55 | 0 | — | — | — |
| 1,1-Dichloroethene | 6.5% | 55 | 0 | — | — | X |
| Cis-1,2-Dichloroethylene | 5.6% | 55 | 0 | — | — | — |
| Ethyl Benzene | 0.8% | 55 | 0 | — | — | X |
| Ethyl Ether | 1.9% | 55 | 0 | — | — | X |
| Methanol | 6.0% | 55 | 10 | 84 | X | X |
| Methyl ethyl ketone | 1.4% at 200 °F | 55 | 4 | 23 | X | X |
| Methyl isobutyl ketone | 1.2% at 200 °F | 55 | 0 | — | — | — |
| Toluene | 1.1% | 55 | 33 | 51 | X | X |
| 1,3,5-Trimethylbenzene | Not known | 55 | 0 | — | — | — |
| 1,2,4-Trimethylbenzene | 0.9% | 55 | 0 | — | — | — |
| m-Xylene and p-xylene | 1.1% | 55 | 0 | — | — | X |
| o-Xylene | 0.9% | 55 | 0 | — | — | X |
| **Total potentially flammable VOCs in a single container*** | — | **55** | — | **473** | **X** | **X** |
| Hydrogen* | 4% | 55 | 32 | 0.38% | X | X |
| Methane* | 5.3% | 55 | 0 | — | — | X |

Source: TWCP-4722

ppmv, part per million by volume; MDL, Method Detection Limit

LEL, Lower explosive (flammable) limit in air, % by volume (at room temperature); data from NIOSH Pocket Guide to Chemical Hazards (NIOSH, 1997)

— Not applicable or not detected

* WIPP WAC requirements state that a waste container cannot be shipped if its headspace gas concentration exceeds 500 ppm for total flammable VOCs, 5% for hydrogen, or 500 ppm for methane concentration.

** The average flammable VOC concentration is 128 ±101 ppm (TWCP-4722). Gases that were below detection are taken into account in this calculation by assuming they are present at concentrations that are equal to one-half of the MDL values.

- *Performing Nondestructive Testing Using the Mobile Real-Time Radiography System* (TWCP-DTP-1.2-008)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)
- *Waste Isolation Pilot Plant Transuranic Waste Baseline Inventory Report* (CAO-94-1005)

## ACCEPTABLE KNOWLEDGE ROADMAP

Waste Streams: TA-55-19 and TA-55-20.

Copies of these documents are in the TWCP RMDC Center. Refer to *Records Management* (TWCP-QP-1.1-004) for information on requesting copies.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| AP-SWO-006,R.3.1 | A | Describes how the TRU Waste Storage Record (TWSR) is prepared, reviewed, submitted, and entered into a TRU waste database | *Review and completion of TWSR* | Section 8.6 describes how waste generator information submitted on the TWSR, as well as other receipt and storage information, is entered into the LANL TRU Waste Database for TRU waste stored at TA-54. | None |
| NMT7-AP-TA55-018,R3 | A | Contains waste generator information required by the LANL TRU Waste Certification Plan | *TA-55 Transuranic Waste Interface Document (TWID)* | Contains information on waste characterization, waste packaging configurations, and TRUCON codes for newly-generated TA-55 waste. Describes how waste generator information in the TA-55 Waste Management System (WMS) database is certified and maintained for waste generated at the TA-55 facility. Contains information on current and projected waste stream volumes. | Document does not give information about RCRA constituents introduced or present in the processes |
| QP-TP-WMS-000.001 | B | Compilation of TA-55 waste generator information, for individual waste containers. | TA-55 Waste Management System (WMS) | Certified and current database of waste container identifiers, waste codes (e.g., IDC, RSWD, EPA HWNs), assay results, packaging dates, waste material content and generating processes for TA-55 wastes. | Overview document – Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-700 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1955,* TRUWM-TA55-CPA-03, R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Provides an explanation of why some waste containers may be packaged with 6 layers of confinement | No Direct way to differentiate between and 6 layers of packaging |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by P/S code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-2102 | B | Presence of VOCs in headspace gas resulting from off-gassing and radiolytic degradation of plastics | Waste Determination Report for Waste Stream TA-55-43 Lot No. 01, Report LA-UR-98-3610, by Rogers et al. | Reviews published literature and presents data and calculations supporting that VOCs are present in headspace gas of TRU waste containers as a result of off-gassing and radiolytic degradation of plastics | None |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-2130 | D | Estimate of the minimum detection limit for Am-243, Np-237, Pa-231, and Th-232 for FRAM analyses | Criteria for reporting Am-243, Np-237, Pa-231, and Th-232 on mobile PAN radioassay data sheets | If the error in the peak area for the isotopes Am-243, Np-237, Pa-231, and Th-232 is greater than 21.5% in the FRAM report, then that isotope is considered to be below the minimum detectable activity. | Memo refers specifically to PAN radioassay data, but the same reasoning is applied to TGS and HENC assay data as well, and to all radionuclides detectable by FRAM. |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests are on residues rather than waste that is lower in Pu content; hence, they are conservative. |
| TWCP-3248 | C | Method Detection Limits for Headspace Gas Analyses | MDL studies with data | MDL values for VOCs, determined 06/19/00 | Different MDL values would have been in effect at the times that the data included in Table 12 of this AK report were acquired, so the MDL values should only be considered as an approximate guide. |
| TWCP-3288 | B | Drum in TA-55-19 waste stream contained material identified as metal by the RTR operator, thereby leading to an apparent WMC of S5110 (for metal debris). After reviewing with the generator how these drums were packaged with very dense in-house fabricated plastic material (Kynar, also known as PVDF) used to line gloveboxes and build equipment in chloride operations starting in about 1988. Hence, the AK WMC S5300 was correct | NCR-00-028 | AK WMC information was correct. | None |
| TWCP-3289 | B | Same as for TWCP-3288 | NCR-00-027 | AK WMC information was correct. | None |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3290 | B | Same as for TWCP-3288 | NCR-00-026 | AK WMC information was correct. | None |
| TWCP-3291 | B | Same as for TWCP-3288 | NCR-00-025 | AK WMC information was correct. | None |
| TWCP-3547/ Cl-25 (UCNI) | D | Answers to questions about chloride processes | Interview with Jim Foxx, 9/23/99 | Answers to questions on Chloride processes; CLS-1 solvent list | None |
| TWCP-3568/ N-74 | C | Chemical list; process description (P/S code CF) | Organic Liquid Emulsification, TRU-NMT2-DP-13, R00; TRUWM-TA55-DP-13-R00; 8/30/93 through 9/30/94 | Emulsifying waste oil and other organic liquids for cement fixation. | None |
| TWCP-3568/ N-82 | C | Clarification of specific processes within the nitrate operations at TA-55 | Jim Foxx, SME, response to comments received on the draft Acceptable Knowledge Summary Report for TA-55 Nitrate Operations, 2/25/00 | Resolutions to the questions and issues raised by Pam Rogers during her review of the Acceptable Knowledge Summary Report for TA-55 Nitrate Operations, 2/25/00 | Information is based on SME knowledge. |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-3947 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-003 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-3948 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3949 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-008 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-3950 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-004 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-3951 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-007 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-4009 | A | Radioassay data for drum from Waste Stream TA-55-19 and -20 per Sampling Plan Rev. 3 | LA00-HENC-007 | Radioassay data | None |
| TWCP-4019 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-006 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4020 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-009 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4021 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-008 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4022 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-006 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4023 | A | Radioassay data for drum from Waste Stream TA-55-19 and –20 per Sampling Plan Rev. 3 | LA00-TGS-003 | Radioassay data | None |
| TWCP-4024 | A | P/S codes of waste items packaged into drums, based on waste generator records | LA00-FRAM-008 | Lists P/S codes for waste items in several drums that underwent VE | No reference to original source of AK information |
| TWCP-4025 | A | P/S codes of waste items packaged into drums, based on waste generator records | LA00-FRAM-009 | Lists P/S codes for waste items in several drums that underwent VE | No reference to original source of AK information |
| TWCP-4052 | A | P/S codes of waste items packaged into drums, based on waste generator records | LA00-FRAM-010 | Lists P/S codes for waste items in several drums that underwent VE | No reference to original source of AK information |
| TWCP-4078 | A | Radioassay data for drum from Waste Stream TA-55-19 and –20 per Sampling Plan Rev. 3 | LA00-TGS-002 | Radioassay data | None |
| TWCP-4080 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-004 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4158 | A | P/S codes of waste items packaged into drums, based on waste generator records | LA00-FRAM-007 | Lists P/S codes for waste items in several drums that underwent VE | No reference to original source of AK information |
| TWCP-4159 | A | Radioassay data for drum from Waste Stream TA-55-19 and –20 per Sampling Plan Rev. 3 | LA00-FRAM-003 | Radioassay data | None |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of Ag, disposal of ash and resins, and use of gases. | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4190 | B | Same as for TWCP-3288 | NCR-00-013 | AK WMC information was correct. | None |
| TWCP-4212 | A | Radioassay data for drum from Waste Stream TA-55-19 and -20 per Sampling Plan Rev. 3 | LA00-HENC-008 | Radioassay data | None |
| TWCP-4219 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-005 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4225 | A | Radioassay data for drum from Waste Stream TA-55-19 and -20 per Sampling Plan Rev. 3 | LA00-HENC-004 | Radioassay data | None |
| TWCP-4226 | A | Radioassay data for drum from Waste Stream TA-55-19 and -20 per Sampling Plan Rev. 3 | LA00-HENC-003 | Radioassay data | None |
| TWCP-4303 | A | P/S codes of waste items packaged into drums, based on waste generator records | LA00-TGS-004 | Drum 54163 contains waste generated by P/S codes DS, LR, SP and SS; also lists codes for drum 54146 | No reference to original source of AK information; listed codes match for drum 54146 but do not match for drum 54163, compared to those listed in TWCP-4052. |
| TWCP-4326 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-3.4.1-008 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-4327 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-3.4.1-009 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4392 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-011 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-4393 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-010 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-4394 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-3.4.1-007 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-4399 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-010 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4400 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-011 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4427 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-009 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-4457 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-025 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4458 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-020 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4459 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-002 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4464 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-017 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4471 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-024 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4542 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-002 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4543 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-012 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4544 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-023 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4545 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-001 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4566 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-021 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4570 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-022 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4572 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-003 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4573 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-026 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4574 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-027 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4577 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-028 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-4721 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-003 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4722 | A | UCL-90 calculations for headspace gas concentrations in 55 drums from waste stream TA-55-19 per (Sampling Plan, R3) | UCL90 Calculations for TA-55-19-R2 | UCL-90 calculations for headspace gas concentrations in 55 drums from waste stream TA-55-19 per (Sampling Plan, R3) | None |
| TWCP-4797 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-008 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. |
| TWCP-4800 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-3.4.1-006 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-4835 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-001 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-5077 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-002 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5083 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-003 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5084 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-VE-001 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5085 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-004 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5086 | B | P/S Codes for TA-55 Waste items, listed by drum | P/S codes for waste items in individual drums are either from the TA-55 Waste Management System or from the certified data base | P/S Codes for drums that underwent VE | Only some drums are included |
| TWCP-5110 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-007 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. |
| TWCP-5112 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-001 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5115 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-003 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5120 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5121 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-009 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5147 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-013 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. |
| TWCP-5157 | D | Use of Kynar lining in chloride operations | Interview with Jim Foxx (TA-55 SME) on March 17, 2001 | Kynar began to be used to line gloveboxes in chloride operations in 1988, and installation was completed in 1992. | Does not explicitly list all P/S codes in which Kynar was used |
| TWCP-5158 | D | Chemical use in P/S code FF | Interview with Fred Hampel (TA-55 SME) on 4/19/01 | Magnesium perchlorate was used in the glovebox line in P/S code FF, and was the only chemical used there. It was used as a water getter, and was changed once during the period 1987 to 1992. The spent chemical was sent to cement fixation, P/S code CF. | No information about after 1992 |
| TWCP-5163 | B | Waste generator records for 5 drums of TA-55 combustible debris waste packaged in 1985-86 | Radioactive Solid Waste Disposal (RSWD) Records | Lists P/S codes (embedded in waste item identifiers) for drums S855627, S862004, S862274, S862456, and S862286. | From noncertified TRU waste data base |
| TWCP-5164 | D | Sources of Cs-137 and Pa-231 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 2, 2001 | Plutonium operations never handled Cs-137 or Pa-231 in any of the Pu processing areas at TA-55. However, Cs-137 is expected to be present in the wastes because it is a fission product of several Pu isotopes. Pa-231 is expected to be present (as a function of the age of the waste) because it is a decay chain daughter of Pu-239 and U-235. | None |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5165 | D | Sources of Cs-137, Pa-231, and Cm-244 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Dominant source of Cs-137 expected to be due to residual contamination from original separation of Pu from production fuel. Cm-244 introduced in P/S code DOP starting in 1988, but could also show up after that date in IS, WE, CA and CF. | None |
| TWCP-5166 | D | Secondary radionuclides used in P/S code PI | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Amendment of Foxx's 1997 memo (TWCP-882): P/S code PI was a user of U, Np and Am isotopes | None |
| TWCP-5169 | D | Use of Kynar in TA-55 operations | Interview with Jim Foxx (TA-55 SME) on April 18, 2001 | Aqueous chloride operations began lining each of their new gloveboxes with Kynar in 1988, finishing in 1992 | None |
| TWCP-5173 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-002 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5372 | D | Appicability of P120 to waste generated by P/S codes SD and SS | Interview with Jim Foxx (TA-55 SME) on May 7, 2001 | Vanadium pentoxide was used between February 1998 and June 1998. SME information indicates that waste from this work would have been packaged into containers that were closed by the end of December 1998. | None |
| TWCP-6988 | B | Compilation of TA-55 waste generator information, for individual waste containers. | *Archived generator's databases 95DRUM and 95 ncdrum.* | Database of waste container identifiers, waste codes (e.g., IDC, RSWD, EPA HWNs), assay results, packaging dates, waste material content and generating processes for TA-55 wastes. | |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

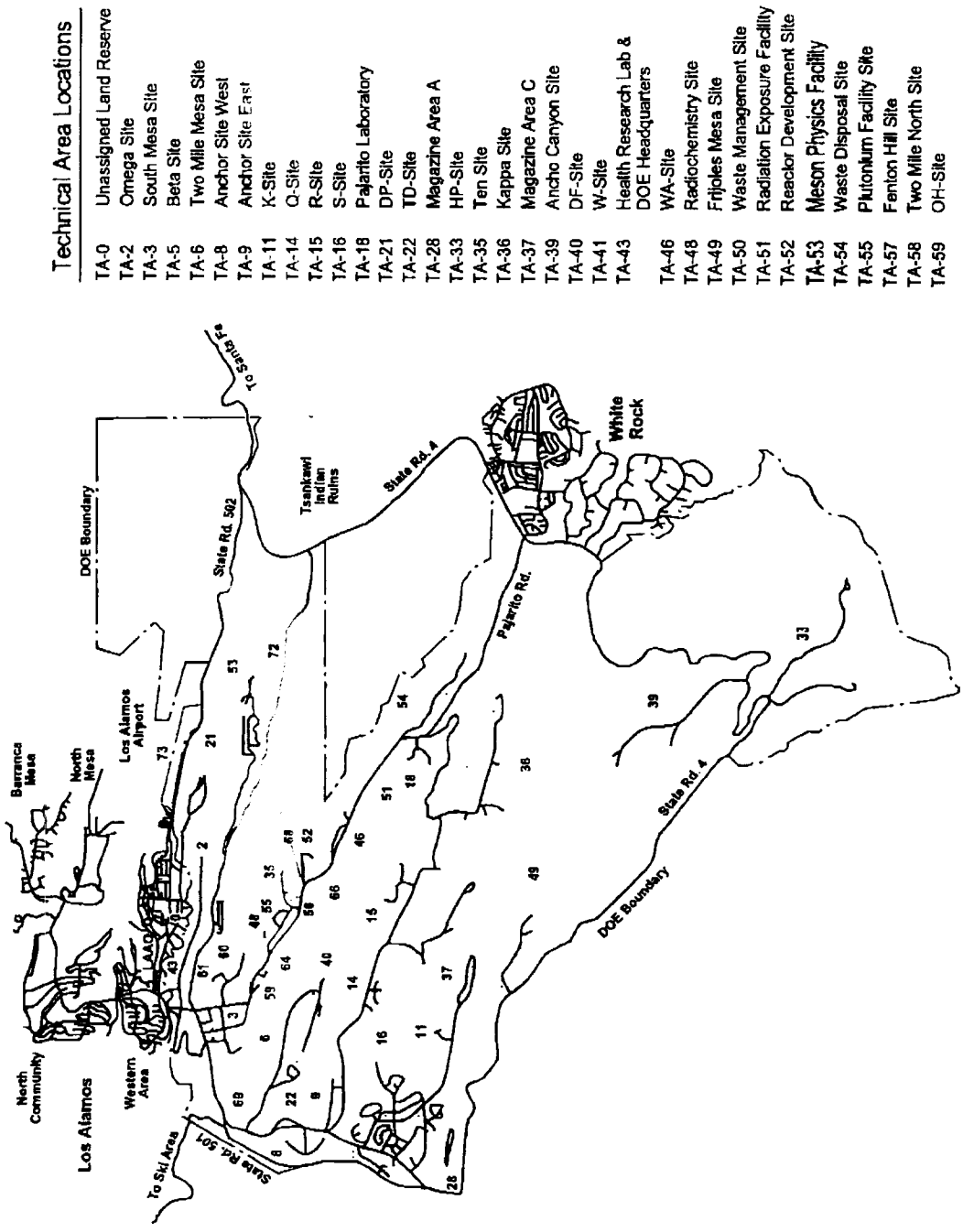
| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-003,R.2 | B | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Metal Operations at TA-55* | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2 | B | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | B | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* | Detailed information on each P/S code for nitrate operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | B | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Pyrochemcial Processes at TA-55* | Detailed information on each P/S code for pyrochemical processes at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | B | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Special Processing Operations at TA-55* | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-To Be Determined | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-006 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | RTR batch data report was approved by project level, but is awaiting review and approval by CBFO |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-To Be Determined | D | Time during which P120 is applicable to waste containers containing waste items generated under P/S codes SD and SS | Interview with Jim Foxx (TA-55 SME), May 7, 2001 | It is a reasonable assumption that all waste from this set of experiments would have been sent to Room 432 and packaged into waste containers that were closed by the end of December 1998. The basis for this assumption is that accumulated waste items are required to be cleaned out of work areas (e.g., gloveboxes) in the Plutonium Facility twice a year, during the biannual inventory. In 1998 and 1999, the biannual inventories occurred in June and December. | None |
| TWCP-To Determined | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP-PLAN-0.2.7-001,R.3 | C | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK references based on generator's original data | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* | Detailed information on each waste drum and waste stream | Reliability and completeness of waste generator data is highly variable |

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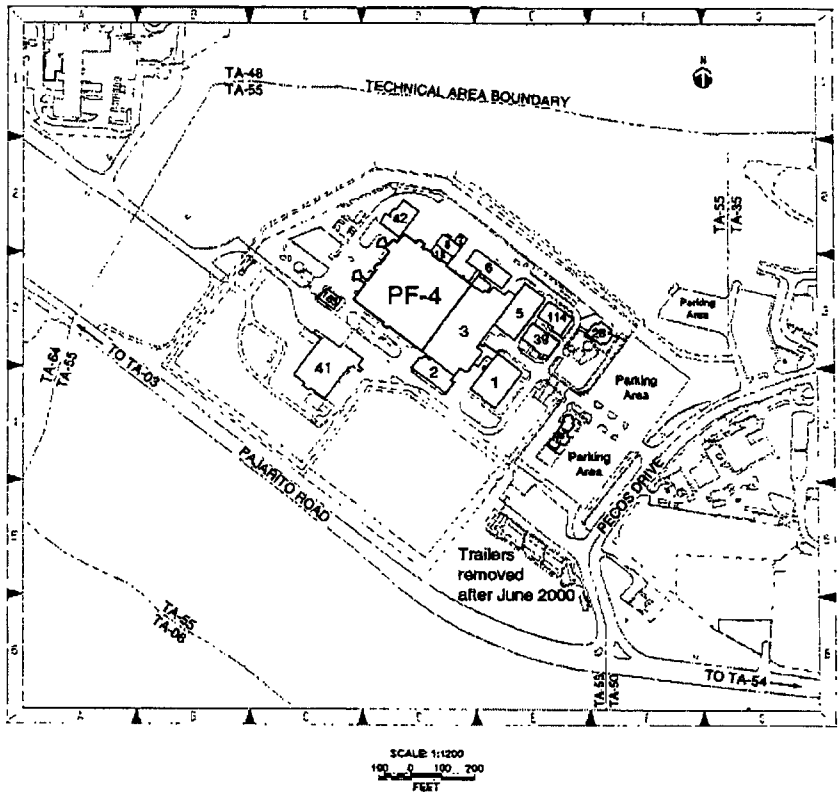
# MAP OF LANL


Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Española
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Los Alamos Airport
Barranca Mesa
North Mesa
North Community
Los Alamos
Western Area
To Ski Area
State Rd. 501
DOE Boundary
State Rd. 4

## MAP OF TA-55

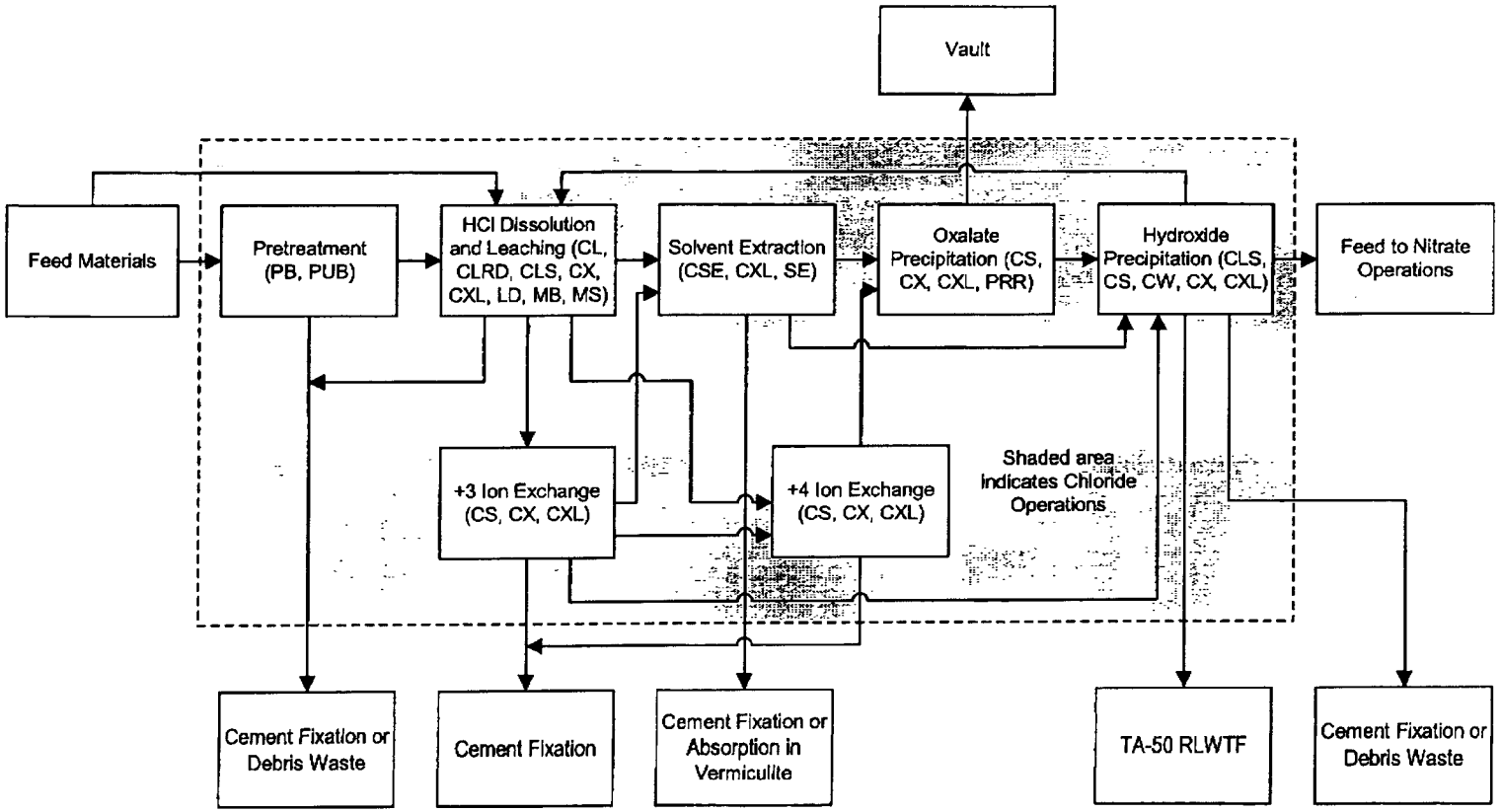
**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.

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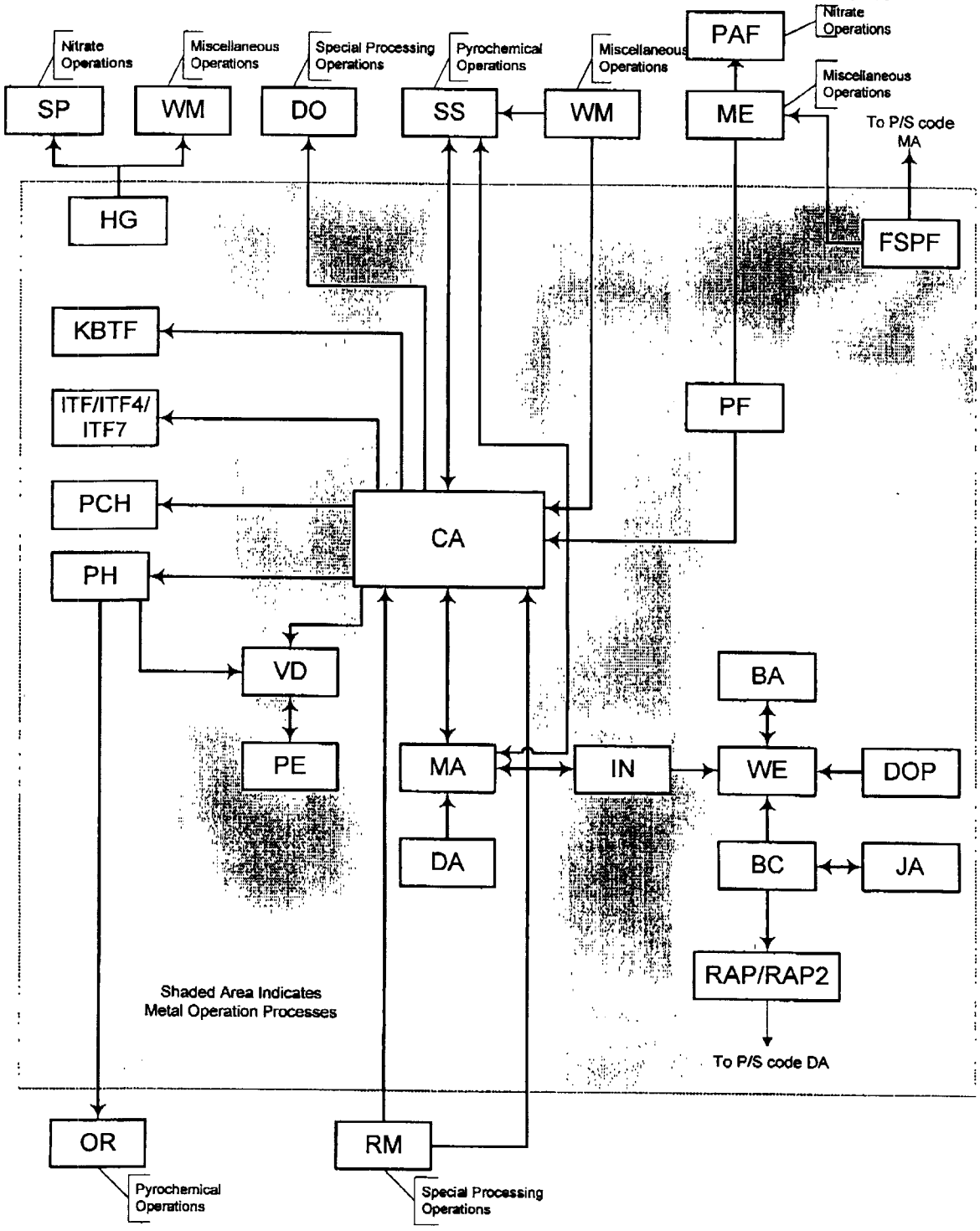
## SIMPLIFIED PROCESS FLOW DIAGRAMS

## SIMPLIFIED PROCESS FLOW DIAGRAM FOR CHLORIDE OPERATIONS



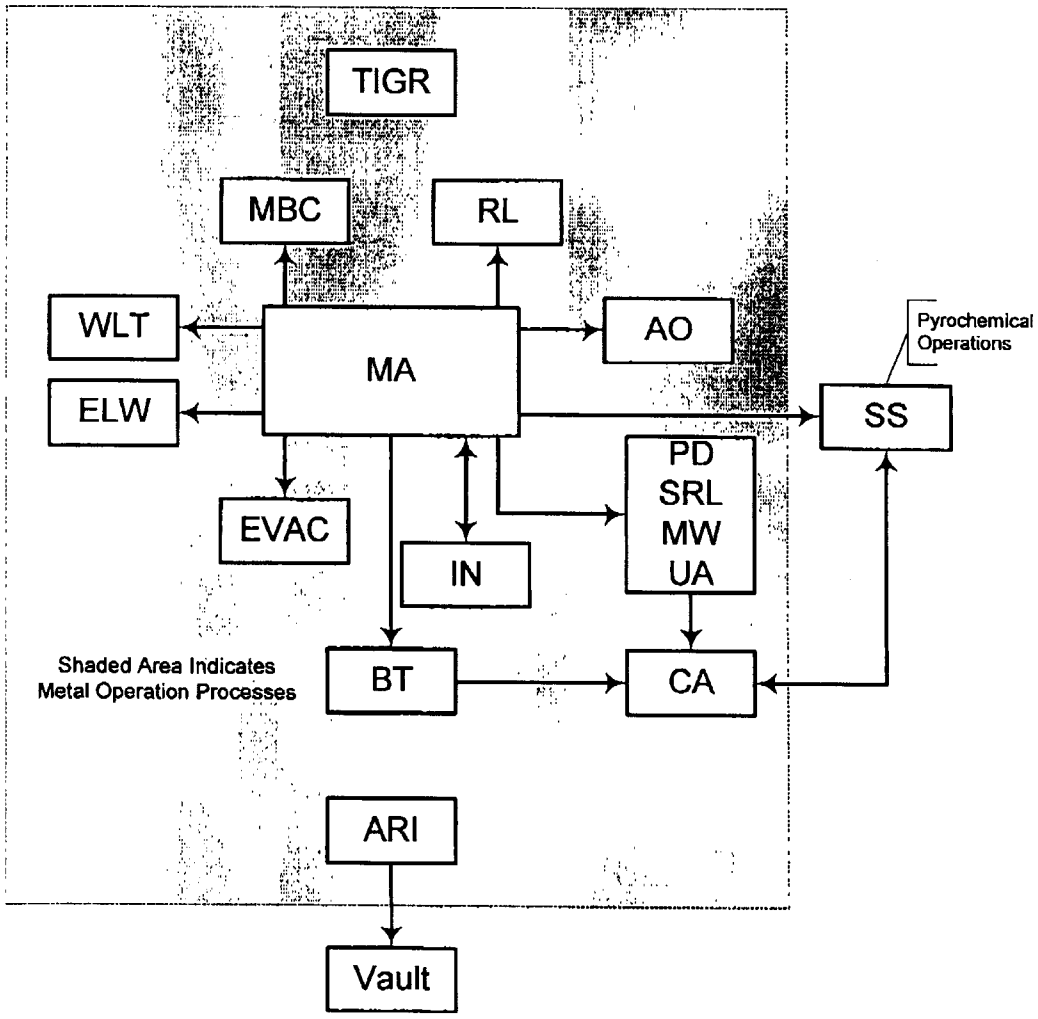

**NOTE:** Many of the P/S codes for chloride operations involve more than one step or activity in the process flow diagram. Thus, the same P/S code can appear in more than one box on the process flow diagram.

## SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS




**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

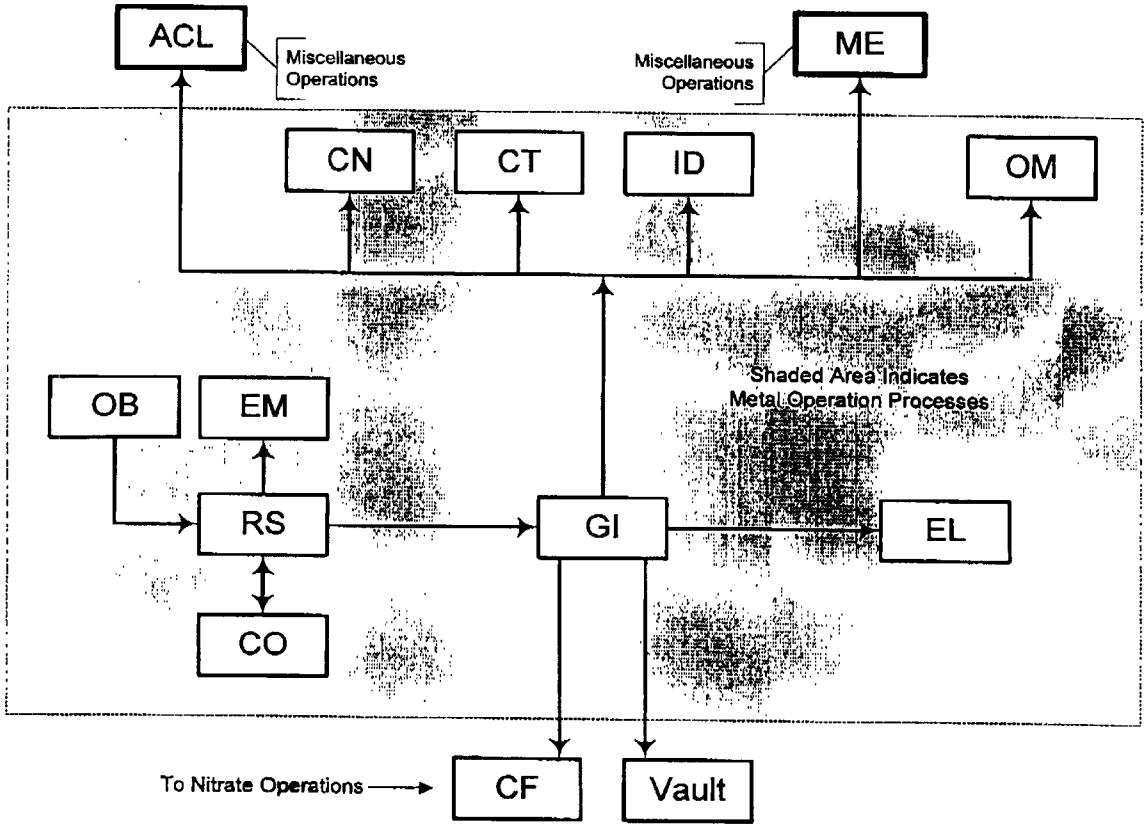
**SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS (continued)**



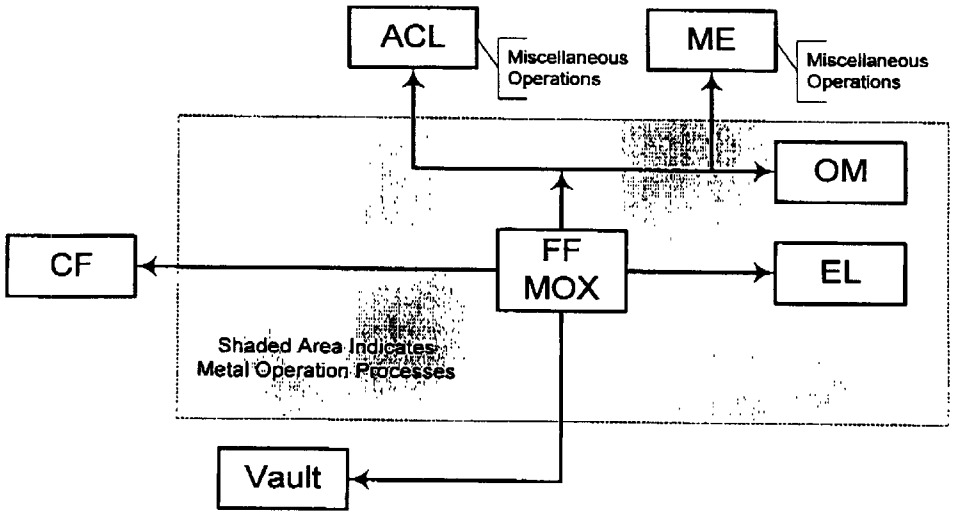

**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

**NOTE:** P/S code UA tracks uranium compounds from Pit Disassembly. Activities under this P/S code would be similar to those under P/S codes IN, MW, and WE.

**SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS (continued)**

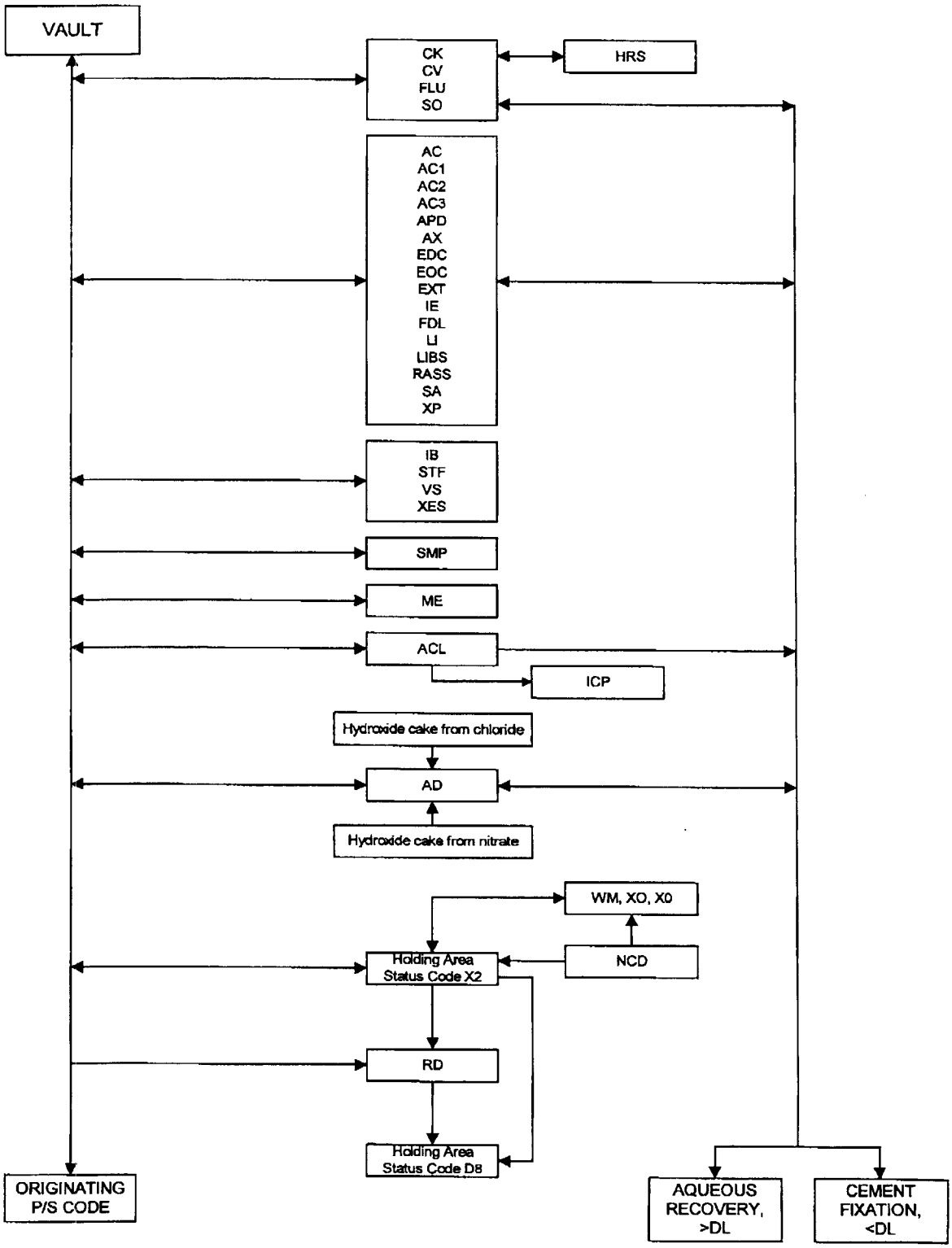



In 1988, P/S codes CO, GI, ID, OB, and RS were combined into P/S code FF. P/S codes CT, ID, and OM are status codes only, and probably do not generate TRU waste.

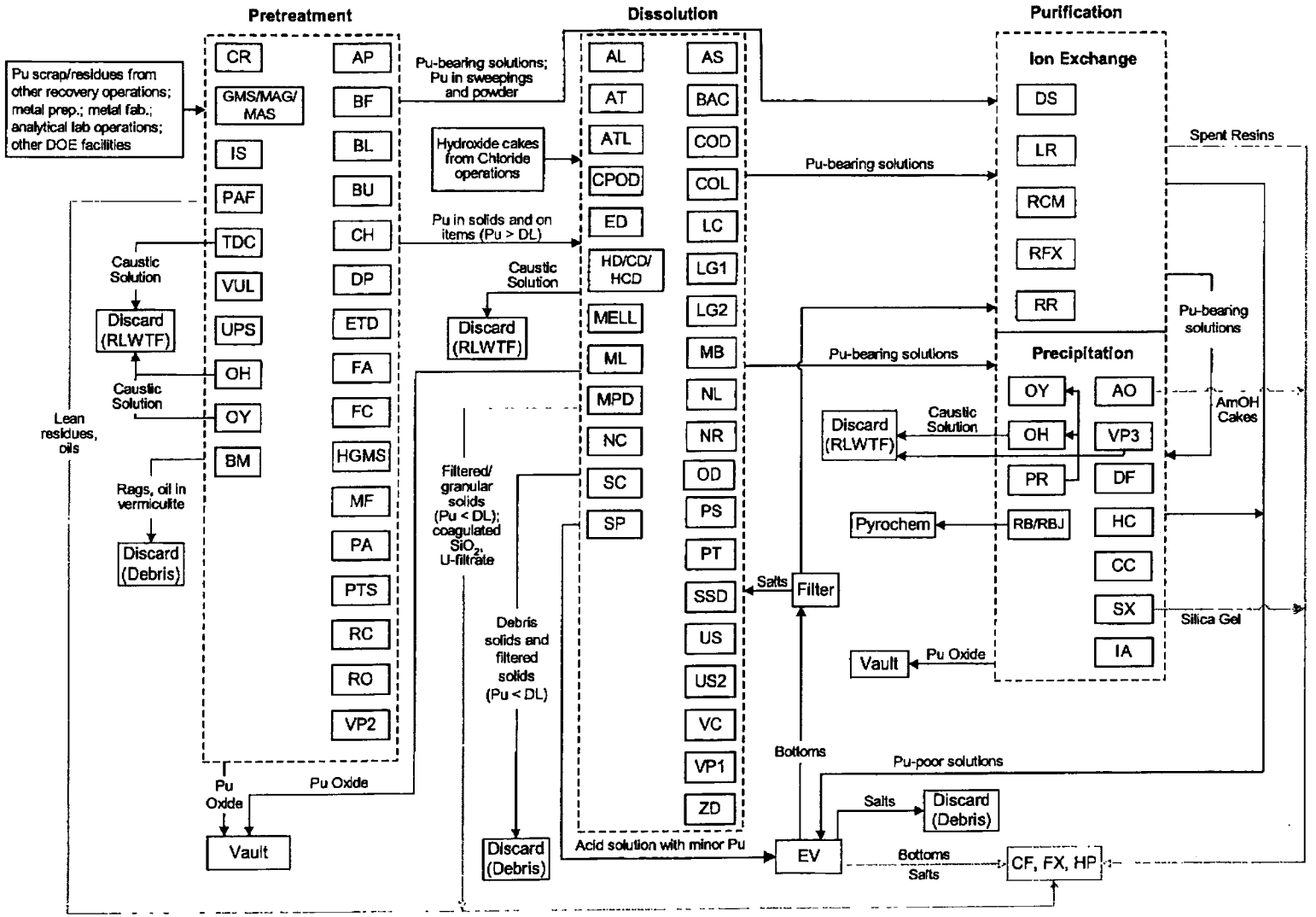



**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

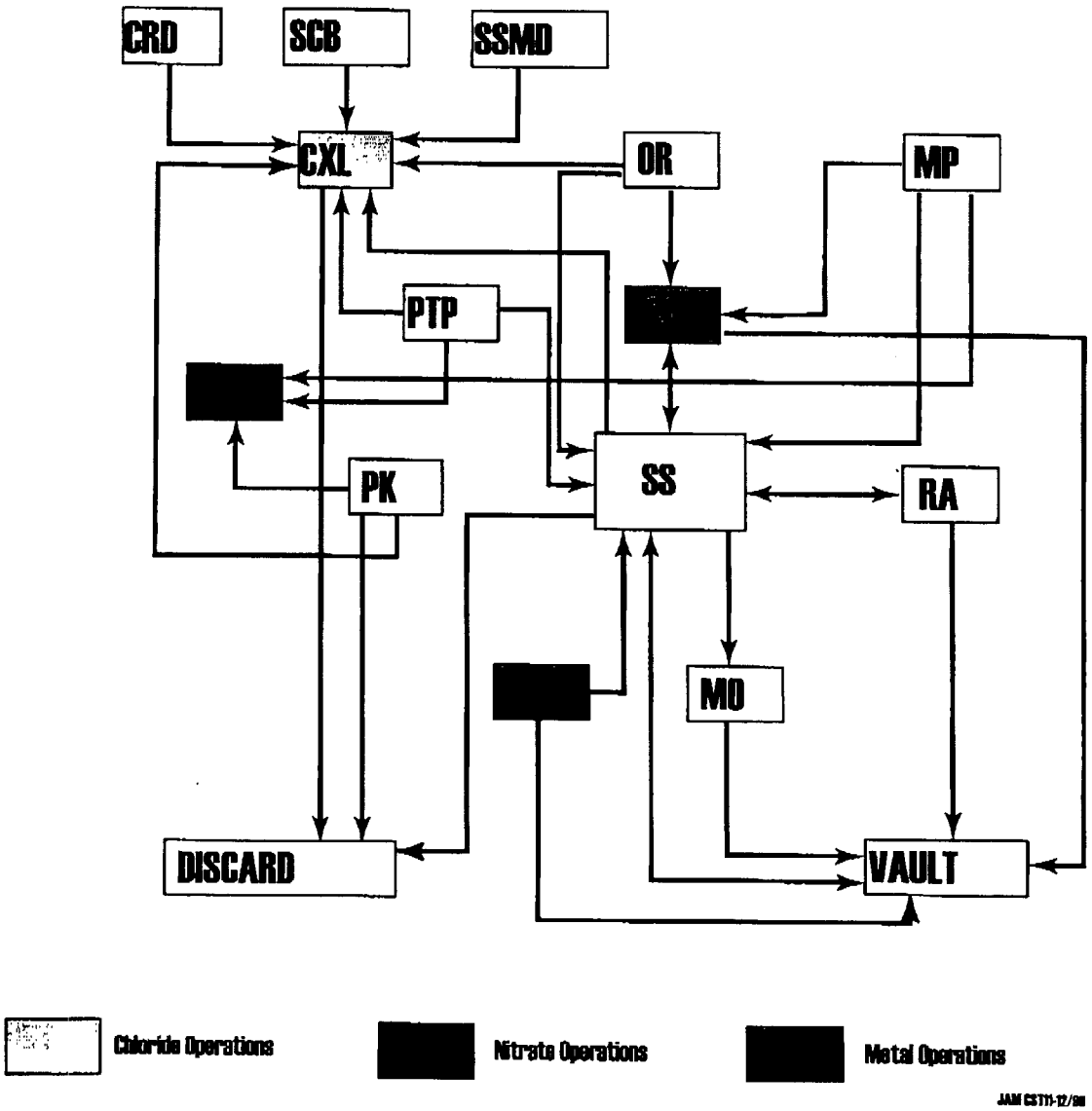
## SIMPLIFIED PROCESS FLOW DIAGRAM FOR MISCELLANEOUS OPERATIONS



## GENERALIZED PROCESS STATUS DIAGRAM FOR NITRATE PROCESSES

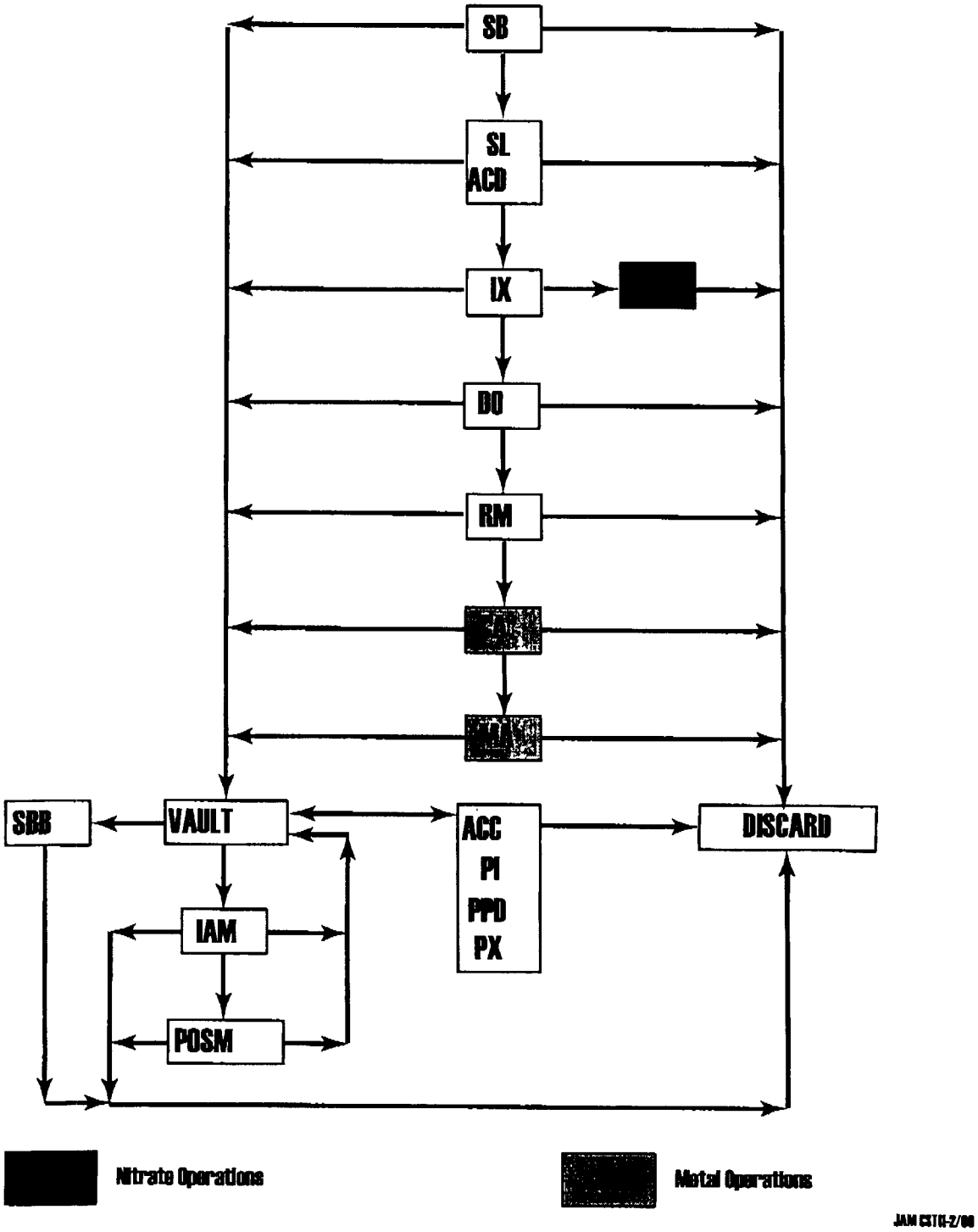


**SIMPLIFIED PROCESS FLOW DIAGRAM
FOR PYROCHEMICAL PROCESSES**



## SIMPLIFIED PROCESS FLOW DIAGRAM

## FOR SPECIAL PROCESSING



**WASTE GENERATOR FORMS FOR TRU WASTE**

**Los Alamos**
NATIONAL LABORATORY

# TRU WASTE STORAGE RECORD

LA00000056636

## 1. GENERATOR'S PRE-USE VISUAL INSPECTION

| Purchase Order # | Inspected Items | | |
|---|---|---|---|
| *This container has been visually inspected according to approved procedures and has been found to be free of damage that would make it unsuitable for TRU waste packaging.* | [X] Ring, Bolt, and Nut | [X] Chime | [X] Dents |
| | [X] Lid and Gasket | [X] Gouges | [X] Paint |
| Name TRUJILLO MICHAEL C | Znumber 098605 | | Date JUL 30 1997 |

## 2. GENERATOR'S PACKAGE INFORMATION

| Group NMT-7 | Technical Area 55 | Building PF-4 | Program Code 8J0700 KF14 1000 0000 | [ ] Off-Normal |
|---|---|---|---|---|

Additional Information TID 826872

| CONTAINER | LINER |
|---|---|
| [X] Steel Drum (55 gal.) | [X] None |
| [ ] Steel Drum (85 gal.) | [ ] 90 mil liner |
| [ ] Standard Waste Box | [ ] 125 mil liner |
| [ ] RH Canister | INTERNAL SHIELDING |
| [ ] Other (Call TWCO) | [X] None |
| [ ] Overpack | Type / Thickness (in.) |
| Carbon Filter ID 01 1578 / 02 | |

RADIONUCLIDE CONTENT

| Nuclide | Amount | Uncertainty | C = Curie M = Gram |
|---|---|---|---|
| PU-238 | 6.007E-3 | 5.136E-4 | M |
| PU-239 | 5.633E+1 | 4.816E+0 | M |
| PU-240 | 3.604E+0 | 3.082E-1 | M |
| PU-241 | 1.201E-1 | 1.027E-2 | M |
| PU-242 | 1.201E-2 | 1.027E-3 | M |
| AM-241 | 9.551E-2 | 8.166E-3 | M |

| | |
|---|---|
| Waste Profile Request Number | 20309 |
| Process Batch Code | NA |
| [ ] PDP Program | Tracking No: |
| Gross Weight (lb.) | 1.12E+2 |
| Net Weight (lb.) | 4.88E+1 |
| Shipping Category | 3003400280 |
| LANL Waste Stream ID | TA-55-3 |
| TRUCON Code | 116C |
| Date Closed (MMDDYY) | AUG 4 1997 |

NONRADIOACTIVE HAZARDOUS MATERIALS

| Name | EPA Code | Quantity (g) |
|---|---|---|
| None | | |
| | | |
| | | |

Accumulation Start Date (MMDDYY)

*The data in this section were collected, and the waste described herein was packaged and labeled according to approved procedures.*

Name VIGIL ROBERT A | Znumber 091564 | Date AUG 11 1997

## 3. GENERATOR SITE HEALTH PHYSICS INFORMATION

| | | Survey Date | Survey Meter Model | Property Number | Calibration Due Date |
|---|---|---|---|---|---|
| Gamma Dose Rate (mrem/h) (contact) | 8.0E+1 | AUG 6 1997 | RO2D | 006467 | SEP 13 1997 |
| Neutron Dose Rate (mrem/h) (contact) | 1.3E+0 | AUG 6 1997 | PNR-4 | 004906 | OCT 2 1997 |
| Total Dose Rate (mrem/h) (contact) | 8.1E+1 | | | | |
| Total Dose Rate (mrem/h) (1 meter) | 8.3E+0 | *The data in this section were collected according to approved procedures.* | | | |
| Alpha Contamination (dpm/100cm$^2$) (rem) | 0.0E+0 | Name CHAVEZ RONALD | | | |
| Beta-Gamma Cont. (dpm/100cm$^2$) (rem) | 0.0E+0 | Znumber 112026 | | Date AUG 11 1997 | |

Form 1562E (7/97) Printed AUG 29 97 11:38:48 by BUSTAMANTE J M Page 1 of 2

Modifications to Computer Generated Data Invalidate this Form

Los Alamos
NATIONAL LABORATORY

# DISCARDABLE WASTE LOG SHEET

LA00000056636

| Item ID | Matrix | Pkg Wt (kg) | Qty | Volume (l) | MT | SNM(g) | Uncert(g) | Pu/Section/Loc/Off Memo |
|---|---|---|---|---|---|---|---|---|
| CORRCXL6 | Combustibles | 6.03 | | | 52 | 0.831 | 0.134 | 814 |
| PLSED3 | Plastic | 5.02 | | | 52 | 29.315 | 1.055 | 8/17 |
| PLSSC28 | Plastic | 11.06 | | | 52 | 49.824 | 5.025 | 8/17 |
| | | | | | | | | |
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| | |
|---|---|
| Total Pkg Wt (lbs) | 48.72 |
| Drum Tare (lbs) | 62.78 |
| Calc Gross Wt (lbs) | 111.50 |
| Meas Gross Wt (lbs) | 111.50 |

| MT | Total SNM | Total Uncert |
|---|---|---|
| 52 | 60.870 | 6.214 |
| | | |
| | | |
| | | |
| | | |

Printed AUG 28 97 11:36:48 by BUSTAMANTE J M

# TRU Waste Origination & Disposition Information

| Item Id | Matrix | | | | Date |
|---|---|---|---|---|---|
| COMCXL5 | Combustibles | | | | JUL 30 1997 |
| Quantity: 1 | Gross Wt (kg): 5.72 | Tare Wt: | Net Wt (kg): 5.72 | Volume (l): | Process Status: CXL |
| Generator: ORTEGA JOSE D | | | Building: 108039 | Room: 420 | Phone: 7-2575 |
| Waste Process: Solid Waste Processing | | Assay: NDA Laboratory | Container Info: | | Drum Id: LA00000056636 |

| | | |
|---|---|---|
| Beryllium: NO | Explosives: NO | PCB's: |
| Compressed Gases: NO | Free Liquids: NO | Particulates: NO |
| Corrosive: NO | Hazardous: | Pyrophorics: NO |

Comment: Trash from hot job.

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 0.031 | 0.134 | G05 | 4.30 | 0.010 | JUL 31 1997 | GUTIERREZ DARLENE D |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| JUL 30 1997 | CHAVEZ RONALD G | CERTIFIED | |
| AUG 4 1997 | VIGIL ROBERT A | PACKED | LA00000056636 |

Printed AUG 29 97 11:38:44 by BUSTAMANTE J M

# TRU Waste Originator & Disposition Information

| | | | | | |
|---|---|---|---|---|---|
| Waste Stream: PLSED3 | Matrix: Plastic | | | | Date: JUL 30 1997 |
| Quantity: | Gross Wt (kg): 3.18 | Tare Wt: | Net Wt (kg): 3.18 | Volume (l): | Process Status: ED |
| Generator: ROMERO JOE C | | | Drawer Number: 109702 | Room: 401 | Phone: 7-2572 |
| Waste Process: Solid Waste Processing | | Facility: NDA Laboratory | | | Drum Id: LA00000056636 |

| | | | | | |
|---|---|---|---|---|---|
| Beryllium | NO | Explosives | NO | PCB's | |
| Compressed Gases | NO | Free Liquids | NO | Particulates | NO |
| Corrosive | NO | Hazardous | | Pyrophorics | NO |

Waste Contents: PLASTICS FOR DISCARD

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 10.215 | 1.055 | G05 | 16.00 | 3.210 JUL 31 1997 | GUTIERREZ DARLENE D |

## Justification Memos

Memo ID
NONE

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| JUL 30 1997 | CHAVEZ RONALD G | CERTIFIED | |
| AUG 4 1997 | VIGIL ROBERT A | PACKED | LA00000056636 |

Printed AUG 29 97 11:38:44 by BUSTAMANTE J M

# TRU Waste Origination & Disposition Information

| Item Id | Matrix | | | | Date |
|---|---|---|---|---|---|
| PLSSC28 | Plastic | | | | JUL 30 1997 |
| Quantity / Gross Wt (kg) | Tare Wt | Net Wt (kg) | Volume (l) | | Process Status |
| 8.70 | | 8.70 | | | SC |
| Custodian | | | Container | Room | Phone |
| LUJAN JOE E | | | 083188 | 420 | 7-2575 |
| Waste Process | | Assay | Container Id | | Drum Id |
| Solid Waste Processing | | NDA Laboratory | | | LA00000056636 |

| | | | | | |
|---|---|---|---|---|---|
| Beryllium | NO | Explosives | NO | PCB's | |
| Compressed Gases | NO | Free Liquids | NO | Particulates | NO |
| Corrosive | NO | Hazardous | | Pyrophorics | NO |

Comments

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 49.824 | 5.025 | G05 | 16.00 | 5.730 | JUL 31 1997 | GUTIERREZ DARLENE D |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| JUL 30 1997 | CHAVEZ RONALD G | CERTIFIED | |
| AUG 4 1997 | VIGIL ROBERT A | PACKED | LA00000056636 |

Printed AUG 29 97 11:38:45 by SUSTAMANTE J M

HEALTH-SAFETY-ENVIRONMENT FORM

LOS ALAMOS SCIENTIFIC LABORATORY

DATE

# CHEMICAL WASTE DISPOSAL REQUEST

REQUESTED BY _____ PHONE _____

GROUP _____ LOCATION: TA-_____ BLDG._____ AREA/WING _____ ROOM _____

WASTE VOLUME ($ft^3$) _____

NUMBER OF CONTAINERS (SIZE/TYPE) _____

WASTE FORM (check as appropriate):

☐ SOLID ☐ LIQUID ☐ GAS

COMMON NAMES OF CHEMICALS: _____

POTENTIAL HAZARDS (check as appropriate):

CORROSIVES ☐ Acids _____strong _____mild _____weak

☐ Bases _____strong _____mild _____weak

☐ FLAMMABLE ☐ TOXIC ☐ OTHER: _____

☐ EXPLOSIVE ☐ CARCINOGEN _____

☐ PYROPHORIC ☐ INFECTIOUS _____

☐ OIL ☐ UNKNOWN _____

CAN MATERIALS REACT VIOLENTLY WHEN EXPOSED TO:

AIR _____ WATER _____ OTHER CHEMICALS _____

If yes, give details: _____

OTHER USEFUL INFORMATION: _____

(TO BE COMPLETED BY H-7)

DISPOSAL RECORD

AREA _____ PIT/SHAFT _____ DATE _____ BY _____

MAIL THIS FORM TO WASTE MANAGEMENT, H-7, MS-~~[illegible]~~ 574

6/80

H&S 7-6A

## DRUM LIST FOR WASTE STREAM LOT TA-55-19A

A review of TA-55 data bases of waste items packaged into drums (TWCP-5086) and the Sampling Plan (TWCP-PLAN-0.2.7-001,R.3) identified the following twelve 55-gallon drums that contained combustible debris generated by P/S codes SD and SS and that were closed between February 1, 1998 and December 31, 1998 (TWCP-5372).

| Drum Identifier | P/S Codes of Waste Items (TWCP-5086) | Packaging Date (Sampling Plan,R.3) |
|---|---|---|
| LA00000056873 | ED, RFX, SS, TDC | 04/13/98 |
| LA00000056876 | CXL, ED, EV, ME, SS | 05/12/98 |
| LA00000056887 | SS | 06/09/98 |
| LA00000056902 | BC, MA, SS, TDC | 09/29/98 |
| LA00000056924 | SS | 07/13/98 |
| LA00000056930 | SS | 08/17/98 |
| LA00000057121 | BM, FF, SS | 08/31/98 |
| LA00000057137 | CXL, SS, TDC | 09/29/98 |
| LA00000057164 | SS | 10/28/98 |
| LA00000057737 | FF, SS | 12/01/98 |
| LA00000057755 | ATL, BM, CXL, MA, SS, TIGR, XO | 11/24/98 |
| LA00000057766 | SS | 11/24/98 |

# TWCP/WRR
# Document Modification/Review Cycle

## Preparation of Document

☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-008,R.2/IC2 New Rev/IC: R2/IC2

Preparer: John Musgrave

Document Title:
Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☒ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☒ Forms have been marked as SAMPLE
- ☒ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 11/1/2001 Signed Initials: [signature]

## Document Control Technician Data Entry

Date Received: 11/2/01

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 11/2/01
- ☑ Master Index Updated - Date: 11/2/01
- N/A Archive old revision (Record)

- ☑ Capture Document: ✓ Word __ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- N/A Add: Controlled Document Original Signatures on File at the RMDC
- ☑ Security Set for: ✓ Read Only
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date N/A LAUR ✓ Title ✓ Link ✓ Test
- ☑ On-line test: ✓ Open Doc N/A Password
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- N/A CAO: __ Electronic Copy __ Printed

Date Completed: 11/5/01 [illegible] Signed Initials: [signature]

If pages are separated match to Document: TWCP-AK-2.1-008,R.2/IC2

# TWCP/WRR
# Document Modification/Review Cycle



☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-008,R.2/IC2 New Rev/IC: R2/IC2

Preparer: John Musgrave

Document Title:
Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

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Document Tracking Closed ○ Open ◉ Closed Date to DC: 11/1/2001 Signed Initials: [signature]

Date Received: 11/2/01

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 11/2/01
- ☑ Master Index Updated - Date: 11/2/01
- N/A Archive old revision (Record)

- ☑ Capture Document: ✓ Word __ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- N/A Add: Controlled Document Original Signatures on File at the RMDC
- ☑ Security Set for: ____ Read Only
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date N/A LAUR __ Title ✓ Link __ Test
- ☑ On-line test: __ Open Doc N/A Password
- ☐ Electronic Notification: __ Sent ✓ Printed
- N/A CAO: __ Electronic Copy __ Printed

Date Completed: 11/5/01 (on [illegible]) Signed Initials: [signature]

If pages are separated match to Document: TWCP-AK-2.1-008,R.2/IC2

# TWCP:WRR
# Document Modification/Review Cycle



Status: ○ Open ◉ Closed ☐ Revision ☒ Interim Change

Date Received: 10/26/2001

Document ID: TWCP-AK-2.1-008,R.2/IC2

Current Rev/IC: R2/IC1

Document Title:

Rev/IC: R2/IC2

Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

Preparer: John Musgrave

Date to DP Team: 11/1/2001

Technical Reviewer:
(QA and Preparer)

Release for Review:

Comments:

☒ IC - Not Applicable

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

If pages are separated match to Document: TWCP-AK-2.1-008,R.2/IC2

# Document Modification/Review Cycle

☒ IC - Not Applicable

Reviewer Comments Incorporated: ..... Comments:

Redline/DRR Given to Preparer: .....

Reconciled Comments Returned: .....

Modifications Made to Document: .....

Preparer Review of Modifications: .....

Signed/Release for Final Signature: .....

☒ IC - Not Applicable

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments

X-Sender: 0c @empo.lanl.gov
X-Mailer: QUAL MM Windows Eudora Version 5.0
Date: Mon, 05 Nov 2001 13:12:11 -0700
To: Patricia G Patton <pgp@lanl.gov>
From: "Pamela Z. Rogers" <pzr@lanl.gov>
Subject: Re: Do AK reports need LAUR #
Cc: gavett@lanl.gov
X-RCPT-TO: <109592@empo.lanl.gov>

In general, an IC would need to go through classification before posting.

However, I have reviewed the content of both of these ICs, and all the material mentioned was obtained directly from various LANL web pages that are not classified nor UCNI. Therefore, since the information is already posted on the LANL web, it should not require another classification review to be posted on our internal-only web page.

At 09:33 AM 11/5/2001 -0700, you wrote:

> Good Morning Pam,
>
> I received AK-008/IC2 on Friday for posting to the web. Please let me know if this needs to go to classification for an LAUR number before posting.
>
> We also spoke earlier last week about AK-010/IC!, and you mention that it didn't need an LAUR number. Would you
> send me an email.
>
> Thanks, have a good day.
>
> --Patricia
>
> **~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**
> ***Patricia G. Patton***
> Los Alamos National Laboratory
> E-ET / TWCP
> Records Management / Document Control
> ( RMDC )
> 557 Oppenheimer
> TA-00 / bldg 764
> MS M319
> Phone: (505) 667-2071
> Email: pgp@lanl.gov
> **~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: For Training Distribution
Cc: fabi@lanl.gov
Bcc:
Attached:

I am sending this report you today, November 5, instead of the on the effective date because I was awaiting Pam's
response letting me know if this report needed to go to classification for an LAUR number before it went on the web,
I have since received her email.

The following is a revised AK report.

**Effective Date: 11/2/01**

**TWCP-AK-2.1-008,R.2/IC2** - Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

***Patricia G. Patton***

**Los Alamos National Laboratory**
**E-ET**
**Records Management / Document Control**
**( RMDC )**
**TA-0**
**557 Oppenheimer Building 764**
**Phone: (505) 667-2071**
**Email: pgp@lanl.gov**

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

# TWCP/WRR
# Document Modification/Review Cycle

☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-008 New Rev/IC: R.2/IC1

Preparer: John Musgrave

Document Title:
Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 7/25/2001 Signed Initials: JJS

Date Received: _____

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 7/26/01
- ☑ Master Index Updated - Date: 7/26/01
- ☑ N/A Archive old revision (Record)

- ☑ Capture Document: ✓ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- ☑ N/A Add: Controlled Document Original Signatures on File at the RMDC
- ☑ N/A Security Set for: ____ Read Only
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date N/A LAUR ✓ Title ✓ Link ✓ Test
- ☑ On-line test: __ Open Doc N/A Password
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- ☑ CAO: ✓ Electronic Copy ✓ Printed

Date Completed: 7/26/01 Signed Initials: [signature]

If pages are separated match to Document: TWCP-AK-2.1-008

# TWCP/WRR
# Document Modification/Review Cycle



Status: ○ Open ◉ Closed ☐ Revision ☒ Interim Change

Date Received: 5/15/2001

Current Rev/IC: R.2

Document ID: TWCP-AK-2.1-008

Rev/IC: R.2/IC1

Document Title:

Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

Preparer: John Musgrave Date to DP Team: 5/15/2001

Technical Reviewer:
(QA and Preparer)

Release for Review:

Comments:

05/15/01: Incorporated changes and sent to CBFO for approval.
07/16/01: CBFO will no longer review AK documents.

☒ IC - Not Applicable

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

# TWCP/WRR
# Document Modification/Review Cycle

☒ IC - Not Applicable

Reviewer Comments Incorporated: .....
Comments:
Redline/DRR Given to Preparer: .....
Reconciled Comments Returned:
Modifications Made to Document: .....
Preparer Review of Modifications: .....
Signed/Release for Final Signature: .....

☒ IC - Not Applicable

| Signature | Position | Sent Out | Returned | Comments |
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Comments:

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
| CAO | W. Ledford | 5/15/2001 | 7/16/2001 | |
| | | | | |
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Comments

"LANL will not be getting any comments on that document."

To: Earl.Bradford@wipp.carlsbad.nm.us, TBowden@wipp.carlsbad.nm.us
From: Louise Garcia <louise@lanl.gov>
Subject: TWCP-AK-2.1-008,R2/IC1
Cc:
Bcc:
Attached: P:\WasteStreams55-19&55-20\TWCP-AK-2^1-008R2IC1.doc;

The following AK Report has been approved and is being sent to you for adequacy review.

Acceptable Knowledge Summary Report for Waste Stream TA-55-19 and TA-55-20 (TWCP-AK-2.1-008,R2/IC1)

The Report will be released for use once you have approved it via email.

**Tammy,**

**Is Earl's e-mail address correct? Should there be anyone else that should be receiving documents for adequacy review? Let me know. Thanks**

X-Server-Uuid: 5df9e970-eedf-11d3-844e-0008c7569817
From: "Ledford, Wayne - CTAC" <Wayne.Ledford@wipp.carlsbad.nm.us>
To: "'Jim Bailey'" <154344@empo.lanl.gov>
cc: "'Larry Souza'" <souza@lanl.gov>,
"'Marji Gavett, CST-7, 5-5392'" <gavett@lanl.gov>
Subject: Procedure Status
Date: Mon, 16 Jul 2001 15:59:24 -0600
X-Mailer: Internet Mail Service (5.5.2650.21)
X-WSS-ID: 174DBB8F110300-01-01
X-RCPT-TO: <154344@empo.lanl.gov>

Would you send another copy of TWCP-DTP-1.2-014, Rev. 8 to me and T. Bowden? It may have been lost in the transition. I'll get it reviewed as quickly as possible.

TWCP-AK-2.1-008, the AK summary report. LANL will not be getting any comments on that document. We normally don't review revisions to AK Summary documents because it is an output of your approved program and processes (kind of like a batch data report). If there is a concern with some specific aspect of that revision that you would like us to look at, please let me know.

TWCP-DTP-1.2-056, R. 4 and 006, R6, IC3 have been sent to Dorothy Gill for review.

THANKS

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: For Training Distribution
Cc: fabi@lanl.gov
Bcc:
Attached:

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**TWCP-AK-2.1-008,R.2/IC1** - Acceptable Knowledge Summary Report for Waste Streams TA-55-19 AND ta-55-20

To: wipp.notify@wipp.carlsbad.nm.us
From: Patricia G Patton <pgp@lanl.gov>
Subject: [Procedure]
Cc: Tammy.Bowden@wipp.carlsbad.nm.us
Bcc: fl@lanl.gov
Attached: \\twcp-web\Pages\twcp\RMDC\AK\TWCP-AK-2.1-008\TWCP-AK-2.1-008,R.2_IC1.pdf;

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**TWCP-AK-2.1-008,R.2/IC1** - Acceptable Knowledge Summary Report for Waste Streams TA-55-19 AND TA-55-20

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Document ID: TWCP-AK-2.1-008,R.2 New Rev/IC: R.2
Preparer: John Musgrave
Document Title:
Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
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Date Received: 3/1/2001

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Rev/IC: R.2

Document Title:

Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

Preparer: John Musgrave Date to DP Team: 3/12/2001

Technical Reviewer:
(QA and Preparer)

Release for Review:

Comments:

Jim incorporated all comments.

☐ IC - Not Applicable

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## TWCP-AK-2.1-008,R.2

**Effective Date** 5-14-2001 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

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From: Louise Garcia <louise@lanl.gov>
Subject: For Training Distribution
Cc: fl@lanl.gov, manmtz@lanl.gov
Bcc:
Attached:

The following is a revised AK Report.

**TWCP-AK-2.1-008,R.2 - Acceptable Knowledge Summary Report for Waste Stream TA-55-19 and TA-55-20**

To: wipp.notify@wipp.carlsbad.nm.us
From: Louise Garcia <louise@lanl.gov>
Subject: [Procedure]
Cc: Tammy.Bowden@wipp.carlsbad.nm.us
Bcc: fl@lanl.gov
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**TWCP-AK-2.1-008,R.2 - Acceptable Knowledge Summary Report for Waste Stream TA-55-19 and TA-55-20**

4/30/01 DRAFT #8 10

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-00-5727)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19, Lot TA-55-19A, and TA-55-20

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
JOHN MUSGRAVE DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| OM | Oxygen to metal ratio determination | Metal Operation Processes | 3.4.1, Att. 4 | |
| OR | Direct oxide reduction | Pyrochemical Processes | 3.4.2, Att. 4 | |
| OY | Oxalate precipitation | Nitrate Operations | 3.4.1, 3.4.3, Att. 4 | |
| PA | Passivation | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| PAF | Passivation furnaces | Nitrate Operations | 3.4.1, Att. 4 | |
| PB | Pu-beryllium source recovery | Chloride Operations | 3.4.1, Att. 4 | D007, D008, D009 |
| PCH | Plasma chemistry | Metal Operation Processes | 3.4.2, Att. 4 | D007 |
| PD | Pit disassembly | Metal Operation Processes | 3.4.2, Att. 4 | |
| PE | Sputtering process | Metal Operation Processes | 3.4.2, Att. 4 | D004 |
| PF | Plutonium surfaces | Metal Operation Processes | 3.4.2, Att. 4 | |
| PH | Thermal hydride/dehydride | Metal Operation Processes | 3.4.2, Att. 4 | |
| PI | Preparation of isotopes | Special Processing | 3.4.4, Att. 4 | |
| PIG | Welding | Metal Operation Processes | 3.4.3, Att. 4 | |
| PK | Pickling and nitrate holding | Pyrochemical Processes | 3.4.11, Att. 4 | D006, D007, D008, D011 |
| POSM | Processing out-of-specification material | Special Processing | 3.4.3, Att. 4 | D007, D011 |
| PPD | Pu pellet dissolution | Special Processing | 3.4.11, Att. 4 | |
| PR | Peroxide precipitation | Nitrate Operations | 3.4.3, Att. 4 | |
| PRR | Pyrochemical residue recovery | Chloride Operations | 3.4.3, 3.4.4, Att. 4 | D007, D009 |
| PS | Peroxide precipitation of MSE salts | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| PT | Plutonium-thorium separation | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D007 |
| PTP | Plutonium trichloride preparation | Pyrochemical Processes | 3.4.12, Att. 4 | D019 |
| PTS | RD&D pretreatment study | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D005, D006, D007, D008, D011 |
| PUB | Pu/Be source recovery | Chloride Operations | 3.4.1, Att. 4 | D007, D008, D009 |
| PX | Pyrochemical R&D | Special Processing | 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, Att. 4 | D006, D008, D019 |
| RA | Recovery of anodes | Pyrochemical Processes | 3.4.6, Att. 4 | ~~D005~~ |
| RAP | Research alloy preparation | Metal Operation Processes | 3.4.3, Att. 4 | |
| RAP2 | Research alloy preparation | Metal Operation Processes | 3.4.3, Att. 4 | |
| RASS/RSS | Raman spectroscopy system | Miscellaneous Operations | 3.4.5, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RB | Roasting and blending | Nitrate Operations | 3.4.3, Att. 4 | |

- Drums containing waste generated from P/S codes SD and SS between 02/98 and 06/98 are segregated as a subset of TA-55-19 due to the potential presence of vanadium pentoxide (EPA HWN P120). (See separate AK summary for waste stream lot TA-55-19A).

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, ~~protactinium-231~~ and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 may be present because this fission product was not completely separated from plutonium during Purex processing at other DOE sites. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120
- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream lot until the potential applicability of HWN U213 has been resolved.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, ~~protactinium-231~~ and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 may be present because this fission product was not completely separated from plutonium during Purex processing at other DOE sites. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

No HWNs apply to containers in waste stream TA-55-20.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, ~~protactinium-231~~ and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace

*Pickling.* Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. After a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts. It then becomes necessary to leach the plutonium from these items. In addition, after calcium metal reduction processes such as metal preparation, direct oxide reduction, and molten salt extraction, plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals.

*Plutonium Trichloride Preparation.* An intermediate process in Pu metal production prepared plutonium trichloride by bubbling a carrier gas (chlorine) through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500 °C–600 °C before being absorbed in a 5–6 molar potassium hydroxide solution. The carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991. Feed material was high purity oxides from the vault or from other P/S codes. The product plutonium trichloride was reduced to metal by the MSE or ER processes.

## 3.6 Material Inputs to the Waste Generation Processes

Material inputs to the waste generation processes derive from four general sources: (a) feed materials, (b) associated nuclear material types, (c) chemical use, and (d) ancillary material inputs such as those related to the use of laboratory equipment and materials and glovebox maintenance activities.

### 3.6.1 Feed Materials Identification

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The feed materials for TA-55 processes that generate waste in waste streams TA-55-19 and TA-55-20 consist of the general types of materials listed in Table 1. These feed materials are obtained either from the storage vault, as process outputs from various P/S codes, or from sources outside TA-55, including other DOE facilities.

These feed materials fall into four general categories:

- pure Pu metal to be recycled from pits and sealed sources or to be reworked into desired shapes or chemical forms

Block indent

- intermediate Pu products in purification processes, in the form of solutions, oxides, hydroxides, salts, anode heels, etc.
- a wide variety of matrices contaminated with Pu above the DL, such as ash, salts, equipment, and solutions
- experimental R&D feed materials

3.6.2 Radionuclide Content Identification

The primary Pu material type inputs for TA-55 processes are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers (see Section 14). The results of these calculations are tabulated in the last three columns of Table 2, assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time(TWCP-698).

^ insert space

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides will be present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material:

3.6.3.5 *Organic chemicals.* The following organic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, ~~acetonitrile,~~ alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, Citrapeel, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), diethyl oxalate, dihexyl n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), diisopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride, ion exchange resin, isopropanol, kerosene, Metalprep 79 (phosphoric acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl diisobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, Organicstrip, perchlorocarbons, phenolphthalein, phosphate buffer solution, phosphine oxide, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, Vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 6 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

Waste containers in a waste stream are characterized as a campaign, in which the targeted group of waste containers to be characterized are selected based on criteria such as availability of the waste containers, waste loading level, availability of waste generator records, and hazardous waste numbers. TA-55-19A is one subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which is expected to consist of only a few drums, is

| | |
|---|---|
| • CLS | F002, F003 |
| • CSE | F002 |
| • CW | F002, F003 |
| • DA | F002 |
| • HP | F002, F003 |
| • MA | F001, F005 |
| • SA | F002, F003, F005 |
| • SE | F002 |
| • WM, X0, XO | F001, F002, F005 |

In addition, debris waste generated under P/S codes SD and SS between 02/01/98 and 06/10/98 is assigned EPA HWN P120 (vanadium pentoxide).

It is possible that waste generated under P/S codes AC, AC2, and SA may require the assignment of EPA HWN U213 (tetrahydrofuran). This possibility is being investigated.

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 (including lot TA-55-19A) is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses for containers assigned to waste stream TA-55-19 (Section 14.4).

8.2 Toxicity Listings

Both TA-55-19 and TA-55-19A are conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040.

TA-55-20 has no D listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE, WLT, and ZD.

RA

| | |
|---|---|
| NL | D006, D008 |
| OD | D006, D007, D008 |
| OH | D006, D007, D008, D009, D011 |
| PB | D007, D008, D009 |
| PCH | D007 |
| PE | D004 (1984–1985) |
| PK | D006, D007, D008, D011 |
| POSM | D007, D011 |
| PRR | D007, D009 |
| PT | D007 |
| PTP | D019 |
| PTS | D005, D006, D007, D008, D011 |
| PUB | D007, D008, D009 |
| PX | D006, D008, D019 |
| ~~RA~~ | ~~D005 (applies only to zinc metal buttons)~~ |
| RASS/RSS | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RC | D005, D006, D007, D008, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SA | D007, D009, D018, D038 |
| SB | D005, D006, D007, D008, D011 |
| SC | D005, D006, D007, D008, D011 |
| SE | D007, D008, D009, D039 |
| SL | D005, D006, D007, D008, D011 |
| SO | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | D007 |
| SS | D006, D008 |
| SSD | D006, D007, D008 |
| SSMD | D009 (D listing applies only from 06/94 to 08/94) |
| STF | D007 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1, VP3 | D009 (D listing ~~applies~~ only from 09/85 to 10/85) |
| VU, VUL | D005, D008 |
| WM, X0, XO | D007, D008, D009, D022, D035, D040 |

**NOTE:** These HWNs are assigned to all three codes in order to be conservative as discussed in *Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004,R.2, Section 3.4.9).

~~part in TA-55~~, which are still in the vault report as of April 2001

ed chemical used

*stet

This code

WM after 1993: No longer used for rejected LLW, which went to XO or XO instead

∴ WM – non-mixed after 1993

Or back to Waste generator

| | |
|---|---|
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." The waste streams covered by this AK report have no listings for corrosivity, reactivity, or ignitability. Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests (see Attachment 5), introduced in June 1980, included check boxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachment for TA-55 (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF (see Attachment 4, pp. 4 and 5) documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in waste, explosives were altogether prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. In case of a misfire or unconsumed explosives, a procedure is in place at TA-55 to ensure that explosives do not enter the waste stream (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive ~~and reactive~~ wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

reactive - See Section 3.6.3

Controls have also been in place to ensure the exclusion of ignitable constituents. D001 does not apply to wastes in these waste streams despite the use of spent non-halogenated solvents (HWN F003), for the following reasons:

- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu.

- If above the DL, the solutions are sent to aqueous processes as part of chloride or nitrate operations. Aqueous recovery steps include dissolution of any solid Pu in hydrochloric or nitric acid, followed by Pu recovery by ion exchange. The solutions are then below the DL and are either sent to the RLWTF or to the evaporator.

- Rags that are above the DL for Pu are thermally decomposed, which destroys any organic component.

- Rags that are below the DL for Pu are discarded as combustible debris, but headspace gas analyses support the contention that the solvents are not present in the waste at levels of concern (Section 14.4).

- Finally, 100 percent of the drums are subjected to headspace gas analysis, and drums showing over 500 ppm total flammable VOCs are prohibited from being shipped to WIPP. (This limit is quite conservative. For comparison, the explosive limit for acetone by itself is 25,000 ppm.)

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed onto ~~kitty litter~~ vermiculite and discarded in an appropriate waste stream and containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the TRUPACT-II. Section 9.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—

Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste items specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from TA-55. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

A chemical compatibility analysis was performed for TRUCON codes 116/216 (combustible waste) which indicated that all chemicals and the waste matrix were compatible at levels greater than trace amounts (*Content Code Assessments for LANL TRUCON Codes* [DOE/WIPP-89-004]). During the process AK search, additional chemicals were identified that necessitated a new compatibility analysis. ~~Because these additional chemicals are only present at trace quantities in the TA-55-19 and TA-55-20 waste streams, no incompatibilities were found to exist.~~ (TWCP-XXX) which is underway at the present time.

## 11.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the container is

**Table 8. RTR waste data for waste streams TA-55-19 and TA-55-20**

| Evaluated waste characteristic | Number of drums | | | |
|---|---|---|---|---|
| WIPP-compliant RTR data | | | | |
| • TA-55-19 | 245 | out of | 4173 | 6% of waste stream |
| • TA-55-20 | 20 | out of | 281 | 7% of waste stream |
| WMC discrepancies | | | | |
| • TA-55-19 | 3 | out of | 245 | 1% of drums examined |
| • TA-55-20 | 0 | out of | 20 | 0% of drums examined |
| *Excluding drums with confirmed WMC discrepancy* | | | | |
| Free liquids (no PWR required; all <1" of container or <1% of drum) | 34 | out of | 262 | 13 % of drums examined |
| Sealed containers > 4L (PWR required) | 31 | out of | 262 | 13 % of drums examined |
| Pressurized containers | 0 | out of | 262 | 0 % of drums examined |
| ~~Loaded gloves (not prohibited)~~ | ~~13~~ | ~~out of~~ | ~~262~~ | ~~5 % of drums examined~~ delete |
| Unpunctured liner | 0 | out of | 262 | 0 % of drums examined |
| Other prohibited items | 0 | out of | 262 | 0 % of drums examined |
| *Excluding drums with PWRs* | | | | |
| Proportion of combustible waste in drum (weight %) | | | | |
| • Less than 25% | 0 | out of | 231 | 0 % of drums examined |
| • 25 to 50% | 1 | out of | 231 | < 1 % of drums examined |
| • 50 to 75% | 7 | out of | 231 | 3 % of drums examined |
| • More than 75% | 223 | out of | 231 | 97 % of drums examined |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835, 5110, 5121, 5147; RTR batch data report still in Project-level review: LA01-RTR-006.

**Table 9. RTR packaging data for waste streams TA-55-19 and TA-55-20**

| Maximum number of layers | Metal Layers | Plastic Layers | No. of Drums | % of Total Examined | |
|---|---|---|---|---|---|
| Less than or equal to 1 | 0 | 1 | 2 | out of 231 | 1% of drums |
| Less than or equal to 2 | 0 | 2 | 21 | out of 231 | 9% of drums |
| Less than or equal to 3 | 0 | 3 | 95 | out of 231 | 41% of drums |
| Less than or equal to 4 | 1 | 3 | 2 | out of 231 | 1% of drums |
| Less than or equal to 5 | None observed | | 0 | out of 231 | 0% of drums |
| Less than or equal to 6 | None observed | | 0 | out of 231 | 0% of drums |
| Total number of layers | 0 | Indeter | 109 | | |
| indeterminant due to number of plastic horsetails: | 1 | Indeter | 2 | | |
| | Subtotal | | 111 | out of 231 | 48% of drums |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835, 5110, 5121, 5147; RTR batch data report still in Project-level review: LA01-RTR-006

25
95
111
231

- confirmation of WMC S5300 for 98.9 percent of the drums examined
- identification of WMC discrepancies for 3 containers (1.1 percent of the drums examined), which must be reassigned to other waste streams
- identification of potentially sealed containers > 4 liters in 13 percent of the drums, for which PWRs were submitted
- confirmation of the absence of any other prohibited item or condition requiring a PWR
- confirmation of 4 or fewer packaging layers for 52 percent of the drums. Plastic packaging layers for the remaining 48 percent were indeterminate due to the large ~~amount~~ number of horsetails present in the drums
- confirmation of the waste stream description:
- 97 percent of the drums contain more than 75 wt percent combustible waste;
- 86 percent of the drums contain less than 5 wt percent metal waste, and 94 percent contain less than 10 wt percent metal waste.

Changes in waste stream assignment because of characterization data are documented in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-2.1-064).

AK information resolved an apparent WMC discrepancy for several drums in waste stream TA-55-19 which contained material identified as metal by the RTR operator, thereby leading to an apparent WMC of S5110 (for metal debris) (TWCP-3288, 3289, 3290, 3291, 4190). After reviewing with the generator how these drums were packaged, the generator determined that these drums were packaged with very dense in-house fabricated plastic material called polyvinyldienefluoride (PVDF, also known as Kynar) used to line gloveboxes and build equipment in chloride operations starting in about 1988 (TWCP-5157). Hence, the WMC S5300 was correct. As a result of this AK information, a sample of Kynar was added to one of the test drums used in the RTR operations.

14.2 Visual Examination Data

VE data are used to confirm AK information on waste stream descriptions, WMC, the absence of prohibited items, the number and type of confining layers, and the relative volumes and weights of waste matrix parameters. AK packaging and WMC information have been evaluated by VE for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). These 22 drums were packaged between 11/85 and 8/97 (Sampling Plan). P/S codes are

~~This~~ Note that TA-55 waste generators followed guidance that waste put ~~into~~ metal cans ~~for disposal~~ used to contain debris were to be considered as packaging, and not as waste.

available for the waste items packaged in these drums, as documented in radioassay batch data reports (TWCP-4024, TWCP-4025, TWCP-4052, TWCP-4158, TWCP-4303) and waste generator records (TWCP-5086). (The codes for these drums are listed in Table 11, which is discussed in section 14.3). VE results are summarized in Table 10, from which the following observations are made:

- VE confirmed the AK WMC for all of these drums, reporting WMC S5300 for 8 drums, and S5310 for 14 drums.
- The maximum number of confining layers observed by VE was five (for one drum), consistent with AK information indicating that the number of layers is six or less (TWCP-816; also Table 7 of this report).

  **NOTE:** RTR data for the number of plastic layers in this particular drum were indeterminate.

- No closed liners were found by VE, which confirmed AK and RTR information.

- For 5 drums, the number of confining layers observed during VE (2 to 4) was greater than the number of layers associated with the TRUCON code assigned for these drums by the waste generator (LA116C, 1 layer).

- For 4 of the above drums, the default AK value (LA116E, 1 layer) would also have been less conservative than the VE findings. All 4 had been packaged after January 1997 such that no more than 1 layer was expected (Table 7).

A conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution, at least with respect to waste containers packaged in 1997 when TA-55 personnel were transitioning from one packaging procedure to another. Additional investigation is needed to remedy this discrepancy in reporting packaging layers.

14.3 Radioassay Data

Radioassay data are examined to confirm AK information on plutonium material type and mass, the presence of other radionuclides contributing to the total drum activity, and evidence for fractionation of other actinides (e.g., uranium, americium) relative to plutonium during material processing. Table 11 summarizes information relevant to these evaluations for the 22 drums from TA-55-19 and TA-55-20 that have undergone VE. These data confirm the following AK information:

- the dominant isotope in all drums is Pu239

- the material type is MT52 or MT53 for all drums

**Table 10. VE data for waste streams TA-55-19 and TA-55-20**

| Characterization data | Number of containers | | | | Comments |
|---|---|---|---|---|---|
| | AK (see Note 1) | | RTR | VE | |
| Waste Matrix Code | | | | | |
| S5000 | — | | — | — | Positive confirmation of AK WMC by RTR and VE for all 22 drums |
| S5300 | 22 | | 22 | 8 | |
| S5310 | — | | — | 14 | |
| Maximum # of layers and associated TRUCON codes | Default (Table 7) | Assigned in SP | See Note 2 | | Number of confining layers<br>• AK and VE match for 3 drums<br>• AK more conservative than VE for 14 drums<br>• AK from waste generator was less conservative than VE for 5 drums |
| 0 LA116G | — | — | | — | |
| 1 LA116C, E, F | — | 6 | | 2 | |
| 2 LA116B, D | — | — | | 2 | |
| 3 None | — | — | | 9 | |
| 4 LA116A | 4 | 4 | | 8 | |
| 5 LA116H | — | — | | 1 | |
| 6 LA116I | 8 | — | | — | |

SP—Sampling Plan (Rev 3)

Notes:
1. AK information for WMC and TRUCON code assignments is from the Sampling Plan, Rev 3. If no TRUCON code was assigned, then the default code was determined from Table 7, using AK information on packaging dates and P/S codes as documented in the Sampling Plan.
2. RTR data indicated no metal packaging layers for any of these drums, which was consistent with AK information and confirmed by VE. The number of plastic packaging layers was indeterminate by RTR except for one drum with three layers, which was consistent with the default TRUCON code and confirmed by VE (TWCP-4393).

Data sources: VE batch data reports TWCP-3947, 3948, 3949, 3950, 3951, 4022, 4326, 4327, 4392, 4393, 4394, 4427, 4800, 5085, 5112, 5120; VE batch data reports still in Project-level review: LA00-3.4.1-005, ~~LA01-VE-002~~, 5115, 5173, 5159 not included? 9 19

Missing records for:
- LA01-VE-003 — TWCP# 5083 → ON HOLD RECON
- LA00-3.4.1-005
- LA00-VE-001
- LA00-VE-002
- -003

5083 Open 5084 5077

which one is 3947?

Count: 22 OK

**Table 11. Radioassay Data for Waste Streams TA-55-19 and TA-55-20**

| Radionuclide Characteristics | Number of drums | Comments |
|---|---|---|
| Pu isotopic fractions | | Dominant isotope is Pu239 in all drums |
| • Pu238 / total Pu | 22 | 0.010 to 0.069 ← too high by ~100 |
| • Pu239 / total Pu | 22 | 0.911 to 0.941 |
| • Pu240 / total Pu | 22 | 0.057 to 0.085 |
| • Pu241 / total Pu | 22 | 0.14 to 0.32 |
| • Pu242 / total Pu | 22 | 0.009 to 0.055 |
| Material type | | |
| • MT52 | 19 | |
| • MT53 | 2 | |
| • MT52/53 mix | 1 | |
| Total Pu mass, expressed as ratio of AK data to NDA data | | AK data from Sampling Plan (Rev 3)<br>AK/NDA ratios range from 0.6 to 1.4 |
| • AK/NDA < 0.7 | 1 | |
| • 0.7 < AK/NDA < 1.3 | 17 | |
| • AK/NDA > 1.3 | 4 | |
| Other actinides present at detectable levels (uncertainties ≤ 21.5%)* | | *Range of ratios of nuclide to total Pu* (2)<br>Measured ratios / Calculated upper bound (Table 6) |
| • Am241 | 22 | $1 \times 10^{-3}$ to $9 \times 10^{-3}$ / $2 \times 10^{-3}$ to $3 \times 10^{-3}$ |
| • Am243 | 22 | $4 \times 10^{-7}$ to $4 \times 10^{-6}$ / Not applicable |
| • Np237 | 22 | $2 \times 10^{-4}$ to $1 \times 10^{-2}$ / Not applicable |
| • U234 | 21 | $7 \times 10^{-3}$ to $6 \times 10^{-2}$ / $2 \times 10^{-5}$ to $2 \times 10^{-5}$ |
| • U235 | 5 | $3 \times 10^{-3}$ to $5 \times 10^{-2}$ / $9 \times 10^{-4}$ to $1 \times 10^{-3}$ |
| • U238 | 0 | No measurable U238 / Not applicable |
| Other radionuclides present at detectable levels (uncertainties ≤ 21.5%)* | | Note Th232 is not detectable by the methods used |
| • Cs137 | 16 | |
| • Pa231(uncertainty <21.5%) | 9 | |
| • No other detectable nuclides | 2 | |
| Ratio of measured ratio (Am241/Total Pu) to calculated upper bound (0.002, Table 2) | | |
| • Ratio < 1 | 2 | Am241 could be from decay of Pu241 |
| • 1 < ratio < 2 | 7 | Process waste probably enriched in Am241 |
| • 2 < ratio < 3 | 7 | Process waste enriched in Am241 |
| • Ratio > 3 | 6 | Process waste enriched in Am241 |
| P/S codes for waste items present in these drums (TWCP-5086). The number of drums containing waste items from each code is given in parentheses, if more than one. | | |
| • Chloride operations | CSE, CW, CX (3), CXL (7), MB, MS | |
| • Metal operations | CA (2), FF, MA, MW, PH, SRL | |
| • Miscellaneous operations | AD (2), CV, IB (5), ME, WM (3), XP | |
| • Nitrate operations | ATL, BM (4), COD, DS (3), ED (7), EV (4), HCD, LR (4), MAG, NC (6), NL (2), OD, PR (2), RBJ, RR (2), SC (8), SP (4), SSD | |
| • Pyrochemical operations | ER (3), MO, OR (3), SS (3) | |
| • Special processing | None | |

NDA—nondestructive assay

- all these drums qualify as TRU waste
- AK information on total mass of Pu in each drum is within 30 percent of the TWCP assay value for 17 drums (77 percent). AK mass for the remaining five drums (23 percent) is within 40 percent of the TWCP assay value.
- As indicated by AK information, all drums contain low but detectable quantities of Am-241, Am-243, and Np-237. A significant proportion also contains Cs-137 and Pa-241.
- No U-236 or U-238 was detected, confirming AK information that uranium is not expected to be present in process waste generated under the P/S codes listed as the source of waste in these drums
- U-235 is present only at trace levels in 5 drums
- In 20 drums (91 percent), Am-241 and U-234 are enriched beyond what would be predicted if they were present solely due to the decay of their precursors in the source Pu, indicating that significant fractionation of Am and U from Pu occurs during processing operations

14.4 Headspace Gas Data

Headspace gas data are examined to confirm AK information about the presence or absence of hazardous constituents in a given waste stream, and the assignment of each drum to the appropriate mixed or nonmixed waste stream. Table 12 summarizes VOC target analyte concentrations for headspace gas samples from 55 containers assigned to waste stream TA-55-19. (No approved data are yet available for drums from waste stream TA-55-20.) These data confirm the AK information:

- Altogether, 13 different VOCs were detected in these drums. All are documented as having been present or used in TA-55 processes contributing to waste stream TA-55-19, and HWNs have already been assigned to this waste stream for these constituents.
- Only one VOC, methylene chloride, had a 90% Upper Concentration Limit ($UCL_{90}$) value that was above its program required quantitation limit (PRQL).
- Four VOCs—acetone, 1,1,2-trichloro-1,2,2-trifluoroethane, methyl ethyl ketone, and toluene—had $UCL_{90}$ values below the PRQL but were present in at least one drum at a concentration above the PRQL.
- One VOC (methanol) had a mean concentration above its Method Detection Limit (MDL) but no concentrations above the PRQL.

- Seven VOCs had mean concentrations below their MDL, but were present in at least one drum at a concentration above the MDL.
- All other target analyte VOCs were below the MDL.
- No Tentatively Identified Compounds (TICs) were detected.

These results are consistent with AK information summarized in this waste stream report, insofar as all of the VOCs that were detected are known to have been present in TA-55 operations. The data confirm that assignment of these HWNs based on AK information is conservative.

Table 13 summarizes concentrations of potentially flammable VOCs, hydrogen, and methane for headspace gas samples from the same 55 containers as are included in Table 12. All were below the WAC limits. The average concentration of potentially flammable VOCs for this set of 55 drums was 128 ±101 ppm ppmv, with a maximum of 473 ppm (TWCP-4722). No methane was detected in any of the drums, and hydrogen concentrations were lower by more than an order of magnitude than the WAC limit of 5 percent.

In conclusion, the headspace gas data confirm the presence of VOCs in waste stream TA-55-19; no VOCs were present which were not expected based on AK. However, no correlation is seen between the presence and absence of a specific VOC and its documented use in a process known to have contributed waste placed in a particular drum. For example, about 60 percent of the containers show measurable concentrations of acetone and/or toluene in the headspace gas, and 20 percent contain methylene chloride, but less than half of the drums in which these chemicals are present contain waste items generated by activities that were known to have used these chemicals. ~~Radiolytic production of VOCs is a possible contributing explanation, but additional AK investigation is needed to verify that a waste generator source of these VOCs has not been overlooked.~~

The most plausible ~~and the most likely~~ explanation is that Acetone + toluene (methylene Cl) ~~and MEK?~~ are present as solvents used in the manufacturing and plastics, and radiolytic degradation of the plastic polymers may also be a contributing factor.

## ACCEPTABLE KNOWLEDGE ROADMAP

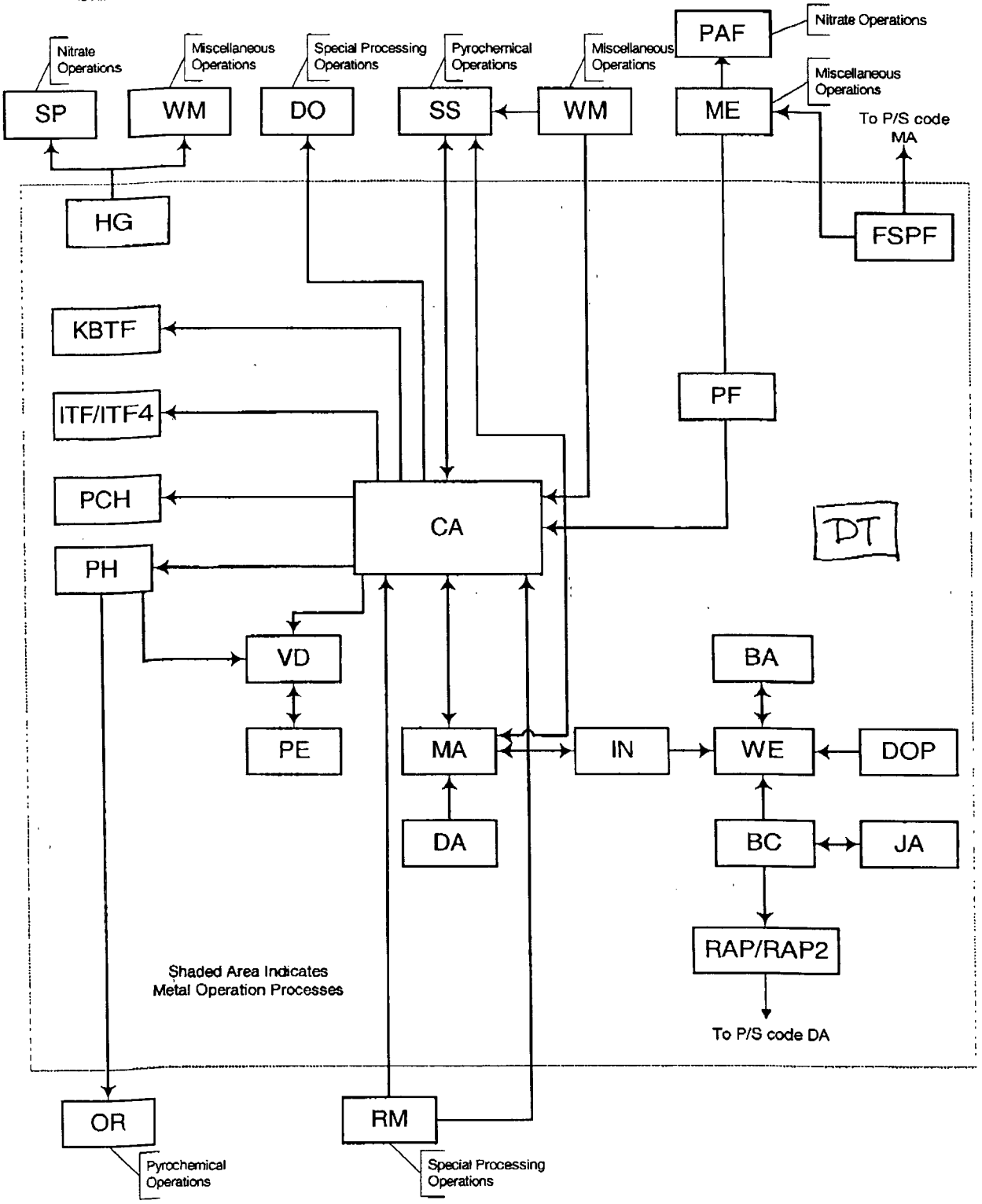
Waste Streams: TA-55-19 and TA-55-20.

Documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-To Be Determined | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP-4800 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-3.4.1-006 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5112 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-001 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-~~To Be Determined~~ 5173 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-002 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ |
| TWCP-5085 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-004 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-5120 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | None |
| TWCP-~~To Be Determined~~ 5115 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-003 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS




**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

P/S code

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-01- )

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19 (including Lot TA-55-19A) and TA-55-20

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
JOHN MUSGRAVE DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| ARIES | Advanced Recovery and Integrated Extraction System |
| CFR | *Code of Federal Regulations* |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| C–N–O | carbon–nitrogen–oxygen |
| CSMO | Central Scrap Management Office |
| DBBP | dibutyl butylphosphonate |
| DCHP | dicesium hexachloroplutonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | Chemical symbol for Fluoride, or RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| ICP | Inductively coupled plasma |
| ID | item identification |
| IDC | item description code |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| M | molar |
| MCDOR | multicycle direct oxide reduction |
| MDL | Method detection limit |
| MEGAS | Multiple Energy Gamma Assay System |
| MSE | molten-salt extraction |
| MT | material type |
| NDA | nondestructive assay |
| NIOSH | National Institute for Occupational Safety and Health |
| NMT | Nuclear Material Technology |
| P | Chemical symbol for Phosphorus, or RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF | Plutonium Facility |
| ppm | part per million |

| | |
|---|---|
| ppmv | part per million, on a volume basis |
| PRQL | program required quantitation limit |
| P/S | process/status [code] |
| PuBe | plutonium–beryllium |
| PVDF | polyvinyldienefluoride (also known as Kynar) |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| RSWD | radioactive solid waste disposal |
| RTR | real-time radiography |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) |
| SME | subject matter expert |
| SOP | safe operating procedure |
| TA | technical area |
| TBP | tributyl phosphate |
| TOPO | trioctylphosphine oxide |
| TRU | transuranic |
| TRUCON | TRUPACT-II Content Code |
| TRUPACT-II | Transuranic Waste Transporter-Model II |
| TWBIR | Transuranic Waste Baseline Inventory Report |
| TWCP | Transuranic Waste Characterization/Certification Project |
| U | Chemical symbol for Uranium, or RCRA hazardous waste number prefix for toxic waste defined in 40 CFR Subpart D, Section 261.33(f) |
| $UCL_{90}$ | 90% Upper Concentration Limit |
| UCNI | unclassified controlled nuclear information |
| VE | visual examination |
| VOC | volatile organic compound |
| WAC | Waste Acceptance Criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request form |
| XES | X-ray energy spectroscopy |

PWR → Prohibited Waste Report

- Drums containing waste generated from P/S codes SD and SS between 02/98 and 06/98 are segregated as a subset of TA-55-19 due to the potential presence of vanadium pentoxide (EPA HWN P120). (See separate AK summary for waste stream lot TA-55-19A).

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, protactinium-231, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 may be present because this fission product was not completely separated from plutonium during Purex processing at other DOE sites. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3)

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

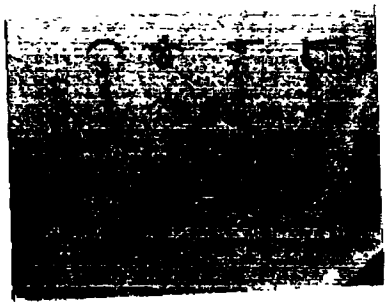
*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

## WASTE GENERATION SUMMARY DIAGRAM



Combustible debris waste items from gloveboxes with P/S codes from TA-55 Operations

Combustible waste items packaged into drums by TA-55 waste management personnel.

Drums sorted into waste streams (based on data base review of items packaged into each drum).

TA-55-20
Non-mixed combustible waste
(e.g., P/S codes ACC, MOX, RM, SX)

- Building TA-55, PF-4
- IDC: 004
- EPA Codes: None

Inspectable storage at TA-54, Area G

TA-55-19
Mixed combustible waste
(e.g., P/S codes AC, CF, EV, OH, XES)

- Building TA-55, PF-4
- IDC: 004
- EPA Codes: D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040, F001, F002, F003, F005

Inspectable storage at TA-54, Area G

TA-55-19A
Mixed combustible waste generated by P/S codes SS or SD between 02/98 and 06/98

- Building TA-55, PF-4
- IDC: 004
- EPA Codes: D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040, F001, F002, F003, F005, P120

Inspectable storage at TA-54, Area G

provide background information to support the process used by TWCP to assign TA-55 waste containers to specific waste streams. Waste stream assignment is made on the basis of waste generator information compiled in the TWCP waste container data base, which comprises the bulk of the Sampling Plan. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents in that drum. which are key factors in the evaluation of

3.2.1 Waste Packaging at TA-55

Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged by this team. Materials are considered waste only when they have been received and processed by the waste management team. Waste segregation schemes used by this team have evolved since operations began at the Plutonium Facility in 1978.

In 1978, the standard operating procedure for waste management at TA-55 stated the guiding philosophy of minimizing the amount of waste generated and minimizing the plutonium content of that waste (TWCP-3943). Discard Limits (DL) for plutonium in various types of waste matrices were established by the waste-generating group, and approved by the LANL division office and the DOE Albuquerque Operations Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of plutonium) into classes such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. All liquids, including oils, were required to be sent to recovery operations for processing. Liquids were explicitly prohibited from any container of solid waste materials.

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific processes and waste streams. TA-55 prepared an attachment in March 1987 for contact-handled combustible and noncombustible solid waste (TWCP-701), defined as follows:

- Combustible waste forms included materials that could be reduced to an ash if desired but that did not require further processing to meet

the combustible debris waste were ever incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

3.4 Waste Volume and Time Period of Waste Generation

The following information is from Appendix D of the Sampling Plan (R.3). These inventories are expected to change because the Sampling Plan is continually updated as new waste information is obtained.

- TA-55-19 includes 4173 containers (873 cubic meters), that were generated from 1978 to the present time.
- Waste stream lot TA-55-19A is a subset of TA-55-19 that contains 12 containers (2.5 $m^3$) with waste items generated from P/S codes SD and SS between February and June 1998 ~~and packaged into drums that were closed by the end of 1998.~~
- TA-55-20 includes 281 containers (59 cubic meters), that were generated from 1979 to the present time.

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3.5 Waste Stream Generation Processes

3.5.1 Overview

The TA-55-19 ~~-19A~~ and TA-55 -20 combustible debris waste streams were generated from combustible materials used in processes to recover plutonium from residues, metal fabrication, and research and development (R&D) activities. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds
- Preparing (on a large scale) specific alloys, including casting and machining these materials into specific shapes
- Determining high-temperature thermodynamic properties of plutonium
- Reclaiming plutonium from scrap and residues produced by numerous feed sources
- Disassembling components for inspection and analysis
- Manufacturing of parts on a limited basis
- Processing mixtures of plutonium and uranium oxides for reactor fuels.

- on-going metal operations
- developmental metal operations
- reactor fuel development

The main goal of metal processes is to take the high purity metal produced by pyrochemical operations and produce shaped metal pieces. On-going metal operation processes include various R&D activities, alloy development, casting of metals, welding, coating, and machining/metalwork on various metals. Developmental metal operations include the Advanced Recovery and Integrated Extraction System (ARIES) project, assembly operations, burst testing of shells, experimental laser welding, furnace operations, and various other experimental activities. In reactor fuel development, enriched uranium oxide, depleted uranium oxide, and/or plutonium oxide feeds are blended and mixed with graphite, and various operations are performed to convert the feed material into pellets that can be used for fuel. Testing and R&D are done on the fuel pellets.

3.5.8 Pyrochemical Processes

P/S codes CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

A detailed description of pyrochemical processes is found in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006).

Pyrochemical processes include metal preparation, metal purification, and ancillary metal production operations. Pyrochemical process outputs are most often high-purity metal feed materials for metal operations.

3.5.8.1 Metal preparation processes include the following:

*Metal Preparation Line.* The metal preparation line produces plutonium metal from fluoride salts. Hydrogen fluoride gas reacts with plutonium oxides obtained from calcination of oxalate or peroxide precipitates from the aqueous nitrate or chloride process lines. The plutonium compound is further reacted with various chemicals to produce plutonium metal, which can then be recovered as a small globlue, or button, by breaking the crucible.

globule

*Direct Oxide Reduction (DOR).* In the single pass DOR process, plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$), or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The

**Table 1. Feed Materials for Processes Contributing to Waste Streams TA-55-19 and TA-55-20**

| Feed Material | Potential Presence of RCRA-Regulated Substances* | P/S Codes, Listed by Process |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• CLS-1 solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (Cl-25/TWCP-3547). | Chloride operations: CLS, CW, (analytical laboratory solutions from LANL Group CLS-1); CSE, CXL, SE (other solutions)<br>Miscellaneous operations: ACL, ICP<br>Nitrate operations: CF, HP |
| Anode heels | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), chromium (D007), lead (D008), and silver (D011). Heavy metals arsenic (D004), mercury (D009), and selenium (D010) are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | Nitrate operations: AS, BF, BU<br>Pyrochemical processes: RA |
| Ash from P/S codes ETD, IS, SB, TDC, or from other DOE facilities | Usually suspect contaminated with barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic (D004), mercury (D009), and selenium (D010) metals are volatilized at high temperatures if present in the oxide and chloride forms. | Miscellaneous operations: CK, CV, FDL, FLU, SO, XP<br>Nitrate operations: AL, AT, ATL, ED, HGMS, IS, MPD, PTS, RC, SC<br>Special processing: ACD, IAM, SB, SL |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | Chloride operations: CL<br>Nitrate operations: MAS, SC<br>Special processing: ACD, SL |
| Disassembled weapons components (pit diassembly) | High-purity Pu and U material types, no RCRA substances present | Metal operation processes: ARI, CA, PH, SRL<br>Miscellaneous operations: EDC<br>Nitrate operations: BM, RB, RBJ |

| Feed Material | Potential Presence of RCRA-Regulated Substances* | P/S Codes, Listed by Process |
|---|---|---|
| | | Special processing: ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |
| Pu oxalates | Typically fairly pure, no RCRA substances present | Nitrate operations: CC, DF, HC |
| Pu oxides | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals cadmium (D006) chromium (D007), and lead (D008)<br>High purity oxides from P/S codes CA, DO, and MA, and from the vault; may or may not contain RCRA substances | Metal operation processes: DOP (high-purity Pu and other radionuclides as oxides)<br>Miscellaneous operations: CK, CV, EOC, EXT, FDL, FLU, IB, IE, LI, LIBS, SO, STF, VS, XP<br>Nitrate operations: ATL, BL, CH, CPOD, DP, ED, FC, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2<br>Pyrochemical processes: MP (generally high purity), OR (variable purity), PTP<br>Special processing: DO, PI, PX, POSM, RM |
| Pu-Be sources | High purity constituents, no RCRA-regulated substances | Chloride operations: PB, PUB |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than barium (D005) are present | Chloride operations: MB, MS, PRR<br>Miscellaneous operations: EXT, IB<br>Nitrate operations: COD, COL, MB<br>Special processing: DO |
| Reactor fuel pellets | High purity Pu and U material types, no RCRA-regulated substances | Metal operation processes: ME |
| Stainless steel and/or tantalum residues from decladding of Pu-Be sources | High purity metals, potential leaching of chromium (D007) from stainless steel if subjected to strong acid | Chloride operations: PUB |

* The information in this column is highly generalized. Applicability of specific HWNs to a process as a result of the feed material must be determined on a case-by-case basis because the presence and fate of contaminants is time and function dependent. These aspects are discussed in the process AK reports.

3.6.2 Radionuclide Content Identification

The primary Pu material type inputs for TA-55 processes are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers (see Section 14). The results of these calculations are tabulated in the last three columns of Table 2; assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

© The Calculations

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides will be present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material:

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present in minor amounts in most debris waste from processes at TA-55.
- In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposely contain uranium. The primary uranium material type inputs for reactor fuel development activities and for pit disassembly at TA-55 are listed in Table 3.
- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239.

- U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2).

- Protactinium (Pa)-231, the decay-chain daughter of U-235, is expected to be present in trace amounts in some TA-55 wastes due to its widespread presence as a contaminant in TA-55 operations (TWCP-5164, TWCP-5165).

- Cs-137 is a product of the spontaneous fission of Pu-238, Pu-239 and especially Pu-240, as well as a trace contaminant in purified plutonium from the production reactors (TWCP-5164, TWCP-5165). In the latter case the remaining Cs could be on the order of 0.5 ng/g Pu. In the former instance the formation of Cs-137 due to spontaneous fission would lead to about 0.4 pg/g Pu in plutonium that is 10 years old. Because Cs-137 due to spontaneous fission is about a factor of a thousand less than that due to residual contamination from the original separation on the production fuel, the latter is the dominant source of Cs in TA-55 waste.

In general no correlation is expected to be seen among the different radioelements, Pu, Np, U, Pa or Am. The differences in valence states and chemical affinities among these elements is expected to result in substantial fractionation during several TA-55 processes, including ion exchange, solvent extraction, hydroxide precipitation, and dissolution.

Secondary radionuclides are also present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memorandum according to P/S code (TWCP-882, amended by TWCP-5166), as summarized in Table 4. This list includes Am-241, Am-243, cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Th-230, Th-232, U-233, U-235, and U-238.

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of a radioassay instrument to use for optimal results. Cm-244 was introduced in TA-55 operations in P/S code DOP, which started in 1988 (TWCP-5165). Material outputs from this process sometimes were sent to P/S codes IS or WE. Cm-244 could also be part of debris waste under P/S code CA because both operations took place in the 300 Wing of PF-4. Because only one room in this area is available for bagouts, TRU waste from P/S codes

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DOP and CA was sometimes combined. In addition, because rags from DOP were sent to IS, Cm-244 could be present in the ash produced by this operation, which is then processed through nitrate aqueous recovery operations. Some unknown fraction of the Cm-244 could ultimately end up in the evaporator bottoms, which are then immobilized in cement in P/S code CF. In any case, however, Cm-244 is not expected to be present in any waste generated before 1988.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The assay results are summarized in Section 14.2.

3.6.3 Chemical Content Identification

Chemical contents of process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from subject matter expert (SME) input. Individual process AK reports contain detailed assessments of these chemical inputs and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

3.6.3.1 *Acids and bases*. Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, phosporic acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) and D003 (reactivity) do not apply to the solid debris waste because there are no free liquids in this waste.

- D002 and D003 also do not apply despite the possible production of perchlorate salts in perchloric acid solutions because:

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- D001 (ignitability) and D003 (reactivity) do not apply to wastes in waste stream TA-55-19 (including TA-55-19A) despite the use of spent non-halogenated solvents (HWN F003) ~~and the possible production of perchlorate salts in perchloric acid solutions~~ for the following reasons:

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  - Perchloric acid solutions are sent to cement fixation.
  - Perchlorate salts used in P/S code FF were sent to cement fixation (TWCP-5158).
  - Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded.
  - Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for plutonium.
  - Solutions containing spent solvents and above the DL for Pu are further treated by aqueous recovery processes as part of routine chloride and nitrate operations. Aqueous recovery involves dissolving any solid plutonium in hydrochloric or nitric acid, followed by ion exchange to extract the plutonium. The processed solutions are below the DL for plutonium and are either sent to the RLWTF or to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, a waste form for which ignitability is not a concern.

plutonium

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  - Rags, if contaminated with spent solvents and above the DL for plutonium, are thermally decomposed, which destroys any organic component.
  - Although contaminated rags that are below the DL for plutonium are discarded as combustible debris, headspace gas analyses support the expectation that the solvents are below the limits established by the WIPP WAC. (see Section 14.4.)
  - In addition, 100 percent of the waste containers are subjected to headspace gas analysis. Any container showing values over 500 ppm total flammable volatile organic compounds (VOCs) is prohibited from being shipped to the WIPP. (For comparison, the explosive limit for acetone is 25,000 ppm.)

silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, Vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Insert text from page 31 (section 3.6.3.1) (do not make a bullet) the first sentence

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 6 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

Waste containers in a waste stream are characterized as a campaign, in which the targeted group of waste containers to be characterized are selected based on criteria such as availability of the waste containers, waste loading level, availability of waste generator records, and hazardous waste numbers. TA-55-19A is one subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which consists of 12 drums, is identical to the rest of the waste stream except for the possibility that the drums may contain vanadium pentoxide (EPA HWN P120), which was used only between 02/01/98 and 06/10/98 in two specific P/S codes. To be conservative, ~~drums~~ drums were assigned to this lot if they were closed as late as the end of 1998.

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

D.C.

Waste Streams TA-55-19 and TA-55-20 have been discussed together in this AK Summary Report. These waste streams are similar in physical form and waste material content. They differ only in that TA-55-19 is assigned EPA HWNs based on P/S code information, whereas TA-55-20 contains non-mixed waste.

Other waste streams resulting from the same plutonium processing activities at TA-55 but differing in physical form and waste matrix code are listed in the Sampling Plan. These include waste streams for more specific types of waste such as metal debris, glass, graphite, HEPA filters, and cemented waste, as well as less specific waste streams such as combustible/noncombustible debris.

conservative, this HWN is assigned to waste containers with packaging dates extending to the end of December 1998.

It is possible that waste generated under P/S codes AC, AC2, and SA may require the assignment of EPA HWN U213 (tetrahydrofuran). This possibility is being investigated.

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 (including lot TA-55-19A) is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses for containers assigned to waste stream TA-55-19 (Section 14.4).

8.2 Toxicity Listings

TA-55-19 (including TA-55-19A) is conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040.

TA-55-20 has no D-listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RA, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD. ITF7

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

| | |
|---|---|
| AC | D007, D009, D011, D018, D022, D038 |
| AC1 | D007, D009, D011, D018, D022 |

- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for plutonium.

- If above the DL, the solutions are sent to aqueous processes as part of chloride or nitrate operations. Aqueous recovery steps include dissolution of any solid plutonium in hydrochloric or nitric acid, followed by plutonium recovery by ion exchange. The solutions are then below the DL and are either sent to the RLWTF or to the evaporator.

- Rags that are above the DL for plutonium are thermally decomposed, which destroys any organic component.

- Rags that are below the DL for plutonium are discarded as combustible debris, but headspace gas analyses support the contention that the solvents are below ~~regulatory~~ the limits (Section 14.4).
  ↑ established by the WIPP WAC
- Finally, 100 percent of the drums are subjected to headspace gas analysis, and drums showing over 500 ppm total flammable VOCs are prohibited from being shipped to the WIPP. (This limit is quite conservative. For comparison, the explosive limit for acetone by itself is 25,000 ppm.)

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed onto vermiculite and discarded in an appropriate waste stream and containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the TRUPACT-II shipping containers. Section 9.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste item specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from TA-55. In addition, waste management inspectors performed visual inspection of

the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

A chemical compatibility analysis was performed for TRUCON codes 116/216 (combustible waste) which indicated that all chemicals and the waste matrix were compatible at levels greater than trace amounts (*Content Code Assessments for LANL TRUCON Codes* [DOE/WIPP-89-004]). During the process AK search, additional chemicals were identified that necessitated a new compatibility analysis, which is underway at the present time.

## 11.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

The effectiveness of Administrative and procedural controls on the prohibition of pyrophorics in TRU waste [~~and the absence of pyrophorics~~] has been verified through testing. For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the RFETS (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules

boxes may be sorted to remove the "hot" item, or the whole box may be bagged and sent to the TRU packaging area for placement in drums containing waste streams TA-55-19 or TA-55-20, as appropriate. When this occurs, the P/S code WM is assigned to the waste. Due to the additional layers of plastic that are present when this operation occurs, drums with the P/S code WM are assumed to contain up to two more layers of internal packaging than other drums.

Waste drum packaging procedures for waste streams TA-55-19 and TA-55-20 have been modified several times since the beginning of operations at TA-55. TRUCON Code assignments made by the waste generator are compiled in the Sampling Plan; however, when TRUCON codes are absent, they will be assigned to the waste container in accordance with the default packaging configurations and associated TRUCON codes shown in Table 7 that reflect the packaging protocols in effect during different periods of time at TA-55 (TWCP-816).

AK information has been compared with visual examination data for about 22 containers in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). In two cases, the number of layers of packaging observed during visual examination was greater than the number of layers reported by the waste generator, and an incorrect TRUCON code was assigned by the waste generator (Section 14.2). It is possible that the extra plastic layers were breached ~~[i.e., these were]~~ confining layers, but that the VE inspection did not note ~~[document]~~ this fact. However, the conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution. Consequently, the most conservative TRUCON code is assigned to each waste container in waste streams TA-55-19 and TA-55-20, in accordance with the following guidance:

— in which case they would not be

a) The default TRUCON codes from Table 7 ~~[are]~~ is assigned if the waste generator has not assigned a TRUCON code.

b) The TRUCON code assigned by the waste generator is used only if it has been positively confirmed by RTR or VE data.

c) If no VE data are available, and if the RTR data are indeterminate, then the default TRUCON code is assigned to the container.

This guidance only applies to retrievably stored waste. It is assumed that newly generated waste packaged under procedures approved by TWCP and CBFO are assigned correct TRUCON codes.

## 14.0 CONFIRMATION OF AK INFORMATION FOR THE WASTE STREAM

Characterization data acquired by WAP-compliant activities provide a means to confirm AK information. Radiography, radioassay, and headspace gas analysis are conducted on all retrievably stored containers of debris waste, and VE is being conducted on at least 50

**Table 7. Maximum Layers of Confinement to Be Used for TA-55-19 and TA-55-20 Waste Containers in the Absence of More Specific Waste Characterization Data**

| Time Frame | P/S Code | Layers of Confinement[a] | TRUCON Code |
|---|---|---|---|
| 01/78–05/87 | All | Maximum of 6 layers:<br>• up to 4 inner bags<br>• up to 2 liner bags<br>• all bag closures by either twist & tie; or twist, tie & tape | LA 116 I |
| 05/87–12/97[b] | All except WM, XO, X0 | Maximum of 4 layers:<br>• up to 2 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded<br>**NOTE:** Folded and taped bags and folded bags do not constitute layers of confinement | LA 116 A |
| 05/87–present | WM, XO, X0 | Maximum of 6 layers:<br>• up to 4 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded<br>**NOTE:** Folded and taped bags and folded bags do not constitute layers of confinement | LA 116 I |
| 01/98–present | All except WM, XO, X0 | Maximum of 1 layer:<br>• 1 carbon-filter vented inner bag (if initial bag is breached, bag is placed in second bag and first bag is slit open), closed by either twist & tie; or twist, tie & tape<br>• 2 liner bags, folded, no closure | LA 116 E |

Superscript

a Layers of confinement for these TRUCON Codes are defined in DOE/WIPP-89-004.

b In Rev 1 of this AK report, LA116A was applicable from 5/87 until 1/97. Its applicability was extended to the end of 1997 in Rev 2 (the current revision) because of inconsistencies found during reconciliation of VE data (Section 14.2).

containers from waste streams TA-55-19 and TA-55-20. Relevant aspects of the data produced by these activities are summarized in the sections below, focusing on the extent to which the data confirm AK information.

14.1 Radiography Data

Radiography data are examined to confirm AK information about WMC assignments, layers of packaging, absence of prohibited items, and relative volumes or weights of waste matrix parameters for a waste stream. The WMC for waste streams TA-55-19 and TA-55-20 is S5300 (combustible debris). Thus far, 265 containers, or about 6 percent of the 4454 containers in these two waste streams (Sampling Plan, Revision 3), have undergone RTR, with the data contained in WIPP-compliant batch data reports. The following observations are made from an examination of these data, as summarized in Table 8 and 9:

- confirmation of WMC S5300 for 98.9 percent of the drums examined
- identification of WMC discrepancies for 3 containers (1.1 percent of the drums examined), which must be reassigned to other waste streams
- identification of potentially sealed containers > 4 liters in 13 percent of the drums, for which PWRs were submitted
- confirmation of the absence of any other prohibited item or condition requiring a PWR
- confirmation of 4 or fewer packaging layers for 52 percent of the drums; Plastic packaging layers for the remaining 48 percent were indeterminate due to the large number of horsetails present in the drums
- confirmation of the waste stream description
- 97 percent of the drums contain more than 75 wt. % combustible waste
- 86 percent of the drums contain less than 5 wt. % metal waste, and 94 percent contain less than 10 wt. % metal waste.

**Note:** TA-55 waste generators followed guidance that metal cans used to contain debris were to be considered as packaging, and not as waste. This may account for the drums of combustible debris that were estimated by RTR to contain more than the expected 5 wt. % metal waste.

Changes in waste stream assignment because of characterization data are documented in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064).

**Table 8. RTR Data for Waste Streams TA-55-19 and TA-55-20**

| Evaluated Waste Characteristic | Number of Drums | | | |
|---|---|---|---|---|
| WIPP-compliant RTR data | | | | |
| • TA-55-19 | 245 | out of | 4173 | 6% of waste stream |
| • TA-55-20 | 20 | out of | 281 | 7% of waste stream |
| WMC discrepancies | | | | |
| • TA-55-19 | 3 | out of | 245 | 1% of drums examined |
| • TA-55-20 | 0 | out of | 20 | 0% of drums examined |
| *Excluding drums with confirmed WMC discrepancy* | | | | |
| Free liquids (no PWR required; all <1" of container or <1% of drum) | 34 | out of | 262 | 13 % of drums examined |
| Sealed containers > 4L (PWR required) | 31 | out of | 262 | 13 % of drums examined |
| Pressurized containers | 0 | out of | 262 | 0 % of drums examined |
| Unpunctured liner | 0 | out of | 262 | 0 % of drums examined |
| Other prohibited items | 0 | out of | 262 | 0 % of drums examined |
| *Excluding drums with PWRs* | | | | |
| Proportion of combustible waste in drum (wt. %) | | | | |
| • Less than 25 | 0 | out of | 231 | 0 % of drums examined |
| • 25 to 50 | 1 | out of | 231 | < 1 % of drums examined |
| • 50 to 75 | 7 | out of | 231 | 3 % of drums examined |
| • More than 75 | 223 | out of | 231 | 97 % of drums examined |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835, 5110, 5121, 5147; RTR batch data report ~~(In Project level review)~~ LA01-RTR-006.

awaiting review and approval by Carlsbad ~~Area~~ Field Office (CBFO).

**Table 9. RTR Packaging Data for Waste Streams TA-55-19 and TA-55-20**

| Maximum Number of Layers | Metal Layers | Plastic Layers | Number of Drums | | |
|---|---|---|---|---|---|
| Less than or equal to 1 | 0 | 1 | 2 | out of 231 | 1% of drums |
| Less than or equal to 2 | 0 | 2 | 21 | out of 231 | 9% of drums |
| Less than or equal to 3 | 0 | 3 | 95 | out of 231 | 41% of drums |
| Less than or equal to 4 | 1 | 3 | 2 | out of 231 | 1% of drums |
| Less than or equal to 5 | None observed | | 0 | out of 231 | 0% of drums |
| Less than or equal to 6 | None observed | | 0 | out of 231 | 0% of drums |
| ~~Total~~ **Number of Layers** | 0 | Indeter | 109 | | |
| ~~Indeterminant due to number of~~ plastic horsetails: | 1 | Indeter | 2 | | |
| | Subtotal | | 111 | out of 231 | 48% of drums |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835, 5110, 5121, 5147; RTR batch data report ~~(in Project-level review)~~: LA01-RTR-006.

awaiting review and approval by CBFO:

bold "Indeterminate"

Stet
~~insert new column labeled~~ ~~Total~~ Layer
1
2
3
4

**Table 10. VE Data for Waste Streams TA-55-19 and TA-55-20**

| Characterization Data | Number of Containers | | | | Comments |
|---|---|---|---|---|---|
| | AK[a] | | RTR | VE | |
| Waste Matrix Code | | | | | |
| S5000 | — | | — | — | Positive confirmation of AK WMC by RTR and VE for 22 drums |
| S5300 | 22 | | 22 | 8 | |
| S5310 | — | | — | 14 | |
| Maximum number of layers and associated TRUCON codes | Default[a] | Assigned in SP | b | | Number of confining layers<br>• AK and VE match for 3 drums<br>• AK more conservative than VE for 14 drums<br>• AK from waste generator was less conservative than VE for 5 drums |
| 0 LA116G | — | — | | — | |
| 1 LA116C, E, F | — | 6 | | 2 | |
| 2 LA116B, D | — | — | | 2 | |
| 3 None | — | — | | 9 | |
| 4 LA116A | 4 | 4 | | 8 | |
| 5 LA116H | — | — | | 1 | |
| 6 LA116I | 8 | — | | — | |

SP—Sampling Plan (Rev 3)

Notes:

Superscript

a AK information for WMC and TRUCON code assignments is from the Sampling Plan, Rev 3. If no TRUCON code was assigned, then the default code was determined from Table 6 in TWCP-AK-2.1-008 (Rev 1), using AK information on packaging dates and P/S codes as documented in the Sampling Plan.

b RTR data indicated no metal packaging layers for any of these drums, which was consistent with AK information and confirmed by VE. The number of plastic packaging layers was indeterminate by RTR except for one drum with three layers, which was consistent with the default TRUCON code and confirmed by VE (TWCP-4393).

Data sources: VE batch data reports TWCP-3947, 3948, 3949, 3950, 3951, 4022, 4326, 4327, 4392, 4393, 4394, 4427, 4800, 5077, 5083, 5084, 5085, 5112, 5115, 5120, 5173; VE batch data report in Project-level review: LA00-3.4.1-005.

## Table 11. Radioassay Data for Waste Streams TA-55-19 and TA-55-20

| Radionuclide Characteristics | Number of Drums | Comments |
|---|---|---|
| Pu isotopic fractions | | Dominant isotope is Pu239 in all drums |
| • Pu238 / total Pu | 22 | 0.010 to 0.069 wt % |
| • Pu239 / total Pu | 22 | 91.1 to 94.1 wt % |
| • Pu240 / total Pu | 22 | 5.7 to 8.5 wt % |
| • Pu241 / total Pu | 22 | 0.14 to 0.32 wt % |
| • Pu242 / total Pu | 22 | 0.009 to 0.055 wt % |
| Material type | | |
| • MT52 | 19 | |
| • MT53 | 2 | |
| • MT52/53 mix | 1 | |
| Total Pu mass, expressed as ratio of AK data to NDA data | | AK data from Sampling Plan (Rev 3)<br>AK/NDA ratios range from 0.6 to 1.4 |
| • AK/NDA < 0.7 | 1 | |
| • 0.7 < AK/NDA < 1.3 | 17 | |
| • AK/NDA > 1.3 | 4 | |
| Other actinides present at detectable levels (uncertainties ≤ 21.5%)* | | *Range of ratios of nuclide to total Pu*<br>Measured ratios / Calculated upper bound (Table 2) |
| • Am241 | 22 | $1 \times 10^{-3}$ to $9 \times 10^{-3}$ / $2 \times 10^{-3}$ to $3 \times 10^{-3}$ |
| • Am243 | 22 | $4 \times 10^{-7}$ to $4 \times 10^{-6}$ / Not applicable |
| • Np237 | 22 | $2 \times 10^{-4}$ to $1 \times 10^{-2}$ / Not applicable |
| • U234 | 21 | $7 \times 10^{-3}$ to $6 \times 10^{-2}$ / $2 \times 10^{-5}$ to $2 \times 10^{-5}$ |
| • U235 | 5 | $3 \times 10^{-3}$ to $5 \times 10^{-2}$ / $9 \times 10^{-4}$ to $1 \times 10^{-3}$ |
| • U238 | 0 | No measurable U238 / Not applicable |
| Other radionuclides present at detectable levels (uncertainties ≤ 21.5%)* | | Th232 is not detectable by the methods used |
| • Cs137 | | |
| • Pa231(uncertainty <21.5%) | 16 | |
| • No other detectable nuclides | 9 | |
| | 2 | |
| Ratio of measured ratio (Am241/Total Pu) to calculated upper bound (0.002, Table 2) | | |
| • Ratio < 1 | 2 | Am241 could be from decay of Pu241 |
| • 1 < ratio < 2 | 7 | Process waste probably enriched in Am241 |
| • 2 < ratio < 3 | 7 | Process waste enriched in Am241 |
| • Ratio > 3 | 6 | Process waste enriched in Am241 |
| P/S codes for waste items present in these drums (TWCP-5086). The number of drums containing waste items from each code is given in parentheses, if more than one. | | |
| • Chloride operations | CSE, CW, CX (3), CXL (7), MB, MS | |
| • Metal operations | CA (2), FF, MA, MW, PH, SRL | |
| • Miscellaneous operations | AD (2), CV, IB (5), ME, WM (3), XP | |
| • Nitrate operations | ATL, BM (4), COD, DS (3), ED (7), EV (4), HCD, LR (4), MAG, NC (6), NL (2), OD, PR (2), RBJ, RR (2), SC (8), SP (4), SSD | |
| • Pyrochemical operations | ER (3), MO, OR (3), SS (3) | |
| • Special processing | None | |

NDA—nondestructive assay MDL— method detection limit

Data sources: Radioassay batch data reports TWCP-4009, 4023, 4024, 4025, 4052, 4078, 4158, 4159, 4212, 4225, 4226, 4303; and Sampling Plan (Rev 3). P/S codes from TWCP-5086 and TWCP-5163.

*The rationale for this MDL cut off (21.5% uncertainty) is given in TWCP-2130.

concentration of potentially flammable VOCs for this set of 55 drums was 128 ±101 ppmv, with a maximum of 473 ppm (TWCP-4722). No methane was detected in any of the drums, and hydrogen concentrations were lower by more than an order of magnitude than the WAC limit of 5 percent.

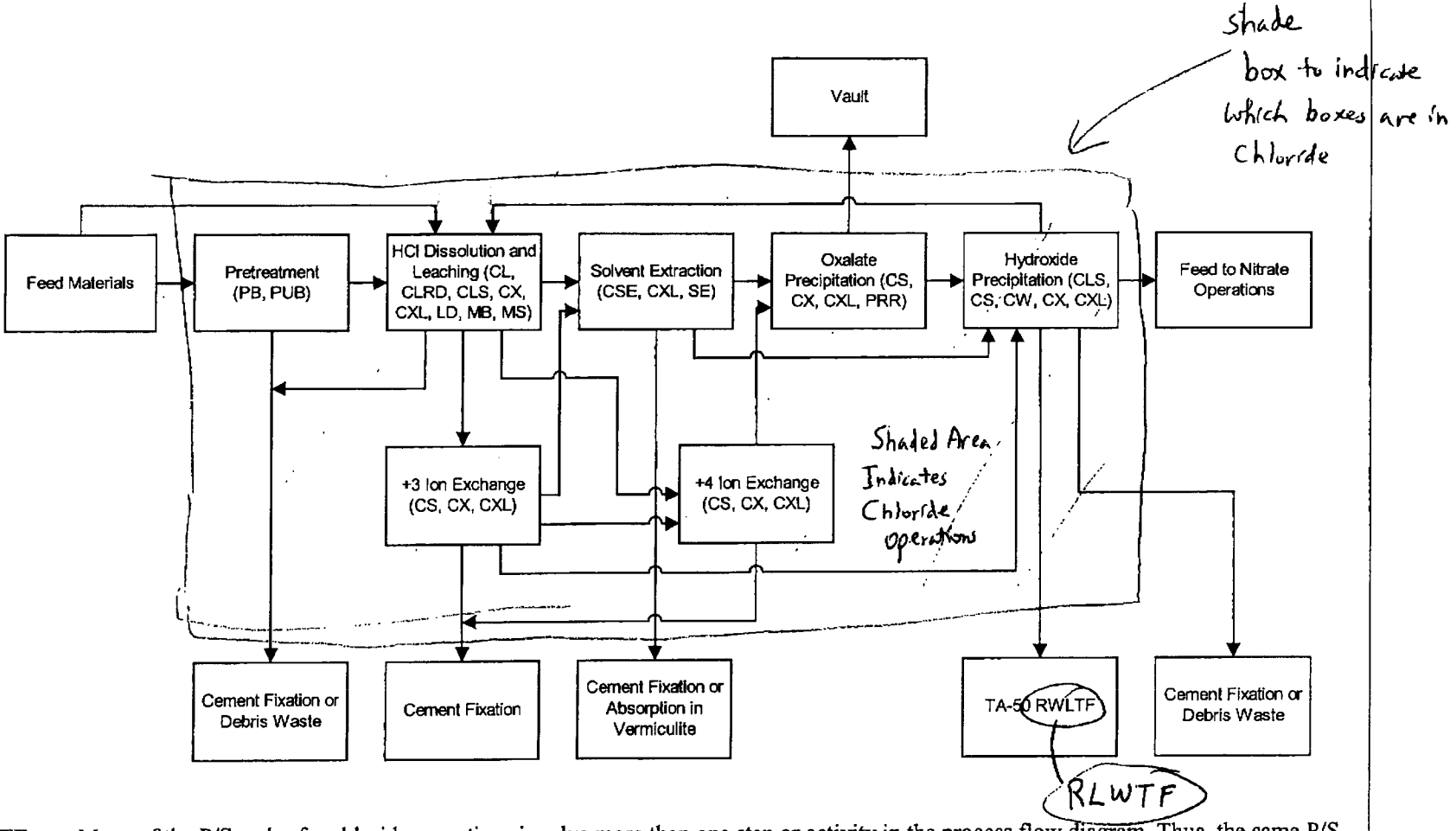
In conclusion, the headspace gas data confirm the presence of VOCs in waste stream TA-55-19. All VOCs present were expected based on AK. However, no correlation is seen between the presence and absence of a specific VOC and its documented use in a process known to have contributed waste placed in a particular drum. For example, about 60 percent of the containers show measurable concentrations of acetone and/or toluene in the headspace gas, and 20 percent contain methylene chloride, but less than half of the drums in which these chemicals are present contain waste items generated by activities that were known to have used these chemicals. The most plausible explanation is that acetone, toluene, and methylene chloride are present as solvents used in the manufacturing of plastics. Radiolytic degradation of the plastic polymers may also be a contributing factor.

## 15.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, Segregation of hazardous materials
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (Attachment B, Waste Analysis Plan)
- *NIOSH Pocket Guide to Chemical Hazards* (1997). National Institute for Occupational Safety and Health (NIOSH) Publication #97-140.
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028).
- *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## SIMPLIFIED PROCESS FLOW DIAGRAMS

### SIMPLIFIED PROCESS FLOW DIAGRAM FOR CHLORIDE OPERATIONS




**NOTE:** Many of the P/S codes for chloride operations involve more than one step or activity in the process flow diagram. Thus, the same P/S code can appear in more than one box on the process flow diagram.

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| FX | Cement to drum | Nitrate Operations | 3.5.6, Att. 4 | D006, D007, D008, D009, D011 |
| GI | Pellet grinding & inspection | Metal Operation Processes | 3.5.1, Att. 4 | |
| GMS | Open gradient magnetic separation | Nitrate Operations | 3.5.1, Att. 4 | |
| HC | Calcination | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 | |
| HCD | Hydroxide cake dissolution | Nitrate Operations | 3.5.2, Att. 4 | D006, D007, D008, D009, D011 |
| HD | Hydroxide cake dissolution | Nitrate Operations | 3.5.2, Att. 4 | D006, D007, D008, D009, D011 |
| HG | Pu removal by mercury | Metal Operation Processes | 3.5.2, Att. 4 | |
| HGMS | High gradient magnetic separation | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 | D006, D007, D008, D009, D011 |
| HP | Cement fixation | Nitrate Operations | 3.5.5, Att. 4 | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 |
| HRA | Hanford Reservation Material | Nitrate Operations | 3.5.6, Att. 4 | D004 D005, D006, D007, D008, D009, D011 D010 |
| HRS | High resolution spectroscopy | Miscellaneous Operations | 3.5.5, Att. 4 | |
| IA | Impure americium holding for discard | Nitrate Operations | 3.5.5, 3.5.6, Att. 4 | D006, D007, D008, D009, D011 |
| IAM | Inspection and measurement | Special Processing | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 |
| IB | Matrix study of pyrochemical salts | Miscellaneous Operations | 3.5.6, Att. 4 | D005, D006, D007, D008, D009, D011 |
| ICP | ICP-AES analysis | Miscellaneous Operations | 3.5.4, Att. 4 | D007, D009 |
| ID | Immersion density | Metal Operation Processes | 3.5.1, Att. 4 | |
| IE | Isotope enrichment | Miscellaneous Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| IN | Inspection | Metal Operation Processes | 3.5.2, Att. 4 | |
| IS | Incinerator | Nitrate Operations | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 |
| ITF | Impact test facility | Metal Operation Processes | 3.5.2, Att. 4 | |
| ITF4 | Impact test facility | Metal Operation Processes | 3.5.2, Att. 4 | |
| ITF7 | Impact test facility | Metal Operation Processes | 3.5.2, Att. 4 | |
| IX | Ion exchange | Special Processing | 3.5.2, Att. 4 | D006, D007, D008, D009, D011 |
| JA | Gas isostatic press | Metal Operation Processes | 3.5.2, Att. 4 | |
| KBTF | Kolsky bar test facility | Metal Operation Processes | 3.5.3, Att. 4 | D008 |
| LC | Uranium plutonium processing | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 | |

| | |
|---|---|
| EDC | D007, ~~D008~~ |
| EL | D040 |
| EOC | D007, D009 |
| ER | D006, D008 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |
| EXT | D005, D006, D007, D008, D009, D011 |
| FDL | D004, D005, D006, D007, D008, D009, D010, D011 |
| FF | D022, D040 |
| FLU | D004, D005, D006, D007, D008, D009, D010, D011 |
| FX | D006, D007, D008, D009, D011 |
| HCD | D006, D007, D008, D009, D011 |
| HD | D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| HRA | D004, D005, D006, D007, D008, D009, D011 |
| IA | D006, D007, D008, D009, D011 D010, |
| IAM | D005, D006, D007, D008, D011 |
| IB | D005, D006, D007, D008, D009, D011 |
| ICP | D007, D009 |
| IE | D005, D006, D007, D008, D009, D011 |
| IS | D005, D006, D007, D008, D011 |
| IX | D006, D007, D008, D009, D011 |
| KBTF | D008 |
| LD | D007, D008, D009 |
| LG1 | D006, D008 |
| LG2 | D006, D007, D008, D009, D011 |
| LI | D005, D006, D007, D008, D009, D011 |
| LR | D006, D007, D008, D009, D011 |
| MA | D035, D040 |
| MB | ~~D005,~~ D007, D008, D009 |
| ME | D007, D040 |
| MELL | D006, D007, D008, D009, D011 |
| ML | D006, D008 |
| MPD | D005, D006, D007, D008, D011 |
| MS | D007, D008, D009 |
| NC | D006, D008 |
| NL | D006, D008 |
| OD | D006, D007, D008 |

Add cover page for Appendix ? to match TOC



**Los Alamos**
NATIONAL LABORATORY

# TRU WASTE STORAGE RECORD

LA00000056636

## 1. GENERATOR'S PRE-USE VISUAL INSPECTION

| Purchase Order # | Inspected Items | | |
|---|---|---|---|
| This container has been visually inspected according to approved procedures and has been found to be free of damage that would make it unsuitable for TRU waste packaging. | [X] Ring, Bolt, and Nut | [X] Chime | [X] Dents |
| | [X] Lid and Gasket | [X] Gouges | [X] Paint |
| Name TRUJILLO MICHAEL C | Znumber 098605 | | Date JUL 30 1997 |

## 2. GENERATOR'S PACKAGE INFORMATION

| Group NMT-7 | Technical Area 55 | Building PF-4 | Program Code 8J0700 KF14 1000 0000 | [ ] Off-Normal |
|---|---|---|---|---|

Additional Information: TIO 826672

| CONTAINER | LINER |
|---|---|
| [X] Steel Drum (55 gal.) | [X] None |
| [ ] Steel Drum (85 gal.) | [ ] 80 mil liner |
| [ ] Standard Waste Box | [ ] 125 mil liner |
| [ ] RH Canister | INTERNAL SHIELDING |
| [ ] Other (Cell TWCO) | [X] None |
| [ ] Overpack | Type: Thickness (in.): |
| Carbon Filter ID: 01 1576; 02 | |

RADIONUCLIDE CONTENT

| Nuclide | Amount | Uncertainty | C=Curie M=Gram |
|---|---|---|---|
| PU-238 | 6.007E-3 | 5.136E-4 | M |
| PU-239 | 5.633E+1 | 4.816E+0 | M |
| PU-240 | 3.604E+0 | 3.082E-1 | M |
| PU-241 | 1.201E-1 | 1.027E-2 | M |
| PU-242 | 1.201E-2 | 1.027E-3 | M |
| AM-241 | 9.551E-2 | 8.166E-3 | M |

| | |
|---|---|
| Waste Profile Request Number | 20309 |
| Process Batch Code | NA |
| [ ] PDP Program | Tracking No: |
| Gross Weight (lb.) | 1.12E+2 |
| Net Weight (lb.) | 4.88E+1 |
| Shipping Category | 3003400280 |
| LANL Waste Stream ID | TA-55-3 |
| TRUCON Code | 116C |
| Date Closed (MMDDYY) | AUG 4 1997 |
| Accumulation Start Date (MMDDYY) | |

NONRADIOACTIVE HAZARDOUS MATERIALS

| Name | EPA Code | Quantity (g) |
|---|---|---|
| None | | |
| | | |
| | | |

*The data in this section were collected, and the waste described herein was packaged and labeled according to approved procedures.*

Name VIGIL ROBERT A | Znumber 091564 | Date AUG 11 1997

## 3. GENERATOR SITE HEALTH PHYSICS INFORMATION

| | | Survey Date | Survey Meter Model | Property Number | Calibration Due Date |
|---|---|---|---|---|---|
| Gamma Dose Rate (mrem/h) (contact) | 8.0E+1 | AUG 6 1997 | RO20 | 006487 | SEP 13 1997 |
| Neutron Dose Rate (mrem/h) (contact) | 1.3E+0 | AUG 6 1997 | PNR-4 | 004906 | OCT 2 1997 |
| Total Dose Rate (mrem/h) (contact) | 8.1E+1 | | | | |
| Total Dose Rate (mrem/h) (1 meter) | 8.8E+0 | | | | |
| Alpha Contamination (dpm/100cm$^2$) (rem) | 0.0E+0 | | | | |
| Beta-Gamma Cont. (dpm/100cm$^2$) (rem) | 0.0E+0 | | | | |

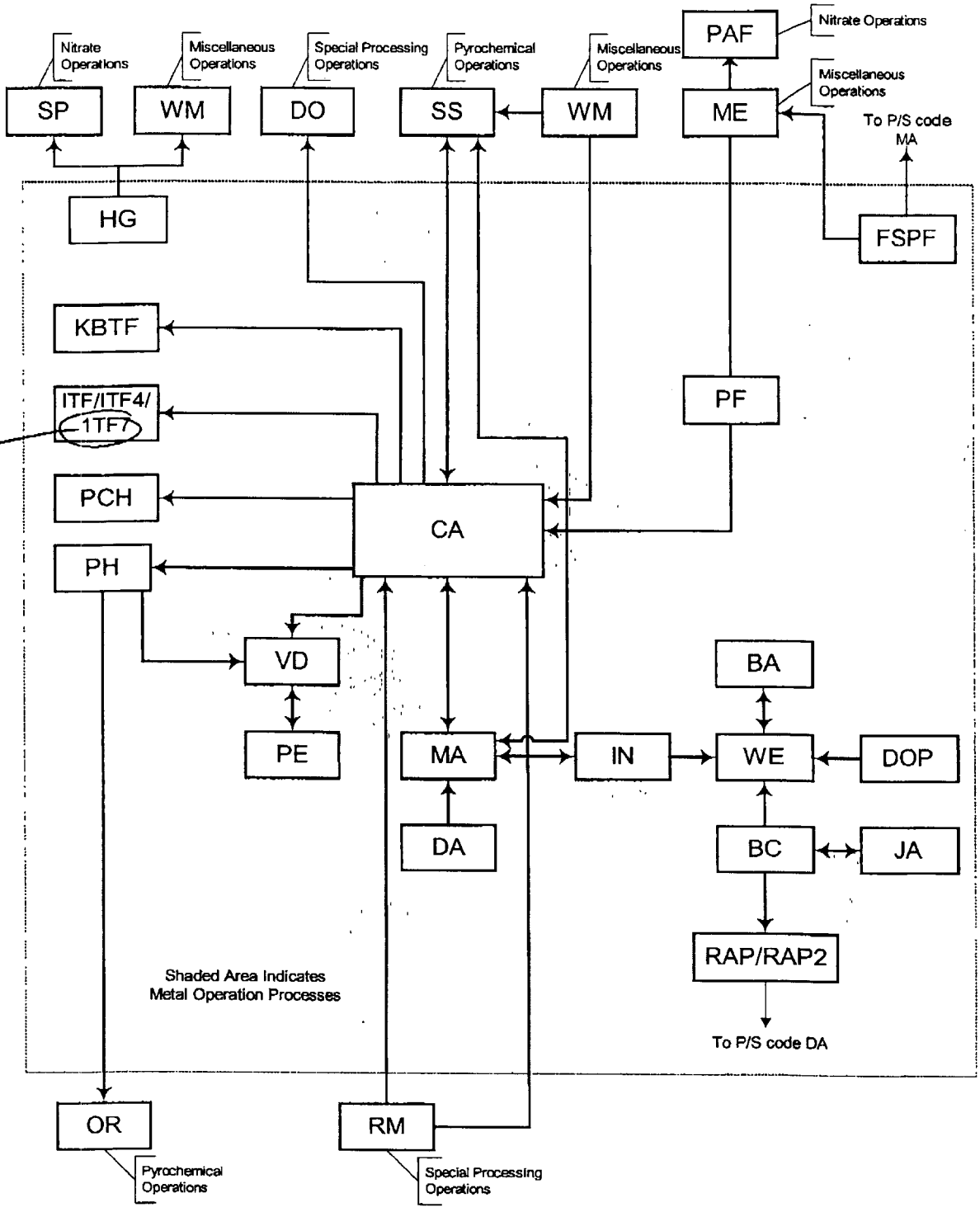
*The data in this section were collected according to approved procedures.*

Name CHAVEZ RONALD | Znumber 112026 | Date AUG 11 1997



Modifications to Computer Generated Data Invalidate this Form

## SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS




ITF7

NOTE: All of these P/S codes may obtain feed material from or send product output to the vault.

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1 Acceptable Knowledge Roadmap (11 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Simplified Process Flow Diagrams (8 pages)
4 Waste Generator Forms for TRU Waste (5 pages)
5 Chemical Waste Disposal Request Form (1 page)

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- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; ~~analytical laboratory solutions~~] residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (generally less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040

- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved.
- Drums containing waste generated from P/S codes SD and SS between 02/98 and 06/98 segregated as a subset of TA-55-19 due to the potential presence of vanadium pentoxide HWN P120). (See separate AK summary for waste stream lot TA-55-19A).

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types, ~~as well as contaminants from uranium-235~~, ~~its decay daughter~~, protactinium-231, ~~and fission product cesium-137~~. Other waste may contain various radionuclides used as feed materials for producing ~~radioassay sources~~, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that are referenced in this summary report. Unclassified Controlled Nuclear Information (UCNI) will be reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK summary report is based on detailed information compiled in a set of closely related reports about TRU waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Process 55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

The process AK reports contain information on over ~~200~~ 175 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. For example, the nitrate operations report (*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005,R.2]) covers waste generation processes and characteristics for over 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generator records. However, as described in section 3.2, TA-55 TRU waste items have always been segregated and packaged into waste containers based on the physical form and material type content of the waste, without regard to process of origin (i.e., P/S code). In order to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number), separate AK reports have been prepared for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in the process AK reports.

This AK summary report summarizes AK information specific to the combustible debris waste streams TA-55-19 (including waste stream lot TA-55-19A) and TA-55-20.

## 3.0 DESCRIPTION OF THE WASTE STREAM

### 3.1 Facility and Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

The combustible waste streams TA-55-19 and TA-55-20 were generated at the TA-55 Plutonium Facility (Building PF-4) as debris waste from process operations and glovebox maintenance involved in plutonium recovery. For this reason, the waste streams are defense related. However, waste also was pr from "special process" and research-related activities. These wastes were segregated until 1998, but rather were commingled in the final waste cont such an extent that segregation is not possible on the basis of waste generating process or glovebox location (TWCP-887). The waste was also co-mingled with room trash related to these same operations (both defense and non-defense), which was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site ~~radioassay~~ assay results showed it exceeded the low-level ~~discard limits (DLs~~ waste threshold value) (TWCP-816).

A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process of origin. Relevant details of these planning and implementation documents are summarized in this section, in order

In addition, each major waste form includes provisions for small quantities of unspecified waste with similar properties. This provision is necessary in order to allow for infrequently encountered waste items.

### 3.2.2 Waste Stream Delineation for TA-55

From the beginning of operations at TA-55, the physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for waste items was sometimes also documented on this form. Starting in 1987, the TA-55 Plutonium Facility began its current system of tracking waste items both by t process from which they originated as well as by their material co... Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item although recording of P/S codes was in consistent until about 1990). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel. Both the WODF and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

one word

Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- First by radioisotope content (Pu-238 or Pu-239 material type)
- Then by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

Waste stream delineation was performed using waste generator information (such as the WODF and DWLS) that has been compiled in an electronic data base that is part of the Sampling Plan. Because waste

Purification steps may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and separate out impurities. Enriched solutions may be further treat oxalic acid to precipitate plutonium oxalate, which is convertec plutonium oxide.

filtrate

In the hydroxide precipitation step, plutonium in solutions from purification steps is precipitated with potassium, magnesium, or sodium hydroxide. Heavy metals are concentrated in the plutonium-rich hydroxide cakes and derive from one or more of the following: (a) feed materials that consist of or contain these metals; (b) leaching of chromium from stainless-steel equipment components; or (c) from the use of silver salt (until 1994) as an indicator of chloride content. The resulting Pu-enriched hydroxide cakes become feed material for nitrate operations, and liquid meeting the TA-50 WAC is sent to the RLWTF using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

### 3.5.4 Nitrate Operations

P/S codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride operations), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- evaporation
- cement fixation

Pretreatment primarily includes physical processes used to separate scrap and residues for the next step, dissolution. It may include calcination, caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing, distillation, filtering of liquids or oils, incineration, magnetic separation, passivation, scraping, or sorting. After pretreatment, solids are sent to dissolution if plutonium concentrations are above the DL and to cement fixation if concentrations are below the DL. Liquids are sent to purification if plutonium concentrations are above the DL and to the TA-50 Radioactive Waste Treatment Facility (RLWTF) if they meet the TA-50 RLWTF WAC or to cement fixation; otherwise, they are further treated until they meet that WAC.

Dissolution includes various steps that generate plutonium nitrate solutions for feed to purification. Primary chemicals used in dissolution are nitric acid and calcium fluoride and/or hydrofluoric acid. Filtered solids are returned to the dissolution process until plutonium concentrations are below the DL, then sent to cement fixation for disposal. Debris items are disposed after removal of plutonium contamination above the DL. Plutonium-bearing solutions are sent on to purification.

Purification consists of ion exchange and precipitation processes. The ion exchange processes use resin-filled columns to collect plutonium, which binds to the resin while impurities flow through the columns; an eluting agent is then used to release purified plutonium in solution. The enriched solutions are then sent to oxalate precipitation, which converts the plutonium to oxide form. The depleted liquids are sent to the evaporator or the RLWTF, and the calcined plutonium oxides are sent to the vault.

The evaporator processes plutonium-poor liquids in order to re-concentrate plutonium, if possible, or to reduce the volume of liquid waste. Evaporator bottoms are either sent back to ion exchange or discarded to cement fixation, depending on their plutonium content. Heavy metals that may be present are concentrated in this process.

In the cement fixation step, wastes with low plutonium concentrations are collected and immobilized in cement. Most of the wastes generated under these processes (P/S codes CF, HP, and IA) are classified as cemented wastes and would not normally be part of the debris waste streams.

### 3.6.2 Radionuclide Content Identification

The primary Pu material type inputs for TA-55 processes are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers (see Section 14). The results of these calculations are tabulated in the last three columns of Table 2, assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time(TWCP-698).

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides will be present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material:

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present mostly in minor amounts in most debris waste from processes at TA-55.

- In general, uranium and its isotopes are expected to be prese at trace levels, if at all, if the feed material did not purposely uranium. The primary uranium material type inputs for react development activities and for pit disassembly at TA-55 are listed in Table 3.

- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239.

- U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2).

- Protactinium (Pa)-241, the decay-chain daughter of U-235, is expected to be present in trace amounts in some TA-55 wastes due to its widespread presence as of a contaminant in TA-55 operations. (TWCP-5164, TWCP-5165).

- Cs-137 is a product of the spontaneous fission of Pu-238, Pu-239 and especially Pu-240, as well as a trace contaminant in purified plutonium from the production reactors. In the latter case the remaining Cs might be on the order of 0.5 ng/g Pu. In the former instance the formation of Cs-137 due to spontaneous fission would lead to about 0.4 pg/g Pu in plutonium that is ten years old. Because Cs-137 due to spontaneous fission is about a factor of a thousand less than that due to residual contamination from the original separation on the production fuel, the latter is the dominant source of Cs in TA-55 waste.

In general no correlation is expected to be seen among the different radio elements, Pu, Np, U, Pa or Am. The differences in valence states and chemical affinities among these elements is expected to result in substantial fractionation during several TA-55 processes, including ion exchange, solvent extraction, hydroxide precipitation, dissolution.

Secondary radionuclides will also be present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memo according to P/S code (TWCP-882), as summarized in Table 4. This list includes Am-241, Am-243, cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Th-230, Th-232, U-233, U-235, and U-238.

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of radioassay procedure to use for optimal results. Cm-244 was introduced in TRU operations in P/S code DOP, which started in 1988. Material outputs from this process sometimes were sent to P/S codes IS or WE. Cm-244 could also be part of debris waste under P/S code CA because both operations took place in the 300 area. Because only one room in this area is available for bagouts, all TRU waste from the 300 area gets combined. In addition, because rags from DOP were sent to IS, Cm-244 could be present in the ash produced by this operation, which is then processed through nitrate aqueous recovery operations. Some unknown fraction of the Cm-244 could ultimately end up in the evaporator bottoms, which are then immobilized in cement in P/S code CF. In any case, however, Cm-244 is not expected to be present in any waste generated before 1988.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The results of these assay results are summarized in Section 14.2.

### 3.6.3 Chemical Content Identification

Chemical contents of process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from subject matter expert (SME) input. Individual process AK reports contain detailed assessments of these chemical inputs, and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

**Table 4. Secondary Radionuclides in TA-55 TRU Waste**

| Secondary Radionuclide | P/S code generating waste |
|---|---|
| Americium-241 | AO, AP, CA, CD, CF, CLX, CXL, DOP, EV, FA, HCD, HD, HP, IA, LR, MA, OH, PI, PR, PRR, PS, SS, SX, WE, XP; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Pu-241 decay. Waste could be either depleted or enriched in Am depending upon whether the source of contamination is the process product or the process residues. |
| Americium-243 | BC, CA, DOP, JA, MA, PH, PI, SS, WE |
| Cerium-144 | DOP, WE |
| Currium-244 | DOP, IS (Mar-Apr 1987), WE |
| Neptunium-237 | ATL, BC, CA, CF, DOP, ED, EV, IS, JA, MA, Neptunium,PI, RB, RFX, WE; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Am-241 decay |
| Protactinium-231 | BC (1989), JA (1989), WE |
| Plutonium-238 | TDC |
| Plutonium-241 | EV, IS, TDC |
| Thorium-232 | CF, DOP, PT, WE |
| Thorium-232 enriched with Thorium-230 | BC, JA, WE |
| Uranium-233 | DOP, WE |
| Uranium-235 or enriched uranium | CN, FF, GI, MW, OB, PD, PI, RS, SRL, UA; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |
| U-238 or depleted uranium | BC, CN, FF, GI, JA, LC, MW, OB, PD, RC, RS, SRL, UA, UPS, US, WE,; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |

Sources: TWCP-882, TWCP-AK-2.1-003, TWCP-AK-2.1-005, TWCP-5166, ~~TWCP-~~

3.6.3.1 *Acids and bases.* Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perch[illegible] acid, stearic acid, sulfuric acid, and superacids (e.g., [illegible]). Bases used in these processes are calcium hydroxide magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) ~~does~~ and D003 (reactivity) do not apply to the solid debris waste because there are no free liquids in this waste.
- D001 (ignitability) ~~does~~ and D003 (reactivity) do not apply to wastes in waste streams TA-55-19 or TA-55-19A despite the use of spent non-halogenated solvents (HWN F003) and the possible production of perchlorate salts in perchloric acid solutions for the following reasons: (TWCP-5157, TWCP-5158)
  - Perchloric acid solutions are sent to cement fixation.
  - Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded.
  - Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu.
  - Solutions containing spent solvents and above the DL for Pu are further treated by aqueous recovery processes as part of routine chloride and nitrate operations. Aqueous recovery involves dissolving any solid Pu in hydrochloric or nitric acid, followed by ion exchange to extract the Pu. The processed solutions are below the DL for Pu and are either sent to the RLWTF or to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, a waste form for which ignitability is not a concern.
  - Rags, if contaminated with spent solvents and above the DL for Pu, are thermally decomposed, which destroys any organic component.
  - Although contaminated rags that are below the DL for Pu are discarded as combustible debris, headspace gas analyses support the expectation that the solvents are not present in the packaged waste at levels of concern.

Check Misc process AK ↙ 1803

Insert Acetonitrile (P/S code ~~AE~~ AC2 ~~AC~~)

**Table 6. Use of RCRA-Regulated Organic Chemicals in TA-55 Processes**

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Acetone (P/S codes FF, ME, and MOX) | • F003 applies to P/S code ME because it may have been used in the glo[illegible] cleaning.<br>• F003 does not apply to P/S code FF or MOX because it was only used glovebox. |
| Benzene (P/S codes AC, AC1, AC2, and SA) | • D018 (benzene) applies to P/S codes AC, AC1, AC2, and SA<br>• F005 applies to P/S codes AC, AC1, AC2, and SA, in which benzene was used as a solvent |
| Carbon tetrachloride (P/S codes AD, CV, PTP, and PX) | • D019 (carbon tetrachloride) applies to P/S codes AD, CV, PTP and PX. This chemical was used in PTP between 1/87 and 6/89.<br>• F002 does not apply to P/S codes AD, CV, PTP, or PX because it was not used as a solvent or for degreasing. |
| Chloroform (P/S codes AC, AC1, AC2, APD, FF, and XO) | • D022 (chloroform) applies to P/S codes AC, AC1, AC2, APD, FF and XO. Concentrations in P/S code FF are expected to be below RCRA threshold because freeze-drying should have removed most, if not all, of the residual chloroform before the microspheres were taken into the glovebox for sintering. |
| Diethyl ether (P/S code SA) | • F003 applies to P/S code SA because of solvent use. |
| Freon and Freon TF (P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | • F002 applies to P/S codes DA, MA and XO.<br>• F002 does not apply to P/S codes CA, MW, PD, SCB, SRL, UA, VD and WE. Although Freon TF is used as a solvent to clean metal parts, the parts are routinely air-dried to avoid the need for cellulosic wipes.<br>• F002 does not apply to P/S code PF because Freon was used as a coolant for a cutting saw. |
| Methanol (P/S codes AD and SO) | • F003 applies to P/S code AD because it may have been used for cleaning inside the glovebox.<br>• F003 does not apply to P/S code SO because it was used in a cold trap outside the glovebox. |
| Methylene chloride (P/S code AC1) | • F002 applies to P/S code AC1 because this chemical was used as a solvent (MA) and a paint stripper (XO). |
| Methyl ethyl ketone (P/S codes MA and XO) | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO.<br>• F005 applies to P/S codes MA and XO, in which methyl ethyl ketone was used as a solvent (MA ~~and paint stripper~~ and XO). |
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA<br>• F005 applies to P/S codes AC, AC2 and SA, in which pyridine was used as solvent. |
| Tap Magic (contains 1,1,1 trichloroethane) (P/S code MA) | • F002 does not apply to P/S code MA because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |

It is possible that waste generated under P/S codes AC, AC2, and SA may require the assignment of EPA HWN U213 (tetrahydrofuran). This possibility is being investigated.

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 (including lot TA-55-19A) is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses for containers assigned to waste stream TA-55-19 (Section 14.4).

8.2 Toxicity Listings

Both TA-55-19 and TA-55-19A are conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040.

TA-55-20 has no D listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DOP, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD.

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

| | |
|---|---|
| AC | D007, D009, D011, D018, D022, D038 |
| AC1 | D007, D009, D011, D018, D022 |
| AC2 | D007, D009, D011, D018, D022, D038 |
| ACD | D005, D006, D007, D008, D011 |

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AK information has been compared with visual examination data for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). In two cases, the number of layers of packaging observed during visual examination was greater than the number of layers reported by the waste generator, and an incorrect TRUCON code was assigned by the waste generator (Section 14.2). It is possible that the extra pl layers were breached (i.e., these were confining layers) but that the VE inspectio catch this detail. However, the conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution. Consequently, the most conservative TRUCON code will be assigned to each waste container in waste streams TA-55-19 and TA-55-20, in accordance with the following guidance:

a) The default TRUCON codes from Table 7 will be assigned if the waste generator has not assigned a TRUCON code.

b) The TRUCON code assigned by the waste generator will be used only if it has been positively confirmed by RTR or VE data.

c) If no VE data are available, and if the RTR data are indeterminate, then the default TRUCON code will be assigned to the container.

This guidance only applies to retrievably stored waste. It is assumed that newly generated waste packaged under procedures approved by TWCP and CBFO will be assigned correct TRUCON codes.

## 14.0 CONFIRMATION OF AK INFORMATION FOR WASTE STREAM

Characterization data acquired by WAP-compliant activities provide a means to judge the reliability of AK information. Radiography, radioassay, and headspace gas analysis are conducted on all retrievably stored containers of debris waste, and VE is being conducted on at least 50 containers from waste streams TA-55-19 and TA-55-20. Relevant aspects of the data produced by these activities are summarized in the sections below, focusing on the extent to which the data confirm AK information and identifying aspects for which additional AK documentation or research may be warranted.

### 14.1 Radiography Data

Radiography data are examined to confirm AK information about WMC assignments, layers of packaging, absence of prohibited items, and the relative volumes or weights of waste matrix parameters for a waste stream. The WMC for waste streams TA-55-19 and TA-55-20 is S5300 (combustible debris). Thus far, 265 containers, or about 6 percent of the 4454 containers in these two waste streams (Sampling Plan, Revision 3), have undergone RTR, with the data contained in WIPP-compliant batch data reports. The following observations are made from an examination of these data, as summarized in Table 8 and 9:

**Table 9. RTR packaging data for waste streams TA-55-19 and TA-55-20**

| Maximum number of layers | Metal Layers | Plastic Layers | No. of Drums | % of Total Examined | |
|---|---|---|---|---|---|
| Less than or equal to 1 | 0 | 1 | 2 | out of 231 | 1% of drums |
| Less than or equal to 2 | 0 | 2 | 21 | out of 231 | 9% of drums |
| Less than or equal to 3 | 0 | 3 | 95 | out of 231 | 41% of drums |
| Less than or equal to 4 | 1 | 3 | 2 | out of 231 | 1% of drums |
| Less than or equal to 5 | None observed | | 0 | out of 231 | 0% of drums |
| Less than or equal to 6 | None observed | | 0 | out of 231 | 0% of drums |
| Number of layers | Metal | Plastic | Drums | | |
| Indeterminant | 0 | Indeter | 109 | Indeterminant due to number of plastic horsetails: | |
| | 1 | Indeter | 2 | | |
| | Subtotal | | 111 | out of 231 | 48% of drums |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835; RTR batch data reports still in Project-level review: LA01-RTR-006, ~~LA01-RTR-007~~, ~~LA01-RTR-009~~, ~~LA01-RTR-013~~

5119, 5121, 5147

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- confirmation of WMC S5300 for 98.9 percent of the drums examined
- identification of WMC discrepancies for 3 containers (1.1 percent of the drums examined), which must be reassigned to other waste streams
- identification of potentially sealed containers > 4 liters in 13 percent of the drums, for which PWRs were submitted
- confirmation of the absence of any other prohibited item or condition requiring a PWR
- confirmation of 4 or fewer packaging layers for 52 percent of the dru Plastic packaging layers for the remaining 48 percent were indeterminate due to the large amount of horsetails present in the drums
- confirmation of the waste stream description:
- 97 percent of the drums contain more than 75 wt percent combustible waste;
- 86 percent of the drums contain less than 5 wt percent metal waste, and 94 percent contain less than 10 wt percent metal waste.

Changes in waste stream assignment because of characterization data are documented in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-2.1-064).

AK information resolved an apparent WMC discrepancy for several drums in waste stream TA-55-19 which contained material identified as metal by the RTR operator, thereby leading to an apparent WMC of S5110 (for metal debris) (NCR-00-013, NCR-00-025, NCR-00-026, NCR-00-027, NCR-00-028). After reviewing with the generator how these drums were packaged, the generator determined that these drums were packaged with very dense in-house fabricated plastic material (Kynar, also known as PVDF) used to line gloveboxes and build equipment in chloride operations starting in about 1988. Hence, the WMC S5300 was correct. ~~All 5 drums contained waste only from P/S code CX (TWCP-5086), although~~

(TWCP-5157).

14.2 Visual Examination Data

VE data are used to confirm AK information on waste stream descriptions, WMC, the absence of prohibited items, the number and type of confining layers, and the relative volumes and weights of waste matrix parameters. AK packaging and WMC information have been evaluated by VE for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). These 22 drums were packaged between 11/85 and 8/97 (Sampling Plan). P/S codes are available for the waste items packaged in these drums, as documented in radioassay batch data reports (TWCP-4024, TWCP-4025, TWCP-4052, TWCP-

As a result of this information, the RTR operations ~~subsequently~~ added Kynar to one of the ~~two~~ test drums used at the start of each sample batch.

**Table 8. VE data for waste streams TA-55-19 and TA-55-20**

| Characterization data | Number of containers | | | | Comments |
|---|---|---|---|---|---|
| | AK (see Note 1) | | RTR | VE | |
| Waste Matrix Code | | | | | |
| S5000 | — | | — | — | Positive confirmation of AK WMC by RTR and VE for all 22 drums |
| S5300 | 22 | | 22 | 8 | |
| S5310 | — | | — | 14 | |
| Maximum # of layers and associated TRUCON codes | Default from Table 6 | Assigned in SP | See Note 2 | — | Number of confining layers<br>• AK and VE match for 3 drums<br>• AK more conservative than VE for 14 drums<br>• AK from waste generator was less conservative than VE for 5 drums |
| 0 LA116G | — | — | | 2 | |
| 1 LA116C, E, F | — | 6 | | 2 | |
| 2 LA116B, D | — | — | | 9 | |
| 3 None | — | — | | 8 | |
| 4 LA116A | 4 | 4 | | 1 | |
| 5 LA116H | — | — | | — | |
| 6 LA116I | 8 | — | | | |

SP—Sampling Plan (Rev 3)

Notes:
1. AK information for WMC and TRUCON code assignments is from the Sampling Plan, Rev 3. If no TRUCON code was assigned, then the default code was determined from Table 6, using AK information on packaging dates and P/S codes as documented in the Sampling Plan.
2. RTR data indicated no metal packaging layers for any of these drums, which was consistent with information and confirmed by VE. The number of plastic packaging layers was indeterminate by RTR except for one drum with three layers, which was consistent with the default TRUCON code and confirmed by VE (TWCP-4393).

Data sources: VE batch data reports TWCP-3947, 3948, 3949, 3950, 3951, 4022, 4326, 4327, 4392, 4393, 4394, 4427; VE batch data reports still in Project-level review: LA00-3.4.1-005, ~~LA00-3.4.1-006,~~ ~~LA01-VE-001,~~ LA01-VE-002, ~~LA01-VE-004,~~ ~~LA01-VE-005~~

4800, 5085, 5112, 5120

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Data sources: Radioassay batch data reports TWCP-4009, 4023, 4024, 4025, 4052, 4078, 4158, 4159, 4212, 4225, 4226, 4303; and Sampling Plan (Rev 3). P/S codes from TWCP-5086 and TWCP-5163.
*The rationale for this MDL cut off (21.5% uncertainty) is given in TWCP-2130.

## Table 12. Headspace Gas Data for Target Analytes in Waste Stream TA-55-19

| ANALYTE | MDL, ppmv | PRQL, ppmv | No. of Samples analyzed | No. of samples above MDL | No. of samples above PRQL | VOC concentrations, in ppmv | | | EPA HWN |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | $UCL_{90}$* | Maximum | Assigned (based on AK) |
| Benzene | 1.96 | 10 | 55 | 4 | 0 | 1.2 | 1.8 | 5 | F005, D018 |
| Bromoform | 2.27 | 10 | 55 | 0 | 0 | 1.1 | 1.1 | — | — |
| Carbon Tetrachloride | 2.00 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 3 | D019 |
| Chlorobenzene | 1.93 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 2 | F002, D021 |
| Chloroform | 1.85 | 10 | 55 | 4 | 0 | 1.0 | 1.4 | 3 | D022 |
| 1,1-Dichloroethane | 1.78 | 10 | 55 | 2 | 0 | 1.0 | 1.9 | 4 | — |
| 1,2-Dichloroethane | 2.40 | 10 | 55 | 0 | 0 | 1.2 | 1.2 | — | |
| 1,1-Dichloroethene | 2.74 | 10 | 55 | 0 | 0 | 1.4 | 1.4 | — | |
| Cis-1,2-Dichloroethylene | 2.06 | 10 | 55 | 0 | 0 | 1.0 | 1.0 | — | |
| Ethyl Benzene | 1.72 | 10 | 55 | 0 | 0 | 0.9 | 0.9 | — | F003 |
| Ethyl Ether | 1.30 | 10 | 55 | 0 | 0 | 0.65 | 0.65 | — | F003 |
| Methylene Chloride | 1.97 | 10 | 55 | 11 | 8 | 8.7 | 18.1 | 100 | F002 |
| 1,1,2,2-Tetrachloroethane | 1.62 | 10 | 55 | 0 | 0 | 0.8 | 0.8 | — | — |
| Tetrachloroethene | 1.44 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | — | F002, D039 |
| Toluene | 1.67 | 10 | 55 | 33 | 11 | 6.5 | 8.5 | 51 | F005 |
| 1,1,2-Trichloro 1,2,2-trifluoroethane (Freon-113) | 1.79 | 10 | 55 | 1 | 1 | 1.7 | 1.7 | 44 | F002 |
| 1,1,1-Trichloroethane | 1.82 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 4 | — |
| Trichloroethene | 1.31 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | 6.0 | F002, D040 |
| m-Xylene and p-xylene | 3.62 | 10 | 55 | 0 | 0 | 1.8 | 1.8 | — | F003 |
| o-Xylene | 1.90 | 10 | 55 | 0 | 0 | 0.95 | 0.95 | — | F003 |
| Acetone | 16.12 | 100 | 55 | 31 | 13 | 69.7 | 91.2 | 410 | F003 |
| Butanol | 8.78 | 100 | 55 | 1 | 0 | 4.8 | 4.8 | 29 | — |
| Methanol | 11.42 | 100 | 55 | 10 | 0 | 14.6 | 24.3 | 84 | F003 |
| Methyl ethyl ketone | 18.42 | 100 | 55 | 4 | 0 | 10.1 | 12.6 | 23 | F005, D035 |
| Methyl isobutyl ketone | 16.05 | 100 | 55 | 0 | 0 | 8.0 | 8.0 | — | — |

Source: TWCP-4722; VOC target analyte list for debris waste from WIPP WAP, Table B3-2.

ppmv, part per million by volume; MDL, Method Detection Limit; UCL90, 90% Upper Concentration Limit

↑ PRQL, Program Required Quantitation Limits

— Not applicable

* For samples with concentrations below the MDL, $UCL_{90}$ concentrations are calculated by assuming concentrations were half of the MDL values as determined in the MDL study dated 6/19/00 (TWCP-3248).

## Table 13. Headspace Gas Data For Flammable VOCs, Hydrogen and Methane in Waste Stream TA-55-19

| ANALYTE | Lower Explosive Limit (LEL) | No. of Samples analyzed | No. of samples above MDL | Maximum measured concentration (ppmv) | Evidence for presence of gas in waste | |
|---|---|---|---|---|---|---|
| | | | | | Gas data | AK |
| Acetone | 2.5% | 55 | 31 | 410 | X | X |
| Benzene | 1.2% | 55 | 4 | 5 | X | X |
| Butanol | 1.4% | 55 | 1 | 29 | X | X |
| Chlorobenzene | 1.3% | 55 | 1 | 2 | X | X |
| Cyclohexane | 1.3% | 55 | 0 | — | — | — |
| 1,1-Dichloroethane | 5.4% | 55 | 2 | 4 | X | — |
| 1,2-Dichloroethane | 6.2% | 55 | 0 | — | — | — |
| 1,1-Dichloroethene | 6.5% | 55 | 0 | — | — | X |
| Cis-1,2-Dichloroethylene | 5.6% | 55 | 0 | — | — | — |
| Ethyl Benzene | 0.8% | 55 | 0 | — | — | X |
| Ethyl Ether | 1.9% | 55 | 0 | — | — | X |
| Methanol | 6.0% | 55 | 10 | 84 | X | X |
| Methyl ethyl ketone | 1.4% at 200 °F | 55 | 4 | 23 | X | X |
| Methyl isobutyl ketone | 1.2% at 200 °F | 55 | 0 | — | — | — |
| Toluene | 1.1% | 55 | 33 | 51 | X | X |
| 1,3,5-Trimethylbenzene | Not known | 55 | 0 | — | — | — |
| 1,2,4-Trimethylbenzene | 0.9% | 55 | 0 | — | — | — |
| m-Xylene and p-xylene | 1.1% | 55 | 0 | — | — | X |
| o-Xylene | 0.9% | 55 | 0 | — | — | X |
| **Total potentially flammable VOCs in a single container*** | — | 55 | — | 473 | X | X |
| Hydrogen* | 4% | 55 | 32 | 0.38% | X | X |
| Methane* | 5.3% | 55 | 0 | — | — | X |

Source: TWCP-4722

ppmv, part per million by volume; MDL, Method Detection Limit

LEL, Lower explosive (flammable) ~~limit~~ in air, % by volume (at room temperature); data from NIOSH ~~Pocket Guide to Chemical Hazards (TWCP ____)~~ (2000)

— Not applicable or not detected

* WAC requirements state that a waste container cannot be shipped if its headspace gas concentration exceeds 500 ppm for total flammable VOCs, 5% for hydrogen, or 500 ppm for methane concentration.

** The average flammable VOC concentration is 128 ±101 ppm (TWCP-4722). Gases that were below detection are taken into account in this calculation by assuming they are present at concentrations that are equal to half of the MDL values.

Add to Section 15, references: National Institute for Occupational Safety and Health (NIOSH). ~~(2000)~~ (1997). NIOSH Pocket Guide to Chemical Hazards, Publication # ~~2000-130~~ 97-140. National Technical Information Service (NTIS): Springfield VA. NTIS Order # PB 97-177-604.

## ACCEPTABLE KNOWLEDGE ROADMAP

Waste Stream: TA-55-19 and TA-55-20.

Documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- 4800 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-3.4.1-006 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ None |
| TWCP- 5112 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-001 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ None |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-002 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- 5085 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-004 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ None |
| TWCP- 5120 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ None |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-003 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | atch data report still in ct-level review |

Need to add Special TWCP #s (to be set by e

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documen ublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP- | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-006 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. RTR batch data report still in Project-level review |
| TWCP- 5110 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-007 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. ~~RTR batch data report still in Project-level review~~ |
| TWCP- 4797 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-008 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. RTR batch data report still in Project-level review |
| TWCP- 5121 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-009 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. ~~RTR batch data report still in Project-level review~~ |
| TWCP- 5147 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-013 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. ~~RTR batch data report still in Project-level review~~ |
| ~~TWCP-~~ | A | | | | |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

DRAFT #8

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-00-5727)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19, Lot TA-55-19A, and TA-55-20

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; ~~analytical laboratory solutions;~~ residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (generally less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040

- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved.
- Drums containing waste generated from P/S codes SD and SS between 02/98 and 06/98 are segregated as a subset of TA-55-19 due to the potential presence of vanadium pentoxide (EPA HWN P120). (See separate AK summary for waste stream lot TA-55-19A).

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types, ~~as well as contaminants from uranium-235~~ its decay daughter, protactinium-231, ~~and fission product cesium-137~~. Other waste may contain various radionuclides used as feed materials for producing ~~radioassay sources~~, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate TRU wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; ~~analytical laboratory solutions;~~ residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (generally less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

TA-55-19A is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120
- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream lot until the potential applicability of HWN U213 has been resolved.

**Radionuclide Content** Replace with revised text (same as used on page xviii

~~These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types, as well as contaminants from uranium-235: its decay daughter, protactinium-231 and fission production cesium-137. Other waste may contain various radionuclides used as feed materials for producing radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.~~

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; ~~analytical laboratory solutions;~~ residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (generally less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

No HWNs apply to containers in waste stream TA-55-20.

**Radionuclide Content** Replace with revised text — same as used on page xxviii

These waste streams predominantly contain a variety of plutonium material types with different well-defined ~~isotopic~~ compositions. Americium-241, neptunium-237, ~~and~~ uranium-234 may be present at detectable concentrations ~~as decay products~~ of their plutonium precursors. Some of the processes separate plutonium ~~from~~ americium and ~~uranium.~~ The waste will usually be enriched in americium-241 ~~and~~ uranium-234 relative to plutonium, but may also be ~~depleted~~ in some cases. ~~Some~~ waste may contain uranium from one of several uranium material types, as well as

contaminants of uranium 235: its decay daughter, protactinium-231 and fission product cesium-137. Other waste may contain various radionuclides used as feed materials for producing radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that are referenced in this summary report. Unclassified Controlled Nuclear Information (UCNI) will be reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK summary report is based on detailed information compiled in a set of closely related reports about TRU waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

The process AK reports contain information on over ~~200~~ 175 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. For example, the nitrate operations report (*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005,R.2]) covers waste generation processes and characteristics for over 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generator records. However, as described in section 3.2, TA-55 TRU waste items have always been segregated and packaged into waste containers based on the physical form and material type content of the waste, without regard to process of origin (i.e., P/S code). In order to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number), separate AK reports have been prepared for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in the process AK reports.

This AK summary report summarizes AK information specific to the combustible debris waste streams TA-55-19 (including waste stream lot TA-55-19A) and TA-55-20.

## 3.0 DESCRIPTION OF THE WASTE STREAM

### 3.1 Facility and Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

The combustible waste streams TA-55-19 and TA-55-20 were generated at the TA-55 Plutonium Facility (Building PF-4) as debris waste from process operations and glovebox maintenance involved in plutonium recovery. For this reason, the waste streams are defense related. However, waste also was produced from "special process" and research-related activities. These wastes were not segregated until 1998, but rather were commingled in the final waste containers to such an extent that segregation is not possible on the basis of waste generating process or glovebox location (TWCP-887). The waste was also co-mingled with room trash related to these same operations (both defense and non-defense), which was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site ~~radioassay~~ assay results showed it exceeded the low-level ~~discard limits (DLs)~~ waste threshold value (TWCP-816).

A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process of origin. Relevant details of these planning and implementation documents are summarized in this section, in order

In addition, each major waste form includes provisions for small quantities of unspecified waste with similar properties. This provision is necessary in order to allow for infrequently encountered waste items.

3.2.2 Waste Stream Delineation for TA-55

From the beginning of operations at TA-55, the physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for waste items was sometimes also documented on this form. Starting in 1987, the TA-55 Plutonium Facility began its current system of tracking waste items both by the process from which they originated as well as by their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item although recording of P/S codes was in consistent until about 1990). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel. Both the WODF and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

one word

Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- First by radioisotope content (Pu-238 or Pu-239 material type)
- Then by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

Waste stream delineation was performed using waste generator information (such as the WODF and DWLS) that has been compiled in an electronic data base that is part of the Sampling Plan. Because waste

Purification steps may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and separate out impurities. Enriched solutions may be further treated with oxalic acid to precipitate plutonium oxalate, which is converted to plutonium oxide.

In the hydroxide precipitation step, plutonium in solutions from purification steps is precipitated with potassium, magnesium, or sodium hydroxide. Heavy metals are concentrated in the plutonium-rich hydroxide cakes and derive from one or more of the following: (a) feed materials that consist of or contain these metals; (b) leaching of chromium from stainless-steel equipment components; or (c) from the use of silver salt (until 1994) as an indicator of chloride content. The resulting Pu-enriched hydroxide cakes become feed material for nitrate operations, and liquid meeting the TA-50 WAC is sent to the RLWTF using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

### 3.5.4 Nitrate Operations

P/S codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride operations), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- evaporation
- cement fixation

Pretreatment primarily includes physical processes used to separate scrap and residues for the next step, dissolution. It may include calcination, caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing, distillation, filtering of liquids or oils, incineration, magnetic separation, passivation, scraping, or sorting. After pretreatment, solids are sent to dissolution if plutonium concentrations are above the DL and to cement fixation if concentrations are below the DL. Liquids are sent to purification if plutonium concentrations are above the DL and to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) if they meet the TA-50 RLWTF WAC or to cement fixation; otherwise, they are further treated until they meet that WAC.

Dissolution includes various steps that generate plutonium nitrate solutions for feed to purification. Primary chemicals used in dissolution are nitric acid and calcium fluoride and/or hydrofluoric acid. Filtered solids are returned to the dissolution process until plutonium concentrations are below the DL, then sent to cement fixation for disposal. Debris items are disposed after removal of plutonium contamination above the DL. Plutonium-bearing solutions are sent on to purification.

Purification consists of ion exchange and precipitation processes. The ion exchange processes use resin-filled columns to collect plutonium, which binds to the resin while impurities flow through the columns; an eluting agent is then used to release purified plutonium in solution. The enriched solutions are then sent to oxalate precipitation, which converts the plutonium to oxide form. The depleted liquids are sent to the evaporator or the RLWTF, and the calcined plutonium oxides are sent to the vault.

The evaporator processes plutonium-poor liquids in order to re-concentrate plutonium, if possible, or to reduce the volume of liquid waste. Evaporator bottoms are either sent back to ion exchange or discarded to cement fixation, depending on their plutonium content. Heavy metals that may be present are concentrated in this process.

In the cement fixation step, wastes with low plutonium concentrations are collected and immobilized in cement. Most of the wastes generated under these processes (P/S codes CF, HP, and IA) are classified as cemented wastes and would not normally be part of the debris waste streams.

3.6.2 Radionuclide Content Identification

The primary Pu material type inputs for TA-55 processes are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers (see Section 14). The results of these calculations are tabulated in the last three columns of Table 2, assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time(TWCP-698).

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides will be present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material:

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present mostly in minor amounts in most debris waste from processes at TA-55.

- In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposely contain uranium. The primary uranium material type inputs for reactor fuel development activities and for pit disassembly at TA-55 are listed in Table 3.

- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239.

- U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2).

- Protactinium (Pa)-231, the decay-chain daughter of U-235, is expected to be present in trace amounts in some TA-55 wastes due to its widespread presence as of a contaminant in TA-55 operations. (TWCP-5164, TWCP-5165).

- Cs-137 is a product of the spontaneous fission of Pu-238, Pu-239 and especially Pu-240, as well as a trace contaminant in purified plutonium from the production reactors. In the latter case the remaining Cs might be on the order of 0.5 ng/g Pu. In the former instance the formation of Cs-137 due to spontaneous fission would lead to about 0.4 pg/g Pu in plutonium that is ten years old. Because Cs-137 due to spontaneous fission is about a factor of a thousand less than that due to residual contamination from the original separation on the production fuel, the latter is the dominant source of Cs in TA-55 waste.

(TWCP-5164, TWCP-5165)

In general no correlation is expected to be seen among the different radio elements, Pu, Np, U, Pa or Am. The differences in valence states and chemical affinities among these elements is expected to result in substantial fractionation during several TA-55 processes, including ion exchange, solvent extraction, hydroxide precipitation, dissolution.

one word

Secondary radionuclides will also be present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memo according to P/S code (TWCP-882), as summarized in Table 4. This list includes Am-241, Am-243, cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Th-230, Th-232, U-233, U-235, and U-238.

(TWCP-5166),

in conjunction with

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of radioassay procedure to use for optimal results. Cm-244 was introduced in TA-55 operations in P/S code DOP, which started in 1988. Material outputs from this process sometimes were sent to P/S codes IS or WE. Cm-244 could also be part of debris waste under P/S code CA because both operations took place in the 300 area. Because only one room in this area is available for bagouts, all TRU waste from the 300 area gets combined. In addition, because rags from DOP were sent to IS, Cm-244 could be present in the ash produced by this operation, which is then processed through nitrate aqueous recovery operations. Some unknown fraction of the Cm-244 could ultimately end up in the evaporator bottoms, which are then immobilized in cement in P/S code CF. In any case, however, Cm-244 is not expected to be present in any waste generated before 1988.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The results of these assay results are summarized in Section 14.2.

### 3.6.3 Chemical Content Identification

Chemical contents of process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from subject matter expert (SME) input. Individual process AK reports contain detailed assessments of these chemical inputs, and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

**Table 4. Secondary Radionuclides in TA-55 TRU Waste**

| Secondary Radionuclide | P/S code generating waste |
|---|---|
| Americium-241 | AO, AP, CA, CD, CF, CLX, CXL, DOP, EV, FA, HCD, HD, HP, IA, LR, MA, OH, PI, PR, PRR, PS, SS, SX, WE, XP; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Pu-241 decay. Waste could be either depleted or enriched in Am depending upon whether the source of contamination is the process product or the process residues. |
| Americium-243 | BC, CA, DOP, JA, MA, PH, PI, SS, WE |
| Cerium-144 | DOP, WE |
| Currium-244 | DOP, IS (Mar-Apr 1987), WE |
| Neptunium-237 | ATL, BC, CA, CF, DOP, ED, EV, IS, JA, MA, Neptunium,PI, RB, RFX, WE; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Am-241 decay |
| Protactinium-231 | BC (1989), JA (1989), WE |
| Plutonium-238 | TDC |
| Plutonium-241 | EV, IS, TDC |
| Thorium-232 | CF, DOP, PT, WE |
| Thorium-232 enriched with Thorium-230 | BC, JA, WE |
| Uranium-233 | DOP, WE |
| Uranium-235 or enriched uranium | CN, FF, GI, MW, OB, PD, PI. RS, SRL, UA; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |
| U-238 or depleted uranium | BC, CN, FF, GI, JA, LC, MW, OB, PD, RC, RS, SRL, UA, UPS, US, WE,; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |

Sources: TWCP-882, TWCP-AK-2.1-003, TWCP-AK-2.1-005, TWCP-5166, ~~TWCP-~~

3.6.3.1 *Acids and bases*. Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) and D003 (reactivity) do ~~does~~ not apply to the solid debris waste because there are no free liquids in this waste.
- D001 (ignitability) and D003 (reactivity) do ~~does~~ not apply to wastes in waste streams TA-55-19 or TA-55-19A despite the use of spent non-halogenated solvents (HWN F003) and the possible production of perchlorate salts in perchloric acid solutions for the following reasons:
  - Perchloric acid solutions are sent to cement fixation (TWCP-5157, TWCP-5158).
  - Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded.
  - Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu.
  - Solutions containing spent solvents and above the DL for Pu are further treated by aqueous recovery processes as part of routine chloride and nitrate operations. Aqueous recovery involves dissolving any solid Pu in hydrochloric or nitric acid, followed by ion exchange to extract the Pu. The processed solutions are below the DL for Pu and are either sent to the RLWTF or to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, a waste form for which ignitability is not a concern.
  - Rags, if contaminated with spent solvents and above the DL for Pu, are thermally decomposed, which destroys any organic component.
  - Although contaminated rags that are below the DL for Pu are discarded as combustible debris, headspace gas analyses support the expectation that the solvents are not present in the packaged waste at levels of concern.

were pyrophoric. However, EPA HWN D003 does not apply to P/S codes AC, AC1, or AC2 because the metals are consumed or oxidized before discarding.

- Arsenic (D004) was used in P/S code PE between 1984 and 1985, and EPA HWN D004 is applicable to P/S code PE during this period.

- Cadmium (D006) applies to a limited number of anode heels produced in P/S codes ER, PX, and SS using cadmium as a solvent.

- Lead (D008) was used in P/S codes DOP, ER, KBTF, PX, and SS. For combustible debris waste, EPA HWN D008 is applicable to P/S codes DOP, KBTF, and PX. ~~It is also~~ For P/S codes ER and SS, D008 is only applicable to the metal waste.

- Tin-lead (D008) solder was used in sensors in P/S code BT, but D008 is only applicable to the metal waste from this P/S code, and not to the combustible debris waste.

- Mercury (D009) applies to P/S code SSMD, in which it was used for about one week in the summer of 1994.

- Nickel powder was used in P/S code CO as a sintering aid. This metal is listed in Appendix VIII but no HWN is given.

- Sodium (D003) was used in P/S code EL. However, D003 does not apply in this case because excess Na is dissolved in Dowanol 80.

- Stainless steel (contains chromium, D007) was used in P/S code WE. However, EPA HWN D007 does not apply in this case. There is no potential to leach chromium because stainless steel is not exposed to strong acids in P/S code WE.

3.6.3.4 *Inorganic chemicals.* The following inorganic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: ~~aluminum bifluoride~~, aluminum chloride, aluminum fluoride, aluminum nitrate, aluminum oxide, ammonium chloride, antimony pentafluoride, bromine, calcium carbonate, calcium chloride, calcium fluoride,

3.6.3.5 *Organic chemicals.* The following organic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, ~~acetonitrile~~ alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, Citrapeel, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), diethyl oxalate, dihexyl n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), diisopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride, ion exchange resin, isopropanol, kerosene, Metalprep 79 (phosphoric acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl diisobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, Organicstrip, perchlorocarbons, phenolphthalein, phosphate buffer solution, phosphine oxide, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, Vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

delete

~~App VIII~~

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 6 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

TA-55-19A is a subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which is expected to consist of only a few drums, is identical to the rest of the waste stream except for the possibility that the drums may contain vanadium pentoxide (EPA HWN P120), which was used only between 02/01/98 and 06/10/98 in two specific P/S codes.

Check Misc. process AK ~~AB03~~

Insert Acetonitrile (P/S code ~~AE~~ AC2 ~~and SA~~)

**Table 6. Use of RCRA-Regulated Organic Chemicals in TA-55 Processes**

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Acetone (P/S codes FF, ME, and MOX) | • F003 applies to P/S code ME because it may have been used in the glovebox for cleaning.<br>• F003 does not apply to P/S code FF or MOX because it was only used outside the glovebox. |
| Benzene (P/S codes AC, AC1, AC2, and SA) | • D018 (benzene) applies to P/S codes AC, AC1, AC2, and SA<br>• F005 applies to P/S codes AC, AC1, AC2, and SA, in which benzene was used as a solvent |
| Carbon tetrachloride (P/S codes AD, CV, PTP, and PX) | • D019 (carbon tetrachloride) applies to P/S codes AD, CV, PTP and PX. This chemical was used in PTP between 1/87 and 6/89.<br>• F002 does not apply to P/S codes AD, CV, PTP, or PX because it was not used as a solvent or for degreasing. |
| Chloroform (P/S codes AC, AC1, AC2, APD, FF, and XO) | • D022 (chloroform) applies to P/S codes AC, AC1, AC2, APD, FF and XO. Concentrations in P/S code FF are expected to be below RCRA threshold because freeze-drying should have removed most, if not all, of the residual chloroform before the microspheres were taken into the glovebox for sintering. |
| Diethyl ether (P/S code SA) | • F003 applies to P/S code SA because of solvent use. |
| Freon and Freon TF (P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | • F002 applies to P/S codes DA, MA and XO.<br>• F002 does not apply to P/S codes CA, MW, PD, SCB, SRL, UA, VD and WE. Although Freon TF is used as a solvent to clean metal parts, the parts are routinely air-dried to avoid the need for cellulosic wipes.<br>• F002 does not apply to P/S code PF because Freon was used as a coolant for a cutting saw. |
| Methanol (P/S codes AD and SO) | • F003 applies to P/S code AD because it may have been used for cleaning inside the glovebox.<br>• F003 does not apply to P/S code SO because it was used in a cold trap outside the glovebox. |
| Methylene chloride (P/S code AC1) | • F002 applies to P/S code AC1 because this chemical was used as a solvent (MA) and a paint stripper (XO). |
| Methyl ethyl ketone (P/S codes MA and XO) | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO.<br>• F005 applies to P/S codes MA and XO, in which methyl ethyl ketone was used as a solvent (MA ~~and paint stripper~~ and XO). |
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA<br>• F005 applies to P/S codes AC, AC2 and SA, in which pyridine was used as solvent. |
| Tap Magic (contains 1,1,1 trichloroethane) (P/S code MA) | • F002 does not apply to P/S code MA because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |

It is possible that waste generated under P/S codes AC, AC2, and SA may require the assignment of EPA HWN U213 (tetrahydrofuran). This possibility is being investigated.

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 (including lot TA-55-19A) is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses for containers assigned to waste stream TA-55-19 (Section 14.4).

8.2 Toxicity Listings

Both TA-55-19 and TA-55-19A are conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040.

TA-55-20 has no D listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DOP, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD.

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

| | |
|---|---|
| AC | D007, D009, D011, D018, D022, D038 |
| AC1 | D007, D009, D011, D018, D022 |
| AC2 | D007, D009, D011, D018, D022, D038 |
| ACD | D005, D006, D007, D008, D011 |

Insert space

AK information has been compared with visual examination data for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). In two cases, the number of layers of packaging observed during visual examination was greater than the number of layers reported by the waste generator, and an incorrect TRUCON code was assigned by the waste generator (Section 14.2). It is possible that the extra plastic layers were breached (i.e., these were confining layers) but that the VE inspection did not catch this detail. However, the conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution. Consequently, the most conservative TRUCON code will be assigned to each waste container in waste streams TA-55-19 and TA-55-20, in accordance with the following guidance:

a) The default TRUCON codes from Table 7 will be assigned if the waste generator has not assigned a TRUCON code.

b) The TRUCON code assigned by the waste generator will be used only if it has been positively confirmed by RTR or VE data.

c) If no VE data are available, and if the RTR data are indeterminate, then the default TRUCON code will be assigned to the container.

This guidance only applies to retrievably stored waste. It is assumed that newly generated waste packaged under procedures approved by TWCP and CBFO will be assigned correct TRUCON codes.

## 14.0 CONFIRMATION OF AK INFORMATION FOR WASTE STREAM

Characterization data acquired by WAP-compliant activities provide a means to judge the reliability of AK information. Radiography, radioassay, and headspace gas analysis are conducted on all retrievably stored containers of debris waste, and VE is being conducted on at least 50 containers from waste streams TA-55-19 and TA-55-20. Relevant aspects of the data produced by these activities are summarized in the sections below, focusing on the extent to which the data confirm AK information and identifying aspects for which additional AK documentation or research may be warranted.

### 14.1 Radiography Data

Radiography data are examined to confirm AK information about WMC assignments, layers of packaging, absence of prohibited items, and the relative volumes or weights of waste matrix parameters for a waste stream. The WMC for waste streams TA-55-19 and TA-55-20 is S5300 (combustible debris). Thus far, 265 containers, or about 6 percent of the 4454 containers in these two waste streams (Sampling Plan, Revision 3), have undergone RTR, with the data contained in WIPP-compliant batch data reports. The following observations are made from an examination of these data, as summarized in Table 8 and 9:

**Table 9. RTR packaging data for waste streams TA-55-19 and TA-55-20**

| Maximum number of layers | Metal Layers | Plastic Layers | No. of Drums | % of Total Examined | |
|---|---|---|---|---|---|
| Less than or equal to 1 | 0 | 1 | 2 | out of 231 | 1% of drums |
| Less than or equal to 2 | 0 | 2 | 21 | out of 231 | 9% of drums |
| Less than or equal to 3 | 0 | 3 | 95 | out of 231 | 41% of drums |
| Less than or equal to 4 | 1 | 3 | 2 | out of 231 | 1% of drums |
| Less than or equal to 5 | None observed | | 0 | out of 231 | 0% of drums |
| Less than or equal to 6 | None observed | | 0 | out of 231 | 0% of drums |
| Number of layers | Metal | Plastic | Drums | | |
| Indeterminant | 0 | Indeter | 109 | Indeterminant due to number of plastic horsetails: | |
| | 1 | Indeter | 2 | | |
| | Subtotal | | 111 | out of 231 | 48% of drums |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835; RTR batch data reports still in Project-level review: LA01-RTR-006, ~~LA01-RTR-007~~, ~~LA01-RTR-009~~, ~~LA01-RTR-013~~

5119, 5121, 5147

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- confirmation of WMC S5300 for 98.9 percent of the drums examined
- identification of WMC discrepancies for 3 containers (1.1 percent of the drums examined), which must be reassigned to other waste streams
- identification of potentially sealed containers > 4 liters in 13 percent of the drums, for which PWRs were submitted
- confirmation of the absence of any other prohibited item or condition requiring a PWR
- confirmation of 4 or fewer packaging layers for 52 percent of the drums. Plastic packaging layers for the remaining 48 percent were indeterminate due to the large amount of horsetails present in the drums
- confirmation of the waste stream description:
- 97 percent of the drums contain more than 75 wt percent combustible waste;
- 86 percent of the drums contain less than 5 wt percent metal waste, and 94 percent contain less than 10 wt percent metal waste.

Changes in waste stream assignment because of characterization data are documented in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-2.1-064).

AK information resolved an apparent WMC discrepancy for several drums in waste stream TA-55-19 which contained material identified as metal by the RTR operator, thereby leading to an apparent WMC of S5110 (for metal debris) (NCR-00-013, NCR-00-025, NCR-00-026, NCR-00-027, NCR-00-028). After reviewing with the generator how these drums were packaged, the generator determined that these drums were packaged with very dense in-house fabricated plastic material (Kynar, also known as PVDF) used to line gloveboxes and build equipment in chloride operations starting in about 1988. Hence, the WMC S5300 was correct. ~~All 5 drums contained waste only from P/S code CX (TWCP-5086), although~~

(TWCP-5157).

14.2 Visual Examination Data

VE data are used to confirm AK information on waste stream descriptions, WMC, the absence of prohibited items, the number and type of confining layers, and the relative volumes and weights of waste matrix parameters. AK packaging and WMC information have been evaluated by VE for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). These 22 drums were packaged between 11/85 and 8/97 (Sampling Plan). P/S codes are available for the waste items packaged in these drums, as documented in radioassay batch data reports (TWCP-4024, TWCP-4025, TWCP-4052, TWCP-

As a result of this information, The RTR operations ~~subsequently~~ added Kynar to one of the ~~two~~ test drums used at the start of each sample batch.

**Table 8. VE data for waste streams TA-55-19 and TA-55-20**

| Characterization data | Number of containers | | | | Comments |
|---|---|---|---|---|---|
| | AK (see Note 1) | | RTR | VE | |
| Waste Matrix Code | | | | | |
| S5000 | — | | — | — | Positive confirmation of AK WMC by RTR and VE for all 22 drums |
| S5300 | 22 | | 22 | 8 | |
| S5310 | — | | — | 14 | |
| Maximum # of layers and associated TRUCON codes | Default from Table 6 | Assigned in SP | See Note 2 | — | Number of confining layers<br>• AK and VE match for 3 drums<br>• AK more conservative than VE for 14 drums<br>• AK from waste generator was less conservative than VE for 5 drums |
| 0 LA116G | — | — | | 2 | |
| 1 LA116C, E, F | — | 6 | | 2 | |
| 2 LA116B, D | — | — | | 9 | |
| 3 None | — | — | | 8 | |
| 4 LA116A | 4 | 4 | | 1 | |
| 5 LA116H | — | — | | — | |
| 6 LA116I | 8 | — | | | |

SP—Sampling Plan (Rev 3)

Notes:
1. AK information for WMC and TRUCON code assignments is from the Sampling Plan, Rev 3. If no TRUCON code was assigned, then the default code was determined from Table 6, using AK information on packaging dates and P/S codes as documented in the Sampling Plan.
2. RTR data indicated no metal packaging layers for any of these drums, which was consistent with AK information and confirmed by VE. The number of plastic packaging layers was indeterminate by RTR except for one drum with three layers, which was consistent with the default TRUCON code and confirmed by VE (TWCP-4393).

Data sources: VE batch data reports TWCP-3947, 3948, 3949, 3950, 3951, 4022. 4326, 4327, 4392, 4393, 4394, 4427; VE batch data reports still in Project-level review: LA00-3.4.1-005, ~~[LA00-3.4.1-006,]~~ ~~[LA01-VE-001]~~ LA01-VE-002, ~~[LA01-VE-004, LA01-VE-005]~~

4800, 5085, 5112, 5120

updated 4-24-01 jm

Data sources: Radioassay batch data reports TWCP-4009, 4023, 4024, 4025, 4052, 4078, 4158, 4159, 4212, 4225, 4226, 4303; and Sampling Plan (Rev 3). P/S codes from TWCP-5086 and TWCP-5163.
*The rationale for this MDL cut off (21.5% uncertainty) is given in TWCP-2130.

## Table 12. Headspace Gas Data for Target Analytes in Waste Stream TA-55-19

| ANALYTE | MDL, ppmv | PRQL, ppmv | No. of Samples analyzed | No. of samples above MDL | No. of samples above PRQL | VOC concentrations, in ppmv | | | EPA HWN |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | $UCL_{90}$* | Maximum | Assigned (based on AK) |
| Benzene | 1.96 | 10 | 55 | 4 | 0 | 1.2 | 1.8 | 5 | F005, D018 |
| Bromoform | 2.27 | 10 | 55 | 0 | 0 | 1.1 | 1.1 | — | — |
| Carbon Tetrachloride | 2.00 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 3 | D019 |
| Chlorobenzene | 1.93 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 2 | F002, D021 |
| Chloroform | 1.85 | 10 | 55 | 4 | 0 | 1.0 | 1.4 | 3 | D022 |
| 1,1-Dichloroethane | 1.78 | 10 | 55 | 2 | 0 | 1.0 | 1.9 | 4 | — |
| 1,2-Dichloroethane | 2.40 | 10 | 55 | 0 | 0 | 1.2 | 1.2 | — | — |
| 1,1-Dichloroethene | 2.74 | 10 | 55 | 0 | 0 | 1.4 | 1.4 | — | — |
| Cis-1,2-Dichloroethylene | 2.06 | 10 | 55 | 0 | 0 | 1.0 | 1.0 | — | — |
| Ethyl Benzene | 1.72 | 10 | 55 | 0 | 0 | 0.9 | 0.9 | — | F003 |
| Ethyl Ether | 1.30 | 10 | 55 | 0 | 0 | 0.65 | 0.65 | — | F003 |
| Methylene Chloride | 1.97 | 10 | 55 | 11 | 8 | 8.7 | 18.1 | 100 | F002 |
| 1,1,2,2-Tetrachloroethane | 1.62 | 10 | 55 | 0 | 0 | 0.8 | 0.8 | — | — |
| Tetrachloroethene | 1.44 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | — | F002, D039 |
| Toluene | 1.67 | 10 | 55 | 33 | 11 | 6.5 | 8.5 | 51 | F005 |
| 1,1,2-Trichloro 1,2,2-trifluoroethane (Freon-113) | 1.79 | 10 | 55 | 1 | 1 | 1.7 | 1.7 | 44 | F002 |
| 1,1,1-Trichloroethane | 1.82 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 4 | — |
| Trichloroethene | 1.31 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | 6.0 | F002, D040 |
| m-Xylene and p-xylene | 3.62 | 10 | 55 | 0 | 0 | 1.8 | 1.8 | — | F003 |
| o-Xylene | 1.90 | 10 | 55 | 0 | 0 | 0.95 | 0.95 | — | F003 |
| Acetone | 16.12 | 100 | 55 | 31 | 13 | 69.7 | 91.2 | 410 | F003 |
| Butanol | 8.78 | 100 | 55 | 1 | 0 | 4.8 | 4.8 | 29 | — |
| Methanol | 11.42 | 100 | 55 | 10 | 0 | 14.6 | 24.3 | 84 | F003 |
| Methyl ethyl ketone | 18.42 | 100 | 55 | 4 | 0 | 10.1 | 12.6 | 23 | F005, D035 |
| Methyl isobutyl ketone | 16.05 | 100 | 55 | 0 | 0 | 8.0 | 8.0 | — | — |

Source: TWCP-4722; VOC target analyte list for debris waste from WIPP WAP, Table B3-2.

ppmv, part per million by volume; MDL, Method Detection Limit; UCL90, 90% Upper Concentration Limit

↑ PRQL, Program Required Quantitation Limits

— Not applicable

* For samples with concentrations below the MDL, $UCL_{90}$ concentrations are calculated by assuming concentrations were half of the MDL values as determined in the MDL study dated 6/19/00 (TWCP-3248).

## Table 13. Headspace Gas Data For Flammable VOCs, Hydrogen and Methane in Waste Stream TA-55-19

| ANALYTE | Lower Explosive Limit (LEL) | No. of Samples analyzed | No. of samples above MDL | Maximum measured concentration (ppmv) | Evidence for presence of gas in waste | |
|---|---|---|---|---|---|---|
| | | | | | Gas data | AK |
| Acetone | 2.5% | 55 | 31 | 410 | X | X |
| Benzene | 1.2% | 55 | 4 | 5 | X | X |
| Butanol | 1.4% | 55 | 1 | 29 | X | X |
| Chlorobenzene | 1.3% | 55 | 1 | 2 | X | X |
| Cyclohexane | 1.3% | 55 | 0 | — | — | — |
| 1,1-Dichloroethane | 5.4% | 55 | 2 | 4 | X | — |
| 1,2-Dichloroethane | 6.2% | 55 | 0 | — | — | — |
| 1,1-Dichloroethene | 6.5% | 55 | 0 | — | — | X |
| Cis-1,2-Dichloroethylene | 5.6% | 55 | 0 | — | — | — |
| Ethyl Benzene | 0.8% | 55 | 0 | — | — | X |
| Ethyl Ether | 1.9% | 55 | 0 | — | — | X |
| Methanol | 6.0% | 55 | 10 | 84 | X | X |
| Methyl ethyl ketone | 1.4% at 200 °F | 55 | 4 | 23 | X | X |
| Methyl isobutyl ketone | 1.2% at 200 °F | 55 | 0 | — | — | — |
| Toluene | 1.1% | 55 | 33 | 51 | X | X |
| 1,3,5-Trimethylbenzene | Not known | 55 | 0 | — | — | — |
| 1,2,4-Trimethylbenzene | 0.9% | 55 | 0 | — | — | — |
| m-Xylene and p-xylene | 1.1% | 55 | 0 | — | — | X |
| o-Xylene | 0.9% | 55 | 0 | — | — | X |
| **Total potentially flammable VOCs in a single container*** | — | **55** | — | **473** | **X** | **X** |
| Hydrogen* | 4% | 55 | 32 | 0.38% | X | X |
| Methane* | 5.3% | 55 | 0 | — | — | X |

Source: TWCP-4722

ppmv, part per million by volume; MDL, Method Detection Limit

LEL, Lower explosive (flammable) limit in air, % by volume (at room temperature); data from NIOSH Pocket Guide to Chemical Hazards (TWCP-____)

— Not applicable or not detected

* WAC requirements state that a waste container cannot be shipped if its headspace gas concentration exceeds 500 ppm for total flammable VOCs, 5% for hydrogen, or 500 ppm for methane concentration.

** The average flammable VOC concentration is 128 ±101 ppm (TWCP-4722). Gases that were below detection are taken into account in this calculation by assuming they are present at concentrations that are equal to half of the MDL values.

# ACCEPTABLE KNOWLEDGE ROADMAP

Waste Stream: TA-55-19 and TA-55-20.

Documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- 4800 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA00-3.4.1-006 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ None |
| TWCP- 5112 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-001 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ None |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-002 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- 5085 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-004 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ None |
| TWCP- 5120 | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | ~~VE batch data report still in Project-level review~~ None |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-003 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP- | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-006 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. RTR batch data report still in Project-level review |
| TWCP- 5110 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-007 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. ~~RTR batch data report still in Project-level review~~ |
| TWCP- 4797 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-008 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. RTR batch data report still in Project-level review |
| TWCP- 5121 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-009 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. ~~RTR batch data report still in Project-level review~~ |
| TWCP- 5147 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-013 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. ~~RTR batch data report still in Project-level review~~ |
| ~~TWCP-~~ | A | | | | |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

Edit round #7

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-00-5727)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19, Lot TA-55-19A, and TA-55-20

Tasks for June
- Check if P120 approved. If so, drop TA-55-19A
- email text on Cs-137 bullet
- Check with Foxx about Default TRUCON code for > 1/97
- Incompatibility determination — End of page to

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**
- Reference for NIOSH Pocket Guide

Doc. Jim's comments on Cm-244, Cs-137, Pa-231 as TWCP- record

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

difference between closure date of drum and date of generation of waste item

_____ _____
FACILITY REPRESENTATIVE DATE

Recommend extending period of applicability of HWN to 2 years following reported cessation of its use — based on ~~length of time a single drum remains open in the area~~ range of generation dates of waste items in single drum

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**Attachments**

1 Acceptable Knowledge Roadmap (11 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Simplified Process Flow Diagrams (8 pages)
4 Waste Generator Forms for TRU Waste ~~Forms~~ (5 pages)
5 Chemical Waste Disposal Request Form (1 page)

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| LG1 | Non combustible leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| LG2 | Hydroxide cake dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008, D009, D011 |
| LI | XF6 experimental measurements | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| LIBS | Laser-induced breakdown spectroscopy system | Miscellaneous Operations | 3.4.5, Att. 4 | |
| LR | Ion exchange | Nitrate Operations | 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |
| MA | Machining | Metal Operation Processes | 3.4.2, Att. 4 | D035, D040, F001, ~~F002~~ F005 |
| MAG | Magnetic separation | Nitrate Operations | 3.4.1, Att. 4 | |
| MAS | RD&D experimental processes | Nitrate Operations | 3.4.1, Att. 4 | |
| MB | Nitric dissolution of molten salts | Chloride Operations<br>Nitrate Operations | 3.4.2, Att. 4<br>3.4.2, 3.4.6, Att. 4 | D007, D008, D009 |
| MBC | Crystal | Metal Operation Processes | 3.4.3, Att. 4 | |
| ME | Metallography | Miscellaneous Operations | 3.4.10, Att. 4 | D007, D040, F003 |
| MELL | Mediated electro-oxidation of LLW | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| MF | Metals furnace | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| ML | Non-Pu metal leach | Nitrate Operations | 3.4.2, Att. 4 | D006, D008 |
| MO | Metal oxidation, room 429 | Pyrochemical Processes | 3.4.9, Att. 4 | |
| MOX | Mixed oxide fuel production | Metal Operation Processes | 3.4.1, Att. 4 | |
| MP | Metal preparation | Pyrochemical Processes | 3.4.1, Att. 4 | |
| MPD | Cascade dissolver | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| MS | Molten salts purification dissolution | Chloride Operations | 3.4.2, Att. 4 | D007, D008, D009 |
| MW | Metal working | Metal Operation Processes | 3.4.2, Att. 4 | |
| NC | Noncombustible leach | Nitrate Operations | 3.4.2, Att. 4 | D006, D008 |
| NCD | Nonconfirming drums | Miscellaneous Operations | 3.4.9, Att. 4 | |
| NEPTUNIUM | Neptunium | Pyrochemical Processes | 3.4.10, Att. 4 | |
| NL | Noncombustible leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| NR | Nitrate recovery | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| OB | Oxide blending | Metal Operation Processes | 3.4.1, Att. 4 | |
| OD | Oxide dissolution | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008 |
| OH | Hydroxide precipitation | Nitrate Operations | 3.4.1, 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |

- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved (~~*Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* [TWCP-AK-2.1-004]~~).
- Drums containing waste generated from P/S codes SD and SS between 02/98 and 06/98 are segregated as a subset of TA-55-19 due to the potential presence of vanadium pentoxide (EPA HWN P120). (See separate AK summary for waste stream lot TA-55-19A).

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types, as well as contaminants from uranium-235: its decay daughter, protactinium-231, and fission product cesium-137. Other waste may contain various radionuclides used as feed material for producing radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120
- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream lot until the potential applicability of HWN U213 ~~(tetrahdrofuran)~~ has been resolved.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types, as well as contaminants from uranium-235: its decay daughter, protactinium-231 and fission production cesium-137. Other waste may contain various radionuclides used as feed material for producing radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

contaminants of uranium-235: its decay daughter, protactinium-231 and fission product cesium-137. Other waste may contain various radionuclides used as feed material for producing radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

In addition, each major waste form includes provisions for small quantities of unspecified waste with similar properties. This provision is necessary in order to allow for infrequently encountered waste items.

3.2.2 Waste Stream Delineation for TA-55

From the beginning of operations at TA-55, the physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for waste items was sometimes also documented on this form. Starting in 1987, the TA-55 Plutonium Facility began its current system of tracking waste items both by the process from which they originated as well as by their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item although recording of P/S codes was consistent until about 1990). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel. Both the WODF and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- First by radioisotope content (Pu-238 or Pu-239 material type)
- Then by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

Waste stream delineation was performed using waste generator information (such as the WODF and DWLS) that has been compiled in an electronic data base that is part of the Sampling Plan. Because waste

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity | Miscellaneous operations: AD, CV, EXT, HRS, RASS, SA, XES, XP<br>Nitrate operations: MAS |
| Hydroxide cakes (process output from P/S codes CLS, CW, CXL, DO, POSM, PRR) | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), lead (D008), mercury (D009), silver (D011), and possibly chromium (D007) | Miscellaneous operations: AD<br>Nitrate operations: CD, HCD, HD, LG2<br>Special processing: DO, POSM |
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters) | May be contaminated with RCRA-regulated heavy metals silver (D011), cadmium (D006), mercury (D009), lead (D008), and possibly chromium (D007) | Miscellaneous operations: APD<br>Nitrate operations: ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD<br>Pyrochemical processes: PK (hardware, metal, anode chips from other P/S codes)<br>Special processing: ACD, DO, SB, SL |
| MSE salts | Typically fairly pure, suspect contaminated with barium (D005) but no other RCRA substances present | Chloride operations: MB, MS<br>Miscellaneous operations: XP<br>Nitrate operations: MB, PS |
| Neptunium residues from vault | No RCRA-regulated substances | Pyrochemical processes: Neptunium (only active in 1993) |
| Pu chlorides and fluorides | Variable purity | Miscellaneous operations: FDL, SO<br>Pyrochemical processes: ER, SD, SS<br>Special processing: RM |

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope (Weight %) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

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The primary uranium material type inputs for reactor fuel development activities and for pit disassembly at TA-55 are listed in Table 3.

**Table 3. Average Isotopic Content of Uranium Material Types and Enrichments (Weight %)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Source: TWCP-698

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present mostly in minor amounts in most debris waste from processes at TA-55.

- In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposely contain uranium. The primary uranium - - - -

move 2 lines from previous page

- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239.

- U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2).

- Protactinium (Pa)-241, the ~~alpha-decay~~ decay-chain daughter of U-235, is expected to be present in trace amounts in some TA-55 wastes due to its widespread presence as of a contaminant in TA-55 operations.

I'll email you text to replace this bullet

- Cesium (CS)-137, ~~fission~~ i.e. is a product of ~~U-235~~ the spontaneous fission of Pu-238, Pu-239 and especially Pu-240, as well as a trace contaminant in purified Pu from the production reactors, is expected to be present at detectable levels in some TA-55 wastes, due to its widespread presence as a contaminant in TA-55 operations. - The remaining Cs might be on the order of 0.5 ng/g (mass ratio $5 \times 10^{-10}$). In the latter case,

In general no ~~No~~ correlation is expected to be seen among the different radio elements, Pu, Np, U, Pa or Am.

~~Although they are products of U-235 fission and decay, Cs-137 and Pa-231 are not expected to show any correlation with U-235 concentrations or even with the presence or absence of this isotope.~~ The differences in valence states and chemical affinities ~~among these~~ elements is expected to result in substantial fractionation during several TA-55 processes, including ion exchange, solvent extraction, hydroxide precipitation, and dissolution, ~~and exposure to very high temperatures~~.

~~In addition,~~ also secondary radionuclides will be present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memo according to P/S code (TWCP-882), as summarized in Table 4. This list includes Am-241, Am-243, cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Th-230, Th-232, U-233, U-235, and U-238.

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of radioassay procedure to use for optimal results. Cm-244 was introduced in TA-55 operations in P/S code DOP, which started in 1988. Material outputs from this process sometimes were sent to P/S codes IS or WE. Cm-244 could also be part of debris waste under P/S code CA because both operations took place in the 300 area. Because only one room in this

3.6.3.1 *Acids and bases.* Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) does not apply to the solid debris waste because there are no free liquids in this waste.
- D001 (ignitability) does not apply to wastes in waste streams TA-55-19 or TA-55-19A despite the use of spent non-halogenated solvents (HWN F003) and the possible production of perchlorate salts in perchloric acid solutions for the following reasons:
  - Perchloric acid solutions are sent to cement fixation.
  - Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded. ~~The rinse water is sent to cement fixation.~~
  - Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu.
  - Solutions containing spent solvents and above the DL for Pu are further treated by aqueous recovery processes as part of routine chloride and nitrate operations. Aqueous recovery involves dissolving any solid Pu in hydrochloric or nitric acid, followed by ion exchange to extract the Pu. The processed solutions are below the DL for Pu and are either sent to the RLWTF or to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, a waste form for which ignitability is not a concern.
  - Rags, if contaminated with spent solvents and above the DL for Pu, are thermally decomposed, which destroys any organic component.
  - Although contaminated rags that are below the DL for Pu are discarded as combustible debris, headspace gas analyses support the expectation that the solvents are not present in the packaged waste at levels of concern.

3.6.3.5 *Organic chemicals.* The following organic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, acetonitrile, alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, Citrapeel, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), diethyl oxalate, dihexyl n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), diisopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride, ion exchange resin, isopropanol, kerosene, Metalprep 79 (phosphoric acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl diisobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, organicstrip, perchlorocarbons, phenolphthalein, phosphate buffer solution, phosphine oxide, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex. U.C. 4-C.

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 5 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

TA-55-19A is a subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which is expected to consist of only a few drums, is identical to the rest of the waste stream except for the possibility that the drums may contain vanadium pentoxide (EPA HWN P120), which was used only between 02/01/98 and 06/10/98 in two specific P/S codes.

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Tetrachloroethane (not used) | • No RCRA codes apply to tetrachloroethane, an Appendix VIII chemical. Although it is listed on the chemical inventory for metal operations, it was never used in glovebox operations. |
| Tetrachloroethylene (P/S codes AD, APD, CSE, CV and SE) | • D039 (tetrachloroethylene) applies to P/S codes AD, APD, CSE and SE in which it was used until 1992.<br>• D039 does not apply to P/S code CV because it was used as a coolant outside the glovebox.<br>• F002 applies to P/S codes AD, APD, CSE and SE. Its use as a solvent in P/S code CSE and SE ended in 1992<br>• F002 does not apply to P/S code CV because it was only used as a coolant outside the glovebox. |
| Tetrahydrofuran (P/S codes AC, AC2, and SA) | • U213 may possibly apply to P/S codes AC, AC2, and SA. Its applicability is currently under investigation. |
| Toluene (P/S codes AC, AC2 and SA) | • F005 applies to P/S codes AC, AC2 and SA because toluene was used as a solvent. |
| Trichloroethylene (P/S codes CK, EL, FF, MA, ME, and XO) | • D040 (trichloroethylene) applies to P/S codes EL, FF, MA, ME, and XO<br>• D040 does not apply to P/S code CK because this chemical was used as a coolant outside the glovebox.<br>• F002 applies to P/S code MA, in which trichloroethylene was used as a degreaser during final cleaning of metal parts from 1979 to 1992, resuming again in February 2000.<br>• F002 does not apply to P/S codes EL or FF, in which it was used as a lubricant for a cutting saw, not as a solvent. |

- Rubber and Teflon-based products used in the operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

The following waste material parameter codes (WMP) are assigned to waste streams TA-55-19 and TA-55-20 based on this information and knowledge of waste generation practices described in the TA-55 Waste Management Procedures (see Section 3.2):

- Cellulosics
- Plastics (waste materials)
- Rubber
- Steel (packaging materials)
- Plastics (packaging materials)
- Iron-based metals/alloys (less than 5 percent by volume)

These WMP codes have been verified with WIPP-compliant waste characterization data from real-time radiography and visual examination (Section 14).

## 8.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

### 8.1 F, K, P, and U Listings

No K-listings apply to any of the debris waste generated by the P/S codes covered by this report.

The following P/S codes require HWN assignments due to the presence or use of F-listed chemicals. In many cases, the applicability of the HWN is limited to waste generated during a specific period, as discussed in the appropriate process AK report.

| | |
|---|---|
| • AC, AC1, AC2, AC3 | F002, F005 |
| • AD | F002, F003 |
| • APD | F002, F003 |
| • CF | F002, F003 |
| • CLS | F002, F003 |
| • CSE | F002 |
| • CW | F002, F003 |
| • DA | F002 |
| • HP | F002, F003 |
| • MA | F001, F002, F005 |
| • SA | F002, F003, F005 |
| • SE | F002 |
| • WM, X0, XO | F001, F002, F005 |

In addition, debris waste generated under P/S codes SD and SS between 02/01/98 and 06/10/98 is assigned EPA HWN P120 (vanadium pentoxide).

| | |
|---|---|
| PTS | D005, D006, D007, D008, D011 |
| PUB | D007, D008, D009 |
| PX | D006, D008, D019 |
| RA | D005 (applies only to zinc metal buttons) |
| RASS/RSS | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RC | D005, D006, D007, D008, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SA | D007, D009, D018, D038 |
| SB | D005, D006, D007, D008, D011 |
| SC | D005, D006, D007, D008, D011 |
| SE | D007, D008, D009, D039 |
| SL | D005, D006, D007, D008, D011 |
| SO | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | D007 |
| SS | D006, D008 |
| SSD | D006, D007, D008 |
| SSMD | D009 (D listing applies only from 06/94 to 08/94) |
| STF | D007 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1, VP3 | D009 (D listing applies only from 09/85 to 10/85) |
| VU, VUL | D005, D008 |
| WM, X0, XO | D007, D008, D009, D022, D035, D040 (These HWNs are assigned in order to be conservative as discussed in *Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004,R.2, Section 3.4.9) |
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

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to all three codes

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." The waste streams covered by this AK report have no listings for corrosivity, reactivity, or ignitability. Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the

- confirmation of WMC S5300 for 98.9 percent of the drums examined
- identification of WMC discrepancies for 3 containers (1.1 percent of the drums examined), which must be reassigned to other waste streams
- identification of potentially sealed containers > 4 liters in 13 percent of the drums, for which PWRs were submitted
- confirmation of the absence of any other prohibited item or condition requiring a PWR
- confirmation of 4 or fewer packaging layers for 52 percent of the drums. Plastic packaging layers for the remaining 48 percent were indeterminate due to the large amount of horsetails present in the drums
- confirmation of the waste stream description:
- 97 percent of the drums contain more than 75 wt percent combustible waste;
- 86 percent of the drums contain less than 5 wt percent metal waste, and 94 percent contain less than 10 wt percent metal waste.

Changes in waste stream assignment because of characterization data are documented in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-2.1-064).

AK information resolved an apparent WMC discrepancy for several drums in waste stream TA-55-19 which contained material identified as metal by the RTR operator, thereby leading to an apparent WMC of S5110 (for metal debris) (NCR-00-013, NCR-00-025, NCR-00-026, NCR-00-027, NCR-00-028). After reviewing with the generator how these drums were packaged, the generator determined that these drums were packaged with very dense in-house fabricated plastic material (Kynar, also known as PVDF) used to line gloveboxes and build equipment in chloride operations starting in about 1988. Hence, the WMC S5300 was correct.

Twcp-4190
3288
3289
3290
3291

14.2 Visual Examination Data

VE data are used to confirm AK information on waste stream descriptions, WMC, the absence of prohibited items, the number and type of confining layers, and the relative volumes and weights of waste matrix parameters. AK packaging and WMC information have been evaluated by VE for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). These 22 drums were packaged between 11/85 and 8/97 (Sampling Plan). P/S codes are available for the waste items packaged in these drums, as documented in radioassay batch data reports (TWCP-4024, TWCP-4025, TWCP-4052, TWCP-

Data sources: Radioassay batch data reports TWCP-4009, 4023, 4024, 4025, 4052, 4078, 4158, 4159, 4212, 4225, 4226, 4303; and Sampling Plan (Rev 3)
*The rationale for this MDL cut off (21.5% uncertainty) is given in TWCP-2130.

21.5

Edit round #6 jtm 4/10/01

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20 checked against Round #7 draft jtm 4/16/01

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-00-5727)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19, Lot TA-55-19A, and TA-55-20

See new Edits on pages up to page ~~26~~ 27, and then just pages 29, 39 and 61 (marked with stickies)

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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11 Headspace gas data for flammable VOCs, Hydrogen and methane in waste stream TA-55-19 .....

line spacing between "paragraphs"

**Attachments**

= means u.c. (upper case)

1 Acceptable Knowledge Roadmap (11 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Simplified Process Flow Diagrams (8 pages)
4 TRU Waste ~~Forms~~ (5 pages)
5 Chemical Waste Disposal Request Form (1 page)

Waste Generator Forms for

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| ARIES | Advanced Recovery and Integrated Extraction System |
| CFR | *Code of Federal Regulations* |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| C–N–O | carbon–nitrogen–oxygen |
| CSMO | Central Scrap Management Office |
| DBBP | dibutyl butylphosphonate |
| DCHP | dicesium hexachloroplutonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | Chemical symbol for Fluoride, or RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| ICP | Inductively coupled plasma |
| ID | item identification |
| IDC | item description code |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| MCDOR | multicycle direct oxide reduction |
| MDL | Method detection limit |
| MEGAS | Multiple Energy Gamma Assay System |
| MT | material type |
| NDA | nondestructive assay |
| NMT | Nuclear Material Technology |
| P | Chemical symbol for Phosphorus, or RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF | Plutonium Facility |
| PPM | part per million |
| PPMV | part per million, on a volume basis |
| PRQL | program required quantitation limit |
| P/S | process/status [code] |

l.c. [lower case]

| | |
|---|---|
| PuBe | plutonium–beryllium |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RD&D | research, development, and demonstration |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| RSWD | radioactive solid waste disposal |
| RTR | Real-time Radiography |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3) |
| SME | subject matter expert |
| SOP | safe operating procedure |
| TA | technical area |
| TBP | tributyl phosphate |
| TOPO | trioctylphosphine oxide |
| TRU | transuranic |
| TRUCON | TRUPACT-II Content Code |
| TRUPACT-II | Transuranic Waste Transporter-Model II |
| TWBIR | Transuranic Waste Baseline Inventory Report |
| TWCP | Transuranic Waste Characterization/Certification Project |
| U | Chemical symbol for Uranium, or RCRA hazardous waste number prefix for toxic waste defined in 40 CFR Subpart D, Section 261.33(f) |
| $UCL_{90}$ | 90% Upper Concentration Limit |
| UCNI | unclassified controlled nuclear information |
| VE | visual examination |
| VOC | volatile organic compound |
| WAC | Waste Acceptance Criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request form |
| XES | X-ray energy spectroscopy |

(~~tetrahydrofuran~~) /stet

- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved (~~*Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* [TWCP-AK-2.1-004]~~).
- Drums containing waste generated from P/S codes SD and SS between 02/98 and 06/98 are segregated as a subset of TA-55-19 due to the potential presence of vanadium pentoxide (EPA HWN P120). (See separate AK summary for TA-55-19A).

**Radionuclide Content** Waste stream lot

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types, as well as contaminants from uranium-235: its decay daughter, protactinium-231, and fission product cesium-137. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

feed materials for producing

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120
- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types, as well as contaminants from uranium-235: its decay daughter, protactinium-231 and fission production cesium-137. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

contaminants of uranium-235: its decay daughter, protactinium-231 and fission product cesium-137. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

This AK summary report summarizes AK information specific to the combustible debris waste streams TA-55-19 (including waste stream lot TA-55-19A) and TA-55-20.

## 3.0 DESCRIPTION OF THE WASTE STREAM

### 3.1 Facility and Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

The combustible waste streams TA-55-19 and TA-55-20 were generated at the TA-55 Plutonium Facility (Building PF-4) as debris waste ~~[glovebox and processing room trash]~~ from process operations and glovebox maintenance involved in plutonium recovery. For this reason, the waste streams are defense related. However, waste also was produced from "special process" and research related activities. These wastes were not segregated, but were commingled in the final waste containers to such an extent that segregation is not possible on the basis of waste generating process or glovebox location (TWCP-887). The waste was also co-mingled with room trash related to these same operations (both defense and non-defense), which was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site radioassay results showed it exceeded the low-level discard limits (DLs) (TWCP-816).

A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process of origin. Relevant details of these planning and implementation documents are summarized in this section, in order

to provide background information to support the process used by TWCP to assign TA-55 waste containers to specific waste streams. Waste stream assignment is made on the basis of waste generator information compiled in the TWCP waste container data base, which comprises the bulk of the Sampling Plan. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, in order to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents.

3.2.1 Waste Packaging at TA-55

Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged by this team. Materials are considered waste only when they have been received and processed by the waste management team. Waste segregation schemes used by this team have evolved since operations began at the Plutonium Facility in 1978.

In 1978, the standard operating procedure for waste management at TA-55 stated the guiding philosophy of minimizing the amount of waste generated, and minimizing the plutonium content of that waste (TWCP-3943). Discard Limits (DL) for plutonium in various types of waste were established by the waste-generating group, and approved by the LANL division office and the DOE Albuquerque Operations Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of plutonium) into classes, such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. All liquids, including oils, were required to be sent to recovery operations for processing. Liquids were explicitly prohibited from any container of solid waste materials.

sort matrices

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific processes and waste streams. TA-55 prepared an attachment in March 1987 for contact-handled combustible and noncombustible solid waste (TWCP-701), defined as follows:

- Combustible waste forms included materials which could be reduced to an ash if desired but which did not require further processing to

meet the WIPP (WAC) (TWCP-701). ~~(This definition is still current.)~~ Subcategories included plastic-base, cellulose-base and miscellaneous (graphite and graphite crucibles). It was acceptable for the combustible waste stream to include some unspecified "small" fraction of noncombustible solids such as scrap metals.

- Noncombustible waste forms included materials that could not be reduced to ash but that did meet the WIPP ~~Waste Acceptance Criteria~~ (WAC) without further processing (TWCP-701). The two subcategories were metals and non-metals. The non-metal wastes included glass, fiberglass heating mantles, porcelain crucibles, ceramic furnace tube inserts, and leaded glovebox gloves. It was acceptable for the noncombustible waste stream to include some unspecified "small" fraction of combustible solids, and that could be contained in plastics. For WIPP purposes, any waste forms that were chemically compatible and that met the WAC, could be combined into a single waste container.

In 1995, a new TRU Waste Certification Plan was adopted, including a new attachment that formalizes how the TA-55 waste management team currently segregates newly generated wastes into waste streams (TWCP-700). Waste materials are segregated ~~by~~:

- by radioisotope, in order to meet nondestructive assay (NDA) and gas generation requirements
- by material matrix, in order to meet NDA and TRUCON requirements
- by hazardous constituents, in order to meet RCRA and Department of Transportation (DOT) requirements

(TRUCON code 116)

Combustible waste forms include plastic base and cellulose base, but graphitic waste ~~is now in~~ was moved to the noncombustible category. Noncombustible debris waste forms are broken down to a finer level of classification than had previously been used:

- metals (TRUCON code 117)
- glass (TRUCON code 118)
- HEPA filters (TRUCON code 119)
- leaded gloves (TRUCON code 123)
- salts (TRUCON code 124)
- graphite (TRUCON code 115)

In addition, each major waste form includes provisions for small quantities of unspecified waste with similar properties. This provision is necessary in order to allow for infrequently encountered waste items.

3.2.2 Waste Stream Delineation for TA-55

From ~~Starting with~~ the beginning of operations at TA-55, The physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator ~~according to controlled procedures~~. The P/S code for ~~[many]~~ waste items was sometimes also documented on this form, ~~although recording of P/S codes was spotty before about 1990.~~

Starting in 1987, the TA-55 Plutonium Facility began its current system of tracking waste items both by the process from which they originated as well as by their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel. Both the WODFs and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

(although recording of P/S codes was inconsistent until about 1990).

Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- First by radioisotope content ($^{238}Pu$ or $^{239}Pu$ material type)
- Then by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

Waste stream delineation was performed using waste generator information (such as the WODF and DWLS) that has been compiled in an electronic data base that is part of the Sampling Plan. Because waste

items from several different P/S codes were combined into each waste drum, a special sort on the P/S code of each waste item in a drum was necessary to determine if the drum contained all non-mixed items, some or all mixed-waste items, or a special case item (such as an item from P/S code SS carrying the EPA Hazardous Waste Number (HWN) P120). If the P/S code information was missing for any item in a waste drum (as was the case for many older wastes), that drum was conservatively assigned to the mixed-waste stream. Fortunately, the special case wastes carrying the HWN P120 were generated relatively recently, such that the data base records for those items are complete. ↑ usually

3.2.3 Waste Container Labeling

The net effect of the waste packaging system used at TA-55 is that several HWNs are conservatively assigned to individual waste streams for the purposes of WIPP disposal, because the WIPP WAP requires HWN assignment on a waste stream rather than a waste container basis. For the purposes of generator and on-site storage, however, LANL labels waste on a container by container basis. Thus, the hazardous labels on containers in storage at LANL should not be expected to correspond to the HWNs assigned to the waste stream through this AK summary report. Hazardous labels are updated to meet WIPP disposal requirements just before loading waste containers into the Transuranic Package Transporter-Model II (TRUPACT-II) for shipping to WIPP.

3.3 Waste Physical Form and Content Description

Both of

The TA-55-19, -19A, and-20 waste streams are defined as combustible debris waste streams (Sampling Plan, Appendix D), with TA-55-19 being a mixed-waste stream and TA-55-20 its non-mixed counterpart. TA-55-19A is a small substream lot, distinguished from TA-55-19 by the addition of HWN P120. These waste streams include paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape, gloves, plastic vials, polystyrene, Tygon tubing, polyvinyl chloride plastic, Teflon products, Plexiglas, and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (scrap metal, metal lids, and clothing zippers) (Sampling Plan, Appendix D).

Leaded gloves are also generated as process waste in TA-55 operations. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams, including TA-55-19. Between 1987 and May 1992, leaded gloves began to be segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if

ever
the combustible debris waste were incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

3.4 Waste Volume and Time Period of Waste Generation

The following information is from Appendix D of the Sampling Plan (R.3). These inventories ~~values~~ are expected to change because the Sampling Plan is continually updated as new waste information is obtained.

- TA-55-19 includes 4173 containers (873 cubic meters), that were generated from 1978 to the present time.
- Waste stream lot TA-55-19A is not yet fully defined in the sense that a list of specific waste containers in this lot has not yet been prepared. This is because P/S codes are not always explicitly identified for waste items in TA-55 waste containers. However, it may be possible to extract this information from the waste item identifiers, at which time waste containers can be assigned to TA-55-19A.
- TA-55-20 includes 281 containers (59 cubic meters), that were generated from 1979 to the present time.

3.5 Waste Stream Generation Processes

3.5.1 Overview

The TA-55-19, -19A, and -20 combustible debris waste streams were generated from combustible materials used in processes to recover plutonium from residues, metal fabrication, and research and development activities. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds
- Preparing on a large scale specific alloys, including casting and machining these materials into specific shapes
- Determining high-temperature thermodynamic properties of plutonium
- Reclaiming plutonium from scrap and residues produced by numerous feed sources
- Disassembling components for inspection and analysis

- Manufacturing of parts on a limited basis
- Processing mixtures of plutonium and uranium oxides for reactor fuels.

The manufacturing and research operations performed at TA-55 in the recovery of plutonium results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scrap generated from operations at various LANL, other U.S. Department of Energy (DOE) facilities, and commercial radioactive sources. These recovery operations, along with associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Plutonium processing ~~facilities~~ operations generate contaminated combustible waste from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber- and Teflon-based products used in operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

3.5.2 Process Flow Diagrams

Detailed information about the TA-55 plutonium recovery processes can be found in the Process AK reports. For purposes of the AK search, and to allow convenient referral to and referencing of the Process AK reports in this waste stream AK Summary Report, the processes have been arbitrarily divided into six major areas:

- Chloride Operations (TWCP-AK-2.1-002)
- Nitrate Operations (TWCP-AK-2.1-005)
- Miscellaneous Operations (TWCP-AK-2.1-004)
- Special Processing (TWCP-AK-2.1-007)
- Metal Operation Processes (TWCP-AK-2.1-003)
- Pyrochemical Processes (TWCP-AK-2.1-006)

Generalized flow diagrams for the six operational areas ~~relevant to this AK search~~ are presented as Attachment 3 and indicate P/S codes for the

various processes. The full block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

The following subsections describe the processes that generated debris waste assigned to the TA-55-19, -19A, and -20 waste streams. The potential for RCRA-regulated constituents to be present due to feed materials and chemical use in these processes is summarized in Sections 3.6.1 and 3.6.3. The applicability of EPA HWNs as a result of this potential is specified in Section 8.

### 3.5.3 Chloride Operations

P/S codes CL, CLRD, CLS, CS, CSE, CW, CX, CXL, LD, MB, MS, PB, PRR, PUB, and SE

A detailed description of chloride operations can be found in *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002).

The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The primary feed sources are plutonium residues from pyrochemical operations, plutonium-beryllium (PuBe) neutron sources, analytical laboratory solutions, and residues from other DOE facilities. Chloride operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- hydroxide precipitation

Pretreatment may include sorting, crushing, and/or pulverizing feed materials prior to being fed into later steps of chloride operations. A separate pretreatment procedure is the decladding of plutonium-beryllium sources. The PuBe metal alloy is removed from the sources, which are then entered into the chloride line for plutonium recovery along with other materials.

In the dissolution step, hydrochloric acid is used to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory. Enriched solutions undergo further purification (see next paragraph), and solid wastes are discarded as debris waste or sent to cement fixation. In nitrate operations (section 3.5-4).

Purification steps may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and separate out impurities. Enriched solutions may be further treated with oxalic acid to precipitate plutonium oxalate, which is converted to plutonium oxide.

In the hydroxide precipitation step, plutonium in solutions from purification steps is precipitated with potassium, magnesium, or sodium hydroxide. Heavy metals are concentrated in the plutonium-rich hydroxide cakes and derive from one or more of the following: (a) feed materials that consist of or contain the metals; (b) leaching of metal from equipment components; or (c) from the use of silver salt (until 1994) as an indicator of chloride content. The resulting enriched hydroxide cakes become feed material for nitrate operations, and liquid meeting the TA-50 WAC is sent to the RLWTF using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

3.5.4 Nitrate Operations

P/S codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride operations), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- evaporation
- cement fixation

compounds, their characterization and reaction chemistry, and application to existing actinide processing technology. Other operations comprised a broad range of laboratory activities in support of fundamental and applied actinide chemistry research, including preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation.

*Analytical Operations.* This category covers all analytical techniques performed in Room 124 of the Plutonium Facility. Processes involve analysis of plutonium and americium, RCRA metals, and trace metals. Originators provide samples, which are prepared for further analyses, such as inductively-coupled plasma (ICP) and X-ray energy spectroscopy (XES). Unused liquid samples are returned to the originator, sent to radiochemistry for counting, or sent to recovery operations.

*R&D Efforts.* Several small-scale R&D efforts primarily focused on plutonium recovery included the following activities:

- Fluoride sintering of $PuO_2$ took advantage of the presence of fluoride to aid the formation of a sintered mass of $PuO_2$ powder at temperatures above 700 °C.
- Chlorination of Pu oxides involved oxides with tantalum chips from Rocky Flats Environmental Technology Site (RFETS). Chlorination was used to recover plutonium from potassium chloride and sodium chloride matrices.
- Processing of molten-salt extraction (MSE) salts generated at LANL and RFETS.
- Recovery of plutonium from ash involving plutonium/thorium oxide mixtures.
- Processing of neptunium oxide and metal was performed to remove the protactinium daughter in order to use the neptunium for NDA standards.

*Measurement/Detection Operations and Studies.* P/S code VS involved the inspection of oxides and metals. Materials were retrieved from the vault, brought to the glovebox, inspected and sampled if necessary, then repackaged and returned to the vault. Assay methods include XES, laser based spectroscopy, and other spectroscopic techniques.

Electron microscopy may be conducted on actinide samples in the future. In addition to elemental and isotopic analyses, other

First check Misc. Op. Process AK report to see if VS is still active

All one P, no bullet

3.5.7 Metal Operation Processes

P/S codes AO, ARI, BA, BC, BT, CA, CN, CO, CT, DA, DOP, DT, EL, ELW, EM, EVAC, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT

A detailed description of metal operation processes is found in *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003).

The processes included in metal operations can be divided into three groups

- on-going metal operation processes
- developmental metal operations
- reactor fuel development processes

The main goal of metal processes is to take the high purity metal produced by pyrochemical operations and produce shaped metal pieces. On-going metal operation processes include various R&D activities, alloy development, casting of metals, welding, coating, and machining/metalwork on various metals. Developmental metal operations include the Advanced Recovery and Integrated Extraction System (ARIES) project, assembly operations, burst testing of shells, experimental laser welding, furnace operations, and various other experimental activities. In reactor fuel development, enriched uranium oxide, depleted uranium oxide, and/or plutonium oxide feeds are blended and mixed with graphite, and various operations are performed to convert the feed material into pellets that can be used for fuel. Testing and R&D are done on the fuel pellets.

3.5.8 Pyrochemical Processes

P/S codes CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

A detailed description of pyrochemical processes is found in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006).

Pyrochemical processes include metal preparation, metal purification, and ancillary metal production operations. Pyrochemical process outputs are most often high purity metals for metal operations.

feed materials

3.5.8.1 Metal preparation processes include the following ~~operations~~:

*Metal Preparation Line.* The metal preparation line produces plutonium metal from fluoride salts. Hydrogen fluoride gas reacts with plutonium oxides obtained from calcination of oxalate or peroxide precipitates from the aqueous nitrate or chloride process lines. The plutonium compound is further reacted with various chemicals to produce plutonium metal, which can then be recovered as a button by breaking the crucible.

*Direct Oxide Reduction (DOR).* In the single pass DOR process, plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible. After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which was sometimes recovered by addition of fresh salt plus additional calcium metal.

*Multiple-Cycle Direct Oxide Reduction (MCDOR).* To minimize the salt waste, the MCDOR process was started, in which the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated.

3.5.8.2 Metal purification processes include the following:

*Molten Salt Extraction (MSE).* MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (TWCP-352). This process is employed only if the americium content is greater than 1000 ppm. In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible and heated to 750°C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. In the LANL

sodium or potassium left in the salts are converted to nonpyrophoric oxide forms.

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping process for a few months in 1998. Wastes that potentially contain this chemical (HWN P120) will be segregrated into waste stream lot TA-55-19A (see Section 4.0).

*Salt Distillation.* Salt distillation allows the recovery of plutonium oxide from the chloride salt and produces purified chloride salt for reuse.

*Pyroredox.* The pyroredox operation was used to recover plutonium from spent anode heels in the mid- to late 1980s. The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements more electroactive than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements less electroactive than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded. The metal phase containing zinc was placed in the vault or further treated, and the plutonium eventually was routed back to ER.

*Ingot Casting.* Metal is melted in a MgO crucible to cast the ingot.

*Metal Coalescence.* Metal coalescence is used for plutonium turnings to coalesce the turnings into a metal button. Calcium metal and $CaCl_2$ are added to a MgO crucible along with the turnings and melted.

*Metal Oxidation.* Small pieces of metal remaining on furnace or crucible surfaces are collected for conversion to the oxide phase. These metal pieces are placed in a furnace for the conversion process. The oxide is then transferred to the vault.

*Neptunium.* A campaign to work off neptunium residues stored in the vault was undertaken in 1993 and was only active that year.

*Pickling.* Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. After a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts. It then becomes necessary to leach the plutonium from these items. In addition, after calcium metal reduction processes such as metal preparation, direct oxide reduction, and molten salt extraction, plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals.

*Plutonium Trichloride Preparation.* An intermediate process in Pu metal production prepared plutonium trichloride by bubbling a carrier gas (chlorine) through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500 °C–600 °C before being absorbed in a 5–6 molar potassium hydroxide solution. The carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991. Feed material was high purity oxides from the vault or from other P/S codes. The product plutonium trichloride was reduced to metal by the MSE or ER processes.

## 3.6 Material Inputs to the Waste Generation Processes

Material inputs to the waste generation processes derive from ~~three~~ four general sources: (a) feed material, (b) associated nuclear material types, (c) chemical use, and (d) ancillary material inputs such as those related to the use of laboratory equipment and materials and glovebox maintenance activities.

### 3.6.1 Feed Material Inputs

The feed materials for TA-55 processes that generate waste in waste streams TA-55-19 and TA-55-20 consist of the general types of materials listed in Table 1. ~~that~~ These feed materials are obtained either from the storage vault, as process output from various P/S codes, or from sources outside TA-55, including other DOE facilities.

These feed materials fall into four general categories:

- pure Pu metal to be recycled from pits and sealed sources or to be reworked into desired shapes or chemical forms
- intermediate Pu products in purification processes, ~~such as~~ in the form of solutions, oxides, hydroxides, salts, ~~or~~ anode heels, etc.

- a wide variety of matrices contaminated with Pu above the DL, such as ash, salts, equipment, and solutions
- experimental R&D feed materials

## Table 1. Feed Materials for Processes Contributing to Waste Streams TA-55-19 and TA-55-20

LANL Group

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• CLS-1 solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (Cl-25/TWCP-3547). | Chloride operations: CLS, CW, CXL (analytical laboratory solutions from CLS-1); CSE, SE (other solutions)<br>Miscellaneous operations: ACL, ICP<br>Nitrate operations: CF, HP |
| Anode heels | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), chromium (D007), lead (D008), and silver (D011). Heavy metals arsenic (D004), mercury (D009), and selenium (D010) are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | Nitrate operations: AS, BF, BU<br>Pyrochemical processes: RA |
| Ash from P/S codes ETD, IS, SB, TDC, or from other DOE facilities | Usually suspect contaminated with barium Ba (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic (D004), mercury (D009), and selenium (D010) metals are volatilized at high temperatures if present in the oxide and chloride forms. | Miscellaneous operations: CK, CV, FDL, FLU, SO, XP<br>Nitrate operations: AL, AT, ATL, ED, HGMS, IS, MPD, PTS, RC, SC<br>Special processing: ACD, IAM, SB, SL |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | Chloride operations: CL<br>Nitrate operations: MAS, SC<br>Special processing: ACD, SL |
| Disassembled weapons components (pit diassembly) | High-purity Pu and U material types, no RCRA substances present | Metal operation processes: ARI, CA, PH, SRL<br>Miscellaneous operations: EDC<br>Nitrate operations: BM, RB, RBJ |

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity | Miscellaneous operations: AD, CV, EXT, HRS, RASS, SA, XES, XP<br>Nitrate operations: MAS |
| Hydroxide cakes (process output from P/S codes CLS, CW, CXL, DO, POSM, PRR) | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), lead (D008), mercury (D009), and silver (D011), and possibly chromium (D007) | Miscellaneous operations: AD<br>Nitrate operations: CD, HCD, HD, LG2<br>Special processing: DO, POSM |
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters) | May be contaminated with RCRA-regulated heavy metals silver (D011), cadmium (D006), mercury (D009), lead (D008), and possibly chromium (D007)<br>Insert space after comma | Miscellaneous operations: APD<br>Nitrate operations: ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD<br>Pyrochemical processes: PK (hardware, metal, anode chips from other P/S codes)<br>Special processing: ACD, DO, SB, SL |
| MSE salts | Typically fairly pure, suspect contaminated with barium (D005) but no other RCRA substances present | Chloride operations: MB, MS<br>Miscellaneous operations: XP<br>Nitrate operations: MB, PS |
| Neptunium residues from vault | No RCRA-regulated substances | Pyrochemical processes: Neptunium (only active in 1993) |
| Pu chlorides and fluorides | Variable purity | Miscellaneous operations: FDL, SO<br>Pyrochemical processes: ER, SD, SS<br>Special processing: RM |

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Pu metal or metal alloy from vault or from various P/S codes | High purity, no RCRA-regulated substances, unless noted otherwise | Metal operation processes: AO, ARI, BC, BT, CA, DA, ELW, EVAC, FSPF, ITF, ITF4, JA, KBTF, MA, MBC, MW, PCH (variable purity), PD, PE, PF, PH, RL, SRL, VD, WE, WLT<br>Miscellaneous operations: AC, AC1, AC2, EXT, LIBS, ME, SA, SMP, VS<br>Nitrate operations: ATL, BM, BU, MF, PAF, VP1<br>Pyrochemical processes: CRD (variable purity), MO, SCB, SS, SSMD<br>Special processing: ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |
| Pu oxalates | Typically fairly pure, no RCRA substances present | Nitrate operations: CC, DF, HC |
| Pu oxides | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals cadmium (D006) chromium(D007), and lead (D008)<br>High purity oxides from P/S codes CA, DO, and MA, and from the vault | Metal operation processes: DOP (high-purity Pu and other radionuclides as oxides)<br>Miscellaneous operations: CK, CV, EOC, EXT, FDL, FLU, IB, IE, LI, LIBS, SO, STF, VS, XP<br>Nitrate operations: ATL, BL, CH, CPOD, DP, ED, FC, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2<br>Pyrochemical processes: MP (generally high purity), OR (variable purity), PTP<br>Special processing: DO, PI, PX, POSM, RM |
| Pu-Be sources | High purity constituents, no RCRA-regulated substances | Chloride operations: PB, PUB |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than barium (D005) are present | Chloride operations: MB, MS, PRR<br>Miscellaneous operations: EXT, IB<br>Nitrate operations: COD, COL, MB<br>Special processing: DO |
| Reactor fuel pellets | High purity Pu and U material types, no RCRA-regulated substances | Metal operation processes: ME |
| Stainless steel and/or tantalum residues from decladding of Pu-Be sources | High purity metals, potential leaching of chromium (D007) from stainless steel if subjected to strong acid | Chloride operations: PUB |

2
3.6.1 Radionuclide Content Identification

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The primary Pu material type inputs for TA-55 processes at TA-55 are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of these bounding calculations is to provide a basis for identifying significant enrichment or depletion of radionuclide versus another, based on radioassays of individual waste containers. The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides will be present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material:

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present mostly in minor amounts in most debris waste from processes at TA-55.

- In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposely contain uranium.

- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239.

- U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2).

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gtm

In addition, secondary radionuclides will be present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memo according to P/S code (TWCP-882), as summarized in Table 3.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The results of these assay results are summarized in Section 14.

3
3.6~~2~~ Chemical Content Identification

Chemical contents of process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from SME input. Individual process AK reports contain detailed assessments of these chemical inputs, and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

Waste Streams TA-55-19 and TA-55-20 have been discussed together in this AK Summary Report. These waste streams are similar in physical form and waste material content. They differ only in that TA-55-19 is assigned EPA HWNs based on P/S code information, whereas TA-55-20 contains non-mixed waste. Other waste streams resulting from the same plutonium processing activities at TA-55 but differing in physical form and waste matrix code are listed in the Sampling Plan.

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

The waste matrix code S5300 is assigned to the waste streams TA-55-19 and TA-55-20 based on waste generation practices described in the TA-55 Waste Management Procedure, 1996 (TWCP-351), description of past segregation practices (TWCP-701, Section 2.1, page 4 of 43), and TA-55 process AK reports (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007). A more detailed waste matrix code can not be assigned to the TA-55-19 and TA-55-20 waste streams because TA-55 waste management personnel did not segregate plastic waste from cellulosic waste.

The following codes also apply to waste streams TA-55-19 and TA-55-20 from the Transuranic Waste Baseline Inventory Report (TWBIR), the TRUPACT II Content Code (TRUCON) (DOE/WIPP-89-004/Rev.13), the Radioactive Solid Waste Disposal (RSWD), and the Item Description Code (IDC) (Sampling Plan).

- TWBIR LA-M16 (TA-55-19) and LA-T16 (TA-55-20)
- TRUCON LA 116A, LA 116B, LA 116C, LA 116D, LA 116E, LA 116F, LA 116H, LA 116I
- RSWD A14, A15, A16, A17, A18, A60
- IDC 004 (combustible waste)

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

~~Feed Materials Identification~~

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The TA-55 Plutonium ~~processing~~ facilities generate contaminated combustible debris waste primarily from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, old bag-out stubs, etc.

- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.

Put Section 15 references in alphabetical order (move to precede "Nonconformance")

- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (Attachment B, Waste Analysis Plan)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste (EPA)* (no italics) Remind me to find the document identifier — Jim
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

**Table 4. Secondary Radionuclides in TA-55 TRU Waste**

| Secondary Radionuclide | P/S code generating waste |
|---|---|
| Americium-241 | AO, AP, CA, CD, CF, CLX, CXL, DOP, EV, FA, HCD, HD, HP, IA, LR, MA, OH, PR, PRR, PS, SS, SX, WE, XP; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Pu-241 decay. Waste could be either depleted or enriched in Am depending upon whether the source of contamination is the process product or the process residues. |
| Americium-243 | BC, CA, DOP, JA, MA, PH, SS, WE |
| Cerium-144 | DOP, WE |
| Curium-244 | DOP, IS (Mar-Apr 1987), PI, WE |
| Neptunium-237 | ATL, BC, CA, CF, DOP, ED, EV, IS, JA, MA, Neptunium, RB, RFX, WE; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Am-241 decay |
| Protactinium-231 | BC (1989), JA (1989), WE |
| Plutonium-238 | TDC |
| Plutonium-241 | EV, IS, TDC |
| Thorium-232 | CF, DOP, PT, WE |
| Thorium-232 enriched with Th-230 | BC, JA, WE |
| Uranium-233 | DOP, WE |
| Uranium-235 or enriched uranium | CN, FF, GI, MW, OB, PD, RS, SRL, UA; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |
| Uranium-238 or depleted uranium | BC, CN, FF, GI, JA, LC, MW, OB, PD, RC, RS, SRL, UA, UPS, US, WE,; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |

Sources: TWCP-882, TWCP-AK-2.1-003, TWCP-AK-2.1-005

3.6.3.1

*Acids and bases*. Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) does not apply to the solid debris waste because there are no free liquids in this waste.

- D001 (ignitability) does not apply to wastes in waste streams TA-55-19 or TA-55-19A despite the use of spent non-halogenated solvents (HWN F003) and the possible production of perchlorate salts in perchloric acid solutions for the following reasons:
  - Perchloric acid solutions are sent to cement fixation.
  - Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded, ~~with~~ the rinse water is sent to cement fixation.
  - Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu.
  - Solutions containing spent solvents and above the DL for Pu are further treated by aqueous recovery processes as part of routine chloride and nitrate operations. Aqueous recovery involves dissolving any solid Pu in hydrochloric or nitric acid, followed by ion exchange to extract the Pu. The processed solutions are below the DL for Pu and are either sent to the RLWTF or to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, a waste form for which ignitability is not a concern.
  - Rags, if contaminated with spent solvents and above the DL for Pu, are thermally decomposed, which destroys any organic component.
  - Although contaminated rags that are below the DL for Pu are discarded as combustible debris, headspace gas analyses support the expectation that the solvents are not present in the packaged waste at levels of concern.
  - In addition, 100 percent of the waste containers are subjected to headspace gas analysis. Any container showing over 500 ppm total flammable volatile organic compounds (VOCs) is prohibited from being shipped to the WIPP. (For comparison, the explosive limit for acetone is 25,000 ppm.)

- Formic acid and hydrofluoric acid are listed in Appendix VIII of 40 CFR Part 261, for their corrosive and toxic characteristics, with EPA HWNs U123 and U134. However, these HWNs are not applicable to the manner in which these chemicals were used and discarded in the processes covered by this report.

- None of these are F, K or P-listed chemicals

3.6.3.2

*Gases and cryogenic fluids.* The following gases and cryogenic fluids used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation:

- argon
- carbon dioxide
- chlorine
- halogen fluorides
- hexafluoroethane
- hydrogen chloride
- krypton fluoride
- methane
- nitrogen (gas)
- nitrogen (liquid)
- perfluoropropane
- tetrafluoromethane

The following gases used in the TA-55 processes are identified in Appendix VIII of 40 CFR Part 261 as having hazardous characteristics. The chemical name is followed by the listed EPA HWN and the P/S codes in which the gas is used:

- Fluorine (P056) is used in P/S codes CV, FDL, FLU, PI, SO
- Hydrogen fluoride (U134) is used in P/S codes MP, PI
- Nitrogen dioxide (P078) is used in P/S code HRS
- Phosgene gas (P095) is used in P/S code PTP

No EPA HWNs are applicable to the use of these gases in the TA-55 processes. Compressed gas cylinders are kept outside of the gloveboxes; most are even outside the building, and the gases are plumbed into the glovebox. Thus, the gas cylinders are not discarded with TRU wastes. Additional reasons are as follows:

- D002 (corrosivity) does not apply to the use of hydrogen fluoride because there are no free liquids in the solid TRU waste.

- D003 (reactivity) does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution.

- P056 (fluorine), P078 (nitrogen dioxide) and P095 (phosgene) are not applicable to the listed TA-55 processes because of the manner in which these gases are used and discarded in the processes covered by this report.

- Hydrogen fluoride (U134) is listed in Appendix VIII of 40 CFR Part 261 for its corrosive and toxic characteristics. However, this code is not applicable to the manner in which this gas is used and discarded in the processes covered by this report.

3.6.3.3

*Metals*. The following metals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII of that regulation: bismuth, bismuth-tin alloy, calcium, copper wool, gallium (metal, oxide or salt), gold, lanthanides, lutetium, niobium +1 percent zirconium metal, platinum, platinum-rhodium alloy, tantalum (metal, alloy, oxide or salt), titanium, uranium powder (depleted), vanadium, and zirconium alloy.

Several metals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. The bullets below list the chemical name, its listed EPA HWN, the P/S codes in which the metal is used, and the applicability of the EPA HWNs for use of these metals in the TA-55 processes:

- Alkaline earth metals (D003) were used in P/S codes AC, AC1 and AC2; it is possible that one or more of these were pyrophoric. However, EPA HWN D003 does not apply to P/S codes AC, AC1, or AC2 because the metals are consumed or oxidized before discarding.

- Arsenic (D004) was used in P/S code PE between 1984 and 1985, and EPA HWN D004 is applicable to P/S code PE during this period.

- Cadmium (D006) applies to a limited number of anode heels produced in P/S codes ER, PX, and SS using cadmium as a solvent.

- Lead (D008) was used in P/S codes DOP, ER, KBTF, PX, and SS. For combustible debris waste, EPA HWN D008 is applicable to P/S codes DOP, KBTF, and PX. For P/S codes ER and SS, D008 is only applicable to the metal waste.

- Tin-lead (D008) solder was used in sensors in P/S code BT, but D008 is only applicable to the metal waste from this P/S code, and not to the combustible debris waste.

- Mercury (D009) applies to P/S code SSMD, in which it was used for about one week in the summer of 1994.

- Nickel powder was used in P/S code CO as a sintering aid. This metal is listed in Appendix VIII but no HWN is given.

- Sodium (D003) was used in P/S code EL. However, D003 does not apply in this case because excess Na is dissolved in Dowanol 80.

- Stainless steel (contains chromium, D007) was used in P/S code WE. However, EPA HWN D007 does not apply in this case. There is no potential to leach chromium because stainless steel is not exposed to strong acids in P/S code WE.

3.6.3.4

*Inorganic chemicals*. The following inorganic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: aluminum bifluoride, aluminum chloride, aluminum fluoride, aluminum nitrate, aluminum oxide, ammonium chloride, antimony pentafluoride, bromine, calcium carbonate, calcium chloride, calcium fluoride, calcium nitrate, cerium nitrate, cesium chloride, cobalt nitrate, dicesium hexachloroplutonate (DCHP), ferric ammonium sulfate hydrate, ferric nitrate, ferrous ammonium sulfate, ferrous chloride, ferrous sulfamate, FOOF, graphite, gypsum cement, hydrogen peroxide, hydroxylamine chloride, hydroxylamine hydrochloride, hydroxylamine nitrate, iodine, lanthanum nitrate, lithium chloride, magnesium chloride, magnesium oxide, magnesium perchlorate, molybdenum oxide, phosphates, Portland cement, potassium chloride, potassium fluoride, potassium permanganate, potassium thiocyanate, silicone lubricant, sodium bicarbonate, sodium carbonate, sodium chloride, sodium chlorite, sodium citrate retarder, sodium dithionate, sodium nitrate, sodium nitrite, sodium oxalate, sodium sulfate, sodium tetraborate, stannous chloride, thorium oxide, uranium oxide (depleted), zinc chloride, zinc stearate, and zirconium carbide. Some processes indicated the use of nitrate, chloride, carbonate, bicarbonate, oxalate, and nitrite salts of sodium, potassium, lithium, magnesium, calcium, and iron.

Several inorganic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 4 lists these chemicals, their HWN, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes:

**Table 5. Use of RCRA-Regulated Inorganic Chemicals in TA-55 Processes**

| Inorganic chemicals and P/S codes in which they were used | The following summarizes the applicability of RCRA D-listings and P-listings due to metals used in the processes: |
|---|---|
| Hydrogen peroxide | D001 (ignitability—oxidizer) and D003 (reactivity) do not apply to the use of hydrogen peroxide because there are no free liquids in the TRU solid waste |
| Lead hydroxide, oxide, or nitrate (P/S code AD) | D008 (lead) applies to P/S code AD. |
| Mercuric nitrate (P/S codes VP1 and VP3) | D009 (mercury) applies to P/S codes VP1 and VP3. Mercuric nitrate is used as a catalyst in P/S code VP1; the hydroxide cake produced in VP1 is processed in P/S code VP3. |
| Potassium dichromate (P/S codes AD, CS, CSE, DO, and SE) | D007 (chromium) applies to P/S codes AD, CS, CSE, DO, and SE because of the use of potassium dichromate as a titration endpoint indicator until end of 1993. The solution and precipitates were processed by hydroxide precipitation under the same codes. The chromium was incorporated as a contaminant in the hydroxide cakes. |
| Silver nitrate and other silver salts (P/S codes AC1, CPOD, CS, CSE, DO, SE) | D011 (silver) applies to P/S codes CW and CX due to the use of silver nitrate for chloride titrations under P/S codes CS, CSE and SE until 1993. The solution and precipitates were processed by hydroxide precipitation under P/S codes CW and CX.. Silver was incorporated as a contaminant in the hydroxide cakes.<br><br>D011 (silver) applies to P/S code CPOD due to the use of silver nitrate as a catalyst from 1990 to 1994. D011 (silver) applies to P/S code AC1 due to the use of silver salts. |
| Sodium chromate (P/S code PT) | D007 (chromium) applies to P/S code PT due to the use of sodium chromate in the separation of thorium from plutonium and americium. |
| Uranium nitride, depleted (P/S code FF) | D003 (reactivity) does not apply to the use of uranium nitride in P/S code FF. Although this chemical is pyrophoric, its disposal in an oxidizing environment eliminates this characteristic because it is converted to uranium oxide. Uranium nitride is oxidized in the passivation furnace (P/S code PA) prior to discard. |
| Vanadium pentoxide (P/S code SS) | P120 (vanadium pentoxide) applies to waste generated under P/S code SD from February to March 1998, and under P/S code SS from May 27, 1998 to June 10, 1998. |

3.6.3.5

*Organic chemicals.* The following organic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, acetonitrile, alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, Citrapeel, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), diethyl oxalate, dihexyl n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), diisopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride, ion exchange resin, isopropanol, kerosene, Metalprep 79 (phosphoric acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl diisobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, organicstrip, perchlorocarbons, phenolphthalein, phosphate buffer solution, phosphine oxide, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 5 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

TA-55-19A is a subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which is expected to consist of only a few drums, is identical to the rest of the waste stream except for the possibility that the drums may contain vanadium pentoxide (EPA HWN P120), which was used only between 02/01/98 and 06/10/98 in two specific P/S codes.

TA-55-19A is not fully defined in the sense that a list of specific waste containers in this lot has not yet been prepared. This is because P/S codes are not always explicitly identified for waste items in TA-55 waste containers. However, the possibility of extracting this information from the waste item identifiers is being evaluated. If successful, this action will permit a listing of waste containers assigned to TA-55-19A.

## Table 5. Use of RCRA-Regulated Organic Chemicals in TA-55 Processes

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Acetone (P/S codes FF, ME, and MOX) | • F003 applies to P/S code ME because it may have been used in the glovebox for cleaning.<br>• F003 does not apply to P/S code FF or MOX because it was only used outside the glovebox. |
| Benzene (P/S codes AC, AC1, AC2, and SA) | • D018 (benzene) applies to P/S codes AC, AC1, AC2, and SA<br>• F005 applies to P/S codes AC, AC1, AC2, and SA, in which benzene was used as a solvent |
| Carbon tetrachloride (P/S codes AD, CV, PTP, and PX) | • D019 (carbon tetrachloride) applies to P/S codes AD, CV, PTP and PX. This chemical was used in PTP between 1/87 and 6/89.<br>• F002 does not apply to P/S codes AD, CV, PTP, or PX because it was not used as a solvent or for degreasing. |
| Chloroform (P/S codes AC, AC1, AC2, APD, FF, and XO) | • D022 (chloroform) applies to P/S codes AC, AC1, AC2, APD, FF and XO. Concentrations in P/S code FF are expected to be below RCRA threshold because freeze-drying should have removed most, if not all, of the residual chloroform before the microspheres were taken into the glovebox for sintering. |
| Diethyl ether (P/S code SA) | • F003 applies to P/S code SA because of solvent use. |
| Freon and Freon TF (P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | • F002 applies to P/S codes DA, MA and XO.<br>• F002 does not apply to P/S codes CA, MW, PD, SCB, SRL, UA, VD and WE. Although Freon TF is used as a solvent to clean metal parts, the parts are routinely air-dried to avoid the need for cellulosic wipes.<br>• F002 does not apply to P/S code PF because Freon was used as a coolant for a cutting saw. |
| Methanol (P/S codes AD and SO) | • F003 applies to P/S code AD because it may have been used for cleaning inside the glovebox.<br>• F003 does not apply to P/S code SO because it was used in a cold trap outside the glovebox. |
| Methylene chloride (P/S code AC1) | • F002 applies to P/S code AC1 because this chemical was used as a solvent (MA) and a paint stripper (XO). |
| Methyl ethyl ketone (P/S codes MA and XO) | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO.<br>• F005 applies to P/S codes MA and XO, in which methyl ethyl ketone was used as a solvent (MA) and paint stripper (XO). |
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA<br>• F005 applies to P/S codes AC, AC2 and SA, in which pyridine was used as solvent. |
| Tap Magic (contains 1,1,1 trichloroethane) (P/S code MA) | • F002 does not apply to P/S code MA because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

Waste Streams TA-55-19 and TA-55-20 have been discussed together in this AK Summary Report. These waste streams are similar in physical form and waste material content. They differ only in that TA-55-19 is assigned EPA HWNs based on P/S code information, whereas TA-55-20 contains non-mixed waste. Other waste streams resulting from the same plutonium processing activities at TA-55 but differing in physical form and waste matrix code are listed in the Sampling Plan. These include waste streams for more specific types of waste, such as metal debris, glass, graphite, HEPA filters, and cemented waste, as well as less specific waste streams such as combustible/noncombustible debris.

new TP

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

The waste matrix code S5300 is assigned to the waste streams TA-55-19 and TA-55-20 based on waste generation practices described in the TA-55 Waste Management Procedure, 1996 (TWCP-351), description of past segregation practices (TWCP-701, Section 2.1, page 4 of 43), and TA-55 process AK reports (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007). A more detailed waste matrix code can not be assigned to the TA-55-19 and TA-55-20 waste streams because TA-55 waste management personnel did not segregate plastic waste from cellulosic waste.

The following codes also apply to waste streams TA-55-19 and TA-55-20 from the Transuranic Waste Baseline Inventory Report (TWBIR), the TRUPACT II Content Code (TRUCON) (DOE/WIPP-89-004/Rev.13), the Radioactive Solid Waste Disposal (RSWD), and the Item Description Code (IDC) (Sampling Plan).

- TWBIR LA-M16 (TA-55-19) and LA-T16 (TA-55-20)
- TRUCON LA 116A, LA 116B, LA 116C, LA 116D, LA 116E, LA 116F, LA 116H, LA 116I
- RSWD A14, A15, A16, A17, A18, A60
- IDC 004 (combustible waste)

Insert new beginning from Section 3.6.1 (First sentence, plus 4 bullets)

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

The following waste material parameter codes are assigned to waste streams TA-55-19 and TA-55-20 based on (1) waste generation practices described in the TA-55 Waste Management Procedures (see Section 3.2); ~~(2) TA-55 process AK reports (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007); and (3)~~ WIPP-compliant waste characterization data from real-time radiography and visual examinations (Section 14).

(wmp)

this information and knowledge of

These ~~WPCs~~ wmp codes have been verified with

- Cellulosics
- Plastics (waste materials)
- Rubber
- Steel (packaging materials)

move this sentence to end of bullets (top of next page)

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses for containers assigned to waste stream TA-55-19 (Section 14.4).

8.2 Toxicity Listings

Both TA-55-19 and TA-55-19A are conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040.

TA-55-20 has no D listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DOP, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD.

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

| | |
|---|---|
| AC | D007, D009, D011, D018, D022, D038 |
| AC1 | D007, D009, D011, D018, D022 |
| AC2 | D007, D009, D011, D018, D022, D038 |
| ACD | D005, D006, D007, D008, D011 |
| ACL | D007, D009 |
| AD | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039 |
| AL | D005, D006, D007, D008, D011 |
| AP | D007, D009 |
| APD | D007, D008, D009, D019, D021, D022, D039 |
| AS | D006, D007, D008, D011 |
| AT | D005, D006, D007, D008, D011 |
| ATL | D005, D006, D007, D008, D011 |
| AX | D007, D009 |

move AD up to line up with codes

| | |
|---|---|
| SC | D005, D006, D007, D008, D011 |
| SE | D007, D008, D009, D039 |
| SL | D005, D006, D007, D008, D011 |
| SO | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | D007 |
| SS | D006, D008 |
| SSD | D006, D007, D008 |
| SSMD | D009 (D listing applies only from 06/94 to 08/94) |
| STF | D007 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1, VP3 | D009 (D listing applies only from 09/85 to 10/85) |
| VU, VUL | D005, D008 |
| WM, X0, XO | D007, D008, D009, D022, D035, D040 (assigned in order to be conservative, *Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004,R.2, Section 3.4.9)) |
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

These HWNs are ~~These RCRA codes~~

as discussed in

Make this a NOTE:

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." The waste streams covered by this AK report have no listings for corrosivity, reactivity, or ignitability. Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests (see Attachment 5), introduced in June 1980, included check boxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachment for TA-55 (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF (see Attachment 4, pp. 4 and 5) documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or

materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in waste, explosives were altogether prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. In case of a misfire or unconsumed explosives, a procedure is in place at TA-55 to ensure that explosives do not enter the waste stream (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

Controls have also been in place to ensure the exclusion of ignitable constituents. D001 does not apply to wastes in these waste streams despite the use of spent non-halogenated solvents (HWN F003), for the following reasons:

- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu.

- If above the DL, the solutions are sent to aqueous processes as part of chloride or nitrate operations. Aqueous recovery steps include dissolution of any solid Pu in hydrochloric or nitric acid, followed by Pu recovery by ion exchange. The solutions are then below the DL and are either sent to the RLWTF or to the evaporator.

- Rags that are above the DL for Pu are thermally decomposed, which destroys any organic component.

- Rags that are below the DL for Pu are discarded as combustible debris, but headspace gas analyses support the contention that the solvents are not present in the waste at levels of concern (Section 14.~~0~~ .4).

- Finally, 100 percent of the drums are subjected to headspace gas analysis, and drums showing over 500 ppm total flammable VOCs are prohibited from being shipped to WIPP. (For comparison, the explosive limit for acetone by itself is 25,000 ppm.)

This limit is quite conservative.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed onto kitty litter (vermiculite) and discarded in an appropriate waste stream and containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the TRUPACT-II. Section 9.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste items specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from TA-55. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

A chemical compatibility analysis was performed for TRUCON codes 116/216 (combustible waste) which indicated that all chemicals and the waste matrix were compatible at levels greater than trace amounts (*Content Code Assessments for LANL TRUCON Codes* [DOE/WIPP-89-004]). During the process AK search, ~~additional~~ chemicals were identified ~~and are listed in Section 3.6.3~~, a new compatibility analysis ~~is underway, but since~~ these additional chemicals are only present at trace quantities in the TA-55-19 and TA-55-20 waste streams, no incompatibilities ~~should~~ exist.

## 11.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005, R.2, Section 9.0). This oil does not enter the LANL disposal operations.

## 13.0 DETERMINATION OF THE MAXIMUM NUMBER OF CONFINEMENT LAYERS PERMITTED FOR WASTE PACKAGING

Waste streams TA-55-19 and TA-55-20 are primarily generated from operations performed in gloveboxes. The waste material is placed directly into bag-out bags (also called inner bags) through an opening in the glovebox where the bag is attached, and the bag is then closed and detached from the glovebox. Waste streams TA-55-19 and TA-55-20 may also be generated from "hot jobs" outside of the glovebox, such as valve changes, or from decontamination of spills or other releases. In these cases, the waste is placed directly into one (or possibly more) inner bags at the work area. The maximum number of confinement layers in any case is six (TWCP-816). This upper limit has been confirmed ~~by~~ by RTR and VE data (section 14).

A minor source of waste streams TA-55-19 and TA-55-20 is room trash that was originally considered low-level waste, which is collected in plastic bags inside cardboard boxes. Occasionally, when assayed, these boxes are determined to be TRU waste. These boxes may be sorted to remove the "hot" item, or the whole box may be bagged and sent to the TRU packaging area for placement in drums containing waste streams TA-55-19 or TA-55-20, as appropriate. When this occurs, the P/S code WM is assigned to the waste. Due to the additional layers of plastic that are present when this operation occurs, drums with the P/S code WM are assumed to contain up to two more layers of internal packaging than other drums.

Waste drum packaging procedures for waste streams TA-55-19 and TA-55-20 have gone through several changes since the beginning of operations at TA-55. TRUCON Code assignments made by the waste generator are compiled in the Sampling Plan. However, in the absence of this information, TRUCON codes will be assigned to the waste container in accordance with the default packaging configurations and associated TRUCON codes shown in Table 6, that reflect the packaging protocols in effect during different periods of time at TA-55 (TWCP-816).

**Table ~~X~~ 7 Maximum Layers of Confinement for be Used for TA-55-19 and TA-55-20 Waste Containers in the Absence of More Specific Waste Characterization Data**

| Time Frame | P/S Code | Layers of Confinement* | TRUCON Code |
|---|---|---|---|

AK information has been compared with visual examination data for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). In two cases, the number of layers of packaging observed during visual examination was greater than the number of layers reported by the waste generator, and an incorrect TRUCON code was assigned by the waste generator. It is possible that the extra plastic layers were breached (i.e., these were confining layers) but that the VE inspection did not catch this detail. However, the conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution. Consequently, the most conservative TRUCON code will be assigned to each waste container in waste streams TA-55-19 and TA-55-20, in accordance with the following guidance:

a) ~~Continue to use~~ default TRUCON codes from Table will be assigned if the waste generator has not assigned a TRUCON code.

b) The TRUCON code assigned by the waste generator will be used only if it has been positively confirmed by RTR or VE data.

c) If no VE data are available, and if the RTR data are indeterminate, then the default TRUCON code will be assigned to the container.

This guidance only applies to retrievably stored waste. It is assumed that newly generated waste packaged under procedures approved by TWCP and CBFO will be assigned correct TRUCON codes.

## 14.0 CONFIRMATION OF AK INFORMATION FOR WASTE STREAM

Characterization data acquired by WAP-compliant ~~TWCP~~ activities provide a means to judge the reliability of AK information. Radiography, radioassay, and headspace gas analysis are conducted on all retrievably stored containers of debris waste, and VE is being conducted on 50 containers from waste streams TA-55-19 and TA-55-20. Relevant aspects of the data produced by these activities are summarized in the sections below, focusing on the extent to which the data confirm AK information and identifying aspects for which additional AK documentation or research may be warranted.

### 14.1 Radiography Data

Radiography data are examined to confirm AK information about WMC assignments, layers of packaging, absence of prohibited items, and the relative volumes or weights of waste matrix parameters for a waste stream. The WMC for waste streams TA-55-19 and TA-55-20 is S5300 (combustible debris). Thus far, 265 containers, or about 6 percent of the 4454 containers in these two waste streams (Sampling Plan, Revision 3), have undergone RTR, with the data contained in WIPP-compliant batch data reports. The following observations are made from an examination of these data, as summarized in Table

8 waste characteristics

**Table X. RTR data for waste streams TA-55-19 and TA-55-20**

| Evaluated waste characteristic | Number of drums | | | |
|---|---|---|---|---|
| WIPP-compliant RTR data | | | | |
| • TA-55-19 | 245 | out of | 4173 | 6% of waste stream |
| • TA-55-20 | 20 | out of | 281 | 7% of waste stream |
| WMC discrepancies | | | | |
| • TA-55-19 | 3 | out of | 245 | 1% of drums examined |
| • TA-55-20 | 0 | out of | 20 | 0% of drums examined |
| *Excluding drums with confirmed WMC discrepancy* | | | | |
| Free liquids (no PWR required; all <1" of container or 1% of drum) | 34 | out of | 262 | 13 % of drums examined |
| Sealed containers > 4L (PWR required) | 31 | out of | 262 | 13 % of drums examined |
| Pressurized containers | 0 | out of | 262 | 0 % of drums examined |
| Leaded gloves | 13 | out of | 262 | 5 % of drums examined |
| Unpunctured liner | 0 | out of | 262 | 0 % of drums examined |
| Other prohibited items | 0 | out of | 262 | 0 % of drums examined |
| *Excluding drums with PWRs* | | | | |
| Number of layers ← Indeterminant | Metal / Plastic / Drums | | | |
| | 0 / Indeter / 109 | | Indeterminant due to number of plastic horsetails: | |
| | 1 / Indeter / 2 | | | |
| | Subtotal / 111 | | out of 231 | 48% of drums |
| Less than or equal to 1 | 0 / 1 / 2 | | out of 231 | 1% of drums |
| Less than or equal to 2 | 0 / 2 / 21 | | out of 231 | 9% of drums |
| Less than or equal to 3 | 0 / 3 / 95 | | out of 231 | 41% of drums |
| Less than or equal to 4 | 1 / 3 / 2 | | out of 231 | 1% of drums |
| Less than or equal to 5 | None observed / 0 | | out of 231 | 0% of drums |
| Less than or equal to 6 | None observed / 0 | | out of 231 | 0% of drums |
| Proportion of combustible waste in drum (weight %) | | | | |
| • Less than 25% | 0 | out of | 231 | 0 % of drums examined |
| • 25 to 50% | 1 | out of | 231 | < 1 % of drums examined |
| • 50 to 75% | 7 | out of | 231 | 3 % of drums examined |
| • More than 75% | 223 | out of | 231 | 97 % of drums examined |

Put in separate table to clarify presentation

006
007
008 – 4797
009
013

same footnote for Table 9.

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4835; RTR batch data reports still in Project-level review: LA01-RTR-006, LA01-RTR-007, LA01-RTR-008, LA01-RTR-009, LA01-RTR-013.

Check if any of these are closed now

New Table 9. RTR packaging data for waste streams TA-55-19 and TA-55-20

| Maximum number of layers | Metal layers | Plastic layers | No. of drums | % of total examined |
|---|---|---|---|---|
| 1 | 0 | 1 | 2 | 1 % |
| 2 | 0 | 2 | 21 | 9 |
| ↓ | ↓ | ↓ | 95 | 41 |
| 6 | None observed | | 8 | 0 |
| Indeterminant | 0 | 1 | | 48 |

- confirmation of WMC S5300 for 98.9 percent of the drums examined
- identification of WMC discrepancies for 3 containers (1.1 percent of the drums examined), which must be reassigned to other waste streams
- identification of potentially sealed containers > 4 liters in 13 percent of the drums, for which PWRs were submitted
- confirmation of the absence of any other prohibited item or condition requiring a PWR
- confirmation of 4 or fewer packaging layers for 52 percent of the drums. Plastic packaging layers for the remaining 48 percent were indeterminate due to the large amount of horsetails present in the drums

(B)

13 – 4190
25 - 3291
26 - 3290
27 - 3289
28 - 3288

- confirmation of the waste stream description:
- 97 percent of the drums contain more than 75 wt percent combustible waste;
- 86 percent of the drums contain less than 5 wt percent metal waste, and 94 percent contain less than 10 wt percent metal waste.

Changes in waste stream assignment because of characterization data are documented in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-2.1-064).

NCRs should be listed on AK Roadmap

AK information resolved an apparent WMC discrepancy for several drums in waste stream TA-55-19 which contained material identified as metal by the RTR operator, thereby leading to an apparent WMC of S5110 (for metal debris) (NCR-00-013, NCR-00-025, NCR-00-026, NCR-00-027, NCR-00-028). After reviewing with the generator how these drums were packaged, the generator determined that these drums were packaged with very dense in-house fabricated plastic material (Kynar, also known as PVDF) used to line gloveboxes and build equipment in chloride operations starting in about 1988. Hence, the WMC S5300 was correct.

↑ AK

14.2 Visual Examination Data

VE data are used to confirm AK information on waste stream descriptions, WMC, the absence of prohibited items, the number and type of confining layers, and the relative volumes and weights of waste matrix parameters. AK packaging and WMC information have been evaluated by VE for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). These 22 drums were packaged between 11/85 and 8/97 (Sampling Plan). P/S codes are available for the waste items packaged in these drums, as documented in radioassay batch data reports (TWCP-4024, TWCP-4025, TWCP-4052, TWCP-

Add to Section 15 (References)

→ Appendix D).

4158, TWCP-4303) and waste generator records. (The codes for these drums are listed in Table 8, which is discussed in section 14.3). VE results are summarized in Table 8, from which the following observations are made:

- VE confirmed the AK WMC for all of these drums, reporting WMC S5300 for 8 drums, and S5310 for 14 drums.

- The maximum number of confining layers observed by VE was five (for one drum), consistent with AK information indicating that the number of layers is six or less (TWCP-816; also Table 7 of this report).

**NOTE:** RTR data for the number of plastic layers in this particular drum were indeterminate.

- No closed liners were found by VE, which confirmed AK and RTR information.

- For 5 drums, the number of confining layers observed during VE (2 to 4) was greater than the number of layers associated with the TRUCON code assigned for these drums by the waste generator (LA116C, 1 layer).

- For 4 of the above drums, the default AK value (LA116E, 1 layer) would also have been less conservative than the VE findings. All 4 had been packaged after January 1997 such that no more than 1 layer was expected (Table 6).

A conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution, at least with respect to waste containers packaged in 1997 when TA-55 personnel were transitioning from one packaging procedure to another. Additional investigation is needed to remedy this discrepancy in reporting packaging layers.

14.3 Radioassay Data

Radioassay data are examined to confirm AK information on plutonium material type and mass, the presence of other radionuclides contributing to the total drum activity, and evidence for fractionation of other actinides (e.g., uranium, americium) relative to plutonium during material processing. Table 9 summarizes information relevant to these evaluations for the 22 drums from TA-55-19 and TA-55-20 that have undergone VE. These data confirm the following AK information:

- the dominant isotope in all drums is Pu239

- the material type is MT52 or MT53 for all drums

**Table 8. VE data for waste streams TA-55-19 and TA-55-20**

| Characterization data | Number of containers | | | | Comments |
|---|---|---|---|---|---|
| | AK (see Note 1) | | RTR | VE | |
| Waste Matrix Code | | | | | |
| S5000 | — | | — | — | Positive confirmation of AK WMC by RTR and VE for all 22 drums |
| S5300 | 22 | | 22 | 8 | |
| S5310 | — | | — | 14 | |
| Maximum # of layers and associated TRUCON codes | Default from Table | Assigned in SP | See Note 2 | | Number of confining layers<br>• AK and VE match for 3 drums<br>• AK more conservative than VE for 14 drums<br>• AK from waste generator was less conservative than VE for 5 drums |
| | 6 | | | — | |
| 0 LA116G | — | — | | 2 | |
| 1 LA116C, E, F | — | 6 | | 2 | |
| 2 LA116B, D | — | — | | 9 | |
| 3 None | — | — | | 8 | |
| 4 LA116A | 4 | 4 | | 1 | |
| 5 LA116H | — | — | | — | |
| 6 LA116I | 8 | — | | | |

SP—Sampling Plan (Rev 3)

need to line up rows

Notes:

1. AK information for WMC and TRUCON code assignments is from the Sampling Plan, Rev 3. If no TRUCON code was assigned, then the default code was determined from Table 6 using AK information on packaging dates and P/S codes as documented in the Sampling Plan.
2. RTR data indicated no metal packaging layers for any of these drums, which was consistent with AK information and confirmed by VE. The number of plastic packaging layers was indeterminate by RTR except for one drum with three layers, which was consistent with the default TRUCON code and confirmed by VE (TWCP-4393).

Data sources: VE batch data reports TWCP-3947, 3948, 3949, 3950, 3951, 4022, 4326, 4327, 4392, 4393, 4394, 4427; VE batch data reports still in Project-level review: LA00-3.4.1-005, LA00-3.4.1-006, LA01-VE-001, LA01-VE-002, LA01-VE-004, LA01-VE-005.

Attachment Check if any closed yet — Friday?

**Table X. Radioassay Data for Waste Streams TA-55-19 and TA-55-20**

| Radionuclide Characteristics | Number of drums | Comments |
|---|---|---|
| Pu isotopic fractions | | Dominant isotope is Pu239 in all drums |
| • Pu238 / total Pu | 22 | 0.010 to 0.069 |
| • Pu239 / total Pu | 22 | 0.911 to 0.941 |
| • Pu240 / total Pu | 22 | 0.057 to 0.085 |
| • Pu241 / total Pu | 22 | 0.14 to 0.32 |
| • Pu242 / total Pu | 22 | 0.009 to 0.055 |
| Material type | | |
| • MT52 | 19 | |
| • MT53 | 2 | |
| • MT52/53 mix | 1 | |
| Total Pu mass, expressed as ratio of AK data to NDA data | | AK data from Sampling Plan (Rev 3)<br>AK/NDA ratios range from 0.6 to 1.4 |
| • AK/NDA < 0.7 | 1 | |
| • 0.7 < AK/NDA < 1.3 | 17 | |
| • AK/NDA > 1.3 | 4 | |
| Other actinides present at detectable levels (uncertainties ≤ 21.5%)* | | *Range of ratios of nuclide to total Pu*<br>Measured ratios / Calculated upper bound (Table 6) |
| • Am241 | 22 | $1 \times 10^{-3}$ to $9 \times 10^{-3}$ / $2 \times 10^{-3}$ to $3 \times 10^{-5}$ |
| • Am243 (uncertainty ≤ 21.5%) | 22 | $4 \times 10^{-7}$ to $4 \times 10^{-6}$ / Not applicable |
| • Np237 (uncertainty ≤ 21.5%) | 22 | $2 \times 10^{-4}$ to $1 \times 10^{-2}$ / Not applicable |
| • U234 | 21 | $7 \times 10^{-3}$ to $6 \times 10^{-2}$ / $2 \times 10^{-5}$ to $2 \times 10^{-5}$ |
| • U235 | 5 | $3 \times 10^{-3}$ to $5 \times 10^{-2}$ / $9 \times 10^{-4}$ to $1 \times 10^{-3}$ |
| • U238 | 0 | No measurable U238 / Not applicable |
| Other radionuclides present at detectable levels (uncertainties ≤ 21.5%)* | | Note Th232 is not detectable by the methods used |
| • Cs137 | 16 | |
| • Pa231 (uncertainty < 21.5%)* | ~~12~~ 9 | |
| • No other detectable nuclides | 2 | |
| Ratio of measured ratio (Am241/Total Pu) to calculated upper bound (0.002, Table X) | 2 | |
| • Ratio < 1 | 2 | Am241 could be from decay of Pu241 |
| • 1 < ratio < 2 | 7 | Process waste probably enriched in Am241 |
| • 2 < ratio < 3 | 7 | Process waste enriched in Am241 |
| • Ratio > 3 | 6 | Process waste enriched in Am241 |
| P/S codes for waste items present in these drums. The number of drums containing waste items from each code is given in parentheses, if more than one. (TWCP-5086) | | |
| • Chloride operations | CSE, CW, CX (3), CXL (7), MB, MS | |
| • Metal operations | CA (2), FF, MA, MW, PH, SRL | |
| • Miscellaneous operations | AD (2), CV, IB (5), ME, WM (3), XP | |
| • Nitrate operations | ATL, BM (4), COD, DS (3), ED (7), EV (4), HCD, LR (4), MAG, NC (6), NL (2), OD, PR (2), RBJ, RR (2), SC (8), SP (4), SSD | |
| • Pyrochemical operations | ER (3), MO, OR (3), SS (3) | |
| • Special processing | None | |

June – ask Hanna about S drums
P/S codes in Otherwise cite FRAM BDR

NDA—nondestructive assay
Data sources: Radioassay batch data reports TWCP-4009, 4023, 4024, 4025, 4052, 4078, 4158, 4159, 4212, 4225, 4226, 4303; ~~and Sampling Plan (Rev 2)~~ ~~TWCP-5086~~ ~~TWCP-2130~~.

* The rationale for this MDL cutoff (21.5% uncertainty) is given in TWCP-2130.

- all these drums qualify as ~~(containing)~~ TRU waste

- AK information on total mass of Pu in each drum is within 30 percent of the TWCP assay value for 17 drums (77 percent). AK mass for the remaining five drums (23 percent) is within 40 percent of the TWCP assay value.

- As indicated by AK information, all drums contain low but detectable quantities of Am-241, Am-243, and Np-237. A significant proportion also contains Cs-137 and Pa-241.
- No U-236 or U-238 was detected, confirming AK information that uranium is not expected to be present in process waste generated under the P/S codes listed as the source of waste in these drums

- U-235 is present only at trace levels in 5 drums

- In 20 drums (91 percent), Am-241 and U-234 are enriched beyond what would be predicted if they were present solely due to the decay of their precursors in the source Pu, indicating that significant fractionation of Am and U from Pu occurs during processing operations

14.4 Headspace Gas Data

Headspace gas data are examined to confirm AK information about the presence or absence of hazardous constituents in a given waste stream, and the assignment of each drum to the appropriate mixed or nonmixed waste stream. Table 10 summarizes VOC target analyte concentrations for headspace gas samples from 55 containers assigned to waste stream TA-55-19. (No approved data are yet available for drums from waste stream TA-55-20.) These data confirm the AK information:

- Altogether, 13 different VOCs were detected in these drums. All are documented as having been present or used in TA-55 processes contributing to waste stream TA-55-19, and HWNs have already been assigned to this waste stream for these constituents.

- Only one VOC, methylene chloride, had a 90% Upper Concentration Limit ($UCL_{90}$) value that was above its program required quantitation limit (PRQL).

- Four VOCs—acetone, 1,1,2-trichloro-1,2,2-trifluoroethane, methyl ethyl ketone, and toluene—had $UCL_{90}$ values below the PRQL but were present in at least one drum at a concentration above the PRQL.

- One VOC (methanol) had a mean concentration above its Method Detection Limit (MDL) but no concentrations above the PRQL.

switch rows to keep in alphabetical order

merge 2 cells

**Table 10. Headspace Gas Data for Target Analytes in Waste Stream TA-55-19**

| ANALYTE | MDL, ppmv | PRQL, ppmv | No. of Samples analyzed | No. of samples above MDL | No. of samples above PRQL | VOC concentrations, in ppmv | | | Applicable EPA HWN | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | $UCL_{90}$* | Maximum | Based on HGAS data | assigned based on AK |
| Benzene | 1.96 | 10 | 55 | 4 | 0 | 1.2 | 1.8 | 5 | — | F005, D018 |
| Bromoform | 2.27 | 10 | 55 | 0 | 0 | 1.1 | 1.1 | — | — | — |
| Carbon Tetrachloride | 2.00 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 3 | — | D019 |
| Chlorobenzene | 1.93 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 2 | — | F002, D021 |
| Chloroform | 1.85 | 10 | 55 | 4 | 0 | 1.0 | 1.4 | 3 | — | D022 |
| 1,1-Dichloroethane | 1.78 | 10 | 55 | 2 | 0 | 1.0 | 1.9 | 4 | — | — |
| 1,2-Dichloroethane | 2.40 | 10 | 55 | 0 | 0 | 1.2 | 1.2 | — | — | — |
| 1,1-Dichloroethene | 2.74 | 10 | 55 | 0 | 0 | 1.4 | 1.4 | — | — | — |
| Cis-1,2-Dichloroethylene | 2.06 | 10 | 55 | 0 | 0 | 1.0 | 1.0 | — | — | — |
| Ethyl Ether | 1.30 | 10 | 55 | 0 | 0 | 0.65 | 0.65 | — | — | F003 |
| Ethyl Benzene | 1.72 | 10 | 55 | 0 | 0 | 0.9 | 0.9 | — | — | F003 |
| Methylene Chloride | 1.97 | 10 | 55 | 11 | 8 | 8.7 | 18.1 | 100 | F002 | F002 |
| 1,1,2,2-Tetrachloroethane | 1.62 | 10 | 55 | 0 | 0 | 0.8 | 0.8 | — | — | — |
| Tetrachloroethene | 1.44 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | — | — | F002, D039 |
| Toluene | 1.67 | 10 | 55 | 33 | 11 | 6.5 | 8.5 | 51 | — | F005 |
| 1,1,2-Trichloro 1,2,2-trifluoroethane (Freon-113) | 1.79 | 10 | 55 | 1 | 1 | 1.7 | 1.7 | 44 | — | F002 |
| 1,1,1-Trichloroethane | 1.82 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 4 | — | — |
| Trichloroethene | 1.31 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | 6.0 | — | F002, D040 |
| m-Xylene and p-xylene | 3.62 | 10 | 55 | 0 | 0 | 1.8 | 1.8 | — | — | F003 |
| o-Xylene | 1.90 | 10 | 55 | 0 | 0 | 0.95 | 0.95 | — | — | F003 |
| Acetone | 16.12 | 100 | 55 | 31 | 13 | 69.7 | 91.2 | 410 | — | F003 |
| Butanol | 8.78 | 100 | 55 | 1 | 0 | 4.8 | 4.8 | 29 | — | F003 |
| Methanol | 11.42 | 100 | 55 | 10 | 0 | 14.6 | 24.3 | 84 | — | F003 |
| Methyl ethyl ketone | 18.42 | 100 | 55 | 4 | 0 | 10.1 | 12.6 | 23 | — | F005, D035 |
| Methyl isobutyl ketone | 16.05 | 100 | 55 | 0 | 0 | 8.0 | 8.0 | — | — | — |

Source: TWCP-4722; VOC target analyte list for debris waste from WIPP WAP, Table B3-2.

ppmv, part per million by volume; MDL, Method Detection Limit; UCL90, 90% Upper Concentration Limit

— Not applicable

* For samples with concentrations below the MDL, $UCL_{90}$ concentrations are calculated by assuming concentrations were half of the MDL values as determined in the MDL study dated 6/19/00 (TWCP-3248).

Delete this column

- Seven VOCs had mean concentrations below their MDL, but were present in at least one drum at a concentration above the MDL.
- All other target analyte VOCs were below the MDL.
- No Tentatively Identified Compounds (TICs) were detected.

These results are consistent with AK information summarized in this waste stream report, insofar as all of the VOCs that were detected are known to have been present in TA-55 operations. The data confirm that assignment of these HWNs based on AK information is conservative.

Table 11 summarizes concentrations of potentially flammable VOCs, hydrogen, and methane for headspace gas samples from the same 55 containers as are included in Table 10. All were below the WAC limits. The average concentration of potentially flammable VOCs for this set of 55 drums was 128 ±101 ppm ppmv, with a maximum of 473 ppm (TWCP-4722). No methane was detected in any of the drums, and hydrogen concentrations were lower by more than an order of magnitude than the WAC limit of 5 percent.

In conclusion, the headspace gas data confirm the presence of VOCs in waste stream TA-55-19; no VOCs were present which were not expected based on AK. However, no correlation is seen between the presence and absence of a specific VOC and its documented use in a process known to have contributed waste placed in a particular drum. For example, about 60 percent of the containers show measurable concentrations of acetone and/or toluene in the headspace gas, and 20 percent contain methylene chloride, but less than half of the drums in which these chemicals are present contain waste items generated by activities that were known to have used these chemicals. Radiolytic production of VOCs is a possible explanation, but additional AK investigation is needed to verify that a waste generator source of these VOCs has not been overlooked.

## 15.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, Segregation of hazardous materials
- Nonconformance Reporting and Tracking (TWCP-QP-1.1-007)
- *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004)
- Acceptable Knowledge Documentation (TWCP-QP-1.1-021)
- Reconciliation of Visual Examination and Radiography Information (TWCP-QP-1.1-028)

italics

ital.

13

**Table V. Headspace Gas Data For Flammable VOCs, Hydrogen and Methane in Waste Stream TA-55-19**

Gas

| ANALYTE | Lower Explosive Limit (LEL) | No. of Samples analyzed | No. of samples above MDL | Maximum measured concentration (ppmv) | Evidence for presence of gas in waste | |
|---|---|---|---|---|---|---|
| | | | | | ~~HGAS~~ data | AK |
| Acetone | 2.5% | 55 | 31 | 410 | X | X |
| Benzene | 1.2% | 55 | 4 | 5 | X | X |
| Butanol | 1.4% | 55 | 1 | 29 | X | X |
| Chlorobenzene | 1.3% | 55 | 1 | 2 | X | X |
| Cyclohexane | 1.3% | 55 | 0 | — | — | — |
| 1,1-Dichloroethane | 5.4% | 55 | 2 | 4 | X | — |
| 1,2-Dichloroethane | 6.2% | 55 | 0 | — | — | — |
| 1,1-Dichloroethene | 6.5% | 55 | 0 | — | — | X |
| Cis-1,2-Dichloroethylene | 5.6% | 55 | 0 | — | — | — |
| Ethyl Ether | 1.9% | 55 | 0 | — | — | X |
| Ethyl Benzene | 0.8% | 55 | 0 | — | — | X |
| Methanol | 6.0% | 55 | 10 | 84 | X | X |
| Methyl ethyl ketone | 1.4% at 200 °F | 55 | 4 | 23 | X | X |
| Methyl isobutyl ketone | 1.2% at 200 °F | 55 | 0 | — | — | — |
| Toluene | 1.1% | 55 | 33 | 51 | X | X |
| 1,3,5-Trimethylbenzene | Not known | 55 | 0 | — | — | — |
| 1,2,4-Trimethylbenzene | 0.9% | 55 | 0 | — | — | — |
| m-Xylene and p-xylene | 1.1% | 55 | 0 | — | — | X |
| o-Xylene | 0.9% | 55 | 0 | — | — | X |
| **Total potentially flammable VOCs in a single container*** | — | **55** | — | **473** | **X** | **X** |
| Hydrogen* | 4% | 55 | 32 | 0.38% | X | X |
| Methane* | 5.3% | 55 | 0 | — | — | X |

Switch rows

Source: TWCP-4722

ppmv, part per million by volume; MDL, Method Detection Limit

LEL, Lower explosive (flammable) limit in air, % by volume (at room temperature); data from NIOSH Pocket Guide to Chemical Hazards (TWCP-____)

— Not applicable or not ~~detected~~

* WAC requirements state that a waste container cannot be shipped if its headspace gas concentration exceeds 500 ppm for total flammable VOCs, 5% for hydrogen, or 500 ppm for methane concentration.

** The average flammable VOC concentration is 128 ±101 ppm (TWCP-4722). Gases that were below detection are taken into account in this calculation by assuming they are present at concentrations that are equal to half of the MDL values

- *Waste Analysis Plan, to the Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088, Attachment B)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)
- Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste (EPA)

Don't know full reference. Delete sentence from text (page 1) if we can't find it. Check QP-21 references

## ACCEPTABLE KNOWLEDGE ROADMAP

Add 5 NCRs from Section 14.3

Waste Stream: TA-55-19 and TA-55-20.

Documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3 | LA00-3.4.1-006 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-001 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-002 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-004 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-003 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by P/S code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-2130 | D | Estimate of the minimum detection limit for Am-243, Np-237, Pa-231, and Th-232 for FRAM analyses | Criteria for reporting Am-243, Np-237, Pa-231, and Th-232 on mobile PAN radioassay data sheets | If the error in the peak area for the isotopes Am-243, Np-237, Pa-231, and Th-232 is greater than 21.5% in the FRAM report, then that isotope is considered to be below the minimum detectable activity. | Memo refers specifically to PAN radioassay data, but the same reasoning is ~~assumed to apply~~ applies to TGS and HENC assay data as well, Memo only and to all radionuclides detectable by FRAM. |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests are on residues rather than waste that is lower in Pu content; hence, they are conservative. |
| TWCP-3248 | C | Method Detection Limits for Headspace Gas Analyses | MDL studies with data | MDL values for VOCs, determined 06/19/00 | Different MDL values would have been in effect at the times that the data included in Table 6 of this AK report were acquired, so the MDL values should only be considered as an approximate guide. |
| TWCP-3547/ Cl-25 (UCNI) | D | Answers to questions about chloride processes | Interview with Jim Foxx, 9/23/99 | Answers to questions on Chloride processes; CLS-1 solvent list | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4570 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-022 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4572 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA01-RTR-003 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4573 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-026 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4574 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-027 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4577 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-028 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued march 27, 2000) = U.C. | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-4721 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-003 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

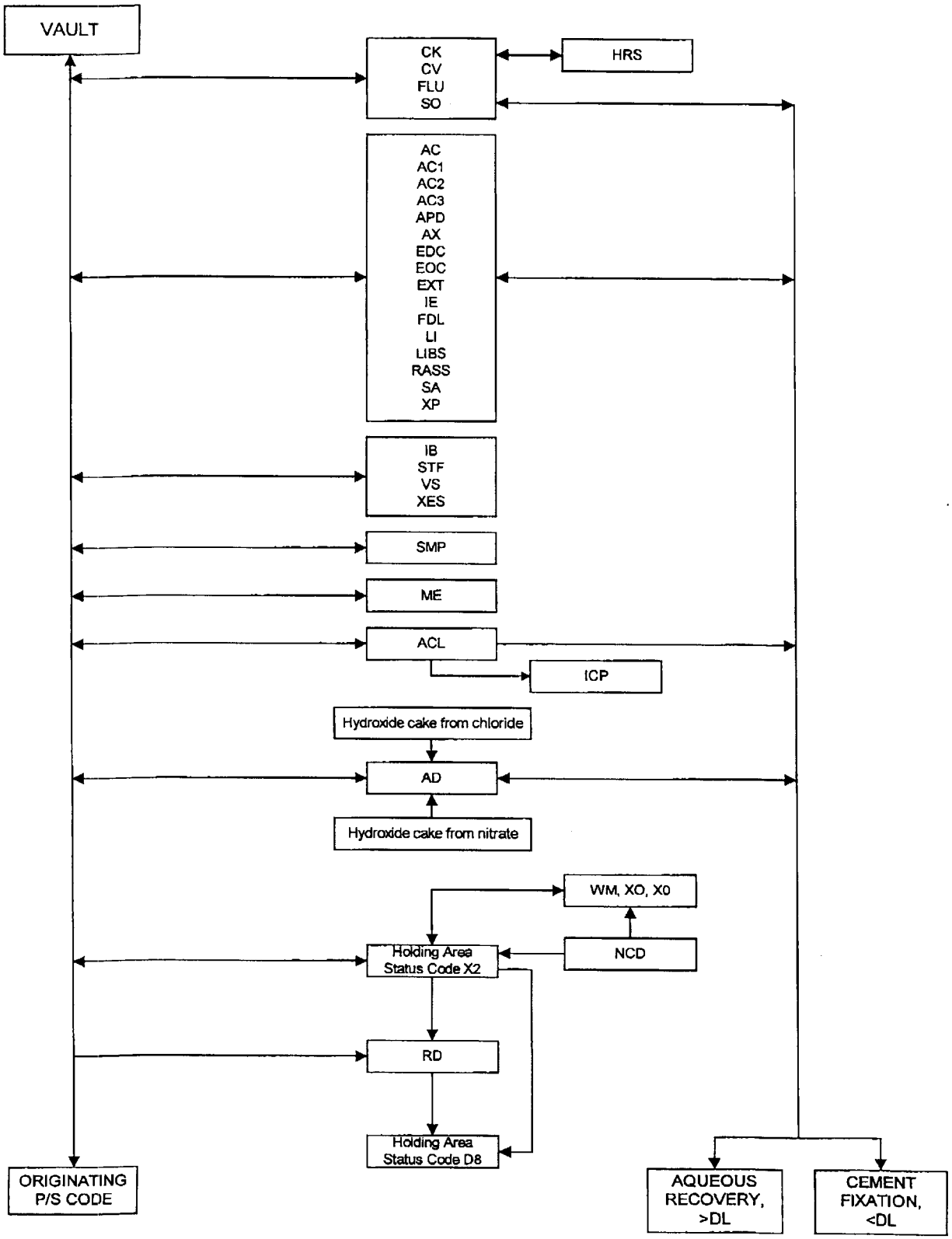
Record Code Information Source Summary Limitations
TWCP-5086 B P/S codes for TA-55 waste items, listed by drum [see record cover page] P/S codes for drums that underwent VE Only some drums included

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4835 | A | RTR data for drums from waste stream TA-55-19 or TA-55-20 | LA00-RTR-001 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Sampling plan (Rev 3) referenced in this batch data report may not be up-to-date with respect to waste stream assignments for containers |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Summary Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2 | A | *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | A | *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for nitrate operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | A | *Process Acceptable Knowledge Summary Report for Pyrochemcial Processes at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for pyrochemical processes at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | *Process Acceptable Knowledge Summary Report for Special Processing Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-PLAN-0.2.7-001,R.3 | C | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK references based on generator's original data | Detailed information on each waste drum and waste stream | ~~None~~ and completeness Reliability of waste generator data is highly variable |

reverse cell entries?

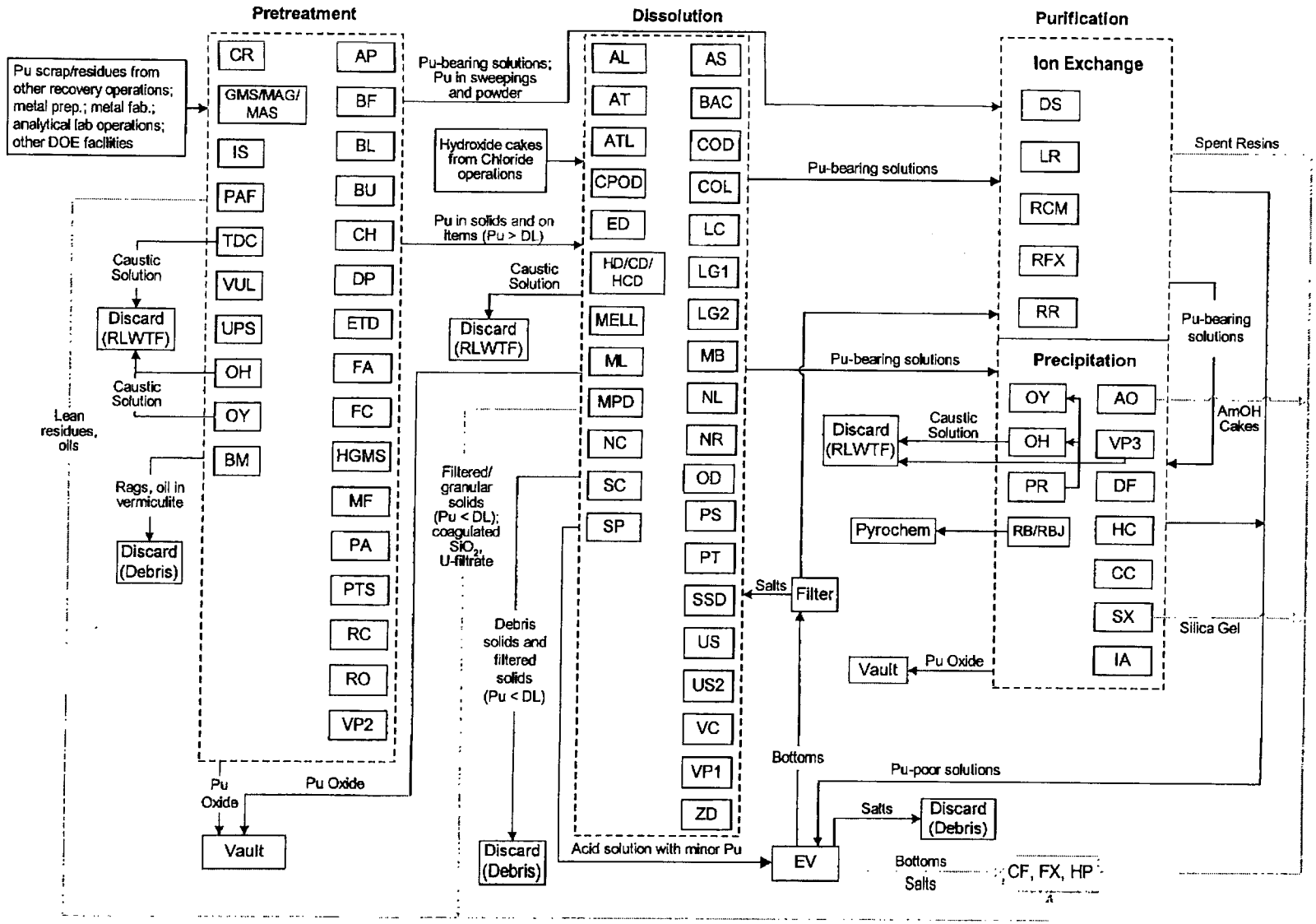
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

## SIMPLIFIED PROCESS FLOW DIAGRAM FOR MISCELLANEOUS OPERATIONS

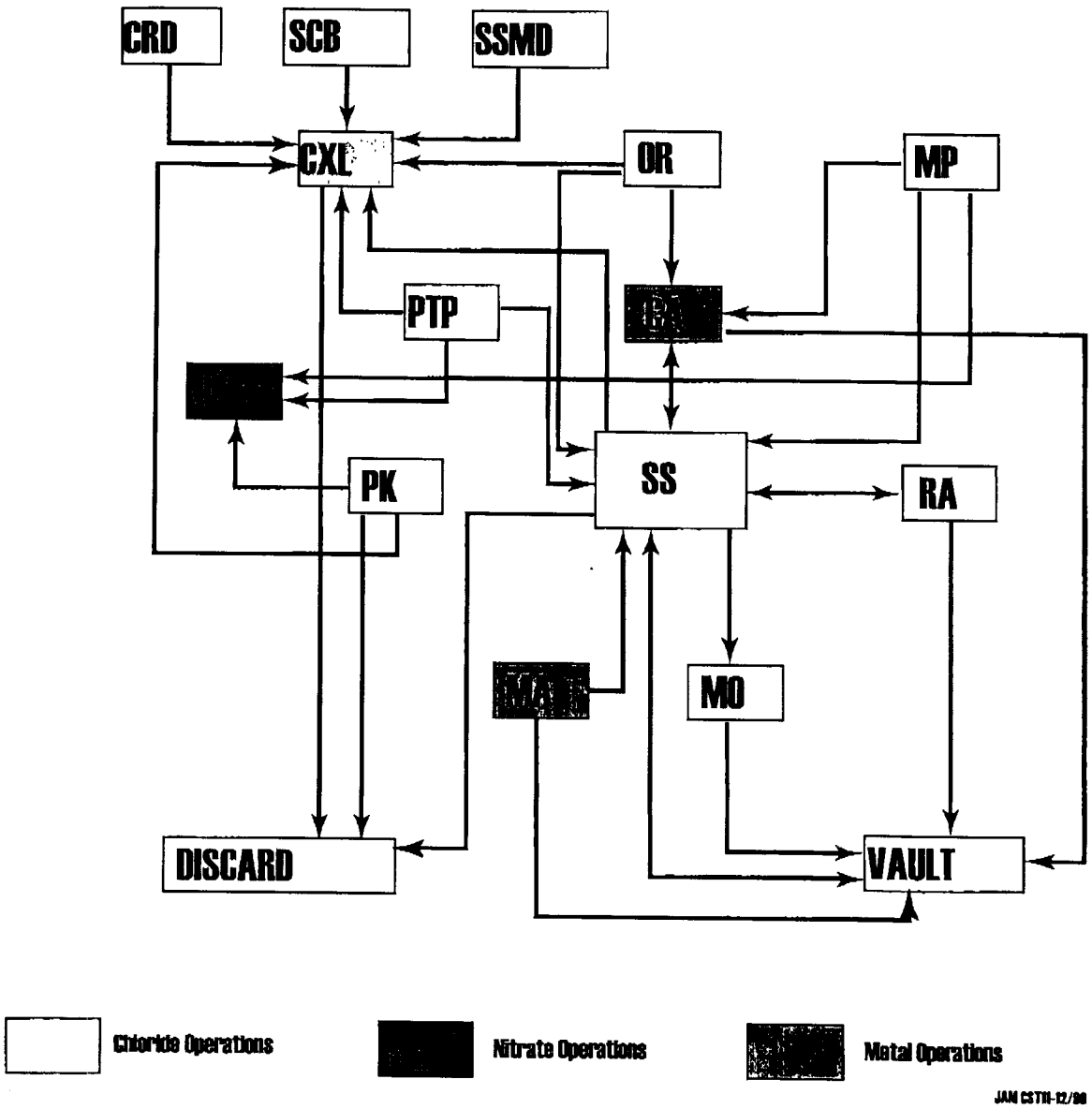


SIMPLIFIED FLOW OPERATIONS

## ~~GENERALIZED~~ PROCESS ~~STATUS~~ DIAGRAM FOR NITRATE ~~PROCESSES~~



## SIMPLIFIED PROCESS ~~STATUS~~ FLOW DIAGRAM FOR PYROCHEMICAL PROCESSES



NCR Info. + Summary columns:
Drum in TA-55-19 waste stream contained ... [p. 5]



## ACCEPTABLE KNOWLEDGE ROADMAP

Waste Stream: TA-55-19 and TA-55-20.

Documents are in the TWCP RMDC Center.

Limitation: NCR cannot be closed until ...

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3 | LA00-3.4.1-006 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-001 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-002 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-004 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-19 (per Sampling Plan, R3) | LA01-VE-005 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |
| TWCP- | A | Reconciliation between AK, VE and RTR data for drum from waste stream TA-55-20 (per Sampling Plan, R3) | LA00-3.4.1-003 | VE, AK and RTR data on WMC, number and types of packaging layers, TRUCON code, and waste items in drum | VE batch data report still in Project-level review |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

X-Sender: 094282@empo.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.0
Date: Tue, 10 Apr 2001 19:37:52 -0600
To: John Musgrave <jmusgrave@lanl.gov>, cfoxx@lanl.gov
From: June Fabryka-Martin <fabryka@lanl.gov>
Subject: Re: Cm-244 and Pa-231
Cc: Louise@lanl.gov
X-RCPT-TO: <107695@empo.lanl.gov>

Thanks, that was very timely input. What do you think of adding the following wording to section 3.6.2 (Radionuclide Contect Identification), starting by appending Pa-231 and Cs-137 as bullets to the list of radioactive contaminants expected to be present in Pu waste:
******
New text:

- Protactinium (Pa)-231, the alpha-decay daughter of U-235, is expected to be present in trace amounts in some TA-55 wastes due to its widespread presence as a contaminant in some TA-55 operations.

- Cesium (Cs)-137, a fission product of U-235, is expected to be present at detectable levels in some TA-55 wastes due to its widespread presence as a contaminant in some TA-55 operations.

Although they are products of U-235 fission and decay, Cs-137 and Pa-231 are not expected to show any correlation with U-235 concentrations, or even with the presence or absence of this isotope. The differences in valence states and chemical affinities among these elements is expected to result in substantial fractionation during several TA-55 processes, including ion exchange, solvent extraction, hydroxide precipitation, dissolution, and exposure to very high temperatures.

In addition, secondary radionuclides will be present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memo according to P/S code (TWCP-882), as summarized in Table 4. This list includes Am-241, Am-243, cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Th-230, Th-232, U-233, U-235, and U-238.

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of radioassay procedure to use for optimal results. Cm-244 was introduced in TA-55 operations in P/S code DOP, which started in 1988. Material outputs from this process sometimes were sent to P/S codes IS or WE. Cm-244 could also be part of debris waste under P/S code CA because both operations took place in the 300 area. Because only one room in this area is available for bagouts, all TRU waste from the 300 area gets combined. In addition, because rags from DOP were sent to IS, Cm-244 could be present in the ash produced by this operation, which is then processed through nitrate aqueous recovery operations. Some unknown fraction of the Cm-244 could ultimately end up in the evaporator bottoms, which are then immobilized in cement in P/S code CF. In any case, however, Cm-244 is not expected to be present in any waste generated before 1988.

At 04:06 PM 4/10/2001 -0600, you wrote:
June,

I was talking with Jim Foxx about the Cm-244 and Pa-231 issues. Jim said that there are a couple of other P/S codes where Cm-244 may appear. It may be part of debris trash under P/S code CA because DOP took place in Rm 319 and casting ops are in Rms 315, 317 and 327, and there is only one room in the 300 area where bagouts are done. Hence, all the trash from the 300 area gets combined. The other issue is if rags from DOP were sent to IS, this begs the question what happened to the Cm-244 that was then a component of the ash? It would, of course, go through nitrate aqueous recovery and ultimately end up in the evaporator bottoms - cemented, of course. So, CF may show some Cm-244.

Pa may be chemically fractionated from U during ion exhange. In addition, there may be enough of a difference in solubility between Pa and U oxalates that there is further separation. Jim and I aren't up on the solubilities of these oxalates, but if this issue warrants further investigation, we can dig deeper.

John

**********

June Fabryka-Martin
TRU Waste Characterization/Certification Program (TWCP)
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Edit Round #5 jhm 4/5/01

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-00-5727)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19, TA-55-19A, and TA-55-20 (Lot)

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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3 Simplified Process Flow Diagrams (8 pages)

4 TRU Waste Forms (5 pages)

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## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| ARIES | Advanced Recovery and Integrated Extraction System |
| CFR | *Code of Federal Regulations* |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| C–N–O | carbon–nitrogen–oxygen |
| CSMO | Central Scrap Management Office |
| DBBP | dibutyl butylphosphonate |
| DCHP | dicesium hexachloroplutonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| ID | item identification |
| IDC | item description code |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| MCDOR | multicycle direct oxide reduction |
| MEGAS | Multiple Energy Gamma Assay System |
| MT | material type |
| NDA | nondestructive assay |
| NMT | Nuclear Material Technology |
| P | RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF | Plutonium Facility |
| PRQL | program required quantitation limit |
| P/S | process/status [code] |
| PuBe | plutonium–beryllium |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RD&D | research, development, and demonstration |
| RCRA | Resource Conservation and Recovery Act |

| | |
|---|---|
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| RSWD | radioactive solid waste disposal |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3) |
| SME | subject matter expert |
| SOP | safe operating procedure |
| TA | technical area |
| TBP | tributyl phosphate |
| TOPO | trioctylphosphine oxide |
| TRU | transuranic |
| TRUCON | TRUPACT-II Content Code |
| TRUPACT-II | Transuranic Waste Transporter-Model II |
| TWBIR | Transuranic Waste Baseline Inventory Report |
| TWCP | Transuranic Waste Characterization/Certification Project |
| U | RCRA hazardous waste number prefix for toxic waste defined in 40 CFR Subpart D, Section 261.33(f) |
| UCNI | unclassified controlled nuclear information |
| VOC | volatile organic compound |
| WAC | Waste Acceptance Criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request form |

RTR — real-time radiography

Th — Chemical Symbol for thorium

(Chemical symbol) for Uranium; or

UCNI — VE

VOC — visual examination

page 13

XES

UCL90 — 90% Upper Concentration Limit

## TA-55 PROCESS/STATUS CODE INDEX

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| AC | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, D038, F002, F005 |
| AC1 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, F002, F005 |
| AC2 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, D038, F002, F005 |
| AC3 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | |
| ACC | Ammonium chloride conversion | Special Processing | 3.4.8, Att. 4 | |
| ACD | Cascade dissolver | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| ACL | Analytical chemistry laboratory | Miscellaneous Operations | 3.4.4, Att. 4 | D007, D009 |
| AD | Actinide processing demonstration | Miscellaneous Operations | 3.4.1, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| AL | Ash leach | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| AO | Assembly operation | Metal Operation Processes | 3.4.3, Att. 4 | |
| AO | Americium processing calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| AP | Americium purification | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | D007, D009 |
| APD | Actinide processing demonstration | Miscellaneous Operations | 3.4.7, Att. 4 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| ARI | ARIES | Metal Operation Processes | 3.4.3, Att. 4 | |
| AS | Anode heel dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008, D011 |
| AT | Ash testing | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| ATL | Advanced test line for actinide separation RD&D | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| AX | Solution assay | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009 |
| BA | Basement isopress | Metal Operation Processes | 3.4.2, Att. 4 | |
| BAC | Bacterial decomposition of cellulose items | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| BC | Physical properties | Metal Operation Processes | 3.4.2, Att. 4 | |
| BF | Unknown name for P/S code | Nitrate Operations | 3.4.6, Att. 4 | D006, D007, D008, D011 |

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19, Mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1978–present |
| **Defense Waste Status:** | Defense-related transuranic (TRU) waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 4173 containers (873 $m^3$) |
| **Waste Stream Volume (after repackaging):** | 850 SWBs, 3873 drums (2390 $m^3$) |

**Facility Mission**

set ~~transuranic (TRU)~~

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU ~~waste~~ contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and ~~so~~ were not segregated until August 27, 1998.

based on funding source

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate ~~transuranic~~ TRU wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; analytical laboratory solutions; residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (generally less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040

- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved (*Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* [TWCP-AK-2.1-004]).
- Drums containing waste generated from P/S codes SD and SS between 02/98 and 06/98 are segregated as a subset of TA-55-19 due to the potential presence of vanadium pentoxide (EPA HWN P120). (See separate AK summary for TA-55-19A).

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium. Contaminants from uranium-235 as well as its decay daughter, protactinium-231, and fission product cesium-137.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19A

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19A, Mixed Combustible Debris with P120 |
| | **NOTE:** This is a subset (i.e., lot) of waste stream TA-55-19. It is distinguished from TA-55-19 only insofar as the waste has the potential to include vanadium pentoxide (EPA HWN P120). |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 02/98–06/98 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | Not yet determined |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU ~~waste~~ contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and ~~so~~ were not segregated until August 27, 1998.

based on funding source

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate ~~transuranic~~ TRU wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; analytical laboratory solutions; residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (generally less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

TA-55-19A is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120
- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium. as well as contaminants from uranium-235: its decay daughter, protactinium-231, and fission product cesium-137.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-20

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-20, Non-mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-T16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1979–present |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 281 containers (59 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not available |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU ~~waste~~ contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and ~~so~~ were not segregated until August 27, 1998.

based on funding source

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate ~~transuranic~~ TRU wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; plutonium scrap; disassembled weapons components (pits); plutonium-beryllium sources; pyrochemical salts; reactor fuel pellets; crucible pieces; ash; analytical laboratory solutions; residues from other DOE facilities; anode heels; and analytical laboratory solutions.

**Waste Material Parameter List**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (generally less than 5 percent by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

No HWNs apply to containers in waste stream TA-55-20.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched

in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium. as well as contaminants of uranium-235: its decay daughter, protactinium-231, and fission product cesium-137.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

# ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR WASTE STREAMS TA-55-19 AND TA-55-20

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK information and provides guidelines on how AK should be obtained and documented.

Add to section 15 references

This AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the Plutonium Facility at Technical Area (TA) 55, one of the TRU waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides technical support for assignment of specific waste containers to the waste stream.

Add to section 15 Reference

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to waste streams TA-55-19 (including lot TA-55-19A) and TA-55-20 covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) (Sampling Plan) that includes information regarding all waste streams, including TA-55-19 and TA-55-20
- Review of documents related to the waste generation and waste management activities at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as documented in process AK reports in the Acceptable Knowledge Roadmap (Attachment 1)

listed

- Review of process AK reports for TA-55 processes (as discussed below)
- Analysis of processes generating waste, as discussed in the process AK reports and in this report

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that are referenced in this summary report. Unclassified Controlled Nuclear Information (UCNI) will be reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK summary report is based on detailed information compiled in a set of closely related reports about TRU waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports ~~for plutonium~~:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

The process AK reports contain information on over 200 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. For example, the nitrate operations report (*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005,R.2]) covers waste generation processes and characteristics for ~~about~~ 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generator records. However, ~~as described in~~ section 3.2, TA-55 TRU waste items have always been segregated and packaged ~~into~~ waste containers based on the physical form and material content of the waste, without regard to process of origin (i.e., P/S code). In order to ~~mitigate confusion resulting from~~ these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number), separate AK reports have been prepared for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in the process AK reports.

This AK summary report summarizes AK information specific to the combustible debris waste streams TA-55-19 (including waste stream lot TA-55-19A) and TA-55-20.

## 3.0 DESCRIPTION OF THE WASTE STREAM

### 3.1 Facility and Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU ~~waste~~ contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and ~~so~~ were not segregated until August 27, 1998. based on funding source

(Building PF-4)

The combustible waste streams TA-55-19 and TA-55-20 were generated at the TA-55 Plutonium Facility as debris waste (glovebox and processing-room trash) from process operations and glovebox maintenance involved in plutonium recovery. For this reason, the waste streams are defense related. However, waste also was produced from "special process" and research-related activities. These wastes were not segregated, but were commingled in the final waste containers to such an extent that segregation is not possible on the basis of waste generating process or glovebox location (~~TWCP-887~~). The waste was also co-mingled with room trash related to these same operations (both defense and non-defense), which was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site radioassay results showed it exceeded the low-level discard limits (DLs) (TWCP-816).

~~TA-55-19 and TA-55-20 combustible debris waste streams were generated in the TA-55 Plutonium Facility (Building PF-4).~~ A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning and continuing to the present day has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process of origin. Relevant details of these

planning and implementation documents are summarized in this section, in order to provide background information to support the process used by TWCP to assign TA-55 waste containers to specific waste streams. Waste stream assignment is made on the basis of waste generator information compiled in the TWCP waste container data base, which comprises the bulk of the Sampling Plan. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, in order to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents.

3.2.1 Waste Packaging at TA-55

Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged by this team. Materials are considered waste only when they have been received and processed by the waste management team. Waste segregation schemes used by this team have evolved since operations began at the Plutonium Facility in 1978.

Discard Limits (DL) for plutonium in various types of waste

In 1978, the standard operating procedure for waste management at TA-55 stated the guiding philosophy of minimizing the amount of waste generated, and minimizing the plutonium content of that waste (TWCP-3943). DLs were established by the waste-generating group, and approved by the LANL division office and the DOE Albuquerque Operations Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of plutonium) into classes, such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. All liquids, including oils, were required to be sent to recovery operations for processing. Liquids were explicitly prohibited from any container of solid waste materials.

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific processes and waste streams. TA-55 prepared an attachment in March 1987 for contact-handled combustible and noncombustible solid waste (TWCP-701).

Waste Acceptance Criteria

- Combustible waste forms included materials which could be reduced to an ash if desired but which did not require further processing to meet the WIPP WAC (TWCP-701). (This definition is still current.) Subcategories included plastic-base, cellulose-base and miscellaneous (graphite and graphite crucibles). It was acceptable for the combustible waste stream to include some unspecified "small" fraction of noncombustible solids such as scrap metals.

- Noncombustible waste forms included materials that could not be reduced to ash but that did meet the WIPP WAC without further processing (TWCP-701). The two subcategories were metals and non-metals. The non-metal wastes included glass, fiberglass heating mantles, porcelain crucibles, ceramic furnace tube inserts, and leaded glovebox gloves. It was acceptable for the noncombustible waste stream to include some unspecified "small" fraction of combustible solids, and that could be contained in plastics. For WIPP purposes, any waste forms that were chemically compatible and that met the WAC, could be combined into a single waste container.

In 1995, a new TRU Waste Certification Plan was adopted, including a new attachment that formalizes how the TA-55 waste management team currently segregates newly generated wastes into waste streams (TWCP-700). Waste materials are segregated by:

- radioisotope, in order to meet nondestructive assay (NDA) and gas generation requirements
- material matrix, in order to meet NDA and TRUCON requirements
- hazardous constituents, in order to meet RCRA and Department of Transportation (DOT) requirements

Combustible waste forms include plastic base and cellulose base, but graphitic waste is now in the noncombustible category. Noncombustible debris waste forms are broken down to a finer level of classification than had previously been used:

- metals (TRUCON code 117)
- glass (TRUCON code 118)
- HEPA filters (TRUCON code 119)
- leaded gloves (TRUCON code 123)
- salts (TRUCON code 124)
- graphite (TRUCON code 115)

In addition, each major waste form includes provisions for small quantities of unspecified waste with similar properties. This provision is necessary in order to allow for infrequently encountered waste items.

3.2.2 Waste Stream Delineation for TA-55

Starting in 1987, the TA-55 Plutonium Facility began its current system of tracking waste items both by the process from which they originated as well as by their material content ~~(although strict adherence to this requirement was inconsistent in the early years)~~. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item. Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. ~~This practice complicates AK tracking because~~ a single waste container can include waste items from several P/S codes.

In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- First by radioisotope content (Pu238 or Pu239 ~~nuclear~~ material type)
- Then by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

~~Waste stream~~ delineation was performed using waste generator information compiled in an electronic data base that is part of the Sampling Plan. Because waste items from several different P/S codes were combined into each waste drum, a special sort on the P/S code of each waste item in a drum was necessary to determine if the drum contained all non-mixed items, some or all mixed-waste items, or a special case item (such as an item from P/S code SS carrying the HWN P120). If the P/S code information was missing for any item in a waste drum (as was the case for many older wastes), that drum was conservatively assigned to the mixed-waste stream. Fortunately, the special case wastes carrying the HWN P120 ~~(or the potential to carry HWN U213)~~ were generated relatively recently, such that the data base records for those items are complete.

### 3.2.3 Waste Container Labeling

The net effect of the waste packaging system used at TA-55 is that several ~~EPA hazardous waste numbers~~ (HWNs) are conservatively assigned to individual waste streams for the purposes of WIPP disposal, because the WIPP WAP requires HWN assignment on a waste stream rather than a waste container basis. For the purposes of generator and on-site storage, however, LANL labels waste on a container by container basis. Thus, the hazardous labels on containers in storage at LANL should not be expected to correspond to the HWNs assigned to the waste stream through this AK summary report. Hazardous labels ~~will be~~ are updated to meet WIPP disposal requirements just before loading waste containers into the Transuranic Package Transporter-Model II (TRUPACT-II) for shipping to WIPP.

## 3.3 Waste Physical Form and Content Description

The TA-55-19, -19A, and-20 waste streams are defined as combustible debris waste streams (Sampling Plan, Appendix D), with TA-55-19 being a mixed waste stream and TA-55-20 its non-mixed counterpart. TA-55-19A is a ~~small substream~~ lot, distinguished from TA-55-19 by the addition of HWN P120. The waste ~~streams~~ includes paper, rags, plastic, rubber, and plastic-based and cellulose-~~based waste~~ generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape, gloves, plastic vials, polystyrene, Tygon tubing, polyvinyl chloride plastic, Teflon products, Plexiglas, and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to rags, wood, paper, and cardboard; laboratory coats and overalls; booties and ~~cotton~~ gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (scrap metal, metal lids, and clothing zippers) (Sampling Plan, Appendix D).

## 3.4 Waste Volume and Time Period of Waste Generation

The following information is from Appendix D of the Sampling Plan (~~TWCP-PLAN-0.2.7-001~~, R.3, ~~Appendix D~~). These values are expected to change because the sampling plan is continually updated as new waste information is obtained. u.c.

- TA-55-19 includes 4173 containers (873 cubic meters), that were generated from 1978 to the present time.

- Waste stream lot TA-55-19A is not yet fully defined in the sense that a list of specific waste containers in this lot has not yet been prepared. This is because P/S codes are not always explicitly identified for waste items in TA-55 waste containers. However, it may be possible to extract this information from the waste item identifiers, at which time waste containers can be assigned to TA-55-19A.

X-Sender: 094282@empo.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.0
Date: Tue, 06 Mar 2001 07:38:01 -0700
To: bailey@lanl.gov, John Musgrave <jmusgrave@lanl.gov>, mavisl@lanl.gov
From: June Fabryka-Martin <fabryka@lanl.gov>
Subject: Fwd: Re: Global edit to AK reports: leaded gloves
X-RCPT-TO: <154344@empo.lanl.gov>

Date: Mon, 05 Mar 2001 17:41:31 -0700
To: June Fabryka-Martin <fabryka@lanl.gov>
From: Charles Foxx <cfoxx@lanl.gov>
Subject: Re: Global edit to AK reports: leaded gloves

June,
I would change the concern statement to read something like "....concern that explosive lead oxides might form if....". Otherwise it looks fine.
Jim Foxx

---

At 04:07 PM 3/4/01 -0700, you wrote:
The following should replace the 4th and 5th sentences in the first paragraph of section 3.5.1 in all of the process AK reports and in the waste stream AK reports:

Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern ~~about releasing lead to the atmosphere~~ if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Replace bullet about leaded gloves in section 4.2 and use as standardized footnote about leaded gloves in the process AK timelines:

Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

**********

June Fabryka-Martin
TRU Waste Characterization/Certification Program (TWCP)
Environmental Technology Group (Group E-ET)
Mail Stop E517
Los Alamos National Laboratory
Los Alamos, NM 87545
Phone (505) 665-2300

- TA-55-20 includes 281 containers (59 cubic meters), that were generated from 1979 to the present time.

3.5 Waste Stream Generation Processes

3.5.1 Overview

The TA-55-19, -19A, and -20 combustible debris waste streams were generated from combustible materials used in processes to recover plutonium from residues, metal fabrication, and research and development activities. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds
- Preparing on a large scale specific alloys, including casting and machining these materials into specific shapes
- Determining high-temperature thermodynamic properties of plutonium
- Reclaiming plutonium from scrap and residues produced by numerous feed sources
- Disassembling components for inspection and analysis
- Manufacturing of parts on a limited basis
- Processing mixtures of plutonium and uranium oxides for reactor fuels.

Should there be a change bar here?

The manufacturing and research operations performed at TA-55 in the recovery of plutonium results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scrap generated from operations at various LANL, other U.S. Department of Energy (DOE) facilities, and commercial radioactive sources. These recovery operations, along with associated maintenance operation, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Plutonium processing facilities generate contaminated combustible waste from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber- and Teflon-based products used in operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

3.5.2 Process Flow Diagrams

Detailed information about the TA-55 plutonium recovery processes can be found in the Process AK reports. For purposes of the AK search, and to allow convenient referral to and referencing of the Process AK reports in this waste stream AK Summary Report, the processes have been arbitrarily divided into six major areas:

Switch order

- Nitrate Operations (TWCP-AK-2.1-005)
- Chloride Operations (TWCP-AK-2.1-002)
- Miscellaneous Operations (TWCP-AK-2.1-004)
- Special Processing (TWCP-AK-2.1-007)
- Metal Operation Processes (TWCP-AK-2.1-003)
- Pyrochemical Processes (TWCP-AK-2.1-006)

Generalized flow diagrams for the six operational areas relevant to this AK search are presented as Attachment 3 and indicate P/S codes for the various processes. The full block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

The following subsections describe the processes that generated debris waste assigned to the TA-55-19, -19A, and -20 waste streams. The potential for RCRA-regulated constituents to be present due to feed materials or chemical use in these processes is summarized in Section ~~3.5~~ 3.6.1 and 3.6.3. The applicability of EPA HWNs as a result of this potential is specified in Section 8.

3.5.3 Nitrate Operations

switch order with Chloride operations (3.5.4)

P/S codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride operations), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- evaporation
- cement fixation

Pretreatment primarily includes physical processes used to separate scrap and residues for the next step, dissolution. It may include calcination, caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing, distillation, filtering of liquids or oils, incineration, magnetic separation, passivation, scraping, or sorting. After pretreatment, solids are sent to dissolution if plutonium concentrations are above the DL and to cement fixation if concentrations are below the DL. Liquids are sent to purification if plutonium concentrations are above the DL and to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) if they meet the TA-50 RLWTF ~~waste acceptance criteria~~ [WAC] or to cement fixation; otherwise, they are further treated until they meet that WAC.

Dissolution includes various steps that generate plutonium nitrate solutions for feed to purification. Primary chemicals used in dissolution are nitric acid and calcium fluoride and/or hydrofluoric acid. [~~Dissolution takes place in pots or cascade systems.~~] Filtered solids are returned to the dissolution process until plutonium concentrations are below the DL, then sent to cement fixation for disposal. Debris items are disposed after removal of plutonium contamination above the DL. [Heavy metals are ~~concentrated in the plutonium-rich hydroxide cakes that are produced in chloride operations~~] and derive from one or more of the following: (a) feed materials that consist of or contain the metals; (b) leaching of metal from equipment components; or (c) [~~in the case of silver,~~] from ~~its~~ the use (until 1994) as an indicator of chloride content. [Plutonium-bearing solutions are sent on to purification.

move to Chloride operations (page 12)

of silver salt

Purification consists of ion exchange and precipitation processes. The ion exchange processes use resin-filled columns to collect plutonium, which binds to the resin while impurities flow through the columns; an eluting agent is then used to release purified plutonium in solution. The enriched solutions are then sent to oxalate precipitation, which converts the plutonium to oxide form. The depleted liquids are sent to the evaporator or the RLWTF, and the calcined plutonium oxides are sent to the vault.

The evaporator processes plutonium-poor liquids in order to re-concentrate plutonium, if possible, or to reduce the volume of liquid waste. Evaporator bottoms are either sent back to ion exchange or discarded to cement fixation, depending on their plutonium content. Heavy metals that may be present are concentrated in this process.

In the cement fixation step, wastes with low plutonium concentrations are collected and immobilized in cement. Most ~~if not all~~ of the wastes generated under these processes (P/S codes CF, HP, and IA) are classified as cemented wastes and would not be part of the debris waste streams. normally

move to precede nitrate operations (3.5.3)

3.5.4 Chloride Operations

P/S codes CL, CLRD, CLS, CS, CSE, CW, CX, CXL, LD, MB, MS, PB, PRR, PUB, and SE

A detailed description of chloride operations can be found in *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002).

The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The primary feed sources are plutonium residues from pyrochemical operations, PuBe neutron sources, analytical laboratory solutions, and residues from other DOE facilities. Chloride operations can be broken down into the following process steps:

plutonium-beryllium

- pretreatment
- dissolution
- purification
- hydroxide precipitation

Pretreatment may include sorting, crushing, and/or pulverizing feed materials prior to being fed into later steps of chloride operations. A separate pretreatment procedure is the decladding of plutonium-beryllium sources. The PuBe metal alloy is removed from the sources,

which are then entered into the chloride line for plutonium recovery along with other materials.

In the dissolution step, hydrochloric acid is used to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory. Enriched solutions undergo further purification (see next paragraph), and solid wastes are discarded as debris waste or sent to cement fixation.

Purification steps may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and separate out impurities. Enriched solutions may be further treated with oxalic acid to precipitate plutonium oxalate, which is converted to plutonium oxide.

In the hydroxide precipitation step, plutonium in solutions from purification steps is precipitated with potassium, magnesium, or sodium hydroxide. The resulting enriched hydroxide cakes become feed material for nitrate operations, and liquid meeting the TA-50 WAC is sent to the RLWTF using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

Insert sentence from page 10

3.5.5 Miscellaneous Operations

P/S codes AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

A detailed description of miscellaneous operations can be found in *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004).

Research and development projects at TA-55 include an array of activities involving applied techniques and methods designed to study and improve processes associated with the purification, separation, extraction, recovery, and characterization of actinides (primarily plutonium) from various matrices. General types of miscellaneous processes are described below.

*Extraction/Separation Studies*. A series of similar actinide extraction, separation, and characterization R&D studies involved processing of actinide hydroxide cakes from chloride and nitrate operations, development of sensors and instrumentation for online chemical analysis, and purification process development. The process R&D activities were of a non-routine developmental nature involving

research, process development, small scale "trouble-shooting," and occasionally preparation of various isotopes and isotopic mixtures of plutonium, uranium, americium, and neptunium.

*Halogenation Studies*. A variety of R&D efforts used fluorinating agents to fluorinate samples containing plutonium residues. A gas flow loop was used to pass a fluorinating agent through a gas-solid reactor where plutonium in the solid residue reacted chemically to form solid $PuF_4$ or gaseous $PuF_6$. Gaseous $PuF_6$ was trapped in a cold trap, distilled, and reduced to $PuF_4$. Separation operations involving experimental chlorination processes were similar to the fluorination procedures. A gas loop was used to flow carbon tetrachloride and perchlorocarbons through a gas-solid reactor to chlorinate plutonium oxides to form recoverable plutonium compounds.

*Non-Aqueous Dissolution/Extraction Operations*. Non-aqueous dissolution/extraction operations included the dissolution of actinide compounds and actinide-containing matrices in superacid media. The superacid solutions were evaporated to leave solid products that were analyzed by a variety of methods. The study of the organometallic chemistry of uranium and thorium in non-aqueous solvents consisted of a variety of small-scale organoactinide operations involving fundamental research of the synthesis in non-aqueous media of new actinide compounds, their characterization and reaction chemistry, and application to existing actinide processing technology. Other operations comprised a broad range of laboratory activities in support of fundamental and applied actinide chemistry research, including preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation.

*Analytical Operations*. This category covers all analytical techniques performed in Room 124 of the Plutonium Facility. Processes involve analysis of plutonium and americium, RCRA metals, and trace metals. Originators provide samples, which are prepared for further analyses, ~~(e.g., ICP and XES)~~ such as inductively-coupled plasma (ICP) and X-ray energy spectroscopy (XES). Unused liquid samples are returned to the originator, sent to radiochemistry for counting, or sent to recovery operations.

*R&D Efforts*. Several small-scale R&D efforts primarily focused on plutonium recovery included the following activities:

- Fluoride sintering of $PuO_2$ took advantage of the presence of fluoride to aid the formation of a sintered mass of $PuO_2$ powder at temperatures above 700 °C.

- Chlorination of Pu oxides involved oxides with tantalum chips from Rocky Flats Environmental Technology Site (RFETS). Chlorination was used to recover plutonium from potassium chloride and sodium chloride matrices.
- Processing of molten-salt extraction (MSE) salts generated at LANL and RFETS.
- Recovery of plutonium from ash involving plutonium/thorium oxide mixtures.
- Processing of neptunium oxide and metal was performed to remove the protactinium daughter in order to use the neptunium for ~~non-destructive assay~~ (NDA) standards.

*Measurement/Detection Operations and Studies.* P/S code VS involved the inspection of oxides and metals. Materials were retrieved from the vault, brought to the glovebox, inspected and sampled if necessary, then repackaged and returned to the vault. Assay methods include XES, laser-based spectroscopy, and other spectroscopic ~~assay~~ techniques.

- ~~P/S code XES is a plutonium assay technique in which samples~~ containing plutonium are excited with X-rays, and the resulting emission spectra are measured to determine plutonium concentrations.
- P/S code RASS involves ~~interrogating small samples (solids or solutions containing less than 1 gram of nuclear material)~~ using laser-based spectroscopy.
- ~~P/S code LIBS used a laser for isotopic analyses of samples of high purity metals and oxides.~~
- P/S code ~~SMP~~ has "never gone hot" but may start up in the near future. The process will involve mounting samples of plutonium metal and stainless steel using a low-melting bismuth-tin alloy in preparation for electron microscopy.
- ~~P/S code EOC is an experiment~~ designed to calculate the surface area and pore size distribution of a sample and to analyze its surface characteristics. ~~Mixtures of helium and nitrogen are passed through a U-shaped cell containing a sample to be analyzed.~~
- P/S code HRS involved spectroscopic studies. Fluorinated actinide compounds were introduced with compressed gases into a long-path, variable temperature cell for spectroscopic measurement and in preparation for physical chemistry.

Electron microscopy may be conducted on actinide samples in the future. In addition to elemental and isotopic analyses, other measurement studies are

*Pyrochemical Matrix Studies.* A pyrochemical matrix study was conducted from 1986-1992 and involved rod milling prior to screening. This process had two objectives: (1) blending large batches of homogeneous plutonium metal oxides ~~(up to 85 percent purity)~~ for pyrochemical operations, and (2) dissolution of ~~78 percent pure (or greater)~~ plutonium metal oxides for nitrate operations. The process changed in August 1992 when a need developed to blend oxides to provide feed material for making NDA standards. In February 1995 the process again changed, with the objective of determining the effect of pyrochemical salt matrices on the accuracy of NDA measurements. Process activities involved crushing, pulverizing, blending, roasting, and sieving pyrochemical salts. The results were used to determine handling and processing of the salts and for correction of bias measurements. The feed material consisted of high-purity oxides to use in the fabrication of standards to be used at LANL and throughout the DOE complex.

A small basic research operation that began in March 1992 explored aqueous extraction of plutonium from various waste streams, particularly used pyrochemical salts.

*Hydrothermal Processing.* The hydrothermal processing procedure involves the reaction of aqueous/organic mixtures, pure organic liquids, or contaminated combustible solids (e.g., ion exchange resins, plastic filters, and cellulose rags) under supercritical conditions (i.e., high temperature and pressure). Feed streams include, but are not limited to, carbon tetrachloride, tributyl phosphate, and organic solvents. Process effluents are gases, liquids and salts. Organic components are oxidized to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

*Electrochemistry Experiments.* Electrochemistry methodologies were designed to decontaminate items, replace processes that produce large amounts of waste, or enhance chemical reactions. The process involved uranium decontamination of disassembled weapon components from various sites with various levels of surface contamination with plutonium. The operation was strictly an aqueous process in which an alkaline solution was reacted with the components to precipitate uranium. Significant amounts of metal could be stripped in a short period. The solution containing the precipitated uranium salts was then dried for mass balance.

*Metallography.* The purpose of the metallography operation is to characterize the microstructure of metallic or ceramic pieces to verify

be low-level waste and no RCRA constituents would be associated with the waste items.

P/S code XO indicated waste materials that were generated within specific rooms but could not be associated with an individual P/S code in that room.

3.5.6 Special Processing

P/S codes ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

A detailed description of special processing is found in *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007).

Special Processing includes processing operations for Material Type (MT) 42, and research and development (R&D) activities for MT 52. (See Section 3.6.2 and Table 2 for descriptions of plutonium material types.) Because processing MT 42 is a smaller scale version of the recovery processes used for MT 52, MT 42 processing has five main recovery steps:

- head-end operations
- nitrate ion exchange operations
- chloride ion exchange operations
- separation and purification by precipitation
- pyrochemical processes

Only head-end operations and separation by purification and precipitation are covered here, since nitrate ion exchange operations, chloride ion exchange operations, and pyrochemical processes are covered briefly elsewhere in this report.

Head-end operations leach tools, labware, crucibles, rags, etc. in nitric acid to remove recoverable plutonium. Plutonium oxide is typically calcined as part of head-end operations.

Separation and purification by precipitation is a method of plutonium removal from aqueous solutions. The most common precipitation methods utilize oxalate, hydroxide, and peroxide anions. By selectively precipitating the plutonium, many of the metals remain in solution, thereby purifying the plutonium.

All wastes generated by MT 52 R&D operations are replicated for MT 42, but carry different P/S codes to differentiate and identify the

radionuclide content of the waste. Outputs from Special Processing include high purity metal for casting and machining.

3.5.7 Metal Operation Processes

P/S codes AO, ARI, BA, BC, BT, CA, CN, CO, CT, DA, DOP, DT, EL, ELW, EM, EVAC, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT

A detailed description of metal operation processes is found in *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003).

The processes included in metal operations can be divided into three groups:

- reactor fuel development processes
- on-going metal operation processes
- developmental metal operations

The main goal of metal processes is to take the high purity metal produced by pyrochemical operations and produce shaped metal pieces.

In reactor fuel development, enriched uranium oxide, depleted uranium oxide, and/or plutonium oxide feeds are blended and mixed with graphite, and various operations are performed to convert the feed material into pellets that can be used for fuel. Testing and R&D are done on the fuel pellets. ~~Trichloroethylene was used as a lubricant from 1979 to 1994.~~

On-going metal operation processes include various R&D activities, alloy development, casting of metals, welding, coating, and machining/metalwork on various metals. ~~In machining, trichloroethylene was used from 1979 to 1992 and from 1997 to the present, for final cleaning. In alloy development, Freon was used from 1989 to 1992 to clean parts. The plutonium sputtering process used arsenic for a short period during 1984 to 1985.~~

Developmental metal operations include the Advanced Recovery and Integrated Extraction System (ARIES) project, assembly operations, burst testing of shells, experimental laser welding, furnace operations, and various other experimental activities. ~~Waste from burst testing, conducted from 1998 to the present, contains lead. Waste from the Kolsky Bar Test Facility also contains lead and/or lead oxide.~~

make these a single PP

3.5.8 Pyrochemical Processes

P/S codes CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

A detailed description of pyrochemical processes is found in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006).

Pyrochemical processes include metal preparation, metal purification, and ancillary metal production operations. Pyrochemical process outputs are most often high purity metals for metal operations.

3.5.8.1

Metal preparation processes include the following operations:

*Metal Preparation Line.* The metal preparation line produces plutonium metal from fluoride salts. Hydrogen fluoride gas reacts with plutonium oxides obtained from calcination of oxalate or peroxide precipitates from the aqueous nitrate or chloride process lines. The plutonium compound is further reacted with various chemicals to produce plutonium metal, which can then be recovered as a button by breaking the crucible.

*Direct Oxide Reduction (DOR) and Multiple-Cycle Direct Oxide Reduction (MCDOR).* In the single pass DOR process, plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible. After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which was sometimes recovered by addition of fresh salt plus additional calcium metal.

To minimize the salt waste, the multicycle DOR (MCDOR) process was started, in which the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated.

3.5.8.2

Metal purification processes include the following:

*Molten Salt Extraction (MSE).* MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (TWCP-352). This process is employed only if the americium content is greater than 1000 ppm. In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten

salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible and heated to 750°C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. In the LANL process, 90 percent of the americium and 10 percent of the plutonium are transferred from the feed metal to the salt. After cooling, the salt and metal are mechanically separated. The salts are transferred to the salt stripping process.

*Electrorefining (ER).* The ER process takes impure metal from the MSE and MCDOR (DOR) processes and produces high purity plutonium metal. Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$. After the anode and salt melt, current is applied to the system, and plutonium at the anode is oxidized to plutonium ions, which travel to the cathode and are reduced back to the metal state. Impurities in the original plutonium anode that are less electroactive than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities more electroactive than plutonium (including barium) are left in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. Anode heels were sent to pyroredox from 1984 to 1986. Currently, salts are sent to chloride operations or carbonate oxidation/distillation.

From 1987 to 1989, secondary solvent metals such as cadmium, bismuth, lead, and gallium were added to experimental studies of the ER process.

3.583 Ancillary metal production operations include the following:

*Salt Stripping.* The MSE and ER salts are further treated by salt stripping, oxygen sparging or carbonate oxidation, and salt distillation. The salt stripping process treats the residue by melting and stirring the salt with calcium metal in a magnesium oxide crucible at 850°C. This treatment reduces the plutonium in the salt to metal and allows the metal to coalesce for physical removal and recovery. After cooling, the crucible is broken and the metal physically separated and recycled to the ER process or burned to oxide and sent back through aqueous recovery. The crucible shards are leached in hydrochloric acid, then discarded.

Oxygen sparging and, since 1996, carbonate oxidation are used to ensure that any plutonium, americium, or metallic sodium or potassium left in the salts are converted to nonpyrophoric oxide forms.

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping process for a few months in 1998. Wastes that potentially contain this chemical (HWN P120) will be segregrated into waste stream lot TA-55-19A (see Section 4.0).

*Salt Distillation.* Salt distillation ~~begun in 1997,~~ allows the recovery of plutonium oxide from the chloride salt and produces purified chloride salt for reuse.

*Pyroredox.* The pyroredox operation was used to recover plutonium from spent anode heels in the mid- to late 1980s. The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements more electroactive than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements less electroactive than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded. The metal phase containing zinc was placed in the vault or further treated, and the plutonium eventually was routed back to ER.

*Ingot Casting.* Metal is melted in a MgO crucible to cast the ingot.

*Metal Coalescence.* Metal coalescence is used for plutonium turnings to coalesce the turnings into a metal button. Calcium metal and $CaCl_2$ are added to a MgO crucible along with the turnings and melted.

*Metal Oxidation.* Small pieces of metal remaining on furnace or crucible surfaces are collected for conversion to the oxide phase. These metal pieces are placed in a furnace for the conversion process. The oxide is then transferred to the vault.

*Neptunium.* A campaign to work off neptunium residues stored in the vault was undertaken in 1993 and was only active that year.

*Pickling.* Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. After a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts. It then becomes necessary to leach the plutonium from these items. In addition, after calcium metal reduction processes such as metal preparation, direct oxide reduction, and molten salt extraction, plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals.

*Plutonium Trichloride Preparation.* An intermediate process in Pu metal production prepared plutonium trichloride by bubbling a carrier gas (chlorine) through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500 °C–600 °C before being absorbed in a 5–6 molar potassium hydroxide solution. The carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991. Feed material was high purity oxides from the vault or from other P/S codes. The product plutonium trichloride was reduced to metal by the MSE or ER processes.

## 3.6 Material Inputs to the Waste Generation Processes

Material inputs to the waste generation processes derive from three general sources: (a) feed material, (b) chemical use, and (d) ancillary material inputs such as those related to the use of laboratory equipment and materials and glovebox maintenance activities. The feed materials for TA-55 processes that generate waste in waste streams TA-55-19 and TA-55-20 consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from various P/S codes, or from sources outside TA-55, including other DOE facilities. ~~Chemical use is discussed in Section 3.6.3. Material waste form inputs are discussed in Section 3.6.1. Radionuclide inputs are discussed in Section 3.6.2.~~

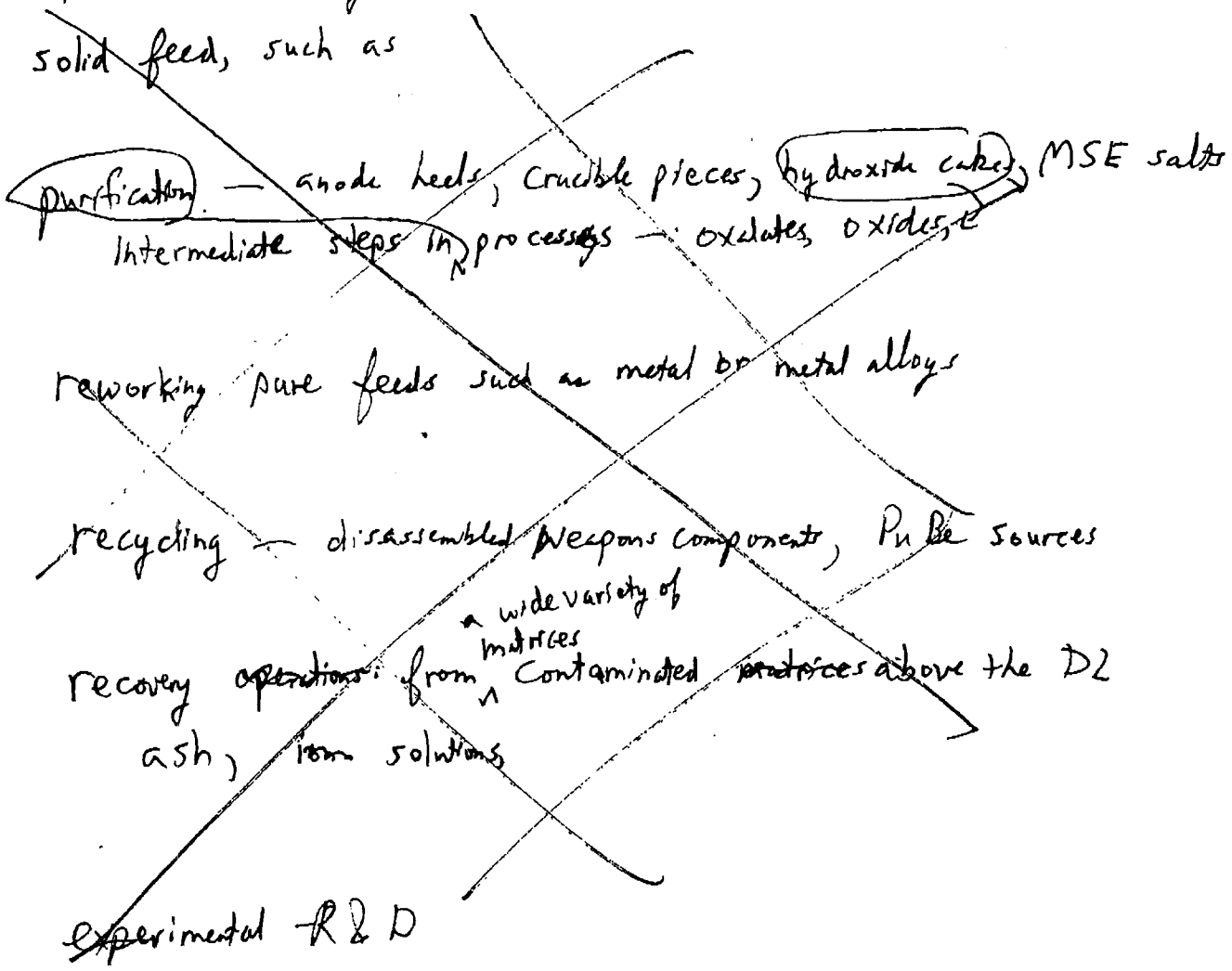
### 3.6.1 ~~Physical Waste Form Identification~~

Plutonium-processing facilities generate contaminated combustible debris waste from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, old bag-out stubs, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber and Teflon-based products used in the operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

~~Waste items from several different processes were segregated by physical waste form (e.g., combustible debris, metal, glass, etc.) and packaged into waste containers~~. The physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for many waste items is also documented on this form, although recording of P/S codes was spotty before about 1990.

- ~~Occasionally, leaded glove rubber waste item gloves and aprons~~
- Prior to 1987, leaded rubber gloves.... [copy from process AK report if email if I sent it to you] Re: Global edit to AK reports: leaded gloves




These feed materials fall into four general categories:

1. Pure Pu to be recycled from pits and sealed sources or to be reworked into desired shapes or chemical forms
2. intermediate Pu products in purification processes, such as solutions, oxides, hydroxides, salts, or anode heels
3. a wide variety of matrices contaminated with Pu above the DL, such as ash, equipment and solutions
4. experimental R&D feed

**Table 1. Feed Materials for Processes Contributing to Waste Streams TA-55-19 and TA-55-20**

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• CLS-1 solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (Cl-25/TWCP-3547). | Chloride operations: CLS, CW, CXL (analytical laboratory solutions from CLS-1); CSE, SE (other solutions)<br>Miscellaneous operations: ACL, ICP<br>Nitrate operations: CF, HP |
| Anode heels<br>spell out<br>Cadmium (D006), chromium (D007), lead (D008), and silver (D011). | Typically contaminated with RCRA-regulated heavy ~~metals (Cd, Cr, Pb and Ag (D006, D007, D008, D011)~~. Heavy metals ~~As, Hg, and Se~~ are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | Nitrate operations: AS, BF, BU<br>Pyrochemical processes: RA<br>arsenic (D004), mercury (D009) and selenium (D010) |
| Ash from P/S codes ETD, IS, SB, TDC, or from other DOE facilities spell out | Usually suspect contaminated with Ba, Cd, Cr, Pb, and Ag (D005, D006, D007, D008, D011). As, Hg, and Se may also be present although these metals are volatilized at high temperatures if present in the oxide and chloride forms. | Miscellaneous operations: CK, CV, FDL, FLU, SO, XP<br>Nitrate operations: AL, AT, ATL, ED, HGMS, IS, MPD, PTS, RC, SC<br>Special processing: ACD, IAM, SB, SL |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | Chloride operations: CL<br>Nitrate operations: MAS, SC<br>Special processing: ACD, SL |
| Disassembled weapons components (pit diassembly) | High-purity Pu and U material types, no RCRA substances present | Metal operation processes: ARI, CA, PH, SRL<br>Miscellaneous operations: EDC<br>Nitrate operations: BM, RB, RBJ |
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity | Miscellaneous operations: AD, CV, EXT, HRS, RASS, SA, XES, XP<br>Nitrate operations: MAS |

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Hydroxide cakes (process output from P/S codes CLS, CW, CXL, DO, POSM, PRR) | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) spell out | Miscellaneous operations: AD<br>Nitrate operations: CD, HCD, HD, LG2<br>Special processing: DO, POSM |
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters) | May be contaminated with RCRA-regulated heavy metals Ag, Cd, Hg, Pb and possibly Cr (D006, D008, D009, D011, and D007) spell out Silver Cadmium | Miscellaneous operations: APD<br>Nitrate operations: ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD<br>Pyrochemical processes: PK (hardware, metal, anode chips from other P/S codes)<br>Special processing: ACD, DO, SB, SL |
| MSE salts | Typically fairly pure, suspect contaminated with barium but no other RCRA substances present (D005) | Chloride operations: MB, MS<br>Miscellaneous operations: XP<br>Nitrate operations: MB, PS |
| Neptunium residues from vault | No RCRA-regulated substances | Pyrochemical processes: Neptunium (only active in 1993) |
| Pu chlorides and fluorides | Variable purity | Miscellaneous operations: FDL, SO<br>Pyrochemical processes: ER, SD, SS<br>Special processing: RM |
| Pu metal or metal alloy from vault or from various P/S codes | High purity, no RCRA-regulated substances, unless noted otherwise | Metal operation processes: AO, ARI, BC, BT, CA, DA, ELW, EVAC, FSPF, ITF, ITF4, JA, KBTF, MA, MBC, MW, PCH (variable purity), PD, PE, PF, PH, RL, SRL, VD, WE, WLT<br>Miscellaneous operations: AC, AC1, AC2, EXT, LIBS, ME, SA, SMP, VS<br>Nitrate operations: ATL, BM, BU, MF, PAF, VP1<br>Pyrochemical processes: CRD (variable purity), MO, SCB, SS, SSMD<br>Special processing: ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Pu oxalates | Typically fairly pure, no RCRA substances present | Nitrate operations: CC, DF, HC |
| Pu oxides | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals ~~Cd, Cr and Pb (D006, D007, D008)~~<br>High purity oxides from P/S codes CA, DO, and MA, and from the vault<br>spell out | Metal operation processes: DOP (high-purity Pu and other radionuclides as oxides)<br>Miscellaneous operations: CK, CV, EOC, EXT, FDL, FLU, IB, IE, LI, LIBS, SO, STF, VS, XP<br>Nitrate operations: ATL, BL, CH, CPOD, DP, ED, FC, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2<br>Pyrochemical processes: MP (generally high purity), OR (variable purity), PTP<br>Special processing: DO, PI, PX, POSM, RM |
| Pu-Be sources | High purity constituents, no RCRA-regulated substances | Chloride operations: PB, PUB |
| Pyrochemical ~~(processes/chemical)~~ salts | Typically fairly pure, no RCRA substances other than ~~Ba~~ barium (D005) are present | Chloride operations: MB, MS, PRR<br>Miscellaneous operations: EXT, IB<br>Nitrate operations: COD, COL, MB<br>Special processing: DO |
| Reactor fuel pellets | High purity Pu and U material types, no RCRA-regulated substances | Metal operation processes: ME |
| Stainless steel and/or tantalum residues from decladding of Pu-Be sources | High purity metals, potential leaching of chromium (D007) from stainless steel if subjected to strong acid | Chloride operations: PUB |

TRU waste drums containing one or more waste items were packaged by the Nuclear Material Technology Group (NMT-7) according to procedures referenced in the applicable version of the TA-55 Attachments to the Certification Plan (TWCP-697). Sample attachments are referenced as TWCP-701 (for 1987) and TWCP-700 (for 1995). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel.

move all this to section 3.2.2

Both the WODFs and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

### 3.6.2 Radionuclide Content Identification

The primary Pu material type inputs for ~~metal operation~~ TA-55 processes at ~~TA-55~~ are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of ~~these~~ such bounding calculations is to provide a basis for identifying significant enrichment or depletion of radionuclide versus another, based on radioassays of individual waste containers. The results of these calculations are ~~also~~ tabulated in Table 2. ~~Assuming~~ (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides will be present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material:

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope (Weight %) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 ($8.26 \times 10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

Where is Table 3. Average Isotopic Content of Uranium Material Types and Enrichments ?

Also the sentence referring to this table
See following page excerpted from earlier draft

Probably was accidentally marked as strike-out — check if still there in the ~~file~~ document but just hidden from view as a deletion

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope (Weight %) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

superscript

(a) These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

The primary uranium material type inputs for reactor fuel development activities and for pit disassembly at TA-55 are listed in Table 3.

**Table 3. Average Isotopic Content of Uranium Material Types and Enrichments (Weight %)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Source: TWCP-698

Insert (2) → cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Pu-241, TA-230, Th-233, U-235 and U-238

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present mostly in minor amounts in most debris waste from processes at TA-55.

- In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposely contain uranium.

- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239.

- U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2).

Insert 2 new bullets plus text from back

In addition, secondary radionuclides will be present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memo according to P/S code (TWCP-882), as summarized in Table 3.4. ~~In addition to the radionuclides previously mentioned above, this list includes~~ This list includes Am-241, Am-243, During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The results of these assay results are summarized in Section 14.2.

3.6.3 Chemical Content Identification

Chemical contents of process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from (SME) input. Individual process AK reports contain detailed assessments of these chemical inputs, and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories:

subject matter expert

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

(*) • Protactinium (Pa)-241, ~~may be present~~ the alpha-decay daughter of U-235, is expected to be present in trace amounts in some TA-55 wastes due to its widespread presence as a contaminant in TA-55 operations.

• Cesium (Cs)-137, a fission product of U-235, is expected to be present at detectable levels in some TA-55 wastes, due to its widespread presence as a contaminant in TA-55 operations.

over → (#1)

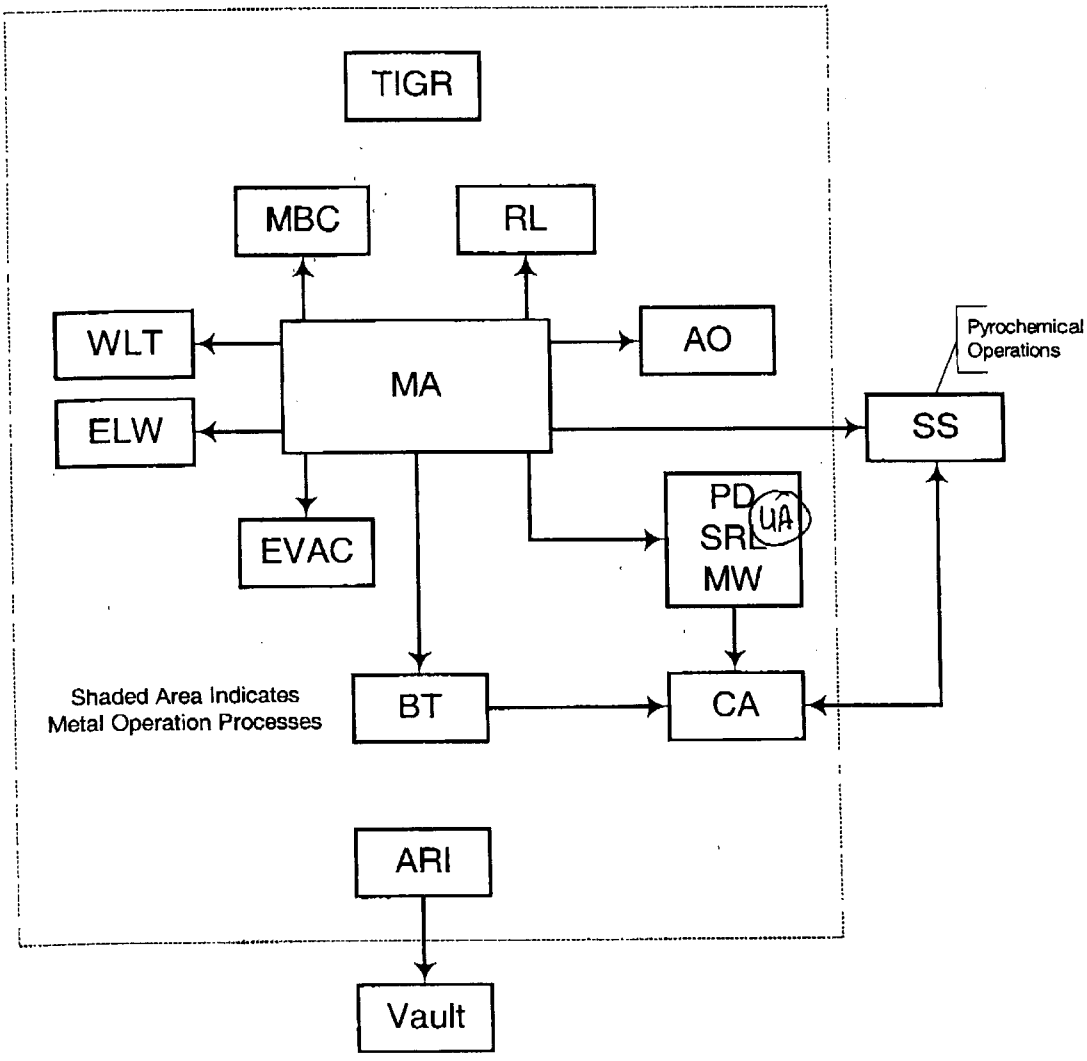
(#1) Although they are products of U-235 fission and decay, Concentrations of Cs-137 and Pa-231 are not expected to show any correlation with the presence or absence of this isotope. The difference in valence states and chemical affinities among these elements is expected to result in substantial fractionation during several TA-55 processes, including ion exchange, solvent extraction, and exposure to very high temperatures.

U-235 concentrations, or even with

hydroxide precipitation, dissolution,

(2) Cm-244 was introduced in TA-55 operations in P/5 code DOP, which began in 1988. Material outputs from this process sometimes were sent to P/5 codes I5 or WE, but this nuclide is not expected to be present in any waste generated before 1988.

**SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS (continued)**

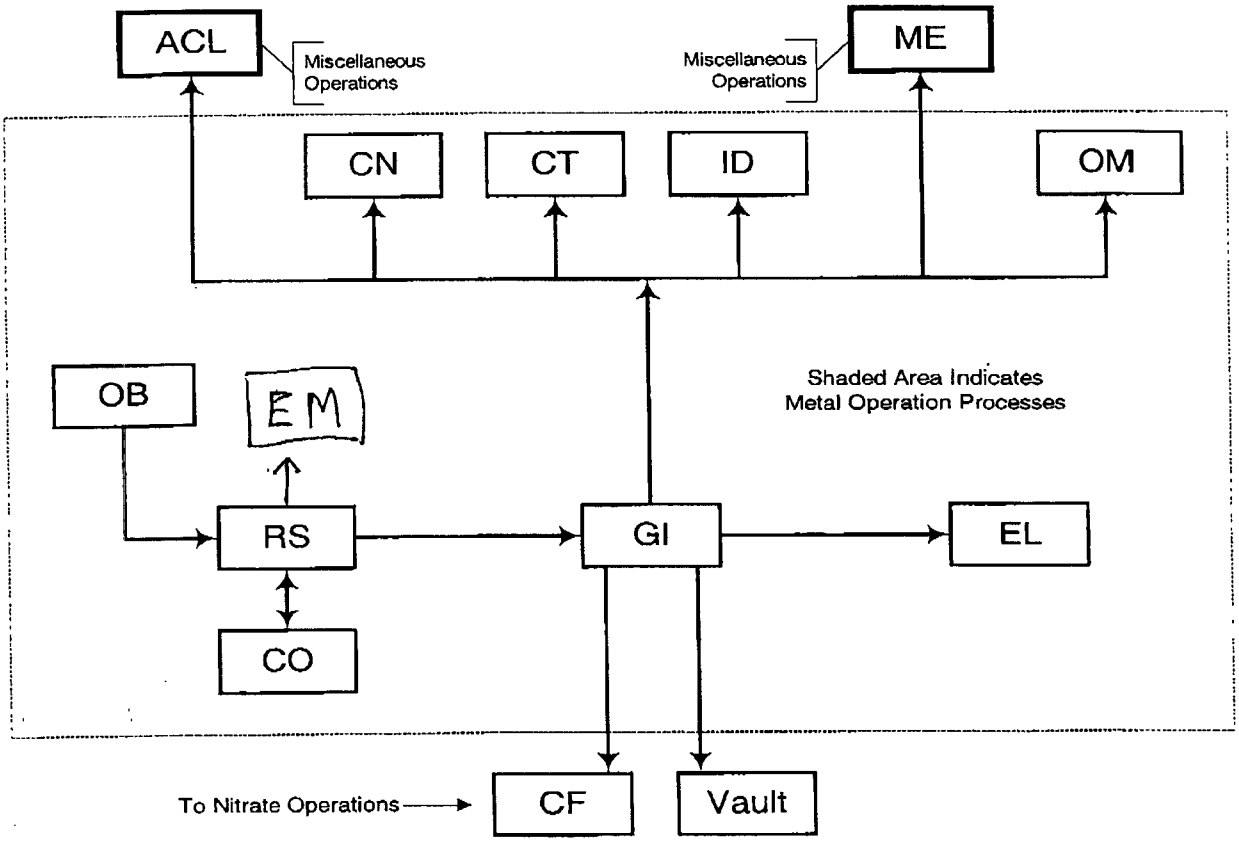



**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

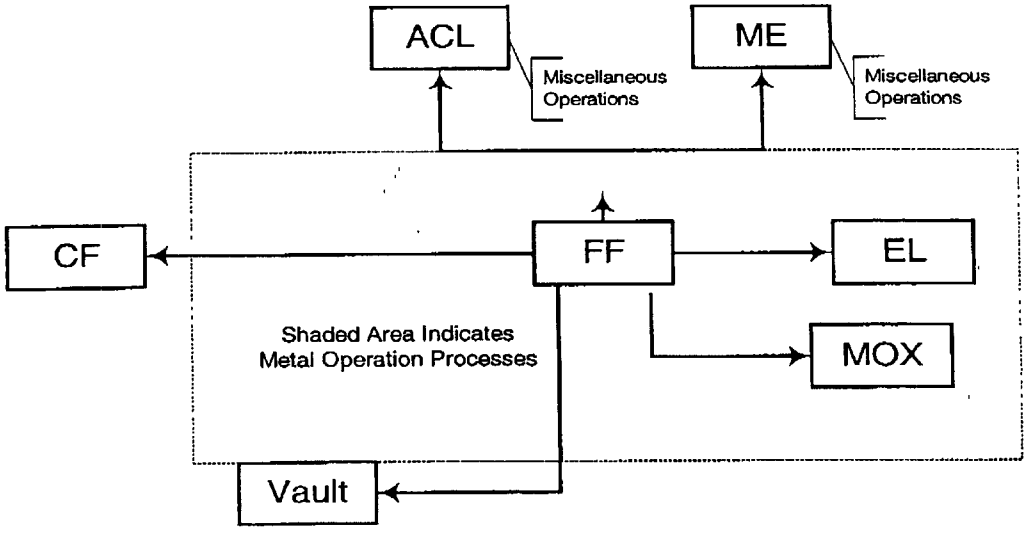
NOTE: P/S code UA ~~treats~~ tracks uranium compounds from Pit Disassembly & Activities under this P/S code would be similar to those under P/S codes IN, MW and WE.

~~Also Produced U-233 detector package~~

## SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS (continued)




In 1988, P/S codes CO, GI, ID, OB, and RS were combined into P/S code FF. P/S codes CT, ID, and OM are statuses only, and will not generate TRU waste.




**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

Sandy's Review 5/4/01

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-01- )

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19 (~~Lot~~ including TA-55-19A) and TA-55-20

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

John Musgrave
JOHN MUSGRAVE — DATE 5/1/01

**APPROVALS:**

June Fabryka-Martin
INDEPENDENT TECHNICAL REVIEWER/EDITOR — DATE 5/1/01

_____
SITE PROJECT MANAGER — DATE

_____
WASTE CERTIFICATION OFFICIAL — DATE

_____
SITE PROJECT QA OFFICER — DATE

_____
FACILITY REPRESENTATIVE — DATE

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**Attachments**

1 Acceptable Knowledge Roadmap (14 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Simplified Process Flow Diagrams (8 pages)
4 Waste Generator Forms for TRU Waste (5 pages)
5 Chemical Waste Disposal Request Form (1 page)

| | |
|---|---|
| PRQL | program required quantitation limit |
| P/S | process/status [code] |
| PuBe | plutonium–beryllium |
| PVDF | polyvinyldienefluoride (also known as Kynar) |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RD&D | research, development, and demonstration |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| RSWD | radioactive solid waste disposal |
| RTR | real-time radiography |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3) |
| SME | subject matter expert |
| SOP | safe operating procedure |
| TA | technical area |
| TBP | tributyl phosphate |
| TOPO | trioctylphosphine oxide |
| TRU | transuranic |
| TRUCON | TRUPACT-II Content Code |
| TRUPACT-II | Transuranic Waste Transporter-Model II |
| TWBIR | Transuranic Waste Baseline Inventory Report |
| TWCP | Transuranic Waste Characterization/Certification Project |
| U | Chemical symbol for Uranium, or RCRA hazardous waste number prefix for toxic waste defined in 40 CFR Subpart D, Section 261.33(f) |
| $UCL_{90}$ | 90% Upper Concentration Limit |
| UCNI | unclassified controlled nuclear information |
| VE | visual examination |
| VOC | volatile organic compound |
| WAC | Waste Acceptance Criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request form |
| XES | X-ray energy spectroscopy |

Replace references to section 3.4... with 3.5... on this Index.



## TA-55 PROCESS/STATUS CODE INDEX

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| AC | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, D038, F002, F005 |
| AC1 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, F002, F005 |
| AC2 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, D038, F002, F005 |
| AC3 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | |
| ACC | Ammonium chloride conversion | Special Processing | 3.4.8, Att. 4 | |
| ACD | Cascade dissolver | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| ACL | Analytical chemistry laboratory | Miscellaneous Operations | 3.4.4, Att. 4 | D007, D009 |
| AD | Actinide processing demonstration | Miscellaneous Operations | 3.4.1, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| AL | Ash leach | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| AO | Assembly operation | Metal Operation Processes | 3.4.3, Att. 4 | |
| AO | Americium processing calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| AP | Americium purification | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | D007, D009 |
| APD | Actinide processing demonstration | Miscellaneous Operations | 3.4.7, Att. 4 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| ARI | ARIES | Metal Operation Processes | 3.4.3, Att. 4 | |
| AS | Anode heel dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008, D011 |
| AT | Ash testing | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| ATL | Advanced test line for actinide separation RD&D | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| AX | Solution assay | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009 |
| BA | Basement isopress | Metal Operation Processes | 3.4.2, Att. 4 | |
| BAC | Bacterial decomposition of cellulose items | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| BC | Physical properties | Metal Operation Processes | 3.4.2, Att. 4 | |
| BF | Unknown name for P/S code | Nitrate Operations | 3.4.6, Att. 4 | D006, D007, D008, D011 |

Stet Same code

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| LG1 | Non combustible leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| LG2 | Hydroxide cake dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008, D009, D011 |
| LI | XF6 experimental measurements | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| LIBS | Laser-induced breakdown spectroscopy system | Miscellaneous Operations | 3.4.5, Att. 4 | |
| LR | Ion exchange | Nitrate Operations | 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |
| MA | Machining | Metal Operation Processes | 3.4.2, Att. 4 | D035, D040, F001, F005 |
| MAG | Magnetic separation | Nitrate Operations | 3.4.1, Att. 4 | |
| MAS | RD&D experimental processes | Nitrate Operations | 3.4.1, Att. 4 | |
| MB | Nitric dissolution of molten salts | Chloride Operations<br>Nitrate Operations | 3.4.2, Att. 4<br>3.4.2, 3.4.6, Att. 4 | D007, D008, D009 |
| MBC | Crystal | Metal Operation Processes | 3.4.3, Att. 4 | |
| ME | Metallography | Miscellaneous Operations | 3.4.10, Att. 4 | D007, D040, F003 |
| MELL | Mediated electro-oxidation of LLW | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| MF | Metals furnace | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| ML | Non-Pu metal leach | Nitrate Operations | 3.4.2, Att. 4 | D006, D008 |
| MO | Metal oxidation, room 429 | Pyrochemical Processes | 3.4.9, Att. 4 | |
| MOX | Mixed oxide fuel production | Metal Operation Processes | 3.4.1, Att. 4 | |
| MP | Metal preparation | Pyrochemical Processes | 3.4.1, Att. 4 | |
| MPD | Cascade dissolver | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| MS | Molten salts purification dissolution | Chloride Operations | 3.4.2, Att. 4 | D007, D008, D009 |
| MW | Metal working | Metal Operation Processes | 3.4.2, Att. 4 | |
| NC | Noncombustible leach | Nitrate Operations | 3.4.2, Att. 4 | D006, D008 |
| NCD | Nonconfirming drums | Miscellaneous Operations | 3.4.9, Att. 4 | |
| NEPTUNIUM | Neptunium | Pyrochemical Processes | 3.4.10, Att. 4 | |
| NL | Noncombustible leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| NR | Nitrate recovery | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| OB | Oxide blending | Metal Operation Processes | 3.4.1, Att. 4 | |
| OD | Oxide dissolution | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008 |
| OH | Hydroxide precipitation | Nitrate Operations | 3.4.1, 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |

Stet

No starter code.

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| OM | Oxygen to metal ratio determination | Metal Operation Processes | 3.4.1, Att. 4 | |
| OR | Direct oxide reduction | Pyrochemical Processes | 3.4.2, Att. 4 | |
| OY | Oxalate precipitation | Nitrate Operations | 3.4.1, 3.4.3, Att. 4 | |
| PA | Passivation | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| PAF | Passivation furnaces | Nitrate Operations | 3.4.1, Att. 4 | |
| PB | Pu-beryllium source recovery | Chloride Operations | 3.4.1, Att. 4 | D007, D008, D009 |
| PCH | Plasma chemistry | Metal Operation Processes | 3.4.2, Att. 4 | D007 |
| PD | Pit disassembly | Metal Operation Processes | 3.4.2, Att. 4 | |
| PE | Sputtering process | Metal Operation Processes | 3.4.2, Att. 4 | D004 |
| PF | Plutonium surfaces | Metal Operation Processes | 3.4.2, Att. 4 | |
| PH | Thermal hydride/dehydride | Metal Operation Processes | 3.4.2, Att. 4 | |
| PI | Preparation of isotopes | Special Processing | 3.4.4, Att. 4 | |
| PIG | Welding | Metal Operation Processes | 3.4.3, Att. 4 | |
| PK | Pickling and nitrate holding | Pyrochemical Processes | 3.4.11, Att. 4 | D006, D007, D008, D011 |
| POSM | Processing out-of-specification material | Special Processing | 3.4.3, Att. 4 | D007, D011 |
| PPD | Pu pellet dissolution | Special Processing | 3.4.11, Att. 4 | |
| PR | Peroxide precipitation | Nitrate Operations | 3.4.3, Att. 4 | |
| PRR | Pyrochemical residue recovery | Chloride Operations | 3.4.3, 3.4.4, Att. 4 | D007, D009 |
| PS | Peroxide precipitation of MSE salts | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| PT | Plutonium-thorium separation | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D007 |
| PTP | Plutonium trichloride preparation | Pyrochemical Processes | 3.4.12, Att. 4 | D019 |
| PTS | RD&D pretreatment study | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D005, D006, D007, D008, D011 |
| PUB | Pu/Be source recovery | Chloride Operations | 3.4.1, Att. 4 | D007, D008, D009 |
| PX | Pyrochemical R&D | Special Processing | 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, Att. 4 | D006, D008, D019 |
| RA | Recovery of anodes | Pyrochemical Processes | 3.4.6, Att. 4 | why not list from Table 1? |
| RAP | Research alloy preparation | Metal Operation Processes | 3.4.3, Att. 4 | |
| RAP2 | Research alloy preparation | Metal Operation Processes | 3.4.3, Att. 4 | |
| RASS/RSS | Raman spectroscopy system | Miscellaneous Operations | 3.4.5, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RB | Roasting and blending | Nitrate Operations | 3.4.3, Att. 4 | |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| SX | Americium processing silicon removal | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| TDC | Thermal decomposition of cellulose items | Nitrate Operations | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| TIGR | Thermally induced gallium removal | Metal Operation Processes | 3.4.3, Att. 4 | |
| UA | Uranium fabrication | Metal Operation Processes | 3.4.2, Att. 4 | |
| UPS | Uranium/plutonium separation | Nitrate Operations | 3.4.2, Att. 4 | |
| US | Uranium separation for solid solution feed | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| US2 | Uranium separation for non-solid solutions feed | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| VC | Variable CSMO scrap dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| VD | Vapor degreaser and sand blasting | Metal Operation Processes | 3.4.2, Att. 4 | |
| VP1 | CSMO scrap dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D009 |
| VP2 | Polycube processing | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| VP3 | Hydroxide precipitation | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | D009/~~D011~~ |
| VS | Confirmation, inspection & sampling | Miscellaneous Operations | 3.4.5, Att. 4 | |
| VU | Vessel unloading | Special Processing | Att. 4 | D005, D008 |
| VUL | Vessel unloading | Nitrate Operations | 3.4.1, Att. 4 | D005, D008 |
| WE | Welding | Metal Operation Processes | 3.4.2, Att. 4 | |
| WLT | Welding leak test | Metal Operation Processes | 3.4.3, Att. 4 | |
| WM | Waste management | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| X0 | Inactive or unspecified P/S material | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-ray energy spectroscopy | Miscellaneous Operations | 3.4.5, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| XO | Inactive or unspecified P/S material | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XP | RD&D experimental processes | Miscellaneous Operations | 3.4.4, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| ZD | Scrap oxide dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Metal Operation Processes (TWCP-AK-2.1-003,R.2), Miscellaneous Operations (TWCP-AK-2.1-004,R.2), Nitrate Operations (TWCP-AK-2.1-005,R.2), Pyrochemical Processes (TWCP-AK-2.1-006,R.2), and Special Processing (TWCP-AK-2.1-007, R.2)

Sue to this will go on previous page

Jim - your call!

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19, Mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1978–present |
| **Defense Waste Status:** | Defense-related transuranic (TRU) waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 4173 containers (873 $m^3$) [including lot TA-55-19A] |
| **Waste Stream Volume (after repackaging):** | 850 SWBs, 3873 drums (2390 $m^3$) |

### Facility Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

### Waste Generating Processes

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate TRU wastes. These operations include:

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19A

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19A, Mixed Combustible Debris Waste with P120 |
| | **NOTE:** This is a subset (i.e., lot) of waste stream TA-55-19. It is distinguished from TA-55-19 only insofar as the waste has the potential to include vanadium pentoxide (EPA HWN P120). |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 02/98–06/98 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | ~~Not yet determined~~ 83 containers (16 m³) |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

I still need to research this

why not if the generation period was only 4 months?

This doesn't make sense - if 55-19A is a subset and you have volumes on 55-19, you need volumes here — or you need to note to exclude 55-19A from 55-19

**Radionuclide Content** Corrections needed on all 3 AK Summaries

~~These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types, as well as contaminants from uranium-235: its decay daughter, protactinium-231, and fission product cesium-137.s. Other waste may contain various radionuclides used as feed materials for producing radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.~~ These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, ~~protactinium-231~~ and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 may be present because ~~this fission product was not completely separated from plutonium during Purex processing at other DOE sites~~. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

and protactinum-231

**Primary References for Documentation of Acceptable Knowledge**

of their widespread presence as contaminants in TA-55 operations.

*Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3)

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-20

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-20, Non-mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-T16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1979–present |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 281 containers (59 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not ~~available~~ yet determined |

Is there a difference in meaning in "Not available" versus "Not yet determined"?

**Facility Mission**

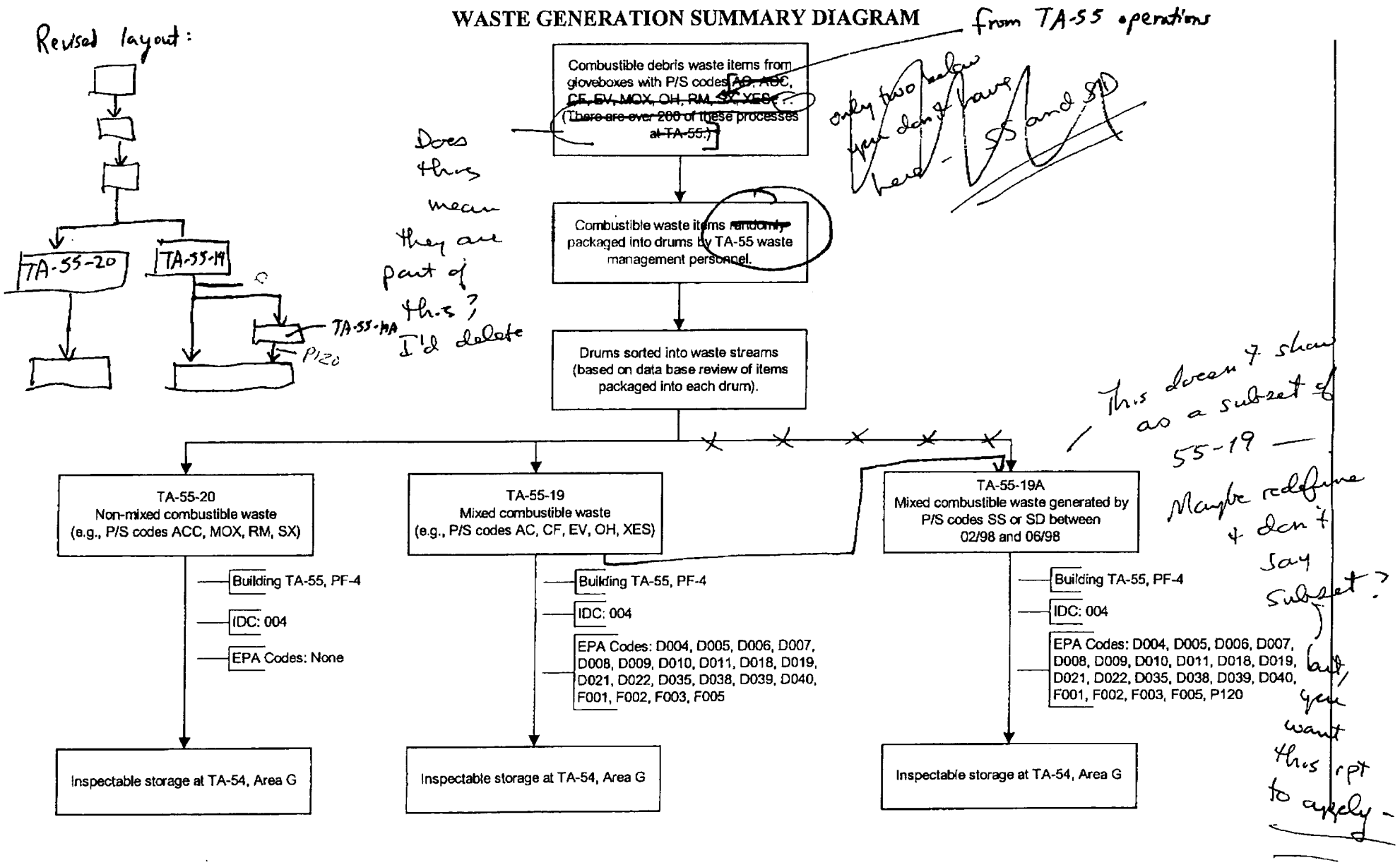
TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate TRU wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds

## WASTE GENERATION SUMMARY DIAGRAM



# ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR WASTE STREAMS TA-55-19, LOT TA-55-19A, AND TA-55-20

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK information and provides guidelines on how AK should be obtained and documented.

This AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the Plutonium Facility at Technical Area (TA) 55, one of the TRU waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides technical support for assignment of specific waste containers to the waste stream.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to waste streams TA-55-19 (including lot TA-55-19A) and TA-55-20 covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) (Sampling Plan) that includes information regarding all waste streams, including TA-55-19 and TA-55-20
- Review of documents related to the waste generation and waste management activities at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as documented in process AK reports listed in the Acceptable Knowledge Roadmap (Attachment 1)
- Review of process AK reports for TA-55 processes (as discussed below)
- Analysis of processes generating waste, as discussed in the process AK reports and in this report

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that are referenced in this summary report. Unclassified Controlled Nuclear Information (UCNI) ~~will be~~ reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK summary report is based on detailed information compiled in a set of closely related reports about TRU waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six ~~arbitrary~~ operational areas. The multiple processes in each area are ~~then~~ described in detail in the following six process AK reports:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

The process AK reports contain information on over 175 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. For example, the nitrate operations report (*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005,R.2]) covers waste generation processes and characteristics for over 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generator records. However, as described in section 3.2, TA-55 TRU waste items have always been segregated and packaged into waste containers based on the physical form and material type content of the waste, without regard to process of origin (i.e., P/S code). In order to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number), separate AK reports have been prepared for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in the process AK reports.

This AK summary report summarizes AK information specific to the combustible debris waste streams TA-55-19 (including waste stream lot TA-55-19A) and TA-55-20.

## 3.0 DESCRIPTION OF THE WASTE STREAM

### 3.1 Facility and Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

The combustible waste streams TA-55-19 and TA-55-20 were generated at the TA-55 Plutonium Facility (Building PF-4) as debris waste from process operations and glovebox maintenance involved in plutonium recovery. For this reason, the waste streams are defense related. However, waste also was produced from "special process" and research-related activities. These wastes were not segregated until 1998, but rather were commingled in the final waste containers to such an extent that segregation is not possible on the basis of waste generating process or glovebox location (TWCP-887). The waste was also co-mingled with room trash related to these same operations (both defense and non-defense), which was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site assay results showed it exceeded the low-level waste threshold value (TWCP-816).

A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process of origin. Relevant details of these planning and implementation documents are summarized in this section~~, in order~~

to provide background information to support the process used by TWCP to assign TA-55 waste containers to specific waste streams. Waste stream assignment is made on the basis of waste generator information compiled in the TWCP waste container data base, which comprises the bulk of the Sampling Plan. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, ~~in order~~ to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents.

3.2.1 Waste Packaging at TA-55

Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged by this team. Materials are considered waste only when they have been received and processed by the waste management team. Waste segregation schemes used by this team have evolved since operations began at the Plutonium Facility in 1978.

In 1978, the standard operating procedure for waste management at TA-55 stated the guiding philosophy of minimizing the amount of waste generated and minimizing the plutonium content of that waste (TWCP-3943). Discard Limits (DL) for plutonium in various types of waste matrices were established by the waste-generating group, and approved by the LANL division office and the DOE Albuquerque Operations Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of plutonium) into classes such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. All liquids, including oils, were required to be sent to recovery operations for processing. Liquids were explicitly prohibited from any container of solid waste materials.

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific processes and waste streams. TA-55 prepared an attachment in March 1987 for contact-handled combustible and noncombustible solid waste (TWCP-701), defined as follows:

- Combustible waste forms included materials ~~which~~ that could be reduced to an ash if desired but ~~which~~ that did not require further processing to meet the WIPP WAC (TWCP-701). (This definition is still current.) Subcategories included plastic-base, cellulose-base and miscellaneous (graphite and graphite crucibles). It was acceptable for the combustible waste stream to include some unspecified "small" fraction of noncombustible solids such as scrap metals.

- Noncombustible waste forms included materials that could not be reduced to ash but that did meet the WIPP WAC without further processing (TWCP-701). The two subcategories were metals and non-metals. The non-metal wastes included glass, fiberglass heating mantles, porcelain crucibles, ceramic furnace tube inserts, and leaded glovebox gloves. It was acceptable for the noncombustible waste stream to include some unspecified "small" fraction of combustible solids, and that could be contained in plastics. For WIPP purposes, any waste forms that were chemically compatible and that met the WAC, could be combined into a single waste container.

In 1995, a new TRU Waste Certification Plan was adopted, including a new attachment that formalizes how the TA-55 waste management team currently segregates newly generated wastes into waste streams (TWCP-700). Waste materials are segregated:

- by radioisotope, ~~in order~~ to meet nondestructive assay (NDA) and gas generation requirements

- by material matrix, ~~in order~~ to meet NDA and TRUCON requirements

- by hazardous constituents, ~~in order~~ to meet RCRA and Department of Transportation (DOT) requirements

Combustible waste forms include plastic base and cellulose base (TRUCON code 116), but graphite waste was moved to the noncombustible category. Noncombustible debris waste forms are broken down to a finer level of classification than had previously been used:

- metals (TRUCON code 117)
- glass (TRUCON code 118)
- HEPA filters (TRUCON code 119)
- leaded gloves (TRUCON code 123)
- salts (TRUCON code 124)
- graphite (TRUCON code 115)

In addition, each major waste form includes provisions for small quantities of unspecified waste with similar properties. This provision is necessary ~~in order~~ to allow for infrequently encountered waste items.

3.2.2 Waste Stream Delineation for TA-55

From the beginning of operations at TA-55, the physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for waste items was sometimes also documented on this form. Starting in 1987, the TA-55 Plutonium Facility began its current system of tracking waste items both by the process from which they originated as well as by their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item (although recording of P/S codes was inconsistent until about 1990). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel. Both the WODF and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- First by radioisotope content (Pu-238 or Pu-239 material type)
- Then by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

Waste stream delineation was performed using waste generator information (such as the WODF and DWLS) that has been compiled in an electronic data base that is part of the Sampling Plan. Because waste

items from several different P/S codes were combined into each waste drum, a special sort on the P/S code of each waste item in a drum was necessary to determine if the drum contained all non-mixed items, some or all mixed-waste items, or a special case item (such as an item from P/S code SS carrying the EPA Hazardous Waste Number (HWN) P120). If the P/S code information was missing for any item in a waste drum (as was the case for many older wastes), that drum was conservatively assigned to the mixed-waste stream. Fortunately, the special case wastes carrying the HWN P120 were generated relatively recently, such that the data base records for those items are usually complete.

### 3.2.3 Waste Container Labeling

The net effect of the waste packaging system used at TA-55 is that several HWNs are conservatively assigned to individual waste streams for the purposes of WIPP disposal, because the WIPP WAP requires HWN assignment on a waste stream rather than a waste container basis. For the purposes of generator and on-site storage, however, LANL labels waste on a container by container basis. Thus, the hazardous labels on containers in storage at LANL should not be expected to correspond to the HWNs assigned to the waste stream through this AK summary report. Hazardous labels are updated to meet WIPP disposal requirements just before loading waste containers into the Transuranic Package Transporter-Model II (TRUPACT-II) for shipping to the WIPP.

## 3.3 Waste Physical Form and Content Description

The TA-55-19, ~~19A,~~ and-20 waste streams are defined as combustible debris waste streams (Sampling Plan, Appendix D), with TA-55-19 being a mixed-waste stream and TA-55-20 its non-mixed counterpart. TA-55-19A is a small substream lot, distinguished from TA-55-19 by the addition of HWN P120. Both of these waste streams include paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape, gloves, plastic vials, polystyrene, Tygon tubing, polyvinyl chloride plastic, Teflon products, Plexiglas, and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (generally less than 5 percent) of non-combustible solids (scrap metal, metal lids, and clothing zippers) (Sampling Plan, Appendix D).

Leaded gloves are also generated as process waste in TA-55 operations. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams, including TA-55-19. Between 1987 and May 1992, leaded gloves began to be segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if

the combustible debris waste were ever incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

3.4 Waste Volume and Time Period of Waste Generation

The following information is from Appendix D of the Sampling Plan (R.3). These inventories are expected to change because the Sampling Plan is continually updated as new waste information is obtained.

- TA-55-19 includes 4173 containers (873 cubic meters), that were generated from 1978 to the present time.
- Waste stream lot TA-55-19A is a subset of TA-55-19 which contains 83 containers (16 cubic meters), with waste items generated between from ~~is not yet fully defined in the sense that a list of specific waste containers in this lot has not yet been prepared. This is because P/S codes are not always explicitly identified for waste items in TA-55 waste containers. However, it may be possible to extract this information from the waste item identifiers, at which time waste containers can be assigned to TA-55-19A.~~
- TA-55-20 includes 281 containers (59 cubic meters), that were generated from 1979 to the present time.

So how do I ensure we are not sending any of this to WIPP?

P/S codes SD and SS between 2/98 and 6/98.

3.5 Waste Stream Generation Processes

3.5.1 Overview

The TA-55-19, -19A, and -20 combustible debris waste streams were generated from combustible materials used in processes to recover plutonium from residues, metal fabrication, and research and development activities. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds
- Preparing, on a large scale, specific alloys, including casting and machining these materials into specific shapes
- Determining high-temperature thermodynamic properties of plutonium
- Reclaiming plutonium from scrap and residues produced by numerous feed sources
- Disassembling components for inspection and analysis

- Manufacturing of parts on a limited basis
- Processing mixtures of plutonium and uranium oxides for reactor fuels.

The manufacturing and research operations performed at TA-55 in the recovery of plutonium results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scrap generated from operations at various LANL, other U.S. Department of Energy (DOE) facilities, and commercial radioactive sources. These recovery operations, along with associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Plutonium processing operations generate contaminated combustible waste from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber- and Teflon-based products used in operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

3.5.2 Process Flow Diagrams

Detailed information about the TA-55 plutonium recovery processes can be found in the process AK reports. For purposes of the AK search, and to allow convenient referral to and referencing of the process AK reports in this waste stream AK summary report, the processes have been ~~arbitrarily~~ divided into six major areas:

- Chloride Operations (TWCP-AK-2.1-002)
- Nitrate Operations (TWCP-AK-2.1-005)
- Miscellaneous Operations (TWCP-AK-2.1-004)
- Special Processing (TWCP-AK-2.1-007)
- Metal Operation Processes (TWCP-AK-2.1-003)
- Pyrochemical Processes (TWCP-AK-2.1-006)

Generalized flow diagrams for these six operational areas are presented as Attachment 3 and indicate P/S codes for the various processes. The

full block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

The following subsections describe the processes that generated debris waste assigned to the TA-55-19, -19A, and -20 waste streams. The potential for RCRA-regulated constituents to be present due to feed materials and chemical use in these processes is summarized in Sections 3.6.1 and 3.6.3. The applicability of EPA HWNs as a result of this potential is specified in Section 8.

3.5.3 Chloride Operations

P/S codes CL, CLRD, CLS, CS, CSE, CW, CX, CXL, LD, MB, MS, PB, PRR, PUB, and SE

A detailed description of chloride operations can be found in *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002).

The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The primary feed sources are plutonium residues from pyrochemical operations, plutonium-beryllium (PuBe) neutron sources, analytical laboratory solutions, and residues from other DOE facilities. Chloride operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- hydroxide precipitation

Pretreatment may include sorting, crushing, and/or pulverizing feed materials prior to being fed into later steps of chloride operations. A separate pretreatment procedure is the decladding of plutonium-beryllium sources. The PuBe metal alloy is removed from the sources, which are then entered into the chloride line for plutonium recovery along with other materials.

In the dissolution step, hydrochloric acid is used to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory. Enriched solutions undergo further purification (see next paragraph), and solid wastes are discarded as debris waste or sent to cement fixation in nitrate operations (Section 3.5.4).

Purification steps may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and separate out impurities. Enriched solutions may be further treated with oxalic acid to precipitate plutonium oxalate, which is converted to plutonium oxide.

In the hydroxide precipitation step, plutonium in filtrate solutions from purification steps is precipitated with potassium, magnesium, or sodium hydroxide. Heavy metals are concentrated in the plutonium-rich hydroxide cakes and derive from one or more of the following: (a) feed materials that consist of or contain these metals; (b) leaching of chromium from stainless-steel equipment components; or (c) ~~from~~ the use of silver salt (until 1994) as an indicator of chloride content. The resulting Pu-enriched hydroxide cakes become feed material for nitrate operations, and liquid meeting the TA-50 WAC is sent to the RLWTF using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

3.5.4 Nitrate Operations

P/S codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride operations), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- evaporation
- cement fixation

Pretreatment primarily includes physical processes used to separate scrap and residues for the next step, dissolution. It may include calcination, caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing, distillation, filtering of liquids or oils, incineration, magnetic separation, passivation, scraping, or sorting. After pretreatment, solids are sent to dissolution if plutonium concentrations are above the DL and to solid waste packaging (at the present time) or to cement fixation (in the past) if concentrations are below the DL. Liquids are sent to purification if plutonium concentrations are above the DL and to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) if they meet the TA-50 RLWTF WAC or to evaporation and cement fixation; otherwise, they are further treated until they meet that WAC.

Dissolution includes various steps that generate plutonium nitrate solutions for feed to purification. Primary chemicals used in dissolution are nitric acid ~~and~~ calcium fluoride, and/or hydrofluoric acid. Filtered solids are returned to the dissolution process until plutonium concentrations are below the DL, then sent to cement fixation for disposal. Debris items are disposed after removal of plutonium contamination above the DL. Plutonium-bearing solutions are sent ~~on~~ to purification.

Purification consists of ion exchange and precipitation processes. The ion exchange processes use resin-filled columns to collect plutonium, which binds to the resin while impurities flow through the columns; an eluting agent is then used to release purified plutonium in solution. The enriched solutions are then sent to oxalate precipitation. Calcination of the oxalate converts the plutonium to oxide form. The depleted liquids are sent to the evaporator or the RLWTF, and the calcined plutonium oxides are sent to the vault.

The evaporator processes plutonium-poor liquids in order to re-concentrate plutonium, if possible, or to reduce the volume of liquid waste. Evaporator bottoms are either sent back to ion exchange or discarded to cement fixation, depending on their plutonium content. Heavy metals that may be present are concentrated in this process.

In the cement fixation step, wastes with low plutonium concentrations are collected and immobilized in cement. Most of the wastes generated under these processes (P/S codes CF, HP, and IA) are classified as cemented wastes and would not normally be part of the debris waste streams.

compounds, their characterization and reaction chemistry, and application to existing actinide processing technology. Other operations comprised a broad range of laboratory activities in support of fundamental and applied actinide chemistry research, including preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation.

*Analytical Operations.* This category covers all analytical techniques performed in Room 124 of the Plutonium Facility. Processes involve analysis of plutonium and americium, RCRA metals, and trace metals. Originators provide samples, which are prepared for further analyses, such as inductively-coupled plasma (ICP) and X-ray energy spectroscopy (XES). Unused liquid samples are returned to the originator, sent to radiochemistry for counting, or sent to recovery operations.

*R&D Efforts.* Several small-scale R&D efforts primarily focused on plutonium recovery included the following activities:

- Fluoride sintering of $PuO_2$ took advantage of the presence of fluoride to aid the formation of a sintered mass of $PuO_2$ powder at temperatures above 700 °C. Spacing is correct (ACS)
- Chlorination of Pu oxides involved oxides with tantalum chips from Rocky Flats Environmental Technology Site (RFETS). Chlorination was used to recover plutonium from potassium chloride and sodium chloride matrices.
- Processing of molten-salt extraction (MSE) salts generated at LANL and RFETS.
- Recovery of plutonium from ash involving plutonium/thorium oxide mixtures.
- Processing of neptunium oxide and metal was performed to remove the protactinium daughter in order to use the neptunium for NDA standards.

*Measurement/Detection Operations and Studies.* P/S code VS involves the inspection of oxides and metals. Materials are retrieved from the vault, brought to the glovebox, inspected and sampled if necessary, then repackaged and returned to the vault. Assay methods include XES, laser based spectroscopy, and other spectroscopic techniques. Electron microscopy may be conducted on actinide samples in the future. In addition to elemental and isotopic analyses, other measurement studies

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are designed to calculate the surface area and pore size distribution of a sample and to analyze its surface characteristics.

*Pyrochemical Matrix Studies.* A pyrochemical matrix study was conducted from 1986-1992 and involved rod milling prior to screening. This process had two objectives: (1) blending large batches of homogeneous plutonium metal oxides for pyrochemical operations, and (2) dissolution of plutonium metal oxides for nitrate operations. The process changed in August 1992 when a need developed to blend oxides to provide feed material for making NDA standards. In February 1995 the process again changed, with the objective of determining the effect of pyrochemical salt matrices on the accuracy of NDA measurements. Process activities involved crushing, pulverizing, blending, roasting, and sieving pyrochemical salts. The results were used to determine handling and processing of the salts and ~~for~~ correction ~~of~~ bias measurements. The feed material consisted of high-purity oxides to use in the fabrication of standards ~~to be~~ used at LANL and throughout the DOE complex.

*Hydrothermal Processing.* The hydrothermal processing procedure involves the reaction of aqueous/organic mixtures, pure organic liquids, or contaminated combustible solids (e.g., ion exchange resins, plastic filters, and cellulose rags) under supercritical conditions (i.e., high temperature and pressure). Feed streams include, but are not limited to, carbon tetrachloride, tributyl phosphate, and organic solvents. Process effluents are gases, liquids, and salts. Organic components are oxidized to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

*Electrochemistry Experiments.* Electrochemistry methodologies were designed to decontaminate items, replace processes that produce large amounts of waste, or enhance chemical reactions. The process involved uranium decontamination of disassembled weapon components from various sites with various levels of surface contamination ~~with plutonium~~. The operation was strictly an aqueous process in which an alkaline solution was reacted with the components to precipitate uranium. Significant amounts of metal could be stripped in a short period. The solution containing the precipitated uranium salts was then dried for mass balance.

*Metallography.* The purpose of the metallography operation is to characterize the microstructure of metallic or ceramic pieces to verify and establish the quality and effectiveness of welds. Materials examined consist of plutonium and uranium carbides, nitrides, and oxides, as well

as zirconium and tantalum alloys, and stainless steel. Metal pieces (pellets) are cut with a diamond saw. Ceramic pieces are subjected to grinding with standard metal grinding media (e.g., papers impregnated with silicon carbides and diamond). The materials are polished with several different chemical compounds.

*Waste Management Operations.* P/S code RD was used ~~only~~ in 1984–1986. It allowed for tracking of demonstration drums (one drum each year) that were packaged and prepared in accordance with the TA-55 Attachments to the Certification Plan (TWCP-701) to meet the WIPP requirements at that time. Packaging of these drums did not of itself result in the generation of TRU waste. The waste drums that were packaged contained non-mixed TRU waste.

Operations under P/S code NCD occurred from April 1989 – April 1991 in Room 432. This P/S code was established to provide a mechanism for dealing with TRU drums that did not confirm specifications (e.g., recorded weight or nuclear material content). Non-confirming drums were temporarily set aside until such time as personnel could reprocess them under P/S code WM to correct the nonconfirming condition. After April 1991, nonconfirming drums were dealt with immediately, and P/S code NCD was no longer needed.

P/S code WM is currently limited to waste that arises from the TRU solid waste management operation in Room 432. This situation has been the case since the beginning of 1993. Room trash boxes from Building PF-4 have always been handled as low-level waste; however, the boxes were assayed to verify contamination levels and any that were determined to be TRU waste were diverted to Room 432 for repackaging as such. From May 1987 through 1992, these boxes were created as P/S code XO or X0. These codes were changed to P/S code WM after 1992. Additional controls were placed on room trash after 1992. Trash was assayed with the Multiple Energy Gamma Assay System (MEGAS). When a container was rejected because of MEGAS data, the rejected container was returned to the originator for removal of any "hot" item(s). This process also allowed greater control to prevent discarding regulated materials (e.g., RCRA constituents) in room trash.

P/S code X0 was designated for waste materials that could not be associated with a specific room, such as a hallway, mezzanine offices, rest rooms ~~and~~ change rooms, basement, pump rooms, and trolleys. The waste from all these areas, except the pump rooms and trolleys, would be low-level waste and no RCRA constituents would be associated with the waste items.

P/S code XO indicated waste materials that were generated within specific rooms but could not be associated with an individual P/S code in that room.

3.5.6 Special Processing

P/S codes ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

A detailed description of special processing is found in *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007).

probably already defined - can just use R&D

Special Processing includes processing operations for Material Type (MT) 42, and research and development (R&D) activities for MT 52. (See Section 3.6.2 and Table 2 for descriptions of plutonium material types.) Because processing MT 42 is a smaller-scale version of the recovery processes used for MT 52, MT 42 processing has five main recovery steps:

- head-end operations
- nitrate ion exchange operations
- chloride ion exchange operations
- separation and purification by precipitation
- pyrochemical processes

Only head-end operations and separation by purification and precipitation are covered here, since ~~nitrate~~ chloride ion exchange operations, nitrate ~~chloride~~ ion exchange operations, and pyrochemical processes are covered briefly ~~elsewhere in this report~~ in Sections 3.5.3, 3.5.7 and 3.5.8, respectively. Part ref to Section ?

Head-end operations leach tools, labware, crucibles, rags, etc. of in nitric acid to remove recoverable plutonium. Plutonium oxide is typically calcined as part of head-end operations.

Separation and purification by precipitation is a method of plutonium removal from aqueous solutions. The most common precipitation methods utilize oxalate, hydroxide, and peroxide anions. By selectively precipitating the plutonium, many of the metals remain in solution, thereby purifying the plutonium.

All wastes generated by MT 52 R&D operations are replicated for MT 42 but carry different P/S codes to differentiate and identify the radionuclide content of the waste. Outputs from Special Processing include high purity metal for casting and machining.

3.5.7 Metal Operation Processes

P/S codes AO, ARI, BA, BC, BT, CA, CN, CO, CT, DA, DOP, DT, EL, ELW, EM, EVAC, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT

A detailed description of metal operation processes is found in *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003).

The processes included in metal operations can be divided into three groups

- on-going metal operations ~~processes~~
- developmental metal operations ~~processes~~
- reactor fuel development ~~processes~~

The main goal of metal processes is to take the high purity metal produced by pyrochemical operations and produce shaped metal pieces. On-going metal operation processes include various R&D activities, alloy development, casting of metals, welding, coating, and machining/metalwork on various metals. Developmental metal operations include the Advanced Recovery and Integrated Extraction System (ARIES) project, assembly operations, burst testing of shells, experimental laser welding, furnace operations, and various other experimental activities. In reactor fuel development, enriched uranium oxide, depleted uranium oxide, and/or plutonium oxide feeds are blended and mixed with graphite, and various operations are performed to convert the feed material into pellets that can be used for fuel. Testing and R&D are done on the fuel pellets.

3.5.8 Pyrochemical Processes

P/S codes CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

A detailed description of pyrochemical processes is found in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006).

Pyrochemical processes include metal preparation, metal purification, and ancillary metal production operations. Pyrochemical process outputs are most often high-purity metal feed materials for metal operations.

Small globule, or

3.5.8.1 Metal preparation processes include the following:

*Metal Preparation Line.* The metal preparation line produces plutonium metal from fluoride salts. Hydrogen fluoride gas reacts with plutonium oxides obtained from calcination of oxalate or peroxide precipitates from the aqueous nitrate or chloride process lines. The plutonium compound is further reacted with various chemicals to produce plutonium metal, which can then be recovered as a button by breaking the crucible.

*Direct Oxide Reduction (DOR).* In the single pass DOR process, plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$), or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible. After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which ~~was~~ is sometimes recovered by addition of fresh salt plus additional calcium metal.

? do we need to define this?

*Multiple-Cycle Direct Oxide Reduction (MCDOR).* To minimize the salt waste, the MCDOR process was started, in which the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated.

3.5.8.2 Metal purification processes include the following:

*Molten Salt Extraction (MSE).* MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (TWCP-352). This process is employed only if the americium content is greater than 1000 ppm. In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible, and heated to 750°C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. ~~In the LANL~~

All thermal processes!

process, 90 percent of the americium and 10 percent of the plutonium are transferred from the feed metal to the salt. After cooling, the salt and metal are mechanically separated. The salts are transferred to the salt stripping process.

*Electrorefining (ER).* The ER process takes impure metal from the MSE and MCDOR (DOR) processes and produces high purity plutonium metal. Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$. After the anode and salt melt, current is applied to the system, and plutonium at the anode is oxidized to plutonium ions, which travel to the cathode and are reduced back to the metal state. Impurities in the original plutonium anode that are less electroactive than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities more electroactive than plutonium (including barium) are left in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. Anode heels were sent to pyroredox from 1984 to 1986. Currently, salts are sent to chloride operations or carbonate oxidation/distillation.

From 1987 to 1989, secondary solvent metals such as cadmium, bismuth, lead, and gallium were added to experimental studies of the ER process.

3.5.8.3 Ancillary metal production operations include the following:

*Salt Stripping.* The MSE and ER salts are further treated by salt stripping, oxygen sparging or carbonate oxidation, and salt distillation. The salt stripping process treats the residue by melting and stirring the salt with calcium metal in a magnesium oxide crucible at 850°C. This treatment reduces the plutonium in the salt to metal and allows the metal to coalesce for physical removal and recovery. After cooling, the crucible is broken and the metal physically separated and recycled to the ER process or burned to oxide and sent back through aqueous recovery. The crucible shards are leached in hydrochloric acid, then discarded.

Oxygen sparging and, (since 1996) carbonate oxidation are used to ensure that any plutonium, americium, or metallic

sodium or potassium left in the salts are converted to nonpyrophoric oxide forms.

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping process ~~for a few months in~~ 1998. Wastes that potentially contain this chemical (HWN P120) ~~will be~~ are segregated into waste stream lot TA-55-19A (see Section 4.0).

*Salt Distillation.* Salt distillation allows the recovery of plutonium oxide from the chloride salt and produces purified chloride salt for reuse.

*Pyroredox.* The pyroredox operation was used to recover plutonium from spent anode heels in the mid- to late 1980s. The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements more electroactive than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements less electroactive than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded. The metal phase containing zinc was placed in the vault or further treated, and the plutonium eventually was routed back to ER.

*Ingot Casting.* Metal is melted in a MgO crucible to cast the ingot.

*Metal Coalescence.* Metal coalescence is used for plutonium turnings to coalesce the turnings into a metal button. Calcium metal and $CaCl_2$ are added to a MgO crucible along with the turnings and melted.

*Metal Oxidation.* Small pieces of metal remaining on furnace or crucible surfaces are collected for conversion to the oxide phase. These metal pieces are placed in a furnace for the conversion process. The oxide is then transferred to the vault.

*Neptunium.* ~~A campaign to work off~~ Neptunium residues stored in the vault ~~was undertaken in~~ 1993 ~~and was only active that year.~~ were processed in

*Pickling.* Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. After a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts. ~~It then~~ becomes necessary to leach the plutonium from these items. In addition, after calcium metal reduction processes such as metal preparation, direct oxide reduction, and molten salt extraction, plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals.

*Plutonium Trichloride Preparation.* An intermediate process in Pu metal production prepared plutonium trichloride by bubbling a carrier gas (chlorine) through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500°C–600°C before being absorbed in a 5–6M (molar) potassium hydroxide solution. The carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991. Feed material was high purity oxides from the vault or from other P/S codes. The product plutonium trichloride was reduced to metal by the MSE or ER processes.

## 3.6 Material Inputs to the Waste Generation Processes

Material inputs to the waste generation processes derive from four general sources: (a) feed materials, (b) associated nuclear material types, (c) chemical use, and (d) ancillary material inputs such as those related to the use of laboratory equipment and materials and glovebox maintenance activities.

### 3.6.1 Feed Materials Identification

The feed materials for TA-55 processes that generate waste in waste streams TA-55-19 and TA-55-20 consist of the general types of materials listed in Table 1. These feed materials are obtained either from the storage vault, as process outputs from various P/S codes, or from sources outside TA-55, including other DOE facilities.

These feed materials fall into four general categories:

- pure Pu metal to be recycled from pits and sealed sources or to be reworked into desired shapes or chemical forms

**Table 1. Feed Materials for Processes Contributing to Waste Streams TA-55-19 and TA-55-20**

| Feed Material | Potential Presence of RCRA-Regulated Substances * | P/S Codes, Listed by Process |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• CLS-1 solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (CI-25/TWCP-3547). | Chloride operations: CLS, CW ~~CXL~~ (analytical laboratory solutions from LANL Group CLS-1); CSE, CXL, SE (other solutions)<br>Miscellaneous operations: ACL, ICP<br>Nitrate operations: CF, HP |
| Anode heels | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), chromium (D007), lead (D008), and silver (D011). Heavy metals arsenic (D004), mercury (D009), and selenium (D010) are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | Nitrate operations: AS, BF, BU<br>Pyrochemical processes: RA |
| Ash from P/S codes ETD, IS, SB, TDC, or from other DOE facilities | Usually suspect contaminated with barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic (D004), mercury (D009), and selenium (D010) metals are volatilized at high temperatures if present in the oxide and chloride forms. | Miscellaneous operations: CK, CV, FDL, FLU, SO, XP<br>Nitrate operations: AL, AT, ATL, ED, HGMS, IS, MPD, PTS, RC, SC<br>Special processing: ACD, IAM, SB, SL |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | Chloride operations: CL<br>Nitrate operations: MAS, SC<br>Special processing: ACD, SL |
| Disassembled weapons components (pit diassembly) | High-purity Pu and U material types, no RCRA substances present | Metal operation processes: ARI, CA, PH, SRL<br>Miscellaneous operations: EDC<br>Nitrate operations: BM, RB, RBJ |

The information on this column is highly generalized.
*Applicability of specific HWNs to a process as result of the feed material must be determined on a case-by-case basis because the presence and fate of contaminants is time and function-dependent. These aspects are discussed in the process AK reports.

Table 1. (continued)

| Feed Material (CH) | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity, no RCRA substances may or may present ? not contain RCRA substances (or not) | Miscellaneous operations: AD, CV, EXT, HRS, RASS, SA, XES, XP<br>Nitrate operations: MAS |
| Hydroxide cakes (process output from P/S codes CLS, CW, CXL, DO, POSM, PRR) | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), lead (D008), mercury (D009), silver (D011), and possibly chromium (D007) | Miscellaneous operations: AD<br>Nitrate operations: CD, HCD, HD, LG2<br>Special processing: DO, POSM |
| Miscellaneous materials contaminated with Pu (e.g., sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters) | May be contaminated with RCRA-regulated heavy metals silver (D011), cadmium (D006), mercury (D009), lead (D008), and possibly chromium (D007) | Miscellaneous operations: APD<br>Nitrate operations: ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD<br>Pyrochemical processes: PK (hardware, metal, anode chips from other P/S codes)<br>Special processing: ACD, DO, SB, SL |
| MSE salts | Typically fairly pure, suspect contaminated with barium (D005) ~~but no other RCRA substances present.~~ | Chloride operations: MB, MS<br>Miscellaneous operations: XP<br>Nitrate operations: MB, PS |
| Neptunium residues from vault | No RCRA-regulated substances | Pyrochemical processes: Neptunium (only active in 1993) |
| Pu chlorides and fluorides | Variable purity, – RCRA ? may or may not contain RCRA substances | Miscellaneous operations: FDL, SO<br>Pyrochemical processes: ER, SD, SS<br>Special processing: RM |

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Pu metal or metal alloy from vault or from various P/S codes | High purity, no RCRA-regulated substances, unless noted otherwise | Metal operation processes: AO, ARI, BC, BT, CA, DA, ELW, EVAC, FSPF, ITF, ITF4, JA, KBTF, MA, MBC, MW, PCH (variable purity), PD, PE, PF, PH, RL, SRL, VD, WE, WLT<br>Miscellaneous operations: AC, AC1, AC2, EXT, LIBS, ME, SA, SMP, VS<br>Nitrate operations: ATL, BM, BU, MF, PAF, VP1<br>Pyrochemical processes: CRD (variable purity), MO, SCB, SS, SSMD<br>Special processing: ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |
| Pu oxalates | Typically fairly pure, no RCRA substances present | Nitrate operations: CC, DF, HC |
| Pu oxides | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals cadmium (D006) chromium (D007), and lead (D008)<br>High purity oxides from P/S codes CA, DO, and MA, and from the vault, no RCRA substances RCRA ? | Metal operation processes: DOP (high-purity Pu and other radionuclides as oxides)<br>Miscellaneous operations: CK, CV, EOC, EXT, FDL, FLU, IB, IE, LI, LIBS, SO, STF, VS, XP<br>Nitrate operations: ATL, BL, CH, CPOD, DP, ED, FC, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2<br>Pyrochemical processes: MP (generally high purity), OR (variable purity), PTP<br>Special processing: DO, PI, PX, POSM, RM |
| Pu-Be sources | High purity constituents, no RCRA-regulated substances | Chloride operations: PB, PUB |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than barium (D005) are present | Chloride operations: MB, MS, PRR<br>Miscellaneous operations: EXT, IB<br>Nitrate operations: COD, COL, MB<br>Special processing: DO |
| Reactor fuel pellets | High purity Pu and U material types, no RCRA-regulated substances | Metal operation processes: ME |
| Stainless steel and/or tantalum residues from decladding of Pu-Be sources | High purity metals, potential leaching of chromium (D007) from stainless steel if subjected to strong acid | Chloride operations: PUB |

- intermediate Pu products in purification processes, in the form of solutions, oxides, hydroxides, salts, anode heels, etc.
- a wide variety of matrices contaminated with Pu above the DL, such as ash, salts, equipment, and solutions
- experimental R&D feed materials

3.6.2 Radionuclide Content Identification

The primary Pu material type inputs for TA-55 processes are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers (see Section 14). The results of these calculations are tabulated in the last three columns of Table 2; assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides will be present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material:

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present ~~mostly~~ in minor amounts in most debris waste from processes at TA-55.
- In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposely contain uranium. The primary uranium material type inputs for reactor fuel development activities and for pit disassembly at TA-55 are listed in Table 3.

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope (~~Weight %~~ wt.%) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

**Table 3. Average Isotopic Content of Uranium Material Types and Enrichments**

**(~~Weight %~~ wt.%)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Source: TWCP-698

- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239.

- U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2).

- Protactinium (Pa)-231, the decay-chain daughter of U-235, is expected to be present in trace amounts in some TA-55 wastes due to its widespread presence as ~~of~~ a contaminant in TA-55 operations (TWCP-5164, TWCP-5165).

- Cs-137 is a product of the spontaneous fission of Pu-238, Pu-239 and especially Pu-240, as well as a trace contaminant in purified plutonium from the production reactors (TWCP-5164, TWCP-5165). In the latter case, the remaining Cs might be on the order of 0.5 ng/g Pu. In the former instance, the formation of Cs-137 due to spontaneous fission would lead to about 0.4 pg/g Pu in plutonium that is ~~ten~~ years old. Because Cs-137 due to spontaneous fission is about a factor of a thousand less than that due to residual contamination from the original separation on the production fuel, the latter is the dominant source of Cs in TA-55 waste.

In general no correlation is expected to be seen among the different radioelements, Pu, Np, U, Pa or Am. The differences in valence states and chemical affinities among these elements is expected to result in substantial fractionation during several TA-55 processes, including ion exchange, solvent extraction, hydroxide precipitation, dissolution.

Secondary radionuclides ~~will~~ also ~~be~~ present in the waste due to processing of feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each process were reviewed by a panel of experts at TA-55 and compiled in a memo, according to P/S code (TWCP-882, amended by TWCP-5166), as summarized in Table 4. This list includes Am-241, Am-243, cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Th-230, Th-232, U-233, U-235, and U-238.

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of radioassay ~~procedure~~ to use for optimal results. Cm-244 was introduced in TA-55 operations in P/S code DOP, which started in 1988 (TWCP-5165). Material outputs from this process sometimes were sent to P/S codes IS or WE. Cm-244 could also be part of debris waste under P/S code CA because both operations took place in ~~the 300 area~~. Because only one room in this area is available for bagouts, TRU waste from P/S codes

**Table 4. Secondary Radionuclides in TA-55 TRU Waste**

| Secondary Radionuclide | P/S code generating waste |
|---|---|
| Americium-241 | AO, AP, CA, CD, CF, CLX, CXL, DOP, EV, FA, HCD, HD, HP, IA, LR, MA, OH, PI, PR, PRR, PS, SS, SX, WE, XP; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Pu-241 decay. Waste could be either depleted or enriched in Am depending upon whether the source of contamination is the process product or the process residues. |
| Americium-243 | BC, CA, DOP, JA, MA, PH, PI, SS, WE |
| Cerium-144 | DOP, WE |
| Curium-244 | DOP, IS (Mar-Apr 1987), WE |
| Neptunium-237 | ATL, BC, CA, CF, DOP, ED, EV, IS, JA, MA, Neptunium, PI, RB, RFX, WE; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Am-241 decay |
| Protactinium-231 | BC (1989), JA (1989), WE |
| Plutonium-238 | TDC |
| Plutonium-241 | EV, IS, TDC |
| Thorium-232 | CF, DOP, PT, WE |
| Thorium-232 enriched with Thorium-230 | BC, JA, WE |
| Uranium-233 | DOP, WE |
| Uranium-235 or enriched uranium | CN, FF, GI, MW, OB, PD, PI, RS, SRL, UA; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |
| U-238 or depleted uranium | BC, CN, FF, GI, JA, LC, MW, OB, PD, RC, RS, SRL, UA, UPS, US, WE,; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD) |

Sources: TWCP-882, TWCP-5166, TWCP-AK-2.1-003, TWCP-AK-2.1-005

DOP and CA was sometimes combined. In addition, because rags from DOP were sent to IS, Cm-244 could be present in the ash produced by this operation, which is then processed through nitrate aqueous recovery operations. Some unknown fraction of the Cm-244 could ultimately end up in the evaporator bottoms, which are then immobilized in cement in P/S code CF. In any case, however, Cm-244 is not expected to be present in any waste generated before 1988.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data ~~will be~~ are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). ~~The results of these~~ The assay results are summarized in Section 14.2.

3.6.3 Chemical Content Identification

Chemical contents of process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from subject matter expert (SME) input. Individual process AK reports contain detailed assessments of these chemical inputs, and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

3.6.3.1 *Acids and bases*. Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) and D003 (reactivity) do not apply to the solid debris waste because there are no free liquids in this waste.
- D001 (ignitability) and D003 (reactivity) do not apply to wastes in waste streams TA-55-19 ~~or~~ (TA-55-19A) despite

the use of spent non-halogenated solvents (HWN F003) and the possible production of perchlorate salts in perchloric acid solutions for the following reasons:

- Perchloric acid solutions are sent to cement fixation.
- Perchlorate salts used in P/S code FF were sent to cement fixation (~~TWCP-5157~~ TWCP-5158).
- Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded.
- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu. Spell out
- Solutions containing spent solvents and above the DL for Pu are further treated by aqueous recovery processes as part of routine chloride and nitrate operations. Aqueous recovery involves dissolving any solid Pu in hydrochloric or nitric acid, followed by ion exchange to extract the Pu. The processed solutions are below the DL for Pu and are either sent to the RLWTF or to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, a waste form for which ignitability is not a concern.
- Rags, if contaminated with spent solvents and above the DL for Pu, are thermally decomposed, which destroys any organic component.
- Although contaminated rags that are below the DL for Pu are discarded as combustible debris, headspace gas analyses support the expectation that the solvents are ~~not present in the packaged waste at levels of concern.~~ no! at regulatory levels? at measurable levels?
- In addition, 100 percent of the waste containers are subjected to headspace gas analysis. Any container showing ~~over~~ more than 500 ppm total flammable volatile organic compounds (VOCs) is prohibited from being shipped to the WIPP. (For comparison, the explosive limit for acetone is 25,000 ppm.)

- Formic acid and hydrofluoric acid are listed in Appendix VIII of 40 CFR Part 261, for their corrosive and toxic characteristics, with EPA HWNs U123 and U134. However, these HWNs are not applicable to the manner

only abbreviate when used w number eg Pu-238

Jim, your call!

below levels the limits established by the WIPP WAC.

WIPP WAC

in which these chemicals were used ~~and discarded~~ in the processes covered by this report.

- None of these are F, K or P-listed chemicals

3.6.3.2 *Gases and cryogenic fluids.* The following gases and cryogenic fluids used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation:

- argon
- carbon dioxide
- chlorine
- dioxygen difluoride (FOOF)
- halogen fluorides
- hexafluoroethane
- hydrogen chloride
- krypton fluoride
- methane
- nitrogen (gas)
- nitrogen (liquid)
- perfluoropropane
- tetrafluoromethane

The following gases used in the TA-55 processes are identified in Appendix VIII of 40 CFR Part 261 as having hazardous characteristics. The chemical name is followed by the listed EPA HWN and the P/S codes in which the gas is used:

- Fluorine (P056) is used in P/S codes CV, FDL, FLU, PI, SO
- Hydrogen fluoride (U134) is used in P/S codes MP, PI
- Nitrogen dioxide (P078) is used in P/S code HRS
- Phosgene gas (P095) is used in P/S code PTP

No EPA HWNs are applicable to the use of these gases in the TA-55 processes. Compressed gas cylinders are kept outside of the gloveboxes; most are even outside the building, and the gases are plumbed into the glovebox. Thus, the gas cylinders are not discarded with TRU wastes. Additional reasons are as follows:

- D002 (corrosivity) does not apply to the use of hydrogen fluoride because there are no free liquids in the solid TRU waste.

- D003 (reactivity) does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution.

- P056 (fluorine), P078 (nitrogen dioxide) and P095 (phosgene) are not applicable to the listed TA-55 processes because of the manner in which these gases are used ~~and discarded~~ in the processes covered by this report.

- Hydrogen fluoride (U134) is listed in Appendix VIII of 40 CFR Part 261 for its corrosive and toxic characteristics. However, this code is not applicable to the manner in which this gas is used ~~and discarded~~ in the processes covered by this report.

3.6.3.3 *Metals*. The following metals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII of that regulation: bismuth, bismuth-tin alloy, calcium, copper wool, gallium (metal, oxide or salt), gold, lanthanides, lutetium, niobium +1 percent zirconium metal, platinum, platinum-rhodium alloy, tantalum (metal, alloy, oxide or salt), titanium, uranium powder (depleted), vanadium, and zirconium alloy.

Several metals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. The bullets below list the chemical name, its listed EPA HWN, the P/S codes in which the metal is used, and the applicability of the EPA HWNs for use of these metals in the TA-55 processes:

- Alkaline earth metals (D003) were used in P/S codes AC, AC1 and AC2; it is possible that one or more of these were pyrophoric. However, EPA HWN D003 does not apply to P/S codes AC, AC1, or AC2 because the metals are consumed or oxidized before discarding.

- Arsenic (D004) was used in P/S code PE between 1984 and 1985, and EPA HWN D004 is applicable to P/S code PE during this period.

perchlorate, molybdenum oxide, phosphates, Portland cement, potassium chloride, potassium fluoride, potassium permanganate, potassium thiocyanate, silicone lubricant, sodium bicarbonate, sodium carbonate, sodium chloride, sodium chlorite, sodium citrate retarder, sodium dithionate, sodium nitrate, sodium nitrite, sodium oxalate, sodium sulfate, sodium tetraborate, stannous chloride, thorium oxide, uranium oxide (depleted), zinc chloride, zinc stearate, and zirconium carbide. Some processes indicated the use of nitrate, chloride, carbonate, bicarbonate, oxalate, and nitrite salts of sodium, potassium, lithium, magnesium, calcium, and iron.

Several inorganic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 5 lists these chemicals, their HWN, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

3.6.3.5 *Organic chemicals.* The following organic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, Citrapeel, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), diethyl oxalate, dihexyl n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), diisopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride, ion exchange resin, isopropanol, kerosene, Metalprep 79 (phosphoric acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl diisobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, Organicstrip, perchlorocarbons, phenolphthalein, phosphate buffer solution, phosphine oxide, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl

**Table 5. Use of RCRA-Regulated Inorganic Chemicals in TA-55 Processes**

| Inorganic chemicals and P/S codes in which they were used | ~~The following summarizes the applicability of~~ RCRA D-listings and P-listings due to metals used in the processes |
|---|---|
| Hydrogen peroxide | D001 (ignitability—oxidizer) and D003 (reactivity) do not apply to the use of hydrogen peroxide because there are no free liquids in the TRU solid waste |
| Lead hydroxide, oxide, or nitrate (P/S code AD) | D008 (lead) applies to P/S code AD. |
| Mercuric nitrate (P/S codes VP1 and VP3) | D009 (mercury) applies to P/S codes VP1 and VP3. Mercuric nitrate is used as a catalyst in P/S code VP1; the hydroxide cake produced in VP1 is processed in P/S code VP3. |
| Potassium dichromate (P/S codes AD, CS, CSE, DO, and SE) | D007 (chromium) applies to P/S codes AD, CS, CSE, DO, and SE because of the use of potassium dichromate as a titration endpoint indicator until end of 1993. The solution and precipitates were processed by hydroxide precipitation under the same codes. The chromium was incorporated as a contaminant in the hydroxide cakes. |
| Silver nitrate and other silver salts (P/S codes AC1, CPOD, CS, CSE, DO, SE) | D011 (silver) applies to P/S codes CW and CX due to the use of silver nitrate for chloride titrations under P/S codes CS, CSE and SE until 1993. The solution and precipitates were processed by hydroxide precipitation under P/S codes CW and CX. Silver was incorporated as a contaminant in the hydroxide cakes.<br><br>D011 (silver) applies to P/S code CPOD due to the use of silver nitrate as a catalyst from 1990 to 1994. D011 (silver) applies to P/S code AC1 due to the use of silver salts. |
| Sodium chromate (P/S code PT) | D007 (chromium) applies to P/S code PT due to the use of sodium chromate in the separation of thorium from plutonium and americium. |
| Uranium nitride, depleted (P/S code FF) | D003 (reactivity) does not apply to the use of uranium nitride in P/S code FF. Although this chemical is pyrophoric, its disposal in an oxidizing environment eliminates this characteristic because it is converted to uranium oxide. Uranium nitride is oxidized in the passivation furnace (P/S code PA) prior to discard. |
| Vanadium pentoxide (P/S code SD and SS) | P120 (vanadium pentoxide) applies to waste generated under P/S code SD from February to March 1998, and under P/S code SS from May 27, 1998 to June 10, 1998. |
| Magnesium perchlorate (P/S code FF) | D001 (oxidizer) does not apply to the use of this chemical in P/S code FF because it was ~~discarded into the~~ sent to cement ~~waste stream~~ (TWCP-5158). |

Limited codes or headings?

Magnesium perchlorate (TWCP-5158)

Insert new row

fixation

phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, Vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 6 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

Waste containers in a waste stream are characterized as a campaign, in which the targeted group of waste containers to be characterized are selected based on criteria such as availability of the waste containers, waste loading level, availability of waste generator records, and hazardous waste numbers. TA-55-19A is one subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which ~~is expected to~~ consist of ~~only a few~~ drums, is identical to the rest of the waste stream except for the possibility that the drums may contain vanadium pentoxide (EPA HWN P120), which was used only between 02/01/98 and 06/10/98 in two specific P/S codes.

delete

TA-55-19A ~~is not~~ fully defined in the sense that a list of specific waste containers in this lot has not yet been prepared. This ~~is~~ because P/S codes ~~are not always explicitly~~ identified for waste items in TA-55 waste containers. ~~However,~~ the possibility of extracting ~~this~~ information from the waste item identifiers is being ~~evaluated~~. If successful, this action will permit a listing of waste containers assigned to TA-55-19A.

Have to do this

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

Waste Streams TA-55-19 and TA-55-20 have been discussed together in this AK Summary Report. These waste streams are similar in physical form and waste material content. They differ only in that TA-55-19 is assigned EPA HWNs based on P/S code information, whereas TA-55-20 contains non-mixed waste.

Other waste streams resulting from the same plutonium processing activities at TA-55 but differing in physical form and waste matrix code are listed in the Sampling Plan. These include waste streams for more specific types of waste such as metal debris, glass, graphite, HEPA filters, and cemented waste, as well as less specific waste streams such as combustible/noncombustible debris.

## Table 6. Use of RCRA-Regulated Organic Chemicals in TA-55 Processes

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Acetone (P/S codes FF, ME, and MOX) | • F003 applies to P/S code ME because it may have been used in the glovebox for cleaning.<br>• F003 does not apply to P/S code FF or MOX because it was only used outside the glovebox. |
| Acetonitrile (P/S code AC2) | • (Appendix VIII chemical) U003 does not apply due to the manner in which this chemical is used in P/S code AC2. |
| Benzene (P/S codes AC, AC1, AC2, and SA) | • D018 (benzene) applies to P/S codes AC, AC1, AC2, and SA<br>• F005 applies to P/S codes AC, AC1, AC2, and SA, in which benzene was used as a solvent |
| Carbon tetrachloride (P/S codes AD, CV, PTP, and PX) | • D019 (carbon tetrachloride) applies to P/S codes AD, CV, PTP and PX. This chemical was used in PTP between 1/87 and 6/89.<br>• F002 does not apply to P/S codes AD, CV, PTP, or PX because it was not used as a solvent or for degreasing. |
| Chloroform (P/S codes AC, AC1, AC2, APD, FF, and XO) | • D022 (chloroform) applies to P/S codes AC, AC1, AC2, APD, FF and XO. Concentrations in P/S code FF are expected to be below RCRA threshold because freeze-drying should have removed most, if not all, of the residual chloroform before the microspheres were taken into the glovebox for sintering. |
| Diethyl ether (P/S code SA) | • F003 applies to P/S code SA because of solvent use. |
| Freon and Freon TF (P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | • F002 applies to P/S codes DA, MA and XO.<br>• F002 does not apply to P/S codes CA, MW, PD, SCB, SRL, UA, VD and WE. Although Freon TF is used as a solvent to clean metal parts, the parts are routinely air-dried to avoid the need for cellulosic wipes.<br>• F002 does not apply to P/S code PF because Freon was used as a coolant for a cutting saw, not as a solvent. |
| Methanol (P/S codes AD and SO) | • F003 applies to P/S code AD because it may have been used for cleaning inside the glovebox.<br>• F003 does not apply to P/S code SO because it was used in a cold trap outside the glovebox. |
| Methylene chloride (P/S code AC1) | • F002 applies to P/S code AC1 because this chemical was used as a solvent (MA) and a paint stripper (XO). |
| Methyl ethyl ketone (P/S codes MA and XO) | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO.<br>• F005 applies to P/S codes MA and XO, in which methyl ethyl ketone was used as a solvent (MA and XO). |
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA<br>• F005 applies to P/S codes AC, AC2 and SA, in which pyridine was used as solvent. |
| Tap Magic (contains 1,1,1 trichloroethane) (P/S code MA) | • F002 does not apply to P/S code MA because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |

Heading ?

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Tetrachloroethane (not used) | • No RCRA codes apply to tetrachloroethane, an Appendix VIII chemical. Although it is listed on the chemical inventory for metal operations, it was never used in glovebox operations. |
| Tetrachloroethylene (P/S codes AD, APD, CSE, CV and SE) | • D039 (tetrachloroethylene) applies to P/S codes AD, APD, CSE and SE in which it was used until 1992.<br>• D039 does not apply to P/S code CV because it was used as a coolant outside the glovebox.<br>• F002 applies to P/S codes AD, APD, CSE and SE. Its use as a solvent in P/S code CSE and SE ended in 1992.<br>• F002 does not apply to P/S code CV because it was only used as a coolant outside the glovebox. |
| Tetrahydrofuran (P/S codes AC, AC2, and SA) | • U213 may possibly apply to P/S codes AC, AC2, and SA. Its applicability is currently under investigation. |
| Toluene (P/S codes AC, AC2 and SA) | • F005 applies to P/S codes AC, AC2 and SA because toluene was used as a solvent. |
| Trichloroethylene (P/S codes CK, EL, FF, MA, ME, and XO) | • D040 (trichloroethylene) applies to P/S codes EL, FF, MA, ME, and XO.<br>• D040 does not apply to P/S code CK because this chemical was used as a coolant outside the glovebox.<br>• F001 applies to P/S code MA, in which trichloroethylene was used as a degreaser during final cleaning of metal parts from 1979 to 1992, resuming again in February 2000.<br>• F002 does not apply to P/S codes EL or FF, in which it was used as a lubricant for a cutting saw, not as a solvent. |

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

The waste matrix code S5300 is assigned to the waste streams TA-55-19 and TA-55-20 based on waste generation practices described in the TA-55 Waste Management Procedure, 1996 (TWCP-351), description of past segregation practices (TWCP-701, Section 2.1, page 4 of 43), and TA-55 process AK reports (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007). A more detailed waste matrix code cannot be assigned to the TA-55-19 and TA-55-20 waste streams because TA-55 waste management personnel did not segregate plastic waste from cellulosic waste.

The following codes also apply to waste streams TA-55-19 and TA-55-20 from the Transuranic Waste Baseline Inventory Report (TWBIR), the TRUPACT II Content Code (TRUCON) (DOE/WIPP-89-004/Rev.12), the Radioactive Solid Waste Disposal (RSWD), and the Item Description Code (IDC) (Sampling Plan).

- TWBIR LA-M16 (TA-55-19) and LA-T16 (TA-55-20)
- TRUCON LA 116A, LA 116B, LA 116C, LA 116D, LA 116E, LA 116F, LA 116H, LA 116I
- RSWD A14, A15, A16, A17, A18, A60
- IDC 004 (combustible waste)

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

The TA-55 Plutonium Facility generates contaminated combustible debris waste primarily from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, old bag-out stubs, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber and Teflon-based products used in the operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

The following waste material parameter codes (WMP) are assigned to waste streams TA-55-19 and TA-55-20 based on this information and knowledge of waste generation practices described in the TA-55 Waste Management Procedures (see Section 3.2):

- Cellulosics
- Plastics (waste materials)

- Rubber
- Steel (packaging materials)
- Plastics (packaging materials)
- Iron-based metals/alloys (less than 5 percent by volume)

These WMP codes have been verified with WIPP-compliant waste characterization data from real-time radiography and visual examination (Section 14).

## 8.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

Unless AK info. to the contrary (e.g. for P120)

**NOTE:** Although the applicability of several of the EPA HWNs discussed below are time-dependent, the period of HWN applicability should generally be extended to two years following cessation of the use of a given listed chemical. This recommendation is based on the observation that a single waste container may stay open for several months, and contain waste items generated over a span of time constituting a year or more (TWCP-5086).

unless AK information is available ~~that~~ to restrict the applicability to a shorter time period.

So, what are dates you've given earlier (- the 2 yrs or + the 2 yrs)?

### 8.1 F, K, P, and U Listings

No K-listings apply to any of the debris waste generated by the P/S codes covered by this report.

The following P/S codes require HWN assignments due to the presence or use of F-listed chemicals. In many cases, the applicability of the HWN is limited to waste generated during a specific period, as discussed in the appropriate process AK report.

| | |
|---|---|
| • AC, AC1, AC2, AC3 | F002, F005 |
| • AD | F002, F003 |
| • APD | F002, F003 |
| • CF | F002, F003 |
| • CLS | F002, F003 |
| • CSE | F002 |
| • CW | F002, F003 |
| • DA | F002 |
| • HP | F002, F003 |
| • MA | F001, F005 |
| • SA | F002, F003, F005 |
| • SE | F002 |
| • WM | F001, F002, F005 (No F-listings apply after 1993) |
| • X0, XO | F001, F002, F005 |

In addition, debris waste generated under P/S codes SD and SS between 02/01/98 and 06/10/98 is assigned EPA HWN P120 (vanadium pentoxide). ~~These~~ To be conservative this HWN is assigned to waste containers ~~are~~ with packaging dates extending to the ~~plus 2 yrs~~ ? ~~Extend to end of~~ Dec 98 end of December 1998.

stet

It is possible that waste generated under P/S codes AC, AC2, and SA may require the assignment of EPA HWN U213 (tetrahydrofuran). This possibility is being investigated.

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 (including lot TA-55-19A) is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses for containers assigned to waste stream TA-55-19 (Section 14.4).

8.2 Toxicity Listings

~~Both~~ TA-55-19 ~~and~~ (including TA-55-19A) ~~are~~ is conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040.

TA-55-20 has no D-listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RA, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD.

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

| | |
|---|---|
| AC | D007, D009, D011, D018, D022, D038 |
| AC1 | D007, D009, D011, D018, D022 |
| AC2 | D007, D009, D011, D018, D022, D038 |
| ACD | D005, D006, D007, D008, D011 |

Are these supposed to be consistent w Table 1 ?

No, stet

Table 1 has no 005 but does have 009

| | |
|---|---|
| ACL | D007, D009 |
| AD | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039 |
| AL | D005, D006, D007, D008, D011 |
| AP | D007, D009 |
| APD | D007, D008, D009, D019, D021, D022, D039 |
| AS | D006, D007, D008, D011 |
| AT | D005, D006, D007, D008, D011 |
| ATL | D005, D006, D007, D008, D011 - See Table 1 |
| AX | D007, D009 |
| BF | D006, D007, D008, D011 |
| BU | D006, D007, D008, D011 |
| CD | D006, D007, D008, D009, D011 |
| CF | D007, D008, D009, D011, D019, D021, D022, D039 |
| CK | D005, D006, D007, D008, D009, D011 |
| CL | D007, D008, D009 |
| CLRD | D007, D008, D009 |
| CLS | D007, D008, D009, D019, D021, D022, D039 |
| COL | D005 |
| CPOD | D011 - See Table 1 |
| CS | D007, D008, D009 |
| CSE | D007, D008, D009, D039 |
| CV | D005, D006, D007, D008, D009, D011, D019 |
| CW | D007, D008, D009, D011, D019, D021, D022, D039 |
| CX | D007, D008, D009, D011 |
| CXL | D007, D008, D009 |
| DO | D007, D011 (no D-listed chemicals used after 1993) |
| DOP | D008 |
| DS | D006, D007, D008, D009, D011 |
| ED | D005, D006, D007, D008, D011 |
| EDC | D007- ? Not in Table 1 |
| EL | D040 |
| EOC | D007, D009 |
| ER | D006, D008 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |
| EXT | D005, D006, D007, D008, D009, D011 |
| FDL | D004, D005, D006, D007, D008, D009, D010, D011 |
| FF | D022, D040 |

| | |
|---|---|
| FLU | D004, D005, D006, D007, D008, D009, D010, D011 |
| FX | D006, D007, D008, D009, D011 |
| HCD | D006, D007, D008, D009, D011 |
| HD | D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| HRA | D005, D006, D007, D008, D009, D011 |
| IA | D006, D007, D008, D009, D011 |
| IAM | D005, D006, D007, D008, D011 |
| IB | D005, D006, D007, D008, D009, D011 |
| ICP | D007, D009 |
| IE | D005, D006, D007, D008, D009, D011 |
| IS | D005, D006, D007, D008, D011 |
| IX | D006, D007, D008, D009, D011 |
| KBTF | D008 |
| LD | D007, D008, D009 |
| LG1 | D006, D008 - See Table 1 |
| LG2 | D006, D007, D008, D009, D011 |
| LI | D005, D006, D007, D008, D009, D011 |
| LR | D006, D007, D008, D009, D011 |
| MA | D035, D040 |
| MB | D007, D008, D009 - See Table 1 |
| ME | D007, D040 |
| MELL | D006, D007, D008, D009, D011 |
| ML | D006, D008 - See Table 1 |
| MPD | D005, D006, D007, D008, D011 |
| MS | D007, D008, D009 - See Table 1 |
| NC | D006, D008 |
| NL | D006, D008 - See Table 1 |
| OD | D006, D007, D008 |
| OH | D006, D007, D008, D009, D011 |
| PB | D007, D008, D009 |
| PCH | D007 |
| PE | D004 (1984–1985) |
| PK | D006, D007, D008, D011 - See Table 1 |
| POSM | D007, D011 - See Table 1, pg 2 |
| PRR | D007, D009 |
| PT | D007 |
| PTP | D019 |

| | |
|---|---|
| PTS | D005, D006, D007, D008, D011 |
| PUB | D007, D008, D009 |
| PX | D006, D008, D019 |
| RASS/RSS | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RC | D005, D006, D007, D008, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SA | D007, D009, D018, D038 |
| SB | D005, D006, D007, D008, D011 |
| SC | D005, D006, D007, D008, D011 |
| SE | D007, D008, D009, D039 |
| SL | D005, D006, D007, D008, D011 |
| SO | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | D007 |
| SS | D006, D008 |
| SSD | D006, D007, D008 |
| SSMD | D009 (D-listed chemicals only used from 06/94 to 08/94) |
| STF | D007 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1, VP3 | D009 (D-listed chemicals only used from 09/85 to 10/85) |
| VU, VUL | D005, D008 |
| WM | D007, D008, D009, D022, D035, D040 (D-listings are not applicable after 1993) |
| X0, XO | D007, D008, D009, D022, D035, D040<br>**NOTE:** The same set of HWNs have been assigned to P/S codes WM, X0, and XO in order to be conservative, as discussed in *Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004,R.2, Section ~~3.4.9).~~ 3.5.10). |
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." The waste streams covered by this AK report have no listings for corrosivity, reactivity, or ignitability. Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

| | |
|---|---|
| PTS | D005, D006, D007, D008, D011 |
| PUB | D007, D008, D009 |
| PX | D006, D008, D019 |
| RASS/RSS | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RC | D005, D006, D007, D008, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SA | D007, D009, D018, D038 |
| SB | D005, D006, D007, D008, D011 |
| SC | D005, D006, D007, D008, D011 |
| SE | D007, D008, D009, D039 |
| SL | D005, D006, D007, D008, D011 |
| SO | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | D007 |
| SS | D006, D008 |
| SSD | D006, D007, D008 |
| SSMD | D009 (D-listed chemicals only used from 06/94 to 08/94) |
| STF | D007 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1, VP3 | D009 (D-listed chemicals only used from 09/85 to 10/85) |
| VU, VUL | D005, D008 |
| WM | D007, D008, D009, D022, D035, D040 (D-listings are not applicable after 1993) |
| X0, XO | D007, D008, D009, D022, D035, D040<br>**NOTE:** The same set of HWNs have been assigned to P/S codes WM, X0, and XO in order to be conservative, as discussed in *Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004,R.2, Section 3.4.9). |
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." The waste streams covered by this AK report have no listings for corrosivity, reactivity, or ignitability. Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests (see Attachment 5), introduced in June 1980, included check boxes ~~which~~ the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments for TA-55 (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF (see Attachment 4, pp. 4 and 5) documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual ~~examination~~ verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in waste, explosives were altogether prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. In case of a misfire or unconsumed explosives, a procedure is in place at TA-55 to ensure that explosives do not enter the waste stream (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids. Controls on reactive wastes are discussed in Section 3.6.3.

Controls have also been in place to ensure the exclusion of ignitable constituents. D001 does not apply to wastes in these waste streams despite the use of spent non-halogenated solvents (HWN F003), for the following reasons:

- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu.

- If above the DL, the solutions are sent to aqueous processes as part of chloride or nitrate operations. Aqueous recovery steps include dissolution of any solid Pu in hydrochloric or nitric acid, followed by Pu recovery by ion exchange. The solutions are then below the DL and are either sent to the RLWTF or to the evaporator.

- Rags that are above the DL for Pu are thermally decomposed, which destroys any organic component.

- Rags that are below the DL for Pu are discarded as combustible debris, but headspace gas analyses support the contention that the solvents are ~~not present in the waste at levels of concern~~ below regulatory limits (Section 14.4). diff. words?

- Finally, 100 percent of the drums are subjected to headspace gas analysis, and drums showing over 500 ppm total flammable VOCs are prohibited from being shipped to the WIPP. (This limit is quite conservative. For comparison, the explosive limit for acetone by itself is 25,000 ppm.)

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed onto vermiculite and discarded in an appropriate waste stream, and containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the shipping containers TRUPACT-II. Section 9.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste item, specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from TA-55. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

A chemical compatibility analysis was performed for TRUCON codes 116/216 (combustible waste) which indicated that all chemicals and the waste matrix were

compatible at levels greater than trace amounts (*Content Code Assessments for LANL TRUCON Codes* [DOE/WIPP-89-004]). During the process AK search, additional chemicals were identified that necessitated a new compatibility analysis, which is underway at the present time.

## 11.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed or ~~else~~ the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

comma

How do you ? test procedure

Administrative and procedural controls on the prohibited pyrophorics in TRU waste and the absence of pyrophorics has been verified through testing. For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the RFETS (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of ~~LANL~~ direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Chemical Waste Disposal Requests dated as early as June 1980 included boxes that were required to be checked if the waste contained pyrophoric, flammable, corrosive, or explosive materials (see Attachment 5, Chemical Waste Disposal Request).

In addition, for wastes generated after the implementation of the 1987 Certification Plan, Generator Attachments, associated waste packaging procedures, and quality assurance systems, the waste generator has signed a statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The TA-55 Attachment to the Certification Plan describes how these restrictions were verified by waste management personnel (TWCP-701, Sections 3.8.5 through 3.8.7).

## 12.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into TA-55 processes as documented in the TA-55 procedures reviewed during this AK search (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007) and summarized in the process inputs listed in Tables 1 and 6. Oils used in the reviewed processes include vacuum pump oils and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005, R.2, Section 9.0). This oil does not enter the LANL disposal operations.

why not on this AK? - is ok to ref OOS?

## 13.0 DETERMINATION OF THE MAXIMUM NUMBER OF CONFINEMENT LAYERS PERMITTED FOR WASTE PACKAGING

Waste streams TA-55-19 and TA-55-20 are primarily generated from operations performed in gloveboxes. The waste material is placed directly into bag-out bags (also called inner bags) through an opening in the glovebox where the bag is attached, and the bag is then closed and detached from the glovebox. Waste streams TA-55-19 and TA-55-20 may also be generated from "hot jobs" outside of the glovebox, such as valve changes, or from decontamination of spills or other releases. In these cases, the waste is placed directly into one (or possibly more) inner bags at the work area. The maximum number of confinement layers in any case is six (TWCP-816). This upper limit has been confirmed by RTR and VE data (Section 14).

A minor source of waste streams TA-55-19 and TA-55-20 is room trash that was originally considered low-level waste, which is collected in plastic bags inside cardboard boxes. Occasionally, when assayed, these boxes are determined to be TRU waste. These boxes may be sorted to remove the "hot" item, or the whole box may be bagged and sent to the TRU packaging area for placement in drums containing waste streams TA-55-19 or TA-55-20, as appropriate. When this occurs, the P/S code WM is assigned to the waste. Due to the additional layers of plastic that are present when this operation occurs, drums with the P/S code WM are assumed to contain up to two more layers of internal packaging than other drums.

Waste drum packaging procedures for waste streams TA-55-19 and TA-55-20 have ~~gone through~~ been modified several ~~changes~~ times since the beginning of operations at TA-55. TRUCON Code assignments made by the waste generator are compiled in the Sampling Plan; However, ~~in the absence of this information~~ when TRUCON codes are used, ~~TRUCON codes~~ they will be assigned to the waste container in accordance with the default packaging configurations and associated TRUCON codes shown in Table 7, that reflect the packaging protocols in effect during different periods of time at TA-55 (TWCP-816).

AK information has been compared with visual examination data for about 22 containers ~~so far~~ in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). In two cases, the number of layers of packaging observed during visual examination was greater than the number of layers reported by the waste generator, and an incorrect TRUCON code was assigned by the waste generator (Section 14.2). It is possible that the extra plastic layers were breached (i.e., these were confining layers) but that the VE inspection did not ~~catch this detail~~ document this fact. However, the conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution. Consequently, the most conservative TRUCON code ~~will be~~ is assigned to each waste container in waste streams TA-55-19 and TA-55-20, in accordance with the following guidance:

a) The default TRUCON codes from Table 7 ~~will~~ are be assigned if the waste generator has not assigned a TRUCON code.

b) The TRUCON code assigned by the waste generator ~~will be~~ is used only if it has been positively confirmed by RTR or VE data.

c) If no VE data are available, and if the RTR data are indeterminate, then the default TRUCON code ~~will be~~ is assigned to the container.

This guidance only applies to retrievably stored waste. It is assumed that newly generated waste packaged under procedures approved by TWCP and CBFO ~~will be~~ are assigned correct TRUCON codes.

## 14.0 CONFIRMATION OF AK INFORMATION FOR THE WASTE STREAM

Characterization data acquired by WAP-compliant activities provide a means to ~~judge the reliability of~~ confirm AK information. Radiography, radioassay, and headspace gas analysis are conducted on all retrievably stored containers of debris waste, and VE is being conducted on at least 50 containers from waste streams TA-55-19 and TA-55-20. Relevant aspects of the data produced by these activities are summarized in the sections below, focusing on the extent to which the data confirm AK information ~~and identifying aspects for which additional AK documentation or research may be warranted.~~

**Table 7. Maximum Layers of Confinement to Be Used for TA-55-19 and TA-55-20 Waste Containers in the Absence of More Specific Waste Characterization Data**

| Time Frame | P/S Code | Layers of Confinement ~~(see Note 1)~~ | TRUCON Code |
|---|---|---|---|
| 01/78–05/87 | All | Maximum of 6 layers:<br>• up to 4 inner bags<br>• up to 2 liner bags<br>• all bag closures by either twist & tie; or twist, tie & tape | LA 116 I |
| 05/87–12/97 ~~(see Note 2)~~ | All except WM, XO, X0 | Maximum of 4 layers:<br>• up to 2 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded<br>**NOTE:** Folded and taped bags and folded bags do not constitute layers of confinement | LA 116 A |
| 05/87–present | WM, XO, X0 | Maximum of 6 layers:<br>• up to 4 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded<br>**NOTE:** Folded and taped bags and folded bags do not constitute layers of confinement | LA 116 I |
| 01/98–present | All except WM, XO, X0 | Maximum of 1 layer:<br>• 1 carbon-filter vented inner bag (if initial bag is breached, bag is placed in second bag and first bag is slit open), closed by either twist & tie; or twist, tie & tape<br>• 2 liner bags, folded, no closure | LA 116 E |

~~Note 1:~~ Layers of confinement for these TRUCON Codes are defined in DOE/WIPP-89-004

~~Note 2:~~ In Rev 1 of this AK report, LA116A was applicable from 5/87 until 1/97. Its applicability was extended to the end of 1997 in Rev 2 (the current revision) because of inconsistencies found during reconciliation of VE data (Section 14.2).

14.1 Radiography Data

Radiography data are examined to confirm AK information about WMC assignments, layers of packaging, absence of prohibited items, and the relative volumes or weights of waste matrix parameters for a waste stream. The WMC for waste streams TA-55-19 and TA-55-20 is S5300 (combustible debris). Thus far, 265 containers, or about 6 percent of the 4454 containers in these two waste streams (Sampling Plan, Revision 3), have undergone RTR, with the data contained in WIPP-compliant batch data reports. The following observations are made from an examination of these data, as summarized in Table 8 and 9:

- confirmation of WMC S5300 for 98.9 percent of the drums examined
- identification of WMC discrepancies for 3 containers (1.1 percent of the drums examined), which must be reassigned to other waste streams
- identification of potentially sealed containers > 4 liters in 13 percent of the drums, for which PWRs were submitted
- confirmation of the absence of any other prohibited item or condition requiring a PWR
- confirmation of 4 or fewer packaging layers for 52 percent of the drums; Plastic packaging layers for the remaining 48 percent were indeterminate due to the large number of horsetails present in the drums .
- confirmation of the waste stream description
- 97 percent of the drums contain more than 75 ~~wt percent~~ wt% combustible waste
- 86 percent of the drums contain less than 5 ~~wt percent~~ wt.% metal waste, and 94 percent contain less than 10 ~~wt percent~~ wt.% metal waste.

  **Note:** TA-55 waste generators followed guidance that metal cans used to contain debris were to be considered as packaging, and not as waste. This may account for the drums of combustible debris that were estimated by RTR to contain more than the expected 5 wt.% ~~percent~~ metal waste.

Changes in waste stream assignment because of characterization data are documented in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-~~2.1~~1.2-064).

AK information resolved an apparent WMC discrepancy for several drums in waste stream TA-55-19 which contained material identified as metal by the RTR operator, thereby leading to an apparent WMC of S5110 (for metal debris)

**Table 8. RTR Waste Data for Waste Streams TA-55-19 and TA-55-20**

| Evaluated Waste Characteristic | Number of Drums | | | |
|---|---|---|---|---|
| WIPP-compliant RTR data | | | | |
| • TA-55-19 | 245 | out of | 4173 | 6% of waste stream |
| • TA-55-20 | 20 | out of | 281 | 7% of waste stream |
| WMC discrepancies | | | | |
| • TA-55-19 | 3 | out of | 245 | 1% of drums examined |
| • TA-55-20 | 0 | out of | 20 | 0% of drums examined |
| *Excluding drums with confirmed WMC discrepancy* | | | | |
| Free liquids (no PWR required; all <1" of container or <1% of drum) | 34 | out of | 262 | 13 % of drums examined |
| Sealed containers > 4L (PWR required) | 31 | out of | 262 | 13 % of drums examined |
| Pressurized containers | 0 | out of | 262 | 0 % of drums examined |
| Unpunctured liner | 0 | out of | 262 | 0 % of drums examined |
| Other prohibited items | 0 | out of | 262 | 0 % of drums examined |
| *Excluding drums with PWRs* | | | | |
| Proportion of combustible waste in drum (~~weight %~~ wt. %) | | | | |
| • Less than 25% | 0 | out of | 231 | 0 % of drums examined |
| • 25 to 50% | 1 | out of | 231 | < 1 % of drums examined |
| • 50 to 75% | 7 | out of | 231 | 3 % of drums examined |
| • More than 75% | 223 | out of | 231 | 97 % of drums examined |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835, 5110, 5121, 5147; RTR batch data report ~~still~~ in Project-level review: LA01-RTR-006.

**Table 9. RTR Packaging Data for Waste Streams TA-55-19 and TA-55-20**

| Maximum number of layers | Metal Layers | Plastic Layers | No. of Drums | ~~% of Total Examined~~ | |
|---|---|---|---|---|---|
| Less than or equal to 1 | 0 | 1 | 2 | out of 231 | 1% of drums |
| Less than or equal to 2 | 0 | 2 | 21 | out of 231 | 9% of drums |
| Less than or equal to 3 | 0 | 3 | 95 | out of 231 | 41% of drums |
| Less than or equal to 4 | 1 | 3 | 2 | out of 231 | 1% of drums |
| Less than or equal to 5 | None observed | | 0 | out of 231 | 0% of drums |
| Less than or equal to 6 | None observed | | 0 | out of 231 | 0% of drums |
| **Total number of layers** | 0 | Indeter | 109 | | |
| Indeterminant due to number of plastic horsetails: | 1 | Indeter | 2 | | |
| | Subtotal | | 111 | out of 231 | 48% of drums |

Data sources: RTR batch data reports TWCP-4019, 4020, 4021, 4080, 4219, 4399, 4400, 4457, 4458, 4459, 4464, 4471, 4542, 4543, 4544, 4545, 4566, 4570, 4572, 4573, 4574, 4577, 4721, 4797, 4835, 5110, 5121, 5147; RTR batch data report ~~still~~ in Project-level review: LA01-RTR-006.

(TWCP-3288, 3289, 3290, 3291, 4190). After reviewing with the generator how these drums were packaged, the generator determined that these drums were packaged with very dense in-house fabricated plastic material called polyvinyldienefluoride (PVDF, also known as Kynar) used to line gloveboxes and build equipment in chloride operations starting in about 1988 (TWCP-5157). Hence, the WMC S5300 was correct. As a result of this AK information, a sample of Kynar was added to one of the test drums used in the RTR operations.

14.2 Visual Examination Data

VE data are used to confirm AK information on waste stream descriptions, WMC, the absence of prohibited items, the number and type of confining layers, and the relative volumes and weights of waste matrix parameters. AK packaging and WMC information have been evaluated by VE for about 22 containers so far in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). These 22 drums were packaged between 11/85 and 8/97 (Sampling Plan). P/S codes are available for the waste items packaged in these drums, as documented in radioassay batch data reports (TWCP-4024, TWCP-4025, TWCP-4052, TWCP-4158, TWCP-4303) and waste generator records (TWCP-5086). (The codes for these drums are listed in Table 11, which is discussed in Section 14.3). VE results are summarized in Table 10, from which the following observations are made:

- VE confirmed the AK WMC for all of these drums, reporting WMC S5300 (Organic Debris) for 8 drums, and S5310 (Plastic/Rubber Debris) for 14 drums.

- The maximum number of confining layers observed by VE was five (for one drum), consistent with AK information indicating that the number of layers is six or less (TWCP-816; also Table 7 of this report).

  **NOTE:** RTR data for the number of plastic layers in this particular drum were indeterminate.

- No closed liners were found by VE, which confirmed AK and RTR information.

- For 5 drums, the number of ~~confining~~ confinement layers observed during VE (2 to 4) was greater than the number of layers associated with the TRUCON code assigned for these drums by the waste generator (LA116C, 1 layer).

- For 4 of the above drums, the default AK value (LA116E, 1 layer) would also have been less conservative than the VE findings. All 4 had been packaged after January 1997 such that no more than 1 layer was expected (Table 7).

**Table 10. VE Data for Waste Streams TA-55-19 and TA-55-20**

| Characterization data | Number of containers | | | | Comments |
|---|---|---|---|---|---|
| | AK ~~(see Note 1)~~ | | RTR | VE | |
| Waste Matrix Code | | | | | |
| S5000 | — | | — | — | Positive confirmation of AK WMC by RTR and VE for ~~all~~ 22 drums |
| S5300 | 22 | | 22 | 8 | |
| S5310 | — | | — | 14 | |
| Maximum # of layers and associated TRUCON codes | Default ~~(Note 1)~~ | Assigned in SP | ~~See Note 2~~ | | Number of confining layers<br>• AK and VE match for 3 drums<br>• AK more conservative than VE for 14 drums<br>• AK from waste generator was less conservative than VE for 5 drums |
| 0 LA116G | — | — | | — | |
| 1 LA116C, E, F | — | 6 | | 2 | |
| 2 LA116B, D | — | — | | 2 | |
| 3 None | — | — | | 9 | |
| 4 LA116A | 4 | 4 | | 8 | |
| 5 LA116H | — | — | | 1 | |
| 6 LA116I | 8 | — | | — | |

SP—Sampling Plan (Rev 3)

~~Notes:~~

1. AK information for WMC and TRUCON code assignments is from the Sampling Plan, Rev 3. If no TRUCON code was assigned, then the default code was determined from Table 6 in TWCP-AK-2.1-008 (Rev 1), using AK information on packaging dates and P/S codes as documented in the Sampling Plan.
2. RTR data indicated no metal packaging layers for any of these drums, which was consistent with AK information and confirmed by VE. The number of plastic packaging layers was indeterminate by RTR except for one drum with three layers, which was consistent with the default TRUCON code and confirmed by VE (TWCP-4393).

Data sources: VE batch data reports TWCP-3947, 3948, 3949, 3950, 3951, 4022, 4326, 4327, 4392, 4393, 4394, 4427, 4800, 5077, 5083, 5084, 5085, 5112, 5115, 5120, 5173; VE batch data report ~~still~~ in Project-level review: LA00-3.4.1-005.

## Table 11. Radioassay Data for Waste Streams TA-55-19 and TA-55-20

| Radionuclide Characteristics | Number of drums | Comments |
|---|---|---|
| Pu isotopic fractions | | Dominant isotope is Pu239 in all drums |
| • Pu238 / total Pu | 22 | 0.010 to 0.069 wt.% |
| • Pu239 / total Pu | 22 | 91.1 to 94.1 wt.% |
| • Pu240 / total Pu | 22 | 5.7 to 8.5 wt.% |
| • Pu241 / total Pu | 22 | 0.14 to 0.32 wt.% |
| • Pu242 / total Pu | 22 | 0.009 to 0.055 wt.% |
| Material type | | |
| • MT52 | 19 | |
| • MT53 | 2 | |
| • MT52/53 mix | 1 | |
| Total Pu mass, expressed as ratio of AK data to NDA data | | AK data from Sampling Plan (Rev 3)<br>AK/NDA ratios range from 0.6 to 1.4 |
| • AK/NDA < 0.7 | 1 | |
| • 0.7 < AK/NDA < 1.3 | 17 | |
| • AK/NDA > 1.3 | 4 | |
| Other actinides present at detectable levels (uncertainties ≤ 21.5%)* | | *Range of ratios of nuclide to total Pu*<br>Measured ratios / Calculated upper bound (Table 2) |
| • Am241 | 22 | $1 \times 10^{-3}$ to $9 \times 10^{-3}$ / $2 \times 10^{-3}$ to $3 \times 10^{-3}$ |
| • Am243 | 22 | $4 \times 10^{-7}$ to $4 \times 10^{-6}$ / Not applicable |
| • Np237 | 22 | $2 \times 10^{-4}$ to $1 \times 10^{-2}$ / Not applicable |
| • U234 | 21 | $7 \times 10^{-3}$ to $6 \times 10^{-2}$ / $2 \times 10^{-5}$ to $2 \times 10^{-5}$ |
| • U235 | 5 | $3 \times 10^{-3}$ to $5 \times 10^{-2}$ / $9 \times 10^{-4}$ to $1 \times 10^{-3}$ |
| • U238 | 0 | No measurable U238 / Not applicable |
| Other radionuclides present at detectable levels (uncertainties ≤ 21.5%)* | | Note Th232 is not detectable by the methods used |
| • Cs137 | | |
| • Pa231(uncertainty <21.5%) | 16 | |
| • No other detectable nuclides | 9 | |
| | 2 | |
| Ratio of measured ratio (Am241/Total Pu) to calculated upper bound (0.002, Table 2) | | |
| • Ratio < 1 | 2 | Am241 could be from decay of Pu241 |
| • 1 < ratio < 2 | 7 | Process waste probably enriched in Am241 |
| • 2 < ratio < 3 | 7 | Process waste enriched in Am241 |
| • Ratio > 3 | 6 | Process waste enriched in Am241 |
| P/S codes for waste items present in these drums (TWCP-5086). The number of drums containing waste items from each code is given in parentheses, if more than one. | | |
| • Chloride operations | CSE, CW, CX (3), CXL (7), MB, MS | |
| • Metal operations | CA (2), FF, MA, MW, PH, SRL | |
| • Miscellaneous operations | AD (2), CV, IB (5), ME, WM (3), XP | |
| • Nitrate operations | ATL, BM (4), COD, DS (3), ED (7), EV (4), HCD, LR (4), MAG, NC (6), NL (2), OD, PR (2), RBJ, RR (2), SC (8), SP (4), SSD | |
| • Pyrochemical operations | ER (3), MO, OR (3), SS (3) | |
| • Special processing | None | |

NDA—nondestructive assay

Data sources: Radioassay batch data reports TWCP-4009, 4023, 4024, 4025, 4052, 4078, 4158, 4159, 4212, 4225, 4226, 4303; and Sampling Plan (Rev 3). P/S codes from TWCP-5086 and TWCP-5163.

*The rationale for this MDL cut off (21.5% uncertainty) is given in TWCP-2130.

**NOTE:** As a result of this discrepancy in packaging layers, Table 7 was revised to extend the period of applicability of LA116A (4 layers of packaging) to the end of 1997.

A conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution, at least with respect to waste containers packaged in 1997 when TA-55 personnel were transitioning from one packaging procedure to another.

14.3 Radioassay Data

Radioassay data are examined to confirm AK information on plutonium material type and mass, the presence of other radionuclides contributing to the total drum activity, and evidence for fractionation of other actinides (e.g., uranium, americium) relative to plutonium during material processing. Table 11 summarizes information relevant to these evaluations for the 22 drums from TA-55-19 and TA-55-20 that have undergone VE. These data confirm the following AK information:

- the dominant isotope in all drums is Pu239
- the material type is MT52 or MT53 for all drums
- all these drums qualify as TRU waste
- AK information on total mass of Pu in each drum is within 30 percent of the TWCP assay value for 17 drums (77 percent). AK mass for the remaining five drums (23 percent) is within 40 percent of the TWCP assay value.
- As indicated by AK information, all drums contain low but detectable quantities of Am-241, Am-243, and Np-237. A significant proportion also contains Cs-137 and Pa-231.
- No U-236 or U-238 was detected, confirming AK information that uranium is not expected to be present in process waste generated under the P/S codes listed as the source of waste in these drums
- U-235 is present only at trace levels in 5 drums
- In 20 drums (91 percent), Am-241 and U-234 are enriched beyond what would be predicted if they were present solely due to the decay of their precursors in the source Pu, indicating that significant fractionation of Am and U from Pu occurs during processing operations

14.4 Headspace Gas Data

Headspace gas data are examined to confirm AK information about the presence or absence of hazardous constituents in a given waste stream, and the assignment of each drum to the appropriate mixed or nonmixed waste stream. Table 12 summarizes VOC target analyte concentrations for headspace gas samples from 55 containers assigned to waste stream TA-55-19. (No approved data are yet available for drums from waste stream TA-55-20.) These data confirm the AK information:

- Altogether, 13 different VOCs were detected in these drums. All are documented as having been present or used in TA-55 processes contributing to waste stream TA-55-19, and HWNs have already been assigned to this waste stream for these constituents.
- Only one VOC, methylene chloride, had a 90% Upper Concentration Limit ($UCL_{90}$) value that was above its program required quantitation limit (PRQL).
- Four VOCs—acetone, 1,1,2-trichloro-1,2,2-trifluoroethane, methyl ethyl ketone, and toluene—had $UCL_{90}$ values below the PRQL but were present in at least one drum at a concentration above the PRQL.
- One VOC (methanol) had a mean concentration above its Method Detection Limit (MDL) but no concentrations above the PRQL.
- Seven VOCs had mean concentrations below their MDL, but were present in at least one drum at a concentration above the MDL.
- All other target analyte VOCs were below the MDL.
- No Tentatively Identified Compounds (TICs) were detected.

These results are consistent with AK information summarized in this waste stream report, insofar as all of the VOCs that were detected are known to have been present in TA-55 operations. The data confirm that assignment of these HWNs based on AK information is conservative.

whose WAC ?

Table 13 summarizes concentrations of potentially flammable VOCs, hydrogen, and methane for headspace gas samples from the same 55 containers as are included in Table 12. All were below the WAC limits. The average concentration of potentially flammable VOCs for this set of 55 drums was 128 ±101 ppm ppmv, with a maximum of 473 ppm (TWCP-4722). No methane was detected in any of the drums, and hydrogen concentrations were lower by more than an order of magnitude than the WAC limit of 5 percent.

WIPP

14.4 Headspace Gas Data

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- One VOC (methanol) had a mean concentration above its Method Detection Limit (MDL) but no concentrations above the PRQL.
- Seven VOCs had mean concentrations below their MDL, but were present in at least one drum at a concentration above the MDL.
- All other target analyte VOCs were below the MDL.
- No Tentatively Identified Compounds (TICs) has been detected.
- No tetrahydrofuran was detected in any drum containing waste from TA-55.

These results are consistent with AK information summarized in this waste stream report, insofar as all of the VOCs that were detected are known to have been present in TA-55 operations. The data confirm that assignment of these HWNs based on AK information is conservative.

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## Table 12. Headspace Gas Data for Target Analytes in Waste Stream TA-55-19

| ANALYTE | MDL, (ppmv) | PRQL, (ppmv) | No. of Samples Analyzed | No. of Samples above MDL | No. of Samples above PRQL | VOC concentrations, in (ppmv) | | | EPA HWN |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Mean | $UCL_{90}$* | Maximum | AssignedAK |
| Benzene | 1.96 | 10 | 55 | 4 | 0 | 1.2 | 1.8 | 5 | F005, D018 |
| Bromoform | 2.27 | 10 | 55 | 0 | 0 | 1.1 | 1.1 | — | — |
| Carbon Tetrachloride | 2.00 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 3 | D019 |
| Chlorobenzene | 1.93 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 2 | F002, D021 |
| Chloroform | 1.85 | 10 | 55 | 4 | 0 | 1.0 | 1.4 | 3 | D022 |
| 1,1-Dichloroethane | 1.78 | 10 | 55 | 2 | 0 | 1.0 | 1.9 | 4 | — |
| 1,2-Dichloroethane | 2.40 | 10 | 55 | 0 | 0 | 1.2 | 1.2 | — | — |
| 1,1-Dichloroethene | 2.74 | 10 | 55 | 0 | 0 | 1.4 | 1.4 | — | — |
| Cis-1,2-Dichloroethylene | 2.06 | 10 | 55 | 0 | 0 | 1.0 | 1.0 | — | — |
| Ethyl Benzene | 1.72 | 10 | 55 | 0 | 0 | 0.9 | 0.9 | — | F003 |
| Ethyl Ether | 1.30 | 10 | 55 | 0 | 0 | 0.65 | 0.65 | — | F003 |
| Methylene Chloride | 1.97 | 10 | 55 | 11 | 8 | 8.7 | 18.1 | 100 | F002 |
| 1,1,2,2-Tetrachloroethane | 1.62 | 10 | 55 | 0 | 0 | 0.8 | 0.8 | — | — |
| Tetrachloroethene | 1.44 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | — | F002, D039 |
| Toluene | 1.67 | 10 | 55 | 33 | 11 | 6.5 | 8.5 | 51 | F005 |
| 1,1,2-Trichloro 1,2,2-trifluoroethane (Freon-113) | 1.79 | 10 | 55 | 1 | 1 | 1.7 | 1.7 | 44 | F002 |
| 1,1,1-Trichloroethane | 1.82 | 10 | 55 | 1 | 0 | 1.0 | 1.0 | 4 | — |
| Trichloroethene | 1.31 | 10 | 55 | 0 | 0 | 0.7 | 0.7 | 6.0 | F002, D040 |
| m-Xylene and p-xylene | 3.62 | 10 | 55 | 0 | 0 | 1.8 | 1.8 | — | F003 |
| o-Xylene | 1.90 | 10 | 55 | 0 | 0 | 0.95 | 0.95 | — | F003 |
| Acetone | 16.12 | 100 | 55 | 31 | 13 | 69.7 | 91.2 | 410 | F003 |
| Butanol | 8.78 | 100 | 55 | 1 | 0 | 4.8 | 4.8 | 29 | — |
| Methanol | 11.42 | 100 | 55 | 10 | 0 | 14.6 | 24.3 | 84 | F003 |
| Methyl ethyl ketone | 18.42 | 100 | 55 | 4 | 0 | 10.1 | 12.6 | 23 | F005, D035 |
| Methyl isobutyl ketone | 16.05 | 100 | 55 | 0 | 0 | 8.0 | 8.0 | — | — |

Source: TWCP-4722; VOC target analyte list for debris waste from WIPP WAP, Table B3-2.

ppmv, part per million by volume; MDL, Method Detection Limit; PRQL, Program Required Quantitation Limit; UCL90, 90% Upper Concentration Limit

— Not applicable

* For samples with concentrations below the MDL, $UCL_{90}$ concentrations are calculated by assuming concentrations were ~~half~~ one-half of the MDL values as determined in the MDL study dated 6/19/00 (TWCP-3248).

Has another one been done? - Aren't they only good for 6 months?

## Table 13. Headspace Gas Data For Flammable VOCs, Hydrogen, and Methane in Waste Stream TA-55-19

| ANALYTE | Lower Explosive Limit (LEL) | No. of Samples Analyzed | No. of Samples Above MDL | Maximum Measured Concentration (ppmv) | Evidence for Presence of Gas in Waste | |
|---|---|---|---|---|---|---|
| | | | | | Gas Data | AK |
| Acetone | 2.5% | 55 | 31 | 410 | X | X |
| Benzene | 1.2% | 55 | 4 | 5 | X | X |
| Butanol | 1.4% | 55 | 1 | 29 | X | X |
| Chlorobenzene | 1.3% | 55 | 1 | 2 | X | X |
| Cyclohexane | 1.3% | 55 | 0 | — | — | — |
| 1,1-Dichloroethane | 5.4% | 55 | 2 | 4 | X | — |
| 1,2-Dichloroethane | 6.2% | 55 | 0 | — | — | — |
| 1,1-Dichloroethene | 6.5% | 55 | 0 | — | — | X |
| Cis-1,2-Dichloroethylene | 5.6% | 55 | 0 | — | — | — |
| Ethyl Benzene | 0.8% | 55 | 0 | — | — | X |
| Ethyl Ether | 1.9% | 55 | 0 | — | — | X |
| Methanol | 6.0% | 55 | 10 | 84 | X | X |
| Methyl ethyl ketone | 1.4% at 200 °F | 55 | 4 | 23 | X | X |
| Methyl isobutyl ketone | 1.2% at 200 °F | 55 | 0 | — | — | — |
| Toluene | 1.1% | 55 | 33 | 51 | X | X |
| 1,3,5-Trimethylbenzene | Not known | 55 | 0 | — | — | — |
| 1,2,4-Trimethylbenzene | 0.9% | 55 | 0 | — | — | — |
| m-Xylene and p-xylene | 1.1% | 55 | 0 | — | — | X |
| o-Xylene | 0.9% | 55 | 0 | — | — | X |
| **Total potentially flammable VOCs in a single container*** | — | 55 | — | 473 | X | X |
| Hydrogen* | 4% | 55 | 32 | 0.38% | X | X |
| Methane* | 5.3% | 55 | 0 | — | — | X |

Source: TWCP-4722

ppmv, part per million by volume; MDL, Method Detection Limit

LEL, Lower explosive (flammable) limit in air, % by volume (at room temperature); data from NIOSH Pocket Guide to Chemical Hazards (NIOSH, 1997)

— Not applicable or not detected

* WAC requirements state that a waste container cannot be shipped if its headspace gas concentration exceeds 500 ppm for total flammable VOCs, 5% for hydrogen, or 500 ppm for methane concentration.

** The average flammable VOC concentration is 128 ±101 ppm (TWCP-4722). Gases that were below detection are taken into account in this calculation by assuming they are present at concentrations that are equal to ~~half~~ one-half of the MDL values.

Headspace

Constituent

**Table 13. Headspace Gas Data For Flammable VOCs, Hydrogen, and Methane in Waste Stream TA-55-19**

| ANALYTE | Lower Explosive Limit (LEL) | No. of Samples Analyzed | No. of Samples Above MDL | Maximum Measured Concentration (ppmv) | Evidence for Presence of VOC in Waste | |
|---|---|---|---|---|---|---|
| | | | | | Gas Data | AK |
| Acetone | 2.5% | 55 | 31 | 410 | X | X |
| Benzene | 1.2% | 55 | 4 | 5 | X | X |
| Butanol | 1.4% | 55 | 1 | 29 | X | X |
| Chlorobenzene | 1.3% | 55 | 1 | 2 | X | X |
| Cyclohexane | 1.3% | 55 | 0 | — | — | — |
| 1,1-Dichloroethane | 5.4% | 55 | 2 | 4 | X | — |
| 1,2-Dichloroethane | 6.2% | 55 | 0 | — | — | — |
| 1,1-Dichloroethene | 6.5% | 55 | 0 | — | — | X |
| Cis-1,2-Dichloroethylene | 5.6% | 55 | 0 | — | — | — |
| Ethyl Benzene | 0.8% | 55 | 0 | — | — | X |
| Ethyl Ether | 1.9% | 55 | 0 | — | — | X |
| Methanol | 6.0% | 55 | 10 | 84 | X | X |
| Methyl ethyl ketone | 1.4% at 200 °F | 55 | 4 | 23 | X | X |
| Methyl isobutyl ketone | 1.2% at 200 °F | 55 | 0 | — | — | — |
| Toluene | 1.1% | 55 | 33 | 51 | X | X |
| 1,3,5-Trimethylbenzene | Not known | 55 | 0 | — | — | — |
| 1,2,4-Trimethylbenzene | 0.9% | 55 | 0 | — | — | — |
| m-Xylene and p-xylene | 1.1% | 55 | 0 | — | — | X |
| o-Xylene | 0.9% | 55 | 0 | — | — | X |
| **Total potentially flammable VOCs in a single container*** | — | **55** | — | **473** | **X** | **X** |
| Hydrogen* | 4% | 55 | 32 | 0.38% | X | X |
| Methane* | 5.3% | 55 | 0 | — | — | X |

Source: TWCP-4722

ppmv, part per million by volume; MDL, Method Detection Limit

LEL, Lower explosive (flammable) limit in air, % by volume (at room temperature); data from NIOSH Pocket Guide to Chemical Hazards (NIOSH, 1997)

— Not applicable or not detected

* WAC requirements state that a waste container cannot be shipped if its headspace gas concentration exceeds 500 ppm for total flammable VOCs, 5% for hydrogen, or 500 ppm for methane concentration.

** The average flammable VOC concentration is 128 ±101 ppm (TWCP-4722). Gases that were below detection are taken into account in this calculation by assuming they are present at concentrations that are equal to half of the MDL values.

I need to revise this P slightly and add a reference

In conclusion, the headspace gas data confirm the presence of VOCs in waste stream TA-55-19. ~~No~~ All VOCs ~~were~~ present ~~which~~ were ~~not~~ expected based on AK. However, no correlation is seen between the presence and absence of a specific VOC and its documented use in a process known to have contributed waste placed in a particular drum. For example, about 60 percent of the containers show measurable concentrations of acetone and/or toluene in the headspace gas, and 20 percent contain methylene chloride, but less than half of the drums in which these chemicals are present contain waste items generated by activities that were known to have used these chemicals. The most plausible explanation is that acetone, toluene, and methylene chloride are present as solvents used in the manufacturing of plastics. Radiolytic degradation of the plastic polymers may also be a contributing factor.

this seems like a bombshell!

Add References

## 15.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, Segregation of hazardous materials
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (Attachment B, Waste Analysis Plan)
- *NIOSH Pocket Guide to Chemical Hazards* (1997). National Institute for Occupational Safety and Health (NIOSH) Publication #97-140.
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028).
- *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

full citations?

Jim: your call.

insert TWCP-351 & 352 here, from p. 3 of Att 1



## ACCEPTABLE KNOWLEDGE ROADMAP

Waste Streams: TA-55-19 and TA-55-20.

Documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983. | Los Alamos Certification Plan, 1983 | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document – Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1955,* TRUWM-TA55-CPA-03, R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Provides an explanation of why some waste containers may be packaged with 6 layers of confinement | No Direct way to differentiate between and 6 layers of packaging |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by P/S code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

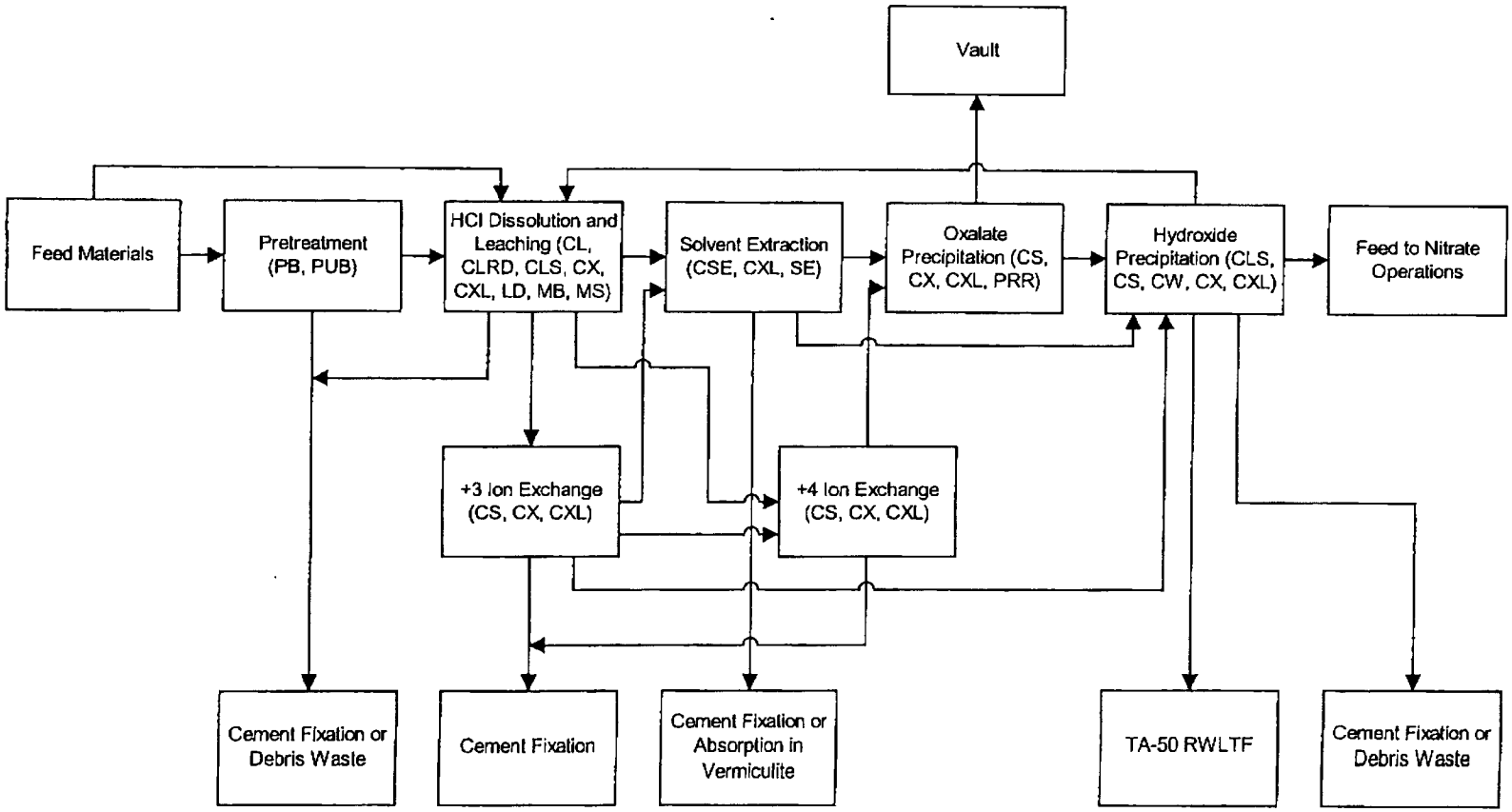
| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-2130 | D | Estimate of the minimum detection limit for Am-243, Np-237, Pa-231, and Th-232 for FRAM analyses | Criteria for reporting Am-243, Np-237, Pa-231, and Th-232 on mobile PAN radioassay data sheets | If the error in the peak area for the isotopes Am-243, Np-237, Pa-231, and Th-232 is greater than 21.5% in the FRAM report, then that isotope is considered to be below the minimum detectable activity. | Memo refers specifically to PAN radioassay data, but the same reasoning is applied to TGS and HENC assay data as well, and to all radionuclides detectable by FRAM. |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests are on residues rather than waste that is lower in Pu content; hence, they are conservative. |
| TWCP-3248 | C | Method Detection Limits for Headspace Gas Analyses | MDL studies with data | MDL values for VOCs, determined 06/19/00 | Different MDL values would have been in effect at the times that the data included in Table 12 of this AK report were acquired, so the MDL values should only be considered as an approximate guide. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

PROCESS

## SIMPLIFIED FLOW DIAGRAMS

### SIMPLIFIED PROCESS FLOW DIAGRAM FOR CHLORIDE OPERATIONS




**NOTE:** Many of the P/S codes for chloride operations involve more than one step or activity in the process flow diagram. Thus, the same P/S code can appear in more than one box on the process flow diagram.

Edit Round #4

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-00-5727)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19, TA-55-19A, and TA-55-20

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

Checked against edit round #5

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**Attachments**

1 Acceptable Knowledge Roadmap (3 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Simplified Process Flow Diagrams (8 pages)
4 TRU Waste Forms (5 pages)
5 Chemical Waste Disposal Request Form (1 page)

June to update #

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| ARIES | Advanced Recovery and Integrated Extraction System |
| CFR | *Code of Federal Regulations* |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| C–N–O | carbon–nitrogen–oxygen |
| CSMO | Central Scrap Management Office |
| DBBP | dibutyl butylphosphonate |
| DCHP | dicesium hexachloroplutonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| ID | item identification |
| IDC | item description code |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| MCDOR | multicycle direct oxide reduction |
| MEGAS | Multiple Energy Gamma Assay System |
| MT | material type |
| NDA | nondestructive assay |
| NMT | Nuclear Material Technology |
| P | RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF | Plutonium Facility |
| PRQL | program required quantitation limit |
| P/S | process/status [code] |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RD&D | research, development, and demonstration |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |

PuBe → plutonium–beryllium

## PROCESS/STATUS CODE INDEX

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| AC | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, D038, F002, F005, ~~U213~~ |
| AC1 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, ~~D038,~~ F002, F005, ~~U213~~ |
| AC2 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, F002, F005 D038 |
| AC3 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | |
| ACC | Ammonium chloride conversion | Special Processing | 3.4.8, Att. 4 | |
| ACD | Cascade dissolver | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| ACL | Analytical chemistry laboratory | Miscellaneous Operations | 3.4.4, Att. 4 | D007, D009 |
| AD | Actinide processing demonstration | Miscellaneous Operations | 3.4.1, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| AL | Ash leach | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| AO | Assembly operation | Metal Operation Processes | 3.4.3, Att. 4 | |
| AO | Americium processing calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| AP | Americium purification | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | D007, D009 |
| APD | Actinide processing demonstration | Miscellaneous Operations | 3.4.7, Att. 4 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| ARI | ARIES | Metal Operation Processes | 3.4.3, Att. 4 | |
| AS | Anode heel dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008, D011 |
| AT | Ash testing | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| ATL | Advanced test line for actinide separation RD&D | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| AX | Solution assay | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009 |
| BA | Basement isopress | Metal Operation Processes | 3.4.2, Att. 4 | |
| BAC | Bacterial decomposition of cellulose items | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| BC | Physical properties | Metal Operation Processes | 3.4.2, Att. 4 | |
| BF | Unknown name for P/S code | Nitrate Operations | 3.4.6, Att. 4 | D006, D007, D008, D011 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| RBJ | Roasting and blending Jr | Nitrate Operations | 3.4.3, Att. 4 | |
| RC | Rotary calciner | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D005, D006, D007, D008, D011 |
| RCM | Rich column material ion exchange | Nitrate Operations | 3.4.3, Att. 4 | |
| RD | Repackaging into retrievable drums | Miscellaneous Operations | 3.4.9, Att. 4 | |
| RFX | Ion exchange | Nitrate Operations | 3.4.3, Att. 4 | |
| RL | Radiochemical coating | Metal Operation Processes | 3.4.2, Att. 4 | |
| RM | Reduction to metal | Special Processing | 3.4.4, 3.4.6, 3.4.7, 3.4.8, 3.4.9, Att. 4 | |
| RO | Oil recovery | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D006, D008, D040 |
| RR | Ion exchange | Nitrate Operations | 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |
| RS | Pellet sintering | Metal Operation Processes | 3.4.1, Att. 4 | |
| SA | Super acid RD&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D018, D038, F002, F003, F005, ~~U211~~ |
| SB | Scrap burning | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| SBB | Ca/Al scrubbing RD&D | Special Processing | 3.4.9, Att. 4 | |
| SC | Cascade dissolver, G437 | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| SCB | Chlorination Ca/Al scrubbing RD&D | Pyrochemical Processes | 3.4.2, Att. 4 | |
| SD | Salt distillation | Pyrochemical Processes | 3.4.5, Att. 4 | P120 |
| SE | Solvent extraction | Chloride Operations | 3.4.3, Att. 4 | D007, D008, D009, D039, F002 |
| SL | Scrap leaching | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| SMP | SP mounting preparation | Miscellaneous Operations | 3.4.5, Att. 4 | |
| SO | Super oxidizer, FOOF program | Miscellaneous Operations | 3.4.2, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | Scrap dissolution, G438 | Nitrate Operations | 3.4.2, Att. 4 | D007 |
| SRL | Special recovery line | Metal Operation Processes | 3.4.2, Att. 4 | |
| SS | Salt stripping | Pyrochemical Processes | 3.4.3, 3.4.4, 3.4.5, 3.4.7, 3.4.8, Att. 4 | D006, D008, P120 |
| SSD | Special scrap dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008 |
| SSMD | SS material development | Pyrochemical Processes | 3.4, Att. 4 | D009 |
| STF | Standard fabrication | Miscellaneous Operations | 3.4.6, Att. 4 | D007 |

Remove change bar

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate transuranic wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; pyrochemical salts; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; reactor fuel pellets; plutonium scrap; dissassembled weapons components (pits); plutonium-beryllium sources; crucible pieces; ash; analytical laboratory solutions; residues from other DOE facilities; anode heels, Np-237 (briefly in 1993); and analytical laboratory solutions.

**Waste Material Parameter List ~~(including packaging)~~**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (<5% by volume)
*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005

- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120
- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved.

NOTE: Drums containing items with HWN P120 will be segregated into Waste Stream TA-55-19A before certification.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium and uranium relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**Process Feed**

Plutonium metal or metal alloys; pyrochemical salts; plutonium oxides and hydroxide cakes; other actinide metals or metal alloys and oxides; reactor fuel pellets; plutonium scrap; dissassembled weapons components (pits); plutonium-beryllium sources; crucible pieces; ash; analytical laboratory solutions; residues from other DOE facilities; anode heels, Np-237 (briefly in 1993); and analytical laboratory solutions.

**Waste Material Parameter List ~~(including packaging)~~**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (<5% by volume)
*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**RCRA Characterization**

No HWNs apply to containers in waste stream TA-55-20.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium and uranium relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types. Other waste may contain

Edit Round #2
JM

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

**REPORT NUMBER:** TWCP-AK-2.1-008,R.2 (LA-UR-00-5727)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19, TA-55-19A, and TA-55-20

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

Checked against edit round #5
JM 4/9/01

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 08/31/00 | — | New report (TWCP-03844) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 1/IC1 | 12/15/00 | Acceptable Knowledge Summary | To clarify segregation of containers in TA-55-19A |
| 2 | | All | To respond to CBFO reviewer comments |
| | | | |
| | | | |
| | | |

Central Scrap Management Office

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| ARIES | Advanced Recovery and Integrated Extraction System |
| CFR | *Code of Federal Regulations* |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| CSMO → C-N-O | DBBP dibutyl butylphosphonate — carbon – nitrogen – oxygen |
| DCHP | dicesium hexachloroplutonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| ID | item identification |
| IDC | item description code |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| MCDOR | multicycle direct oxide reduction |
| MEGAS | Multiple Energy Gamma Assay System |
| MT | material type |
| NDA | nondestructive assay |
| NMT | Nuclear Material Technology |
| P | RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PF → PCB | polychlorinated biphenyl — Plutonium Facility |
| PRQL | program required quantitation limit |
| P/S | process/status [code] |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RD&D | research, development, and demonstration |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| RSWD | radioactive solid waste disposal |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| GI | Pellet grinding & inspection | Metal Operation Processes | 3.4.1, Att. 4 | |
| GMS | Open gradient magnetic separation | Nitrate Operations | 3.4.1, Att. 4 | |
| HC | Calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| HCD | Hydroxide cake dissolution | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| HD | Hydroxide cake dissolution | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| HG | Pu removal by mercury | Metal Operation Processes | 3.4.2, Att. 4 | |
| HGMS | High gradient magnetic separation | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D006, D007, D008, D009, D011 |
| HP | Cement fixation | Nitrate Operations | 3.4.5, Att. 4 | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 |
| HRA | Hanford Reservation Material | Nitrate Operations | 3.4.6, Att.4 | D005, 6, 7, 8, 9, 11, [illegible] |
| HRS | High resolution spectroscopy | Miscellaneous Operations | 3.4.5, Att. 4 | |
| IA | Impure americium holding for discard | Nitrate Operations | 3.4.5, 3.4.6, Att. 4 | D006, D007, D008, D009, D011 |
| IAM | Inspection and measurement | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| IB | Matrix study of pyrochemical salts | Miscellaneous Operations | 3.4.6, Att. 4 | D005, D006, D007, D008, D009, D011 |
| ICP | ICP-AES analysis | Miscellaneous Operations | 3.4.4, Att. 4 | D007, D009 |
| ID | Immersion density | Metal Operation Processes | 3.4.1, Att. 4 | |
| IE | Isotope enrichment | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| IN | Inspection | Metal Operation Processes | 3.4.2, Att. 4 | |
| IS | Incinerator | Nitrate Operations | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| ITF | Impact test facility | Metal Operation Processes | 3.4.2, Att. 4 | |
| ITF4 | Impact test facility | Metal Operation Processes | 3.4.2, Att. 4 | |
| ITF7 | Impact test facility | Metal Operation Processes | 3.4.2, Att. 4 | |
| IX | Ion exchange | Special Processing | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| JA | Gas isostatic press | Metal Operation Processes | 3.4.2, Att. 4 | |
| KBTF | Kolsky bar test facility | Metal Operation Processes | 3.4.3, Att. 4 | D008 |
| LC | Uranium plutonium processing | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| LD | Chloride leach & dissolution | Chloride Operations | 3.4.2, Att. 4 | D007, D008, D009 |
| LG1 | Non combustible leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |

Create new AK Summary for TA-55-19A, delete mention of TA-55-19A on Summary for TA-55-19



**ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19 ~~and 19A~~**

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19, Mixed Combustible Debris Waste<br>TA-55-19A, Mixed Combustible Debris with P120 |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | TA-55-19: 1978—present; TA-55-19A: 2/98—6/98 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | TA-55-19: 4173 containers (873 $m^3$)<br>TA-55-19A: Not yet determined |
| **Waste Stream Volume (after repackaging):** | TA-55-19: 850 SWBs, 3873 drums (2390 $m^3$)<br>TA-55-19A: Not yet determined |

**Waste Material Parameter List (including packaging)**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (<5% by volume)
*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

new sections

→ Facility Mission (check placement in latest Rev of QP-21)
Copy mission text from process AK Summary

→ Process feed (compiled ~~Copy~~ from all process AK ~~rep~~ Summaries, then edited to delete repetitious text)

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate transuranic wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**RCRA Characterization:**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- ~~TA-55-19A~~ P120 ~~is assigned in addition to the codes listed for TA-55-19.~~

NOTE: Drums containing items with HWN P120 will be segregated into Waste Stream TA-55-19A before certification.

- ~~U213~~ ← delete

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium and uranium relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

Include in Summaries for TA-55-19 and TA-55-19A

- Drums containing waste from P/S codes AC, AC2 and SA ~~will be~~ are segregated from this waste stream until the potential applicability of HWN U213 has been resolved.

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-20

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-20, Non-mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-T16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | TA-55-20: 1979–present |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | TA-55-20: 281 containers (59 $m^3$) |
| **Waste Stream Volume (after repackaging):** | TA-55-20: not available |

**Waste Material Parameter List (including packaging)**

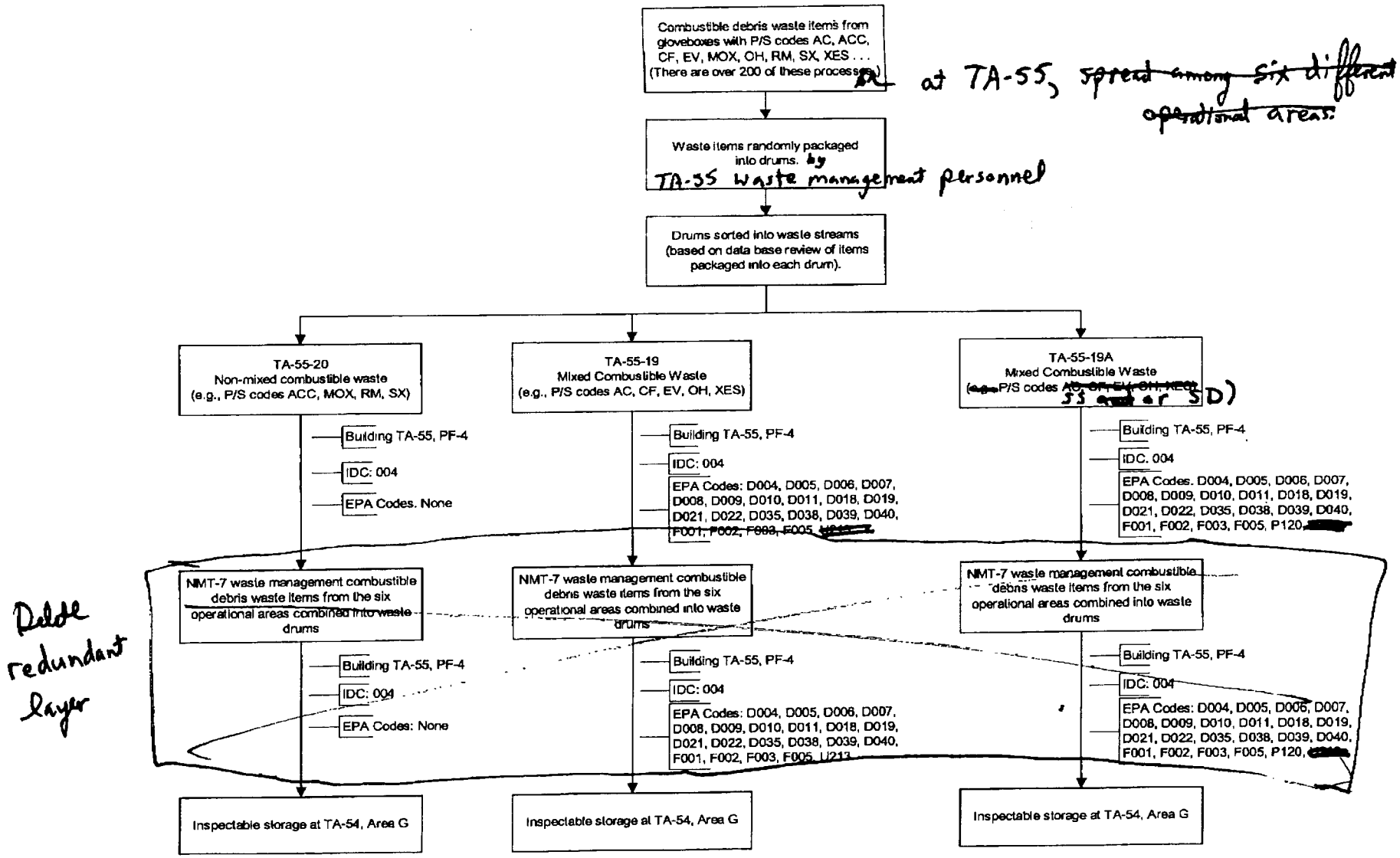
*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (<5% by volume)
*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

Add new sections, identical to TA-55-19: Facility Mission, and Process Feed

## WASTE GENERATION SUMMARY DIAGRAM



# ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR WASTE STREAMS TA-55-19 AND TA-55-20

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK information and provides guidelines on how AK should be obtained and documented.

This AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides technical support for assignment of specific waste containers to the waste stream.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to waste streams TA-55-19 and -20 covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) (Sampling Plan) that includes information regarding all waste streams, including TA-55-19 and TA-55-20.
- Review of documents related to the waste generation and waste management activities at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1),
- Interviews with personnel involved with waste generation and waste management at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1), and
- Review of process AK reports for TA-55 processes (as discussed below), and
- Analysis of processes generating waste, as discussed in the process AK reports and in this report.

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that are referenced in this summary report. Unclassified Controlled Nuclear Information

(UCNI) will be reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK summary report is based on detailed information compiled in a set of closely related reports about TRU waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

The process AK reports contain information on over 200 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. For example, the nitrate operations report (TWCP-AK-2.1-005, R.1) covers waste generation processes and characteristics for about 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generation records.

as well as by

The TA-55 Plutonium Facility tracks waste items both by the process from which they originated ~~and~~ their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item. Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. Further complication is introduced because the waste streams for TA-55 have been defined based primarily on the physical form and material content of the waste and only secondarily on the waste generation process through mixed or non-mixed waste stream designations. Hence, any given waste stream could potentially contain items from all of the plutonium recovery

TA-55-19 and TA-55-20 combustible debris waste streams were generated in the TA-55 Plutonium Facility (Building PF-4). A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

3.2 Waste Physical Form and Content Description

-19A,

The TA-55-19 and-20 are defined as combustible debris waste streams (Sampling Plan, Appendix D), with TA-55-19 being a mixed waste stream and TA-55-20 its non-mixed counterpart. The waste includes paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape, gloves, plastic vials, polystyrene, Tygon tubing, polyvinyl chloride plastic, Teflon products, Plexiglas, and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (<5%) of non-combustible solids (scrap metal, metal lids, and clothing zippers) (Sampling Plan, Appendix D).

3.3 Waste Volume and Time Period of Waste Generation

The following information is from the Sampling Plan (TWCP-PLAN-0.2.7-001, R.3, Appendix D). These values are expected to change because the sampling plan is continually updated as new waste information is obtained.

- TA-55-19 includes 4173 containers (873 cubic meters), that were generated from 1978 to the present time.
- TA-55-19A
- TA-55-20 includes 281 containers (59 cubic meters), that were generated from 1979 to the present time.

3.4 Basis, Rationale, and Assumption Used to Delineate the Waste Stream

3.5 Waste Stream Generation Processes

3.5.1 Overview

The TA-55-19 and TA-55-20 combustible debris waste streams were generated from combustible materials used in processes to recover plutonium from residues, metal fabrication, and research and development activities. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds

- Nitrate Operations
- Chloride Operations
- Miscellaneous Operations
- Special Processing
- Metal Operation Processes
- Pyrochemical Processes

Generalized flow diagrams for the six operational areas relevant to this AK search are presented as Attachment 3. With the exception of the report on chloride operations, these generalized flow diagrams indicate P/S codes for the various processes. ~~(For chloride operations, P/S codes did not correspond to individual steps as shown on the diagram, so were not included.)~~ The full block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

The following subsections describe the processes that generated debris waste assigned to the TA-55-19A and TA-55-20 waste streams. The potential for RCRA-regulated constituents to be present due to feed materials or chemical use in these processes is summarized in Section 3.5. The applicability of EPA HWNs as a result of this potential is specified in Section 8.

### 3.5.3 Nitrate Operations

P/S codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride operations), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following process steps:

- pretreatment
- dissolution

3.6.2

Special Processing includes processing operations for Material Type (MT) 42, and research and development (R&D) activities for MT 52. (See Section 3.5.1 for a discussion of plutonium material types.) (Refer to TWCP-698.) Because processing MT 42 is a smaller scale version of the recovery processes used for MT 52, MT 42 processing has five main recovery steps: (1) head-end operations, (2) nitrate ion exchange operations, (3) chloride ion exchange operations, (4) separation and purification by precipitation, and (5) pyrochemical processes. Only head-end operations and separation by purification and precipitation are covered here, since nitrate ion exchange operations, chloride ion exchange operations, and pyrochemical processes are covered briefly elsewhere in this report.

list as bullets →

Head-end operations leach tools, labware, crucibles, rags, etc in nitric acid to remove recoverable plutonium. Plutonium oxide is typically calcined as part of head-end operations.

Separation and purification by precipitation is a method of plutonium removal from aqueous solutions. The most common precipitation methods utilize oxalate, hydroxide, and peroxide anions. By selectively precipitating the plutonium, many of the metals remain in solution, thereby purifying the plutonium.

All wastes generated by MT 52 R&D operations are replicated for MT 42, but carry different P/S codes to differentiate and identify the radionuclide content of the waste. Outputs from Special Processing include high purity metal for casting and machining.

### 3.5.7 Metal Operation Processes

P/S codes AO, ARI, BA, BC, BT, CA, CN, CO, CT, DA, DOP, DT, EL, ELW, EM, EVAC, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT .

A detailed description of metal operation processes is found in *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003).

The processes included in metal operations can be divided into three groups:

- reactor fuel development processes
- on-going metal operation processes
- developmental metal operations

*Acids and bases*. Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, Hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) does not apply to the solid debris waste because there are no free liquids in this waste.
- D001 (ignitability) does not apply to the use of the oxidizers (nitric acid, perchloric acid, and superacids) because there are no free liquids in this waste. Perchloric acid in solutions are sent to cement fixation. The solids, perchlorate salts, are rinsed from rags with water before they are discarded, so any perchlorate salts end up in the cemented waste.
- Formic acid and hydrofluoric acid are listed in Appendix VIII of 40 CFR Part 261, for their corrosive and toxic characteristics, with EPA HWN U123 and U134. However, these HWNs are not applicable to the manner in which these chemicals were used and discarded in the processes covered by this report.
- None of these are F, K or P-listed chemicals

*Gases and cryogenic fluids*. The following gases and cryogenic fluids used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: argon, carbon dioxide, chlorine, halogen fluorides, hexafluoroethane, hydrogen chloride, krypton fluoride, methane, nitrogen (gas), nitrogen (liquid), perfluoropropane, and tetrafluoromethane.

The following gases used in the TA-55 processes are identified in Appendix VIII of 40 CFR Part 261 as having hazardous characteristics. The chemical name is followed by the listed EPA HWN and the P/S codes in which the gas is used:

- Fluorine (P056) is used in P/S codes CV, FDL, FLU, PI, SO
- Hydrogen fluoride (U134) is used in P/S codes MP, PI
- Nitrogen dioxide (P078) is used in P/S code HRS
- Phosgene gas (P095) is used in P/S code PTP

No EPA HWNs are applicable to the use of these gases in the TA-55 processes. Compressed gas cylinders are kept outside of the gloveboxes;

- Cadmium (D006) applies to a limited number of anode heels produced in P/S codes ER, PX, and SS using cadmium as a solvent.

- Lead (D008) was used in P/S codes DOP, ER, KBTF, PX, SS, and WE. For combustible debris waste, EPA HWN D008 is applicable to P/S codes DOP, KBTF, and PX. For P/S codes ER and SS, D008 is only applicable to the metal waste.

- Tin-lead (D008) solder was used in sensors in P/S code BT, but D008 is only applicable to the metal waste from this P/S code, and not to the combustible debris waste.

- Mercury (D009) applies to P/S code SSMD, in which it was used for about one week in the summer of 1994.

- Nickel powder ~~and nibblets~~ ~~were~~ Was used in P/S code CO as a sintering aid. This metal is listed in Appendix VIII but no HWN is given.

- Sodium (D003) was used in P/S code EL. However, D003 does not apply in this case because excess Na is dissolved in Dowanol 80.

- Stainless steel (contains chromium, D007) was used in P/S code WE. However, EPA HWN D007 does not apply in this case. There is no potential to leach chromium because stainless steel is not exposed to strong acids in P/S code WE.

*Inorganic chemicals*. The following inorganic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: aluminum bifluoride, aluminum chloride, aluminum fluoride, aluminum nitrate, aluminum oxide, ammonium chloride, antimony pentafluoride, bromine, calcium carbonate, calcium chloride, calcium fluoride, calcium nitrate, cerium nitrate, cesium chloride, cobalt nitrate, dicesium hexachloroplutonate (DCHP), ferric ammonium sulfate hydrate, ferric nitrate, ferrous ammonium sulfate, ferrous chloride, ferrous sulfamate, FOOF, graphite, gypsum cement, hydrogen peroxide, hydroxylamine chloride, hydroxylamine hydrochloride, hydroxylamine nitrate, iodine, lanthanum nitrate, lithium chloride, magnesium chloride, magnesium oxide, magnesium perchlorate, molybdenum oxide, phosphates, Portland cement, potassium chloride, potassium fluoride, potassium permanganate, potassium thiocyanate, silicone lubricant, sodium bicarbonate, sodium carbonate, sodium chloride, sodium chlorite, sodium citrate retarder, sodium dithionate, sodium nitrate, sodium nitrite, sodium oxalate, sodium sulfate, sodium tetraborate, stannous chloride, thorium oxide, uranium oxide (depleted), zinc chloride, zinc

stearate, and zirconium carbide. Some processes indicated the use of nitrate, chloride, carbonate, bicarbonate, oxalate, and nitrite salts of sodium, potassium, lithium, magnesium, calcium, and iron.

Several inorganic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 4 lists these chemicals, their HWN, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes:

*Organic chemicals.* The following organic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), diethyl oxalate, dihexyl n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), diisopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride,

Citrapeel,

acetonitrile,

organic strip

acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl diisobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, perchlorocarbons, phenolphthalein, phosphate buffer solution, phosphine oxide, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 5 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

TA-55-19A is a subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which is expected to consist of only a few drums, is identical to the rest of the waste stream except for the possibility that the drums may contain vanadium pentoxide (EPA HWN P120), which was used only between 02/01/98 and 06/10/98 in two specific P/S codes.

TA-55-19A is not fully defined in the sense that a list of specific waste containers in this lot has not yet been prepared. This is because P/S codes are not always explicitly identified for waste items in TA-55 waste containers. However, the possibility of extracting this information from the waste item identifiers is being evaluated. If successful, this action will permit a listing of waste containers assigned to TA-55-19A.

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

Waste Streams TA-55-19 and TA-55-20 have been discussed together in this AK Summary Report. These waste streams are similar in physical form and waste material content. They differ only in that TA-55-19 is assigned EPA HWNs based on P/S code information, whereas TA-55-20 contains non-mixed waste. Other waste streams resulting from the same plutonium processing activities at TA-55 but differing in waste matrix code are listed in the Sampling Plan.

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

The waste matrix code S5300 is assigned to the waste streams TA-55-19 and TA-55-20 based on waste generation practices described in the TA-55 Waste Management

Procedure, 1996 (TWCP-351), description of past segregation practices (TWCP-701, Section 2.1, page 4 of 43), and TA-55 process AK reports (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007). A more detailed waste matrix code can

**Table 5. Use of RCRA-Regulated Organic Chemicals in TA-55 Processes**

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Acetone (P/S codes FF, ME, and MOX) | • F003 applies to P/S code ME because it may have been used in the glovebox for cleaning.<br>• F003 does not apply to P/S code FF or MOX because it was only used outside the glovebox. |
| Benzene (P/S codes AC, AC1, AC2, and SA) | • D018 (benzene) applies to P/S codes AC, AC1, AC2, and SA<br>• F005 applies to P/S codes AC, AC1, AC2, and SA, in which benzene was used as a solvent |
| Carbon tetrachloride (P/S codes AD, CV, PTP, and PX) | • D019 (carbon tetrachloride) applies to P/S codes AD, CV, PTP and PX. This chemical was used in PTP between 1/87 and 6/89.<br>• F002 does not apply to P/S codes AD, CV, PTP, or PX because it was not used as a solvent or for degreasing. |
| Chloroform (P/S codes AC, AC1, AC2, APD, FF, and XO) | • D022 (chloroform) applies to P/S codes AC, AC1, AC2, APD, FF and XO. Concentrations in P/S code FF are expected to be below RCRA threshold because freeze-drying should have removed most, if not all, of the residual chloroform before the microspheres were taken into the glovebox for sintering. |
| Diethyl ether (P/S code SA) | • F003 applies to P/S code SA because of solvent use. |
| Freon and Freon TF (P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | • F002 applies to P/S codes DA, MA and XO.<br>• F002 does not apply to P/S codes CA, MW, PD, SCB, SRL, UA, VD and WE. Although Freon TF is used as a solvent to clean metal parts, the parts are routinely air-dried to avoid the need for cellulosic wipes.<br>• F002 does not apply to P/S code PF because Freon was used as a coolant for a cutting saw. |
| Methanol (P/S codes AD and SO) | • F003 applies to P/S code AD because it may have been used for cleaning inside the glovebox.<br>• F003 does not apply to P/S code SO because it was used in a cold trap outside the glovebox. |
| Methylene chloride (P/S code AC1) | • F002 applies to P/S code AC1 because this chemical was used as a solvent (MA) and a paint stripper (XO). |
| Methyl ethyl ketone (P/S codes MA and XO) | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO<br>• F005 applies to P/S codes MA and XO, in which methyl ethyl ketone was used as a paint stripper |

~~Butyl alcohol (P/S codes~~

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA<br>• F005 applies to P/S codes AC, AC2 and SA, in which pyridine was used as solvent. |
| Tap Magic (contains 1,1,1 trichloroethane) (P/S code MA) | • F002 does not apply to P/S code MA because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |
| Tetrachloroethane (not used) | • No RCRA codes apply to tetrachloroethane, an Appendix VIII chemical. Although it is listed on the chemical inventory for metal operations, it was never used in glovebox operations. |
| Tetrachloroethylene (P/S codes AD, APD, CSE, CV and SE) | • D039 (tetrachloroethylene) applies to P/S codes AD, APD, CSE and SE in which it was used until 1992.<br>• D039 does not apply to P/S code CV because it was used as a coolant outside the glovebox.<br>• F002 applies to P/S codes AD, APD, CSE and SE. Its use as a solvent in P/S code CSE and SE ended in 1992<br>• F002 does not apply to P/S code CV because it was only used as a coolant outside the glovebox. |
| Tetrahydrofuran | • ~~U213 applies to P/S codes AC, AC2, and SA~~. |
| Toluene (P/S codes AC, AC2 and SA) | • F005 applies to P/S codes AC, AC2 and SA because toluene was used as a solvent. |
| Trichloroethylene (P/S codes CK, EL, FF, MA, ME, and XO) | • D040 (trichloroethylene) applies to P/S codes EL, FF, MA, ME, and XO<br>• D040 does not apply to P/S code CK because this chemical was used as a coolant outside the glovebox.<br>• F002 applies to P/S code MA, in which trichloroethylene was used during final cleaning of metal parts from 1979 to 1992, resuming again in February 2000.<br>• F002 does not apply to P/S codes EL or FF, in which it was used as a lubricant for a cutting saw, not as a solvent. |

not be assigned to the TA-55-19 and TA-55-20 waste streams because TA-55 waste management personnel did not segregate plastic waste from cellulosic waste.

The following codes also apply to waste streams TA-55-19 and TA-55-20 from the Transuranic Waste Baseline Inventory Report (TWBIR), the TRUPACT II Content Code (TRUCON) (DOE/WIPP-89-004/Rev.13), the Radioactive Solid Waste Disposal (RSWD), and the Item Description Code (IDC) (Sampling Plan).

- TWBIR LA-M16 (TA-55-19) and LA-T16 (TA-55-20)
- TRUCON LA 116A, LA 116B, LA 116C, LA 116D, LA 116E, LA 116F, LA 116H, LA 116I
- RSWD A14, A15, A16, A17, A18, A60
- IDC 004 (combustible waste)

U213 may possibly apply to P/S codes AC, AC2, and SA.
Its applicability is currently under investigation.

In addition, debris waste generated under P/S codes SD and SS between 02/01/98 and 06/10/98 are assigned EPA HWN P120 (vanadium pentoxide).

It is possible that may require the assignment of Waste generated under P/S codes AC, AC2, and SA ~~are assigned~~ EPA HWN U213 (tetrahydrofuran). This possibility is being investigated.

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses (not WIPP-compliant) for 60 containers assigned to waste stream TA-55-19 (Table 6). Measured gas concentrations were above the program required quantitation limit (PRQL) for several regulated volatile organic compounds: acetone, ethyl benzene, methanol, methylene chloride, methyl ethyl ketone, toluene, and xylenes. These results are consistent with the AK information summarized in this waste stream report.

8.2 Toxicity Listings

Both TA-55-19 ~~(including~~ and TA-55-19A) are conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040. TA-55-20 has no listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DOP, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD.

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

**Table 6. Preliminary Headspace Gas Data For 60 Drums Assigned To Waste Stream TA-55-19**

| | AK information | | | Preliminary headspace gas analyses for VOCs | | | |
|---|---|---|---|---|---|---|---|
| ANALYTE | Chemical used in processes | Chemical present in process feed solution | EPA HWN assignment | MDL (ppmv except for hydrogen and methane)* | Mean concentration is above MDL | PRQL | $UCL_{90}$ analysis indicates presence above PRQL |
| Acetone | X | X | (F003) | 16.12 | X | 100 | X |
| Benzene | X | | F005, D018 | 1.96 | X | 10 | |
| Bromoform | | | None apply | 2.27 | | 10 | |
| Butanol (n-butyl alcohol) | | X F003 ~~None apply~~ | | 8.78 | X | 100 | |
| Carbon Tetrachloride | X | X | D019 | 2.00 | X | 10 | |
| Chlorobenzene | | X | F002, D021 | 1.93 | X | 10 | |
| Chloroform | X | X | D022 | 1.85 | X | 10 | |
| Cyclohexane | | | --- | 1.88 | X | 10 | |
| 1,1-Dichloroethane | | | --- | 1.78 | | 10 | |
| 1,2-Dichloroethane | | | --- | 2.40 | | 10 | |
| 1,1-Dichloroethylene | X | | None apply | 2.74 | X | 10 | |
| cis-1,2-Dichloroethene | | | None apply | 2.06 | X | 10 | |
| Ethyl benzene | See Note | | F003 | 1.72 | X | 10 | X |
| Ethyl ether | X | | F003 | 1.30 | X | 10 | |
| Hydrogen | | | --- | 0.02 % vol | X | 0.1 | |
| Methane | X | | --- | 0.02 % vol | X | 0.1 | |
| Methanol | X | X | F003 | 11.42 | X | 100 | X |
| Methyl ethyl ketone | X | | F005, D035 | 18.42 | X | 100 | X |
| Methyl isobutyl ketone | | | None apply | 16.05 | X | 100 | |
| Methylene chloride | X | X | F002 | 1.97 | X | 10 | X |
| 1,1,2,2-Tetrachloroethane | | | None apply | 1.63 | X | 10 | |
| Tetrachloroethene | X | X | F001, F002, D039 | 1.44 | X | 10 | |
| Toluene | X | | F005 | 1.67 | X | 10 | X |
| 1,1,2-Trichloro-1,2,2-trifluoroethane (also known as Freon TF and Freon 113) | X | | F002 | 1.79 | X | 10 | |
| 1,1,1-Trichloroethane | X | | None apply | 1.82 | X | 10 | |
| Trichloroethene | X | | F002, D040 | 1.31 | X | 10 | |
| 1,2,4-Trimethylbenzene | | | --- | 2.04 | X | 10 | |
| 1,3,5-Trimethylbenzene | | | --- | 2.26 | X | 10 | |
| Xylene (m and p-xylene) | | X | F003 | 3.62 | X | 10 | X |
| Xylene (o-xylene) | | X | F003 | 1.9 | X | 10 | X |

Abbreviations: AK, acceptable knowledge; HWN, Hazardous Waste Number; MDL, Minimum Detection Limit; PRQL, Program-Required Quantitation Limit; VOC, Volatile Organic Compound

| | |
|---|---|
| DS | D006, D007, D008, D009, D011 |
| ED | D005, D006, D007, D008, D011 |
| EDC | D007 |
| EL | D040 |
| EOC | D007, D009 |
| ER | D006, D008 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |
| EXT | D005, D006, D007, D008, D009, D011 |
| FDL | D004, D005, D006, D007, D008, D009, D010, D011 |
| FF | D022, D040 |
| FLU | D004, D005, D006, D007, D008, D009, D010, D011 |
| FX | D006, D007, D008, D009, D011 |
| HCD | D006, D007, D008, D009, D011 |
| HD | D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| IA | D006, D007, D008, D009, D011 |
| IAM | D005, D006, D007, D008, D011 |
| IB | D005, D006, D007, D008, D009, D011 |
| ICP | D007, D009 |
| IE | D005, D006, D007, D008, D009, D011 |
| IS | D005, D006, D007, D008, D011 |
| IX | D006, D007, D008, D009, D011 |
| KBTF | D008 |
| LD | D007, D008, D009 |
| LG1 | D006, D008 |
| LG2 | D006, D007, D008, D009, D011 |
| LI | D005, D006, D007, D008, D009, D011 |
| LR | D006, D007, D008, D009, D011 |
| MA | D035, D040 |
| MB | D007, D008, D009 |
| ME | D007, D040 |
| MELL | D006, D007, D008, D009, D011 |
| ML | D006, D008 |
| MPD | D005, D006, D007, D008, D011 |
| MS | D007, D008, D009 |
| NC | D006, D008 |
| NL | D006, D008 |

HRA → D005, D006, D007, D008, D009, D011

wastes in these waste streams
to ~~the~~
D001 does not apply, despite the use of ~~the~~
spent non-halogenated solvents (~~#~~ HWN F003), for the
following reasons:
Bullet 1 • Rags ~~which have~~ which are above the DL for Pu
are thermally decomposed, ~~and the~~ which ~~vented~~
Bullet 2 destroys any organic component. • Rags which are below
the DL for Pu are discarded ~~in~~ as combustible
debris but ~~[fact to calculation of]~~ headspace gas analyses support the
Contention that the solvents are not present in the
Bullet 3 waste at levels of concern. • Solutions containing ~~these~~ spent, non-halogenated solvents
Solvents are sent to the RLWTF if they are below
the DL for Pu. Bullet 4 • If above the DL, the solutions
are sent to aqueous recovery processes as part of
chloride or nitrate operations. ~~[Continue]~~ Aqueous recovery steps
include dissolution of any solid Pu in hydrochloric or nitric
acid, followed by ~~[illegible]~~ Pu recovery by
ion exchange. ~~[illegible]~~ The solutions
are then below the DL and are either sent to the RLWTF or to the evaporators.

In addition, 100% of the drums are subjected to headspace
gas analysis, and drums showing over 500ppm total flammable VOCs
are prohibited from being shipped to WIPP. (For comparison, the
explosive limit for acetone is 25,000 ppm.)

8.3 Corrosivity, Reactivity, and Ignitability

TA-55-19 has no listings for corrosivity, reactivity, or ignitability.

TA-55-19A has no listings for corrosivity, reactivity, or ignitability.

TA-55-20 has no listings for corrosivity, reactivity, or ignitability.

See Section 10.0

D001 does not apply due to flammable organic solvent use because solutions containing these solvents are sent to aqueous recovery. For aqueous recovery, steps include dissolution of any solid Pu in ~~2-16 molar~~ hydrochloric or ~~HNO3~~ and purification by ion exchange. After recovery of Pu from ion exchange, ~~the solutions are below the DL, which are then sent~~ to the evaporator for volume reduction. Evaporator bottoms are fixed in cement; therefore, ignitability is not a concern in these wastes. ~~Furthermore, the UCL99 calculation summary sheet for headspace gas analysis confirms the absence of these flammable compounds.~~

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests (see Attachment 5), introduced in June 1980, included check boxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF (see Attachment 4, pp. 4 and 5) documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

In addition to the above-mentioned prohibitions on explosives in waste,

- Explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s ~~Replace this bullet with~~ altogether

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed onto kitty litter (vermiculite) and discarded in an appropriate waste stream and containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the TRUPACT-II.

~~*Intro sentence on compatible here.*~~ Section 10.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste items specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from TA-55. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

→ In the event of a misfire or unconsumed explosives, a procedure is in place at TA-55 to ~~mitigate~~ ensure that explosives do not enter the waste stream (TWCP-xxxx) ← John Musgrove to get this reference.

Edit Round #3



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new section 3.2

checked against edit round #5

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| SX | Americium processing silicon removal | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| TDC | Thermal decomposition of cellulose items | Nitrate Operations | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| TIGR | Thermally induced gallium removal | Metal Operation Processes | 3.4.3, Att. 4 | |
| UA | Uranium fabrication | Metal Operation Processes | 3.4.2, Att. 4 | |
| UPS | Uranium/plutonium separation | Nitrate Operations | 3.4.2, Att. 4 | |
| US | Uranium separation for solid solution feed | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| US2 | Uranium separation for non-solid solutions feed | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| VC | Variable CSMO scrap dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| VD | Vapor degreaser and sand blasting | Metal Operation Processes | 3.4.2, Att. 4 | |
| VP1 | CSMO scrap dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D009 |
| VP2 | Polycube processing | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| VP3 | Hydroxide precipitation | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | D009, D011 |
| VS | Confirmation, inspection & sampling | Miscellaneous Operations | 3.4.5, Att. 4 | |
| VU | Vessel unloading | Special Processing | Att. 4 | D005, D008 |
| VUL | Vessel unloading | Nitrate Operations | 3.4.1, Att. 4 | D005, D008 |
| WE | Welding | Metal Operation Processes | 3.4.2, Att. 4 | |
| WLT | Welding leak test | Metal Operation Processes | 3.4.3, Att. 4 | ~~D008~~ |
| WM | Waste management | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| X0 | Inactive or unspecified P/S material | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-ray energy spectroscopy | Miscellaneous Operations | 3.4.5, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| XO | Inactive or unspecified P/S material | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XP | RD&D experimental processes | Miscellaneous Operations | 3.4.4, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| ZD | Scrap oxide dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |

delete D008

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19, Mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1978–present |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 4173 containers (873 $m^3$) |
| **Waste Stream Volume (after repackaging):** | 850 SWBs, 3873 drums (2390 $m^3$) |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

Insert Waste generating processes here →

**Process Feed**

Don't list operations separately, Combine into single list + delete repetitious text (6)

~~CHLORIDE~~ OPERATIONS: (1) Plutonium metal or metal alloys; ~~and oxides~~; pyrochemical salts; plutonium-beryllium sources; crucible pieces; ash; analytical laboratory solutions; and residues from other DOE facilities.

Order as shown for 1st 6 process feed items, order for remainder doesn't matter

move to follow Facility Mission

METAL: ~~Plutonium metal or metal alloys and oxides~~, disassembled weapons components (pits), other actinide metals or metal alloys and oxides, reactor fuel pellets.

MISC: Plutonium metal or metal alloy, oxides and hydroxide cakes; pyrochemical salts; anode heels; ash; and residues from other DOE facilities.

NITRATE: Plutonium ~~metal or metal alloys~~, oxides and hydroxide cakes; pyrochemical salts; crucible pieces; anode heels; ash; analytical laboratory solutions; and residues from other DOE facilities.

PYRO: Plutonium metal, metal alloys, or oxides; plutonium scrap; Np-237 (briefly in 1993).

SPECIAL: Plutonium metal or metal alloys and oxides; pyrochemical salts; crucible pieces; anode heels; and ash.

**Waste Material Parameter List (including packaging)**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (<5% by volume)

*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate transuranic wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**RCRA Characterization:**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved. (TWCP-AK-2.1-004).
- Drums containing waste from P/S codes SD ~~Seam~~ and SS generated between 2/98 and 6/98 are segregated from as a subset of TA-55-19 due to the potential presence of vanadium pentoxide (EPA HWN P120). (See separate AK Summary.)

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium and uranium relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)

*Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)

*Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)

*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)

*Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)

*Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19A

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19A, Mixed Combustible Debris with P120 |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-M16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 02/98–06/98 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | Not yet determined |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

NOTE: This is a ~~sub~~ waste stream TA-55-19. subset (i.e., lot) ~~It differs from the TA A separate~~ It is distinguished from TA-55-19 only insofar as the waste has the potential to include Vanadium pentoxide (EPA HWN P120).

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

Insert Waste Generating Processes here →

**Process Feed**

***Will be copied from 19 once text is edited by June or John.***

OK

move to follow Facility Mission



**Waste Material Parameter List (including packaging)**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (<5% by volume)
*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate transuranic wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**RCRA Characterization:**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120
- Drums containing waste from P/S codes AC, AC2, and SA are segregated from this waste stream until the potential applicability of HWN U213 has been resolved.

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-20

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-20, Non-mixed Combustible Debris Waste |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5300 |
| **TWBIR:** | LA-T16 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1979–present |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 281 containers (59 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not available |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

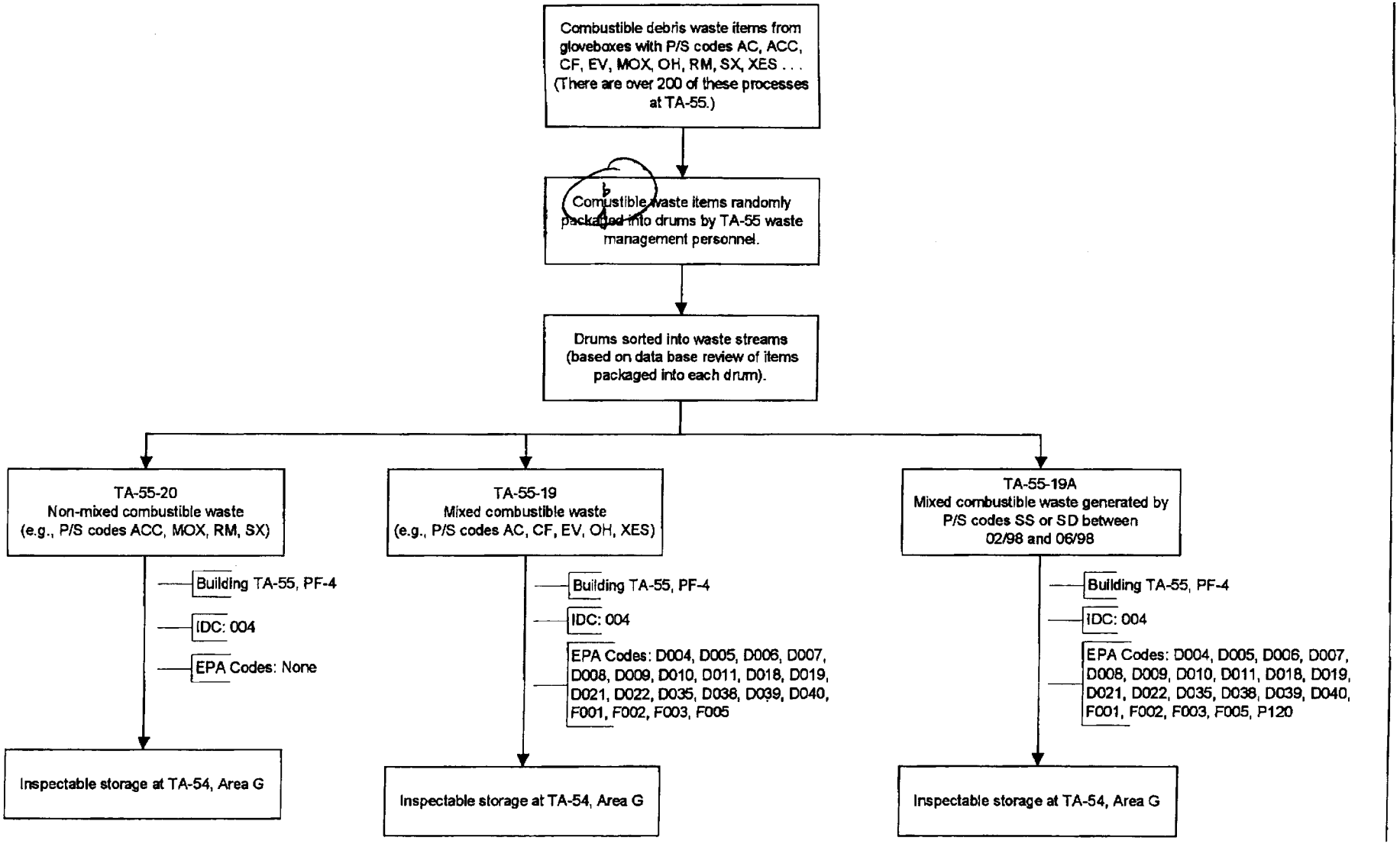
Insert waste generating processes here →

**Process Feed**

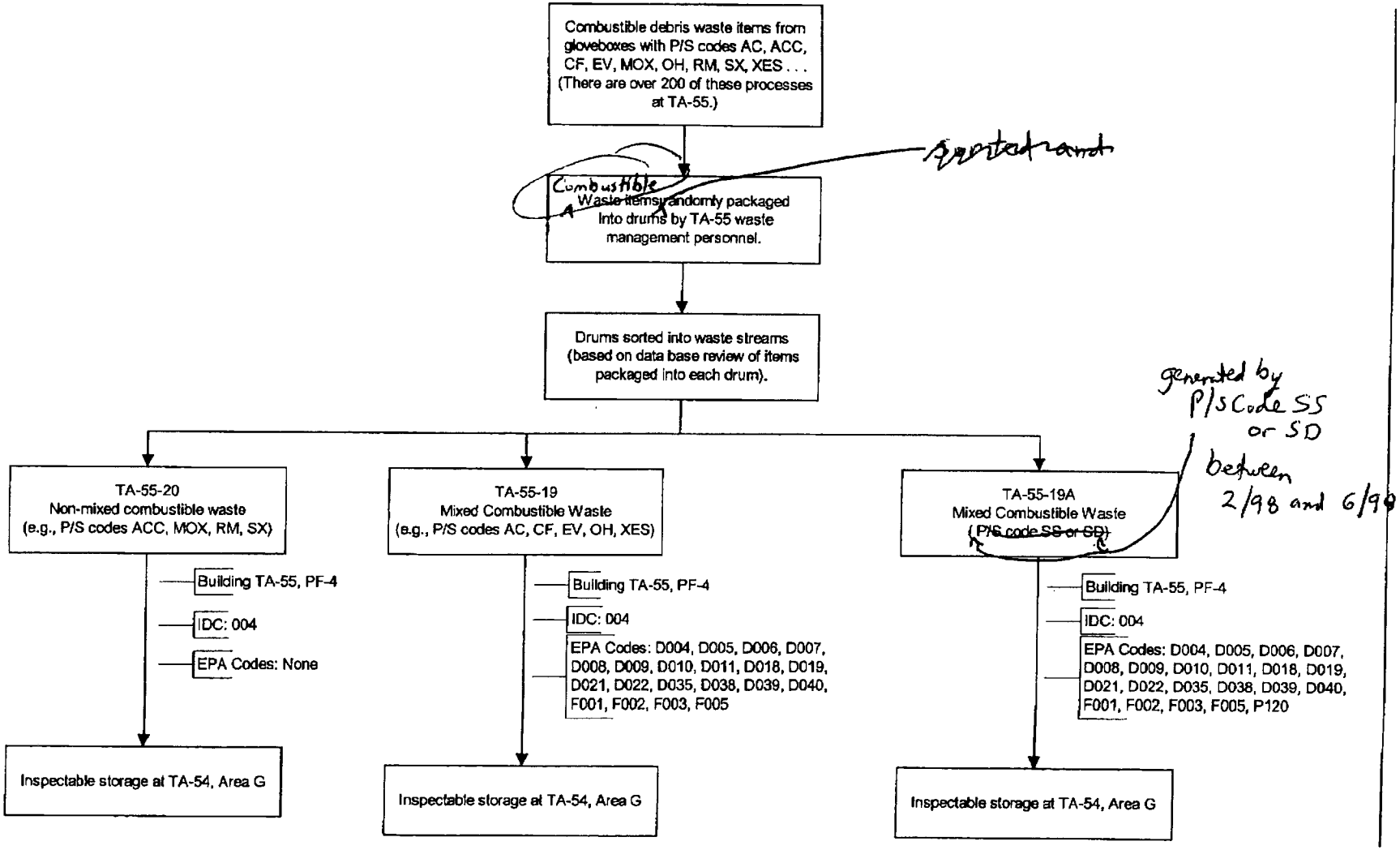
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OK

## WASTE GENERATION SUMMARY DIAGRAM



## WASTE GENERATION SUMMARY DIAGRAM



# ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR WASTE STREAMS TA-55-19 AND TA-55-20

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK information and provides guidelines on how AK should be obtained and documented.

This AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides technical support for assignment of specific waste containers to the waste stream.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS (including lot TA-55-19A)

The AK search for the information related to waste streams TA-55-19, ~~[-19A]~~ and -20 TA-55 covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) (Sampling Plan) that includes information regarding all waste streams, including TA-55-19~~[-19A]~~ and -20. ~~(including lot TA-55-19A)~~
- Review of documents related to the waste generation and waste management activities at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1),
- Interviews with personnel involved with waste generation and waste management at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1), and
- Review of process AK reports for TA-55 processes (as discussed below), and
- Analysis of processes generating waste, as discussed in the process AK reports and in this report.

~~process AK reports~~ s/c+

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that

are referenced in this summary report. Unclassified Controlled Nuclear Information (UCNI) will be reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK summary report is based on detailed information compiled in a set of closely related reports about TRU waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

R.2

See next page for edits

The process AK reports contain information on over 200 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. For example, the nitrate operations report (TWCP-AK-2.1-005, R.2) covers waste generation processes and characteristics for about 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generation records. However, as described [explained] in section 3.2, waste segregation, ...

as well as by

move to new section 3.2

The TA-55 Plutonium Facility tracks waste items both by the process from which they originated and their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item. Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. Further complication is introduced because the waste streams for TA-55 have been defined based primarily on the physical form and material content of the waste and only secondarily on the waste generation process through mixed or non-mixed waste stream designations. Hence, any given waste stream could potentially contain items from all of the plutonium recovery

3.2.2 ~~Waste Management at TA-55~~ ~~Packaging~~ Waste Tracking at TA-55

June: check out TWCP-351 [cited in Section 7.0]

Revise last paragraphs in Section 2 (note the next-to-last paragraph has been moved to section 3.2.3):

The process AK reports contain information on over 200 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. For example, the nitrate operations report (TWCP-AK-2.1-005, R.2) covers waste generation processes and characteristics for about 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generator records. However, as described in section 3.2, TA-55 TRU waste items have always been segregated and packaged into waste containers based on the physical form and material content of the waste, without regard to process of origin (i.e., P/S code). In order to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number) separate AK reports have been prepared for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in the process AK reports.

This AK summary report summarizes AK information specific to the combustible debris waste streams TA-55-19 (including waste stream lot TA-55-19A) and TA-55-20.

## 3.0 DESCRIPTION OF THE WASTE STREAM

### 3.1 Facility and Mission

1st paragraph: Copy text from AK Summary

2nd paragraph: delete first sentence of existing paragraph, and continue with remainder, "The combustible waste streams TA-55-19 and TA-55-20 were generated..."

### 3.2 Basis, Rationale, and Assumptions for Delineation of Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning and continuing to the present day has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process of origin. Relevant details of these planning and implementation documents are summarized in this section, in order to provide background information to support the process used by TWCP to assign TA-55 waste containers to specific waste streams. This assignment is made on the basis of waste generator information compiled in the TWCP waste container data base, which comprises the bulk of the Sampling Plan. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, in order to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents.

Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged by this team. Materials are considered waste streams only when they have been received and processed by the waste management team. Waste segregation schemes used by this team have evolved since operations began at the Plutonium Facility in 1978.

In 1978, the standard operating procedure for waste management at TA-55 stated the guiding philosophy of minimizing the amount of waste generated, and minimizing the contamination of that waste (TWCP-3943). Discard limits were established by the waste-generating group, and approved by the division office and the DOE Field Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of plutonium) into classes, such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. All liquids, including oils, were required to be sent to recovery operations for processing. Liquids were explicitly prohibited from any container of solid waste materials.

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific processes and waste streams. TA-55 prepared an attachment in March 1987 for contact-handled combustible and noncombustible solid waste (TWCP-701).

- Combustible waste forms included materials which could be reduced to an ash if desired but which did not require further processing to meet the WIPP WAC (TWCP-701). (This definition is still current.) Subcategories included plastic-base, cellulose-base and miscellaneous (graphite and graphite crucibles). It was acceptable for the combustible waste stream to include some unspecified "small" fraction of noncombustible solids such as scrap metals.
- Noncombustible waste forms included materials which could not be reduced to ash but which did meet the WIPP WAC without further processing (TWCP-701). The two subcategories were metals and non-metals. The non-metal wastes included glass, fiberglass heating mantles, porcelain crucibles, ceramic furnace tube inserts, and leaded glovebox gloves. It was acceptable for the noncombustible waste stream to include some unspecified "small" fraction of combustible solids, and which may be contained in plastics. For WIPP purposes, any waste forms which were chemically compatible and which met the WAC, could be combined into a single waste container.

In 1995, a new TRU Waste Certification Plan was currently adopted, including a new attachment that formalizes how the TA-55 waste management team segregates newly generated wastes into waste streams (TWCP-700). Waste materials are segregated by:

- radioisotope for nondestructive assay (NDA) and gas generation requirements,
- material matrix for NDA and TRUCON requirements, and
- hazardous constituents for RCRA and Department of Transportation (DOT) requirements.

processes that were active at TA-55 over the time span of the generation of the waste stream.

We have attempted to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number) by providing separate AK reports for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in the process AK reports. Information specific to waste streams TA-55-19 and TA-55-20 is presented in this AK summary report. This AK summary report also contains a summary of the AK process information applicable to waste streams TA-55-19 and TA-55-20.

move to new section 3.2

The net effect of the waste packaging system used at TA-55 is that several EPA hazardous waste numbers (HWN) are conservatively assigned to individual waste streams for the purposes of WIPP disposal, because the WIPP WAP requires HWN assignment on a waste stream rather than a waste container basis. For the purposes of generator and on-site storage, however, LANL labels waste on a container by container basis. Thus, the hazardous labels on containers in storage at LANL should not be expected to correspond to the HWNs assigned to the waste stream through this AK summary report. Hazardous labels will be updated to meet WIPP disposal requirements just before loading waste containers into the Transuranic Package Transporter-Model II (TRUPACT-II) for shipping to WIPP.

3.2.2

## 3.0 DESCRIPTION OF THE WASTE STREAM

Copy Mission from AK Summary → New P1

Insert new 3.2 Basis, Rationale, etc.

### 3.1 Facility and Mission

~~The TA-55 Plutonium Facility processed plutonium from residues generated at LANL and throughout the defense complex into pure plutonium feedstock.~~ The combustible waste streams TA-55-19 and TA-55-20 were generated at the TA-55 Plutonium Facility as debris waste (glovebox and processing-room trash) from process operations and glovebox maintenance involved in plutonium recovery. For this reason the waste streams are defense related. However, waste also was produced from "special process" and research-related activities. These wastes were not segregated, but were commingled in the final waste containers to such an extent that segregation is not possible on the basis of waste generating process or glovebox location (TWCP-887). The waste was also co-mingled with room trash related to these same operations (both defense and non-defense), which was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site radioassay results showed it exceeded the low-level discard limits (TWCP-816).

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TA-55-19 and TA-55-20 combustible debris waste streams were generated in the TA-55 Plutonium Facility (Building PF-4). A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

3.2 Waste Physical Form and Content Description

The TA-55-19, -19A, and -20 waste streams are defined as combustible debris waste streams (Sampling Plan, Appendix D), with TA-55-19 being a mixed waste stream and TA-55-20 its non-mixed counterpart. The waste includes paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape, gloves, plastic vials, polystyrene, Tygon tubing, polyvinyl chloride plastic, Teflon products, Plexiglas, and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (<5 percent) of non-combustible solids (scrap metal, metal lids, and clothing zippers) (Sampling Plan, Appendix D).

3.3 Waste Volume and Time Period of Waste Generation

The following information is from the Sampling Plan (TWCP-PLAN-0.2.7-001, R.3, Appendix D). These values are expected to change because the sampling plan is continually updated as new waste information is obtained.

- TA-55-19 includes 4173 containers (873 cubic meters), that were generated from 1978 to the present time.
- The number of containers to be included TA-55-19A has not yet been determined.
- TA-55-20 includes 281 containers (59 cubic meters), that were generated from 1979 to the present time.

3.4 2 Basis, Rationale, and Assumption Used to Delineate the Waste Stream

3.2.1 Waste Management Categorization at TA-55

3.5 Waste Stream Generation Processes

3.5.1 Overview

The TA-55-19, -19A, and -20 combustible debris waste streams were generated from combustible materials used in processes to recover plutonium from residues, metal fabrication, and research and

3.5.2 Process Flow Diagrams

Detailed information about the TA-55 plutonium recovery processes can be found in the Process AK reports. For purposes of the AK search, and to allow convenient referral to and referencing of the Process AK reports in this waste stream AK Summary Report, the processes have been divided into six major areas:

- Nitrate Operations (TWCP-AK-2.1-005)
- Chloride Operations (TWCP-AK-2.1-002)
- Miscellaneous Operations (TWCP-AK-2.1-004)
- Special Processing (TWCP-AK-2.1-007)
- Metal Operation Processes (TWCP-AK-2.1-003)
- Pyrochemical Processes (TWCP-AK-2.1-006)

Generalized flow diagrams for the six operational areas relevant to this AK search are presented as Attachment 3. ~~With the exception of the report on chloride operations, these generalized flow diagrams~~ and indicate P/S codes for the various processes. The full block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

The following subsections describe the processes that generated debris waste assigned to the TA-55-19, -19A, and -20 waste streams. The potential for RCRA-regulated constituents to be present due to feed materials or chemical use in these processes is summarized in Section 3.5. The applicability of EPA HWNs as a result of this potential is specified in Section 8.

3.5.3 Nitrate Operations

P/S codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g.,

The evaporator processes plutonium-poor liquids in order to re-concentrate plutonium, if possible, or to reduce the volume of liquid waste. Evaporator bottoms are either sent back to ion exchange or discarded to cement fixation, depending on their plutonium content. Heavy metals that may be present are concentrated in this process.

In the cement fixation step, wastes with low plutonium concentrations are collected and immobilized in cement. Most if not all of the waste generated under these processes (P/S codes CF, HP, and IA) are classified as cemented wastes and would not be part of the debris waste streams.

3.5.4 Chloride Operations

P/S codes CL, CLRD, CLS, CS, CSE, CW, CX, CXL, LD, MB, MS, PB, PRR, PUB, and SE

A detailed description of chloride operations can be found in *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002).

The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The primary feed sources are plutonium residues from pyrochemical operations, PuBe neutron sources, analytical laboratory solutions, and residues from other DOE facilities. Chloride operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- hydroxide precipitation

Pretreatment may include sorting, crushing, and/or pulverizing feed materials prior to being fed into later steps of chloride operations. A separate pretreatment procedure is the decladding of plutonium-beryllium sources. The PuBe metal alloy is removed from the sources, which are then entered into the chloride line for plutonium recovery along with other materials.

In the dissolution step, hydrochloric acid is used to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory. Enriched solutions undergo further purification (see next paragraph), and solid wastes are discarded as debris waste or cement fixation ~~(see Section 3.4.2.1, Nitrate Operations)~~.

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~~TWCP-AK-2.1-005~~

Purification steps may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and separate out impurities. Enriched solutions may be further treated with oxalic acid to precipitate plutonium oxalate, which is converted to plutonium oxide.

In the hydroxide precipitation step, plutonium in solutions from purification steps is precipitated with potassium, magnesium, or sodium hydroxide. The resulting enriched hydroxide cakes become feed material for nitrate operations [~~see Section 3.4.2.1, Nitrate Operations~~], and liquid meeting the TA-50 WAC is sent to the RLWTF using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

### 3.5.5 Miscellaneous Operations

P/S codes AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

A detailed description of miscellaneous operations can be found in *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004).

Research and development projects at TA-55 include an array of activities involving applied techniques and methods designed to study and improve processes associated with the purification, separation, extraction, recovery, and characterization of actinides (primarily plutonium) from various matrices. General types of miscellaneous processes are described below.

*Extraction/Separation Studies*. A series of similar actinide extraction, separation, and characterization R&D studies involved processing of actinide hydroxide cakes from chloride and nitrate operations, development of sensors and instrumentation for online chemical analysis, and purification process development ~~(R&D)~~. The process R&D activities were of a non-routine developmental nature involving research, process development, small scale "trouble-shooting," and occasionally preparation of various isotopes and isotopic mixtures of plutonium, uranium, americium, and neptunium.

*Halogenation Studies*. A variety of R&D efforts used fluorinating agents to fluorinate samples containing plutonium residues. A gas flow loop was used to pass a fluorinating agent through a gas-solid reactor where plutonium in the solid residue reacted chemically to form solid $PuF_4$ or gaseous $PuF_6$. Gaseous $PuF_6$ was trapped in a cold trap, distilled, and

involved crushing, pulverizing, blending, roasting, and sieving pyrochemical salts. The results were used to determine handling and processing of the salts and for correction of bias measurements. The feed material consisted of high-purity oxides to use in the fabrication of standards to be used at LANL and throughout the DOE complex.

A small basic research operation that began in March 1992 explored aqueous extraction of plutonium from various waste streams, particularly used pyrochemical salts.

*Hydrothermal Processing.* The hydrothermal processing procedure involves the reaction of aqueous/organic mixtures, pure organic liquids, or contaminated combustible solids (e.g., ion exchange resins, plastic filters, and cellulose rags) under supercritical conditions (i.e., high temperature and pressure). Feed streams include, but are not limited to, carbon tetrachloride, tributyl phosphate, and organic solvents. Process effluents are gases, liquids and salts. Organic components are oxidized to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

*Electrochemistry Experiments.* Electrochemistry methodologies were designed to decontaminate items, replace processes that produce large amounts of waste, or enhance chemical reactions. The process involved uranium decontamination of disassembled weapon components from various sites with various levels of surface contamination with plutonium. The operation was strictly an aqueous process in which an alkaline solution was reacted with the components to precipitate uranium. Significant amounts of metal could be stripped in a short period of time. The ~~precipitated~~ solution ~~comprised either uranyl hydroxide or uranyl sulfate, which~~ was then dried for mass balance. containing the precipitated uranium salts

*Metallography.* The purpose of the metallography operation is to characterize the microstructure of metallic or ceramic pieces to verify and establish the quality and effectiveness of welds. Materials examined consist of plutonium and uranium carbides, nitrides, and oxides, as well as zirconium and tantalum alloys, and stainless steel. Metal pieces (pellets) are cut with a diamond saw. Ceramic pieces are subjected to grinding with standard metal grinding media (e.g., papers impregnated with silicon carbides and diamond). The materials are polished with several different chemical compounds.

*Waste Management Operations.* P/S code RD was used only in 1984–1986. It allowed for tracking of demonstration drums (one drum each year) that were packaged and prepared in accordance with the TA-55

A detailed description of special processing is found in *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007).

Special Processing includes processing operations for Material Type (MT) 42, and research and development (R&D) activities for MT 52. (See Section 3.6.2 for ~~a discussion of~~ plutonium material types.) (~~Refer to TWCP-698.~~) Because processing MT 42 is a smaller scale version of the recovery processes used for MT 52, MT 42 processing has five main recovery steps:

- head-end operations
- nitrate ion exchange operations
- chloride ion exchange operations
- separation and purification by precipitation
- pyrochemical processes

Only head-end operations and separation by purification and precipitation are covered here, since nitrate ion exchange operations, chloride ion exchange operations, and pyrochemical processes are covered briefly elsewhere in this report.

Head-end operations leach tools, labware, crucibles, rags, etc in nitric acid to remove recoverable plutonium. Plutonium oxide is typically calcined as part of head-end operations.

Separation and purification by precipitation is a method of plutonium removal from aqueous solutions. The most common precipitation methods utilize oxalate, hydroxide, and peroxide anions. By selectively precipitating the plutonium, many of the metals remain in solution, thereby purifying the plutonium.

All wastes generated by MT 52 R&D operations are replicated for MT 42, but carry different P/S codes to differentiate and identify the radionuclide content of the waste. Outputs from Special Processing include high purity metal for casting and machining.

3.5.7 Metal Operation Processes

P/S codes AO, ARI, BA, BC, BT, CA, CN, CO, CT, DA, DOP, DT, EL, ELW, EM, EVAC, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT

Pyrochemical processes include metal preparation, metal purification, and ancillary metal production operations. Pyrochemical process outputs are most often high purity metals for metal operations.

Metal preparation processes include the following operations:

*Metal Preparation Line.* The metal preparation line produces plutonium metal from fluoride salts ~~derived by reacting~~ hydrogen fluoride gas with plutonium oxides obtained from calcination of oxalate or peroxide precipitates from the aqueous nitrate or chloride process lines. The plutonium compound is further reacted with various chemicals to produce plutonium metal, which can then be recovered as a button by breaking the crucible.

*Direct Oxide Reduction (DOR) and Multiple-Cycle Direct Oxide Reduction (MCDOR).* In the single pass DOR process, plutonium oxide ~~and calcium~~ *metal* are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible. After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which was sometimes *recovered* by addition of fresh salt plus additional calcium metal.

To minimize the salt waste, the multicycle DOR (MCDOR) process was started, in which the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated.

Metal purification processes include the following:

*Molten Salt Extraction (MSE).* MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (TWCP-352). This process is employed only if the americium content is greater than 1000 ppm. In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible and heated to 750°C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. In the LANL process, 90 percent of the americium and 10 percent of the plutonium are transferred from the

was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991. Feed material was high purity oxides from the vault or from other P/S codes. The product plutonium trichloride was reduced to metal by the MSE or ER processes.

## 3.6 Material Inputs to the Waste Generation Processes

Material inputs to the waste generation processes derive from three general sources: (a) feed material, (b) chemical use, and (c) ancillary material inputs such as those related to the use of laboratory equipment and materials and glovebox maintenance activities. The feed materials for TA-55 processes that generate waste in waste streams TA-55-19 and TA-55-20 consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from various P/S codes, or from sources outside TA-55, including other DOE facilities. Chemical use is discussed in Section 3.6.3. Material waste form inputs are discussed in Section 3.6.1. Radionuclide inputs are discussed in Section 3.6.2.

### 3.6.1 Physical Waste Form Identification

Plutonium-processing facilities generate contaminated combustible debris waste from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, old bag-out stubs, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.

**Table 1. Feed Materials for Processes Contributing to Waste Streams TA-55-19 and TA-55-20**

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|

- Rubber and Teflon-based products used in the operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

Waste items from several different processes were segregated by physical waste form (e.g., combustible debris, metal, glass, etc.) and packaged into waste containers. The physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for many waste items is also documented on this form, although recording of P/S codes was spotty before about 1990. TRU waste drums containing one or more waste items were packaged by the Nuclear Material Technology Group (NMT-7) according to procedures referenced in the applicable version of the TA-55 Attachments to the Certification Plan (TWCP-697). Sample attachments are referenced as TWCP-701 (for 1987) and TWCP-700 (for 1995). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel.

Both the WODFs and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

### 3.6.2 Radionuclide Content Identification

The primary Pu material type inputs for metal operation processes at TA-55 are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

The purpose of these bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers.

- Th-232 enriched with Th-230—very small quantity in P/S codes BC and WE
- U-235 and U-238—expected in all P/S codes applicable to Nitrate Operations (TWCP-AK-2.1-005, R.1)

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). If warranted, this AK report will be updated to incorporate the results of these comparisons.

3.6.3 Chemical Content Identification

Chemical contents of process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from SME input. Individual process AK reports contain detailed assessments of these chemical inputs, and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals ~~that are not included in 40 *Code of Federal Regulations* (CFR) Part 261~~
- ~~Inorganic chemicals that are included in 40 CFR Part 261, including Appendix VIII to that regulation~~
- Organic chemicals ~~that are not included in 40 CFR Part 261~~
- ~~Organic chemicals that are included in 40 CFR Part 261, including Appendix VIII to that regulation.~~

*Acids and bases*. Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, Hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) does not apply to the solid debris waste because there are no free liquids in this waste.

Potentially Ignitable

- D001 (ignitability) does not apply to the use of the oxidizers (nitric acid, perchloric acid, and superacids) because there are no free liquids in this waste. Perchloric acid in solutions are sent to cement fixation. The solids (perchlorate salts) are rinsed from rags with water before they are discarded, such that any dissolved perchlorate salts also end up in the cemented waste.

- Formic acid and hydrofluoric acid are listed in Appendix VIII of 40 CFR Part 261, for their corrosive and toxic characteristics, with EPA HWN U123 and U134. However, these HWNs are not applicable to the manner in which these chemicals were used and discarded in the processes covered by this report.

- None of these are F, K or P-listed chemicals

*Gases and cryogenic fluids.* The following gases and cryogenic fluids used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: argon, carbon dioxide, chlorine, halogen fluorides, hexafluoroethane, hydrogen chloride, krypton fluoride, methane, nitrogen (gas), nitrogen (liquid), perfluoropropane, and tetrafluoromethane.

The following gases used in the TA-55 processes are identified in Appendix VIII of 40 CFR Part 261 as having hazardous characteristics. The chemical name is followed by the listed EPA HWN and the P/S codes in which the gas is used:

- Fluorine (P056) is used in P/S codes CV, FDL, FLU, PI, SO
- Hydrogen fluoride (U134) is used in P/S codes MP, PI
- Nitrogen dioxide (P078) is used in P/S code HRS
- Phosgene gas (P095) is used in P/S code PTP

No EPA HWNs are applicable to the use of these gases in the TA-55 processes. Compressed gas cylinders are kept outside of the gloveboxes; most are even outside the building, and the gases are plumbed into the glovebox. Thus the gas cylinders are not discarded with TRU wastes. Additional reasons are as follows:

- D002 (corrosivity) does not apply to the use of hydrogen fluoride because there are no free liquids in the solid TRU waste.

- D003 (reactivity) does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution.

- P056 (fluorine), P078 (nitrogen dioxide) and P095 (phosgene) are not applicable to the listed TA-55 processes because of the manner in which these gases are used and discarded in the processes covered by this report.

- Hydrogen fluoride (U134) is listed in Appendix VIII of 40 CFR Part 261 for its corrosive and toxic characteristics. However, this code is not applicable to the manner in which this gas is used and discarded in the processes covered by this report.

*Metals.* The following metals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII of that regulation: bismuth, bismuth-tin alloy, calcium, copper wool, gallium (metal, oxide or salt), gold, lanthanides, lutetium, niobium + 1% zirconium metal, platinum, platinum-rhodium alloy, tantalum (metal, alloy, oxide or salt), titanium, uranium powder (depleted), vanadium, and zirconium alloy.

Several metals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. The bullets below list the chemical name, its listed EPA HWN, the P/S codes in which the metal is used, and the applicability of the EPA HWNs to the use of these metals in the TA-55 processes:

- Alkaline earth metals (D003) were used in P/S codes AC, AC1 and AC2; it is possible that one or more of these were pyrophoric. However, EPA HWN D003 does not apply to P/S codes AC, AC1, or AC2 because the metals are consumed or oxidized before discarding.

- Arsenic (D004) was used in P/S code PE between 1984 and 1985, and EPA HWN D004 is applicable to P/S code PE during this period.

- Cadmium (D006) applies to a limited number of anode heels produced in P/S codes ER, PX, and SS using cadmium as a solvent.

- Lead (D008) was used in P/S codes DOP, ER, KBTF, PX, SS, ~~and WE~~. For combustible debris waste, EPA HWN D008 is applicable to P/S codes DOP, KBTF, and PX. For P/S codes ER and SS, D008 is only applicable to the metal waste.

acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl diisobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, organicstrip, perchlorocarbons, phenolphthalein, phosphate buffer solution, phosphine oxide, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 5 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

TA-55-19A is a subset (i.e., lot) of waste stream TA-55-19. Waste in this lot, which is expected to consist of only a few drums, is identical to the rest of the waste stream except for the possibility that the drums may contain vanadium pentoxide (EPA HWN P120), which was used only between 02/01/98 and 06/10/98 in two specific P/S codes.

TA-55-19A is not fully defined in the sense that a list of specific waste containers in this lot has not yet been prepared. This is because P/S codes are not always explicitly identified for waste items in TA-55 waste containers. However, the possibility of extracting this information from the waste item identifiers is being evaluated. If successful, this action will permit a listing of waste containers assigned to TA-55-19A.

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

Waste Streams TA-55-19 and TA-55-20 have been discussed together in this AK Summary Report. These waste streams are similar in physical form and waste material content. They differ only in that TA-55-19 is assigned EPA HWNs based on P/S code information, whereas TA-55-20 contains non-mixed waste. Other waste streams resulting from the same plutonium processing activities at TA-55 but differing in waste matrix code are listed in the Sampling Plan.

physical form and etc

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Methyl ethyl ketone (P/S codes MA and XO) | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO<br>• F005 applies to P/S codes MA and XO, in which methyl ethyl ketone was used as a paint stripper (XO). |
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA<br>• F005 applies to P/S codes AC, AC2 and SA, in which pyridine was used as solvent |
| Tap Magic (contains 1,1,1 trichloroethane) (P/S code MA) | • F002 does not apply to P/S code MA because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |
| Tetrachloroethane (not used) | • No RCRA codes apply to tetrachloroethane, an Appendix VIII chemical. Although it is listed on the chemical inventory for metal operations, it was never used in glovebox operations. |
| Tetrachloroethylene (P/S codes AD, APD, CSE, CV and SE) | • D039 (tetrachloroethylene) applies to P/S codes AD, APD, CSE and SE in which it was used until 1992.<br>• D039 does not apply to P/S code CV because it was used as a coolant outside the glovebox.<br>• F002 applies to P/S codes AD, APD, CSE and SE. Its use as a solvent in P/S code CSE and SE ended in 1992<br>• F002 does not apply to P/S code CV because it was only used as a coolant outside the glovebox. |
| Tetrahydrofuran (P/S codes AC, AC2 and SA) | • U213 may possibly apply to P/S codes AC, AC2, and SA. Its applicability is currently under investigation. |
| Toluene (P/S codes AC, AC2 and SA) | • F005 applies to P/S codes AC, AC2 and SA because toluene was used as a solvent. |
| Trichloroethylene (P/S codes CK, EL, FF, MA, ME, and XO) | • D040 (trichloroethylene) applies to P/S codes EL, FF, MA, ME, and XO<br>• D040 does not apply to P/S code CK because this chemical was used as a coolant outside the glovebox.<br>• F002 applies to P/S code MA, in which trichloroethylene was used during final cleaning of metal parts from 1979 to 1992, resuming again in February 2000.<br>• F002 does not apply to P/S codes EL or FF, in which it was used as a lubricant for a cutting saw, not as a solvent. |

not be assigned to the TA-55-19 and TA-55-20 waste streams because TA-55 waste management personnel did not segregate plastic waste from cellulosic waste.

The following codes also apply to waste streams TA-55-19 and TA-55-20 from the Transuranic Waste Baseline Inventory Report (TWBIR), the TRUPACT II Content Code (TRUCON) (DOE/WIPP-89-004/Rev.13), the Radioactive Solid Waste Disposal (RSWD), and the Item Description Code (IDC) (Sampling Plan).

- TWBIR LA-M16 (TA-55-19) and LA-T16 (TA-55-20)
- TRUCON LA 116A, LA 116B, LA 116C, LA 116D, LA 116E, LA 116F, LA 116H, LA 116I
- RSWD A14, A15, A16, A17, A18, A60
- IDC 004 (combustible waste)

(see section 3.2);

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

The following waste material parameter codes are assigned to waste streams TA-55-19 and TA-55-20 based on (1) waste generation practices described in the TA-55 Waste Management Procedure (~~TWCP-351~~); (~~2) description of past segregation practices (TWCP-701, Section 2.1, page 4 of 43)~~; (2) TA-55 process AK reports (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007); and (3) waste characterization data from real-time radiography and visual examination:

and

WIPP-compliant

- Cellulosics
- Plastics (waste materials)
- Rubber
- Steel (packaging materials)
- Plastics (packaging materials)
- Iron-based metals/alloys (<5% by volume)

## 8.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

### 8.1 F, K, P, and U Listings

No K-listings apply to any of the debris waste generated by the P/S codes covered by this report.

The following P/S codes require HWN assignments due to the presence or use of F-listed chemicals. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report.

- AC, AC1, AC2, AC3 F002, F005
- AD F002, F003
- APD F002, F003
- CF F002, F003
- CLS F002, F003
- CSE F002
- CW F002, F003
- ~~CXL F002, F003~~
- DA F002

- HP F002, F003
- MA F001, F002, F005
- SA F002, F003, F005
- SE F002
- WM, X0, XO F001, F002, F005

In addition, debris waste generated under P/S codes SD and SS between 02/01/98 and 06/10/98 ~~are~~ is assigned EPA HWN P120 (vanadium pentoxide).

It is possible that waste generated under P/S codes AC, AC2, and SA may require the assignment of EPA HWN U213 (tetrahydrofuran). This possibility is being investigated.

(including at TA-55-19A)

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses (~~not~~ WIPP-compliant) for 60 containers assigned to waste stream TA-55-19 (Table 6). Measured gas concentrations were above the program required quantitation limit (PRQL) for several regulated volatile organic compounds: acetone, ethyl benzene, methanol, methylene chloride, methyl ethyl ketone, toluene, and xylenes. These results are consistent with the AK information summarized in this waste stream report.

June to update #

8.2 Toxicity Listings

Both TA-55-19 and TA-55-19A are conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040. TA-55-20 has no D listings.

make this sentence a stand-alone P.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DOP, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD.

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due

to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

TWCP-4722

June to update table

**Table 6. Preliminary Headspace Gas Data For 60 Drums Assigned To Waste Stream TA-55-19**

| ANALYTE | AK information | | | Preliminary headspace gas analyses for VOCs | | | |
|---|---|---|---|---|---|---|---|
| | Chemical used in processes | Chemical present in process feed solution | EPA HWN assignment | MDL (ppmv except for hydrogen and methane)* | Mean concentration is above MDL | PRQL | $UCL_{90}$ analysis indicates presence above PRQL |
| Acetone | X | X | F003 | 16.12 | 7.70X | 100 | X |
| Benzene | X | | F005, D018 | 1.96 | X | 10 | |
| Bromoform | | | None apply | 2.27 | | 10 | |
| Butanol (n-butyl alcohol) | | | F003 | 8.78 | X | 100 | |
| Carbon Tetrachloride | X | X | D019 | 2.00 | X | 10 | |
| Chlorobenzene | | X | F002, D021 | 1.93 | X | 10 | |
| Chloroform | X | X | D022 | 1.85 | X | 10 | |
| Cyclohexane | | | --- | 1.88 | X | 10 | |
| 1,1-Dichloroethane | | | --- | 1.78 | | 10 | |
| 1,2-Dichloroethane | | | --- | 2.40 | | 10 | |
| 1,1-Dichloroethylene | X | | None apply | 2.74 | X | 10 | |
| cis-1,2-Dichloroethene | | | None apply | 2.06 | X | 10 | |
| Ethyl benzene | See Note | | F003 | 1.72 | X | 10 | X |
| Ethyl ether | X | | F003 | 1.30 | X | 10 | |
| Hydrogen | | | --- | 0.02 % vol | X | 0.1 | |
| Methane | X | | --- | 0.02 % vol | X | 0.1 | |
| [redacted]thanol | X | X | F003 | 11.42 | X | 100 | X |
| Methyl ethyl ketone | X | | F005, D035 | 18.42 | X | 100 | X |
| Methyl isobutyl ketone | | | None apply | 16.05 | X | 100 | |
| Methylene chloride | X | X | F002 | 1.97 | X | 10 | X |
| 1,1,2,2-Tetrachloroethane | | | None apply | 1.63 | X | 10 | |
| Tetrachloroethene | X | X | F001, F002, D039 | 1.44 | X | 10 | |
| Toluene | X | | F005 | 1.67 | X | 10 | X |
| 1,1,2-Trichloro-1,2,2-trifluoroethane (also known as Freon TF and Freon 113) | X | | F002 | 1.79 | X | 10 | |

| ANALYTE | AK information | | | Preliminary headspace gas analyses for VOCs | | | |
|---|---|---|---|---|---|---|---|
| | Chemical used in processes | Chemical present in process feed solution | EPA HWN assignment | MDL (ppmv except for hydrogen and methane)* | Mean concentration is above MDL | PRQL | $UCL_{90}$ analysis indicates presence above PRQL |
| 1,1,1-Trichloroethane | X | | None apply | 1.82 | X | 10 | |
| Trichloroethene | X | | F002, D040 | 1.31 | X | 10 | |
| 1,2,4-Trimethylbenzene | | | --- | 2.04 | X | 10 | |
| 1,3,5-Trimethylbenzene | | | --- | 2.26 | X | 10 | |
| Xylene (m and p-xylene) | | X | F003 | 3.62 | X | 10 | X |
| Xylene (o-xylene) | | X | F003 | 1.9 | X | 10 | X |

Abbreviations: AK, acceptable knowledge; HWN, Hazardous Waste Number; MDL, Minimum Detection Limit; PRQL, Program-Required Quantitation Limit; VOC, Volatile Organic Compound

--- This chemical is not regulated under 40 CFR Part 261, Subparts C and D, nor is it listed in Appendix VIII of that regulation.

* These MDL values are from the MDL study dated 6/19/00 (TWCP-3248). Different MDL values would have been in effect at the times that the data included in this table were acquired, so the above MDL values should only be considered as an approximate guide.

**NOTE:** There is no record documenting the use of ethyl benzene under any of the P/S codes covered by this report. However, recent analyses of some vacuum pump oils from TA-55, PF-4, showed it to be present. Consequently, F003 is applicable to this waste stream. Other constituents on the above table that were identified in these analyses included acetone, benzene, chlorobenzene, 1,2-dichloroethane, tetrachloroethene, toluene, Freon-113, trichloroethene, 1,2,4-trimethylbenzene, 1,3,5-trichlorobenzene, m- and p-xylene, and o-xylene.

| | |
|---|---|
| AC, ~~AC1~~, ~~AC2~~ | D007, D009, D011, D018, D022, D038 |
| AC1 | D007, D009, D011, D018, D022 |
| AC2 | D007, D009, D011, D018, D022, D038 |
| ACD | D005, D006, D007, D008, D011 |
| ACL | D007, D009 |
| AD | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039 |
| AL | D005, D006, D007, D008, D011 |
| AP | D007, D009 |
| APD | D007, D008, D009, D019, D021, D022, D039 |
| AS | D006, D007, D008, D011 |
| AT | D005, D006, D007, D008, D011 |
| ATL | D005, D006, D007, D008, D011 |
| AX | D007, D009 |
| BF | D006, D007, D008, D011 |
| BU | D006, D007, D008, D011 |
| CD | D006, D007, D008, D009, D011 |
| CF | D007, D008, D009, D011, D019, D021, D022, D039 |
| CK | D005, D006, D007, D008, D009, D011 |
| CL | D007, D008, D009 |
| CLRD | D007, D008, D009 |
| CLS | D007, D008, D009, D019, D021, D022, D039 |

| | |
|---|---|
| COL | D005 |
| CPOD | D011 |
| CS | D007, D008, D009 |
| CSE | D007, D008, D009, D039 |
| CV | D005, D006, D007, D008, D009, D011, D019 |
| CW | D007, D008, D009, D011, D019, D021, D022, D039 |
| CX | D007, D008, D009, D011 |
| CXL | D007, D008, D009 ~~D019, D021, D022, D039~~ |
| DO | D007, D011 (no D-listings apply after 1993) |
| DOP | D008 |
| DS | D006, D007, D008, D009, D011 |
| ED | D005, D006, D007, D008, D011 |
| EDC | D007 |
| EL | D040 |
| EOC | D007, D009 |
| ER | D006, D008 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |
| EXT | D005, D006, D007, D008, D009, D011 |
| FDL | D004, D005, D006, D007, D008, D009, D010, D011 |
| FF | D022, D040 |
| FLU | D004, D005, D006, D007, D008, D009, D010, D011 |
| FX | D006, D007, D008, D009, D011 |
| HCD | D006, D007, D008, D009, D011 |
| HD | D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| HRA | D005, D006, D007, D008, D009, D011 |
| IA | D006, D007, D008, D009, D011 |
| IAM | D005, D006, D007, D008, D011 |
| IB | D005, D006, D007, D008, D009, D011 |
| ICP | D007, D009 |
| IE | D005, D006, D007, D008, D009, D011 |
| IS | D005, D006, D007, D008, D011 |
| IX | D006, D007, D008, D009, D011 |
| KBTF | D008 |
| LD | D007, D008, D009 |
| LG1 | D006, D008 |
| LG2 | D006, D007, D008, D009, D011 |

| | |
|---|---|
| STF | D007 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1, VP3 | D009 (D listing applies only from 09/85 to 10/85) |
| VU, VUL | D005, D008 |
| ~~X~~WM, X0, XO | D007, D008, D009, D022, D035, D040 (assigned in order to be conservative; TWCP-AK-2.1-004, R2, Section 3.4.9) |
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

~~(* conservative)~~

8.3 Corrosivity, Reactivity, and Ignitability

TA-55-19 has no listings for corrosivity, reactivity, or ignitability.

TA-55-19A has no listings for corrosivity, reactivity, or ignitability.

TA-55-20 has no listings for corrosivity, reactivity, or ignitability.

See Section ~~10.0~~ 9.0 for a ~~discussion~~ description of the controls in place at TA-55 to ensure the absence of corrosive, reactive or ignitable chemicals in these waste streams. D001 does not apply to wastes in these waste streams despite the use of spent non-halogenated solvents (HWN F003), for the following reasons:

- Rags that are above the DL for Pu are thermally decomposed, which destroys any organic component.
- Rags that are below the DL for Pu are discarded as combustible debris, but headspace gas analyses support the contention that the solvents are not present in the waste at levels of concern. ~~In addition,~~ 100 percent of the drums are subjected to headspace gas analysis, and drums showing over 500 ppm total flammable VOCs are prohibited from being shipped to WIPP. (For comparison, the explosive limit for acetone is 25,000 ppm.) (Table 6). (new last bullet. Finally,)
- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for Pu. (by itself)
- If above the DL, the solutions are sent to aqueous processes as part of chloride or nitrate operations. Aqueous recovery steps include dissolution of any solid Pu in hydrochloric or nitric acid, followed by Pu recovery by ion exchange. The solutions are then below the DL and are either sent to the RLWTF or to the evaporator.

(switch order)

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests (see Attachment 5), introduced in June 1980, included check boxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials. for TA-55

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF (see Attachment 4, pp. 4 and 5) documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in waste, explosives were altogether prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. In the event of a misfire or unconsumed explosives, a procedure is in place at TA-55 to ensure that explosives do not enter the waste stream (TWCP-xxxx). John to provide

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids. (The Controls to ensure the exclusion of ignitable constituents are described in Section 8.3.)

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed onto kitty litter (vermiculite) and discarded in an appropriate waste stream and containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the TRUPACT-II. Section 9.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste items specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from TA-55. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

A chemical compatibility analysis was performed for TRUCON codes 116/216 (combustible waste) which indicated that all chemicals and the waste matrix were compatible at levels greater than trace amounts (*Content Code Assessments for LANL TRUCON Codes* [DOE/WIPP-89-004]). During the process AK search, additional chemicals were identified and are listed in Section 3.6.3; a new compatibility analysis is underway, but since these additional chemicals are only present at trace quantities in the TA-55-19 and TA-55-20 waste streams, no incompatibilities should exist.

## 11.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

Administrative and procedural controls on the prohibited pyrophorics in TRU waste and the absence of pyrophorics has been verified through testing. For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the RFETS (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of LANL direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Chemical Waste Disposal Requests dated as early as June 1980 included boxes that were required to be checked if the waste contained pyrophoric, flammable, corrosive, or explosive materials (see Attachment 5, Chemical Waste Disposal Request).

In addition, for wastes generated after the implementation of the 1987 Certification Plan, Generator Attachments, associated waste packaging procedures, and quality assurance systems, the waste generator has signed a statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The TA-55 Attachment to the Certification Plan describes how these restrictions were verified by waste management personnel (TWCP-701, Sections 3.8.5-3.8.7).

## 12.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into TA-55 processes as documented in the TA-55 procedures reviewed during this AK search ~~(reports)~~ (TWCP-AK-2.1-002; TWCP-AK-2.1-003; TWCP-AK-2.1-004; TWCP-AK-2.1-005; TWCP-AK-2.1-006; and TWCP-AK-2.1-007) and summarized in the process inputs listed in Tables 1 and 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none

of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005, R.1, Section 9.0). This oil does not enter the LANL disposal operations.

## 13.0 DETERMINATION OF THE MAXIMUM NUMBER OF CONFINEMENT LAYERS PERMITTED FOR WASTE PACKAGING

June to add text per AK-VE Reconciliation findings

Waste streams TA-55-19 and TA-55-20 are primarily generated from operations performed in gloveboxes. The waste material is placed directly into bag-out bags (also called inner bags) through an opening in the glovebox where the bag is attached, and the bag is then closed and detached from the glovebox. Waste streams TA-55-19 and TA-55-20 may also be generated from "hot jobs" outside of the glovebox, such as valve changes, or from decontamination of spills or other releases. In these cases, the waste is placed directly into one (or possibly more) inner bags at the work area. The maximum number of confinement layers in any case is six (TWCP-816).

A minor source of waste streams TA-55-19 and TA-55-20 is room trash that was originally considered to be low-level waste, which is collected in plastic bags inside cardboard boxes. Occasionally, when assayed, these boxes are determined to be TRU waste. These boxes may be sorted to remove the "hot" item, or the whole box may be bagged and sent to the TRU packaging area for placement in drums containing waste streams TA-55-19 or TA-55-20, as appropriate. When this occurs, the P/S code WM is assigned to the waste. Due to the additional layers of plastic that are present when this operation occurs, drums with the P/S code WM are assumed to contain up to two more layers of internal packaging than other drums.

Waste drum packaging procedures for waste streams TA-55-19 and TA-55-20 have gone through several changes since the beginning of operations at TA-55. TRUCON Code assignments made by the waste generator are compiled in the Sampling Plan. However, in the absence of this information, TRUCON Codes will be assigned to the waste container in accordance with the default packaging configurations and associated TRUCON codes shown in Table 7, that reflect the packaging protocols in effect during different periods of time at TA-55 (TWCP-816).

**Table 7. Maximum Layers of Confinement for be Used for TA-55-19 and TA-55-20 Waste Containers in the Absence of More Specific Waste Characterization Data**

| Time Frame | P/S Code | Layers of Confinement* | TRUCON Code |
|---|---|---|---|

| | | | |
|---|---|---|---|
| 01/78–05/87 | all | Maximum of 6 layers:<br>• up to 4 inner bags<br>• up to 2 liner bags<br>• all bag closures by either twist & tie; or twist, tie & tape | LA 116 I |
| 05/87–01/97 | all except WM, XO | Maximum of 4 layers:<br>• up to 2 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded | LA 116 A |
| 05/87–present | WM, XO | Maximum of 6 layers:<br>• up to 4 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded | LA 116 I |
| 01/97–present | all except WM, XO | Maximum of 1 layer:<br>• 1 carbon-filter vented inner bag (if initial bag is breached, bag is placed in second bag and first bag is slit open), closed by either twist & tie; or twist, tie & tape<br>• 2 liner bags, folded, no closure | LA 116 E |

* Layers of confinement for these TRUCON Codes are defined in DOE/WIPP-89-004

June to
Check — FT are closed or not?

June to insert new section
on AK confirmation

Add to P15 code list
Hanford wastes — HRA

only if we have info. on the processes

Insert info. about high-density plastic from CE operations (see email)

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20

Edit round #1 ltm

**REPORT NUMBER:** TWCP-AK-2.1-008,R.1 (LA-UR-00-5727)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-19 and TA-55-20

Update to new QP-21 (get from Jim Bailey)

What about leaded gloves prior to 1987?

**EFFECTIVE DATE:** 12/04/00

**NEXT REVIEW DATE:** 12/04/02

**DOCUMENT PREPARER:**

John Musgrave — NAME — 12/04/00 — DATE

**APPROVALS:**

June Fabryka-Martin — INDEPENDENT TECHNICAL REVIEWER/EDITOR — 12/04/00 — DATE

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## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| ARIES | Advanced Recovery and Integrated Extraction System |
| CFR | *Code of Federal Regulations* |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| DCHP | dicesium hexachloroplutonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste code for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | oxygen fluoride |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| ID | item identification |
| IDC | item description code |
| K | RCRA hazardous waste code for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| MCDOR | multicycle direct oxide reduction |
| MT | material type |
| NMT | Nuclear Material Technology |
| P | RCRA hazardous waste code for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PRQL | program required quantitation limit |
| P/S | process/status [code] |
| QA | quality assurance |
| R&D | research and development |
| RD&D | research, development, and demonstration |
| RCRA | Resource Conservation and Recovery Act |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| RSWD | radioactive solid waste disposal |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3) |
| SME | subject matter expert |
| SOP | safe operating procedure |
| TA | technical area |
| TBP | tributyl phosphate |

## PROCESS/STATUS CODE INDEX

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| AC ✓ | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, F002, F005, D038, W213 |
| ACI | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, F002, F005 |
| AC2 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D011, D018, D022, F002, F005, D038, W213 |
| AC3 | Actinide chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 | |
| ACC | Ammonium chloride conversion | Special Processing | 3.4.8, Att. 4 | |
| ACD | Cascade dissolver | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| ACL | Analytical chemistry laboratory | Miscellaneous Operations | 3.4.4, Att. 4 | D007, D009 |
| AD | Actinide processing demonstration | Miscellaneous Operations | 3.4.1, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| AL | Ash leach | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| AO | Assembly operation | Metal Operation Processes | 3.4.3, Att. 4 | |
| AO | Americium processing calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| AP | Americium purification | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | D007, D009 |
| APD ✓ | Actinide processing demonstration | Miscellaneous Operations | 3.4.7, Att. 4 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| ARI | ARIES | Metal Operation Processes | 3.4.3, Att. 4 | |
| AS | Anode heel dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008, D011 |
| AT | Ash testing | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| ATL | Advanced test line for actinide separation RD&D | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| AX | Solution assay | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009 |
| BA | Basement isopress | Metal Operation Processes | 3.4.2, Att. 4 | |
| BAC | Bacterial decomposition of cellulose items | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| BC | Physical properties | Metal Operation Processes | 3.4.2, Att. 4 | |
| BF | Unknown name for P/S code | Nitrate Operations | 3.4.6, Att. 4 | D006, D007, D008, D011 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| BL | Blending | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| BM | Burning metal | Nitrate Operations | 3.4.1, Att. 4 | |
| BT | Burst testing | Metal Operation Processes | 3.4.3, Att. 4 | ~~D006~~ No |
| BU | Button burning | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D006, D007, D008, D011 |
| CA | Casting | Metal Operation Processes | 3.4.2, Att. 4 | |
| CC | Calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| CD | Hydroxide cake dissolution | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| CF ✓ | Cement fixation | Nitrate Operations | 3.4.5, Att. 4 | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 |
| CH | Characterization | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| CK | RD&D volatile fluoride Pu recovery | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| CL | Crucible processing | Chloride Operations | 3.4.2, 3.4.3, Att. 4 | D007, D008, D009 |
| CLRD | Aqueous chloride R&D | Chloride Operations | 3.4.2, Att. 4 | D007, D008, D009 |
| CLS | Accountable CLS chloride solutions | Chloride Operations | 3.4.2, 3.4.3, 3.4.4, Att. 4 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| CN | C-N-O analysis | Metal Operation Processes | 3.4.1, Att. 4 | |
| CO | Comminution | Metal Operation Processes | 3.4.1, Att. 4 | |
| COD | Chlorinated oxide dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| COL | Chlorinated oxide leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D005 |
| CPOD | Catalyzed electrochemical plutonium oxide dissolver | Nitrate Operations | 3.4.2, Att. 4 | D011 |
| CR | Crushing and pulverizing | Nitrate Operations | 3.4.1, Att. 4 | |
| CRD | Chlorination/reduction RD&D | Pyrochemical Processes | 3.4, Att. 4 | |
| CS | Chloride solutions | Chloride Operations | 3.4.3, Att. 4 | D007, D008, D009 |
| CSE | Chloride solvent extraction | Chloride Operations | 3.4.3, Att. 4 | D007, D008, D009, D039, F002 |
| CT | Compatibility testing | Metal Operation Processes | 3.4.1, Att. 4 | |
| CV | RD&D experimental chlorination processes | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011, D019, ~~D039~~ |
| CW | Caustic waste | Chloride Operations | 3.4.4, Att. 4 | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| CX | Chloride anion exchange | Chloride Operations | 3.4.2, 3.4.3, 3.4.4, Att. 4 | D007, D008, D009, D011 |
| CXL | Experimental chloride extraction line | Chloride Operations | 3.4.2, 3.4.3, Att. 4 | D007, D008, D009, D019, D021, D022, D039, D042, F003 |
| DA | Alloy development Pu items | Metal Operation Processes | 3.4.2, Att. 4 | F002 |
| DF | DS furnace and oxide preparation | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| DO | Dissolution of oxide | Special Processing | 3.4.3, 3.4.5, 3,4,7, Att. 4 | D007, D011 |
| DOP | Detector oxide preparation | Metal Operation Processes | 3.4.2, Att. 4 | D008 |
| DP | Dry processing | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| DS | Ion exchange | Nitrate Operations | 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |
| DT | John Ward R&D | Metal Operation Processes | 3.4.2, Att. 4 | |
| ED | Cascade dissolver | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| EDC | Electrolytic decontamination | Miscellaneous Operations | 3.4.8, Att. 4 | D007, D008 |
| EL | Element loading | Metal Operation Processes | 3.4.1, Att. 4 | D040 |
| ELW | Experimental laser welding | Metal Operation Processes | 3.4.3, Att. 4 | |
| EM | Electron microscopy | Metal Operation Processes | 3.4.2, Att. 4 | |
| EOC | Experimental oxide characterization | Miscellaneous Operations | 3.4.5, Att. 4 | D007, D009 |
| ER | Electrorefining | Pyrochemical Processes | 3.4.4, Att. 4 | D006, D008 |
| ETD | Experimental thermal decomposition | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D005, D006, D007, D008, D011 |
| EV | Evaporator | Nitrate Operations | 3.4.4, Att. 4 | D006, D007, D008, D009, D011 |
| EVAC | Evacuation and bake out | Metal Operation Processes | 3.4.3, Att. 4 | |
| EXT | Extraction RD&D | Miscellaneous Operations | 3.4.6, Att. 4 | D005, D006, D007, D008, D009, D011 |
| FA | Americium processing | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| FC | Canning | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| FDL | FOOF demonstration loop | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011 D004, D010 |
| FF | Fuel fabrication | Metal Operation Processes | 3.4.1, Att. 4 | D022, D040 |
| FLU | Fluorination RD&D | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011 D004, D010 |
| FSPF | Special furnace operations | Metal Operation Processes | 3.4.3, Att. 4 | |
| FX | Cement to drum | Nitrate Operations | 3.4.6, Att. 4 | D006, D007, D008, D009, D011 |
| GI | Pellet grinding & inspection | Metal Operation Processes | 3.4.1, Att. 4 | |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| GMS | Open gradient magnetic separation | Nitrate Operations | 3.4.1, Att. 4 | |
| HC | Calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| HCD | Hydroxide cake dissolution | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| HD | Hydroxide cake dissolution | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| HG | Pu removal by mercury | Metal Operation Processes | 3.4.2, Att. 4 | |
| HGMS | High gradient magnetic separation | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D006, D007, D008, D009, D011 |
| HP | Cement fixation | Nitrate Operations | 3.4.5, Att. 4 | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 |
| HRS | High resolution spectroscopy | Miscellaneous Operations | 3.4.5, Att. 4 | |
| IA | Impure americium holding for discard | Nitrate Operations | 3.4.5, 3.4.6, Att. 4 | D006, D007, D008, D009, D011 |
| IAM | Inspection and measurement | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| IB | Matrix study of pyrochemical salts | Miscellaneous Operations | 3.4.6, Att. 4 | D005, D006, D007, D008, D009, D011 |
| ICP | ICP-AES analysis | Miscellaneous Operations | 3.4.4, Att. 4 | D007, D009 |
| ID | Immersion density | Metal Operation Processes | 3.4.1, Att. 4 | |
| IE | Isotope enrichment | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011 |
| IN | Inspection | Metal Operation Processes | 3.4.2, Att. 4 | |
| IS | Incinerator | Nitrate Operations | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| ITF | Impact test facility | Metal Operation Processes | 3.4.2, Att. 4 | |
| ITF4 | Impact test facility | Metal Operation Processes | 3.4.2, Att. 4 | |
| IX | Ion exchange | Special Processing | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| JA | Gas isostatic press | Metal Operation Processes | 3.4.2, Att. 4 | |
| KBTF | Kolsky bar test facility | Metal Operation Processes | 3.4.3, Att. 4 | D008 |
| LC | Uranium plutonium processing | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| LD | Chloride leach & dissolution | Chloride Operations | 3.4.2, Att. 4 | D007, D008, D009 |
| LG1 | Non combustible leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| LG2 | Hydroxide cake dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008, D009, D011 |
| LI | XF6 experimental measurements | Miscellaneous Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D009, D011 |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| LIBS | Laser-induced breakdown spectroscopy system | Miscellaneous Operations | 3.4.5, Att. 4 | |
| LR | Ion exchange | Nitrate Operations | 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |
| MA | Machining | Metal Operation Processes | 3.4.2, Att. 4 | D035, D040, F002, F005 F001 |
| MAG | Magnetic separation | Nitrate Operations | 3.4.1, Att. 4 | |
| MAS | RD&D experimental processes | Nitrate Operations | 3.4.1, Att. 4 | |
| MB | Nitric dissolution of molten salts | Chloride Operations<br>Nitrate Operations | 3.4.2, Att. 4<br>3.4.2, 3.4.6, Att. 4 | D005, D007, D008, D009 |
| MBC | Crystal | Metal Operation Processes | 3.4.3, Att. 4 | |
| ME | Metallography | Miscellaneous Operations | 3.4.10, Att. 4 | D007, D040, F003 |
| MELL | Mediated electro-oxidation of LLW | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008, D009, D011 |
| MF | Metals furnace | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| ML | Non-Pu metal leach | Nitrate Operations | 3.4.2, Att. 4 | D006, D008 |
| MO | Metal oxidation, room 429 | Pyrochemical Processes | 3.4.9, Att. 4 | |
| MOX | Mixed oxide fuel production | Metal Operation Processes | 3.4.1, Att. 4 | |
| MP | Metal preparation | Pyrochemical Processes | 3.4.1, Att. 4 | |
| MPD | Cascade dissolver | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| MS | Molten salts purification dissolution | Chloride Operations | 3.4.2, Att. 4 | D007, D008, D009 |
| MW | Metal working | Metal Operation Processes | 3.4.2, Att. 4 | |
| NC | Noncombustible leach | Nitrate Operations | 3.4.2, Att. 4 | D006, D008 |
| NCD | Nonconfirming drums | Miscellaneous Operations | 3.4.9, Att. 4 | |
| NEPTUNIUM | Neptunium | Pyrochemical Processes | 3.4.10, Att. 4 | |
| NL | Noncombustible leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| NR | Nitrate recovery | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| OB | Oxide blending | Metal Operation Processes | 3.4.1, Att. 4 | |
| OD | Oxide dissolution | Nitrate Operations | 3.4.2, Att. 4 | D006, D007, D008 |
| OH | Hydroxide precipitation | Nitrate Operations | 3.4.1, 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |
| OM | Oxygen to metal ratio determination | Metal Operation Processes | 3.4.1, Att. 4 | |
| OR | Direct oxide reduction | Pyrochemical Processes | 3.4.2, Att. 4 | |
| OY | Oxalate precipitation | Nitrate Operations | 3.4.1, 3.4.3, Att. 4 | |
| PA | Passivation | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| PAF | Passivation furnaces | Nitrate Operations | 3.4.1, Att. 4 | |
| PB | Pu-beryllium source recovery | Chloride Operations | 3.4.1, Att. 4 | D007, D008, D009 |
| PCH | Plasma chemistry | Metal Operation Processes | 3.4.2, Att. 4 | D007 |
| PD | Pit disassembly | Metal Operation Processes | 3.4.2, Att. 4 | |
| PE | Sputtering process | Metal Operation Processes | 3.4.2, Att. 4 | D004 |
| PF | Plutonium surfaces | Metal Operation Processes | 3.4.2, Att. 4 | |
| PH | Thermal hydride/dehydride | Metal Operation Processes | 3.4.2, Att. 4 | |
| PI | Preparation of isotopes | Special Processing | 3.4.4, Att. 4 | |
| PIG | Welding | Metal Operation Processes | 3.4.3, Att. 4 | |
| PK | Pickling and nitrate holding | Pyrochemical Processes | 3.4.11, Att. 4 | D006, D007, D008, D011 |
| POSM | Processing out-of-specification material | Special Processing | 3.4.3, Att. 4 | D007, D011 |
| PPD | Pu pellet dissolution | Special Processing | 3.4.11, Att. 4 | |
| PR | Peroxide precipitation | Nitrate Operations | 3.4.3, Att. 4 | |
| PRR | Pyrochemical residue recovery | Chloride Operations | 3.4.3, 3.4.4, Att. 4 | D007, D009 |
| PS | Peroxide precipitation of MSE salts | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| PT | Plutonium-thorium separation | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D007 |
| PTP | Plutonium trichloride preparation | Pyrochemical Processes | 3.4.12, Att. 4 | D019 |
| PTS | RD&D pretreatment study | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D005, D006, D007, D008, D011 |
| PUB | Pu/Be source recovery | Chloride Operations | 3.4.1, Att. 4 | D007, D008, D009 |
| PX | Multiple DOR with in-situ regeneration and electrorefining | Special Processing | 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, Att. 4 | D006, D008, D019 |
| RA | Recovery of anodes | Pyrochemical Processes | 3.4.6, Att. 4 | D005 |
| RAP | Research alloy preparation | Metal Operation Processes | 3.4.3, Att. 4 | |
| RAP2 | Research alloy preparation | Metal Operation Processes | 3.4.3, Att. 4 | |
| RASS/RSS | Raman spectroscopy system | Miscellaneous Operations | 3.4.5, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RB | Roasting and blending | Nitrate Operations | 3.4.3, Att. 4 | |
| RBJ | Roasting and blending Jr | Nitrate Operations | 3.4.3, Att. 4 | |
| RC | Rotary calciner | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D005, D006, D007, D008, D011 |
| RCM | Rich column material ion exchange | Nitrate Operations | 3.4.3, Att. 4 | |

Rename "Pyrochemical R&D"

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| RD | Repackaging into retrievable drums | Miscellaneous Operations | 3.4.9, Att. 4 | |
| RFX | Ion exchange | Nitrate Operations | 3.4.3, Att. 4 | |
| RL | Radiochemical coating | Metal Operation Processes | 3.4.2, Att. 4 | |
| RM | Reduction to metal | Special Processing | 3.4.4, 3.4.6, 3.4.7, 3.4.8, 3.4.9, Att. 4 | |
| RO | Oil recovery | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | D006, D008, D040 |
| RR | Ion exchange | Nitrate Operations | 3.4.3, Att. 4 | D006, D007, D008, D009, D011 |
| RS | Pellet sintering | Metal Operation Processes | 3.4.1, Att. 4 | |
| SA | Super acid RD&D | Miscellaneous Operations | 3.4.3, Att. 4 | D007, D009, D018, D038, F002, F003, F005 |
| SB | Scrap burning | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| SBB | Ca/Al scrubbing RD&D | Special Processing | 3.4.9, Att. 4 | |
| SC | Cascade dissolver, G437 | Nitrate Operations | 3.4.2, Att. 4 | D005, D006, D007, D008, D011 |
| SCB | Chlorination Ca/Al scrubbing RD&D | Pyrochemical Processes | 3.4.2, Att. 4 | |
| SD | Salt distillation | Pyrochemical Processes | 3.4.5, Att. 4 | P120 |
| SE | Solvent extraction | Chloride Operations | 3.4.3, Att. 4 | D007, D008, D009, D039, F002 |
| SL | Scrap leaching | Special Processing | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| SMP | SP mounting preparation | Miscellaneous Operations | 3.4.5, Att. 4 | |
| SO | Super oxidizer, FOOF program | Miscellaneous Operations | 3.4.2, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | Scrap dissolution, G438 | Nitrate Operations | 3.4.2, Att. 4 | D007 |
| SRL | Special recovery line | Metal Operation Processes | 3.4.2, Att. 4 | |
| SS | Salt stripping | Pyrochemical Processes | 3.4.3, 3.4.4, 3.4.5, 3.4.7, 3.4.8, Att. 4 | D006, D008, P120 |
| SSD | Special scrap dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D007, D008 |
| SSMD | SS material development | Pyrochemical Processes | 3.4, Att. 4 | D009 |
| STF | Standard fabrication | Miscellaneous Operations | 3.4.6, Att. 4 | D007 |
| SX | Americium processing silicon removal | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | |
| TDC | Thermal decomposition of cellulose items | Nitrate Operations | 3.4.1, Att. 4 | D005, D006, D007, D008, D011 |
| TIGR | Thermally induced gallium removal | Metal Operation Processes | 3.4.3, Att. 4 | |

| P/S Code | P/S Name | AK Process Report and Primary Report Section in which P/S Code is Described* | | RCRA Listings for Combustible Debris |
|---|---|---|---|---|
| UA | Uranium fabrication | Metal Operation Processes | 3.4.2, Att. 4 | |
| UPS | Uranium/plutonium separation | Nitrate Operations | 3.4.2, Att. 4 | |
| US | Uranium separation for solid solution feed | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| US2 | Uranium separation for non-solid solutions feed | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |
| VC | Variable CSMO scrap dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D006, D008 |
| VD | Vapor degreaser and sand blasting | Metal Operation Processes | 3.4.2, Att. 4 | |
| VP1 | CSMO scrap dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | D009 |
| VP2 | Polycube processing | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 | |
| VP3 | Hydroxide precipitation | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 | D011 ~~D009~~ ? — stet |
| VS | Confirmation, inspection & sampling | Miscellaneous Operations | 3.4.5, Att. 4 | |
| VU | Vessel unloading | Special Processing | Att. 4 | D005, D008 |
| VUL | Vessel unloading | Nitrate Operations | 3.4.1, Att. 4 | D005, D008 |
| WE | Welding | Metal Operation Processes | 3.4.2, Att. 4 | D008 ? — Fxxx |
| WLT | Welding leak test | Metal Operation Processes | 3.4.3, Att. 4 | |
| WM | Waste management | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| X0 | Inactive or unspecified P/S material | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-ray energy spectroscopy | Miscellaneous Operations | 3.4.5, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| XO | Inactive or unspecified P/S material | Miscellaneous Operations | 3.4.9, Att. 4 | D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XP | RD&D experimental processes | Miscellaneous Operations | 3.4.4, Att. 4 | D004, D005, D006, D007, D008, D009, D010, D011 |
| ZD | Scrap oxide dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 | |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002, R.1), Metal Operation Processes (TWCP-AK-2.1-003, R.1), Miscellaneous Operations (TWCP-AK-2.1-004, R.1), Nitrate Operations (TWCP-AK-2.1-005, R.1), Pyrochemical Processes (TWCP-AK-2.1-006, R.1), and Special Processing (TWCP-AK-2.1-007, R.1)

need seperated AK report for each WS

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-19 & 20

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-19, Mixed Combustible Debris Waste<br>TA-55-20, Non-mixed Combustible Debris Waste |
| **Waste Matrix Code and Description:** | S5300 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA116I |
| **Maximum Layers of Packaging:** | 6 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | TA-55-19: 1978—present; TA-55-20: 1979—present |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | TA-55-19: 4173 containers (873 $m^3$)<br>TA-55-20: 281 containers (59 $m^3$) |
| **Waste Stream Volume (after repackaging):** | TA-55-19: 850 SWBs, 3873 drums (2390 $m^3$)<br>TA-55-20: not available |

**Waste Material Parameter List (including packaging)**

*Waste materials*: cellulosics, rubber, plastics; iron-based metals and alloys (<5% by volume)
*Packaging materials*: steel, plastics

**Waste Stream Description**

The combustible debris waste stream includes rubber, plastic-based, and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape; gloves; plastic vials; polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; Plexiglas; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to, rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (less than 5 percent) of non-combustible solids (e.g., scrap metal, metal lids, zippers, discarded tools).

**Waste Generating Processes**

Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate transuranic wastes. These operations include:

- Preparation of ultra-pure plutonium metals, alloys, and compounds
- Preparation of specific alloys, including casting and machining these materials into specific shapes
- Determination of the high-temperature thermodynamic properties of plutonium
- Reclamation of plutonium from scrap and residues produced by numerous feed sources
- Disassembly of components for inspection and analysis
- Manufacturing of parts on a limited basis

**RCRA Characterization:**

TA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWN). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.

- F001, F002, F003 and F005
- D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040
- P120 (applies only to waste stream TA-55-19A)

No HWNs apply to containers in waste stream TA-55-20.

**Radionuclide Content**

These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium and uranium relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium from one of several uranium material types. Other waste may contain various radionuclides used as radioassay sources, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium.

**Primary References for Documentation of Acceptable Knowledge**

*Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002, ~~R1~~ 0)

# ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR WASTE STREAMS TA-55-19 AND TA-55-20

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK information and provides guidelines on how AK should be obtained and documented.

This AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021, R5). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides technical support for assignment of specific waste containers to the waste stream.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to waste streams TA-55-19 and -20 covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001, R3) (Sampling Plan) that includes information regarding all waste streams, including TA-55-19 and TA-55-20.
- Review of documents related to the waste generation and waste management activities at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1),
- Interviews with personnel involved with waste generation and waste management at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1), and
- Review of process AK reports for TA-55 processes (as discussed below), and
- Analysis of processes generating waste, as discussed in the process AK reports and in this report.

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that are referenced in this summary report. Unclassified Controlled Nuclear Information

(UCNI) will be reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK summary report is based on detailed information compiled in ~~the summation of~~ a set of closely related reports about TRU waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002, R.1)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003, R.1)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004, R.1)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005, R.1)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006, R.1)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007, R.1)

The process AK reports contain information on over 200 ~~multiple~~ individual processes that have each been assigned a unique identifier called a process status (P/S) code. For example, the nitrate operations report (TWCP-AK-2.1-005, R.1) covers waste generation processes and characteristics for about 80 different processes, each with its own P/S code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generation records.

The TA-55 Plutonium Facility tracks waste items both by the process from which they originated and their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item. Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. Further complication is introduced because the waste streams for TA-55 have been defined based primarily on the physical form and material content of the waste and only secondarily on the waste generation process through mixed or non-mixed waste stream designations. Hence, any given waste stream could potentially contain items from all of the plutonium recovery

TA-55-19 and TA-55-20 combustible debris waste streams were generated in the TA-55 Plutonium Facility (Building PF-4). A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

3.2 Waste Physical Form and Content Description

Check with Pam (Item 2)

The TA-55-19 and-20 combustible debris waste streams ~~are defined as retrievably stored waste streams~~ are defined as (Sampling Plan, Appendix D), with TA-55-19 being a mixed waste stream and TA-55-20 its non-mixed counterpart. The waste includes paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated at the facility. Plastic-based waste includes, but may not be limited to, polyethylene and vinyl tape, gloves, plastic vials, polystyrene, Tygon tubing, polyvinyl chloride plastic, Teflon products, Plexiglas, and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain a small fraction (<5%) of non-combustible solids (scrap metal, metal lids, and clothing zippers) (Sampling Plan, Appendix D).

3.3 Waste Volume and Time Period of Waste Generation

The following information is from the Sampling Plan (TWCP-PLAN-0.2.7-001, R.3, Appendix D). These values are expected to change because the sampling plan is continually updated as new waste information is obtained.

TA55-19&20

- TA-55-19 includes 4173 containers (873 cubic meters), that were generated from 1978 to the present time.
- TA-55-20 includes 281 containers (59 cubic meters), that were generated from 1979 to the present time.

3.4 Waste Stream Generation Processes

3.4.1 Overview

Basis, Rational, and Assumption used to Delineate the Waste Stream.

The TA-55-19 and TA-55-20 combustible debris waste streams were generated from combustible materials used in processes to recover plutonium from residues, metal fabrication, and research and development activities ~~performed in Pu-certified laboratories~~. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds
- Preparing on a large scale specific alloys, including casting and machining these materials into specific shapes

- Determining high-temperature thermodynamic properties of plutonium
- Reclaiming plutonium from scrap and residues produced by numerous feed sources
- Disassembling components for inspection and analysis
- Manufacturing of parts on a limited basis
- Processing mixtures of plutonium and uranium oxides for reactor fuels.

The manufacturing and research operations performed at TA-55 in the recovery of plutonium results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scrap generated from operations at various LANL, other U.S. Department of Energy (DOE) facilities, and commercial radioactive sources. These recovery operations, along with associated maintenance operation, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Plutonium processing facilities generate contaminated combustible waste from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber- and Teflon-based products used in operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

3.5.2 ~~Process~~ Process Flow Diagrams →

Detailed information about the TA-55 plutonium recovery processes can be found in the Process AK reports. For purposes of the AK search, and to allow convenient referral to and referencing of the Process AK reports in this waste stream AK Summary Report, the processes have been divided into six major areas:

- Nitrate Operations
- Chloride Operations
- Miscellaneous Operations
- Special Processing

- Metal Operation Processes
- Pyrochemical Processes

Generalized flow diagrams for the six operational areas relevant to this AK search are presented as Attachment 3. With the exception of the report on chloride operations, these generalized flow diagrams indicate P/S codes for the various processes. (For chloride operations, P/S codes did not correspond to individual steps as shown on the diagram, so were not included.) The full block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

The following subsections describe the processes that generated debris waste assigned to the TA-55-19 and TA-55-20 waste streams. The potential for RCRA-regulated constituents to be present due to feed materials or chemical use in these processes is summarized in Section 3.5. The applicability of EPA HWNs as a result of this potential is specified in Section 8.

Insert P/S codes

### 3.4.2 Nitrate Operations

A detailed description of nitrate operations can be found in *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005, R.1).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following process steps:

operations

- pretreatment
- dissolution
- purification
- evaporation
- cement fixation

Pretreatment primarily includes physical processes used to separate scrap and residues for the next step, dissolution. It may include calcination, caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing, distillation, filtering of liquids or oils, incineration, magnetic separation, passivation, scraping, or sorting. After pretreatment, solids are sent to dissolution if plutonium concentrations are above the discard limit (DL) and to cement fixation if

concentrations are below the DL. Liquids are sent to purification if plutonium concentrations are above the DL and to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) if they meet the TA-50 RLWTF waste acceptance criteria (WAC) or to cement fixation; otherwise, they are further treated until they meet that WAC.

Dissolution includes various steps that generate plutonium nitrate solutions for feed to purification. Primary chemicals used in dissolution are nitric acid and calcium fluoride and/or hydrofluoric acid. Dissolution takes place in pots or cascade systems. Filtered solids are returned to the dissolution process until plutonium concentrations are below the DL, then sent to cement fixation for disposal. Debris items are disposed after removal of plutonium contamination above the DL. Heavy metals are concentrated in the plutonium-rich hydroxide cakes that are produced in chloride operations and derive from one or more of the following: (a) feed materials that consist of or contain the metals; (b) leaching of metal from equipment components; or (c) in the case of silver, from its use (until 1994) as an indicator of chloride content. Plutonium-bearing solutions are sent on to purification.

Purification consists of ion exchange and precipitation processes. The ion exchange processes use resin-filled columns to collect plutonium, which binds to the resin while impurities flow through the columns; an eluting agent is then used to release purified plutonium in solution. The enriched solutions are then sent to oxalate precipitation, which converts the plutonium to oxide form. The depleted liquids are sent to the evaporator or the RLWTF, and the calcined plutonium oxides are sent to the vault.

The evaporator processes plutonium-poor liquids in order to re-concentrate plutonium, if possible, or to reduce the volume of liquid waste. Evaporator bottoms are either sent back to ion exchange or discarded to cement fixation, depending on their plutonium content. Heavy metals that may be present are concentrated in this process.

In the cement fixation step, wastes with low plutonium concentrations are collected and immobilized in cement. Most if not all of the waste generated under these processes (P/S codes CF, HP, and IA) are classified as cemented wastes and would not be part of the debris waste streams.

Insert P/S codes →

### 3.4.3 Chloride Operations

A detailed description of chloride operations can be found in *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002, R.1).

The overall goal of the chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The primary feed sources are plutonium residues from pyrochemical operations, PuBe neutron sources, analytical laboratory solutions, and residues from other DOE facilities. Chloride operations can be broken down into the following process steps:

- pretreatment
- dissolution
- purification
- hydroxide precipitation

Pretreatment may include sorting, crushing, and/or pulverizing feed materials prior to being fed into later steps of chloride operations. A separate pretreatment procedure is the decladding of plutonium-beryllium sources. The PuBe metal alloy is removed from the sources, which are then entered into the chloride line for plutonium recovery along with other materials.

In the dissolution step, hydrochloric acid is used to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory. Enriched solutions undergo further purification (see next paragraph), and solid wastes are ~~sent to~~ debris (waste) or cement fixation (see Section 3.4.2.1, Nitrate Operations). discarded as ~~sent to~~

Purification steps may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and separate out impurities. Enriched solutions may be further treated with oxalic acid to precipitate plutonium oxalate, which is converted to plutonium oxide.

In the hydroxide precipitation step, plutonium in solutions from purification steps is precipitated with potassium, magnesium, or sodium hydroxide. The resulting enriched hydroxide cakes become feed material for nitrate operations (see Section 3.4.2.1, Nitrate Operations), and liquid meeting the TA-50 WAC is sent to the RLWTF using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

Insert MS codes →

### 3.4.4 Miscellaneous Operations

A detailed description of miscellaneous operations can be found in *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004, ~~R.1~~).

Research and development projects at TA-55 include an array of activities involving applied techniques and methods designed to study and improve processes associated with the purification, separation, extraction, recovery, and characterization of actinides (primarily plutonium) from various matrices. ~~The nature of many of the investigations and experimental activities has been such that no one detailed procedure can describe the variety of activities carried out.~~ General types of miscellaneous processes are described below.

*Extraction/Separation Studies.* ~~From July 1979 until September 1994 or later,~~ a series of similar actinide extraction, separation, and characterization R&D studies ~~occurred in Room 208. These studies were conducted under various revisions of three series of procedures:~~ Involved: processing of actinide hydroxide cakes from chloride and nitrate operations, development of sensors and instrumentation for online chemical analysis, and purification process development (R&D). The process R&D activities were of a non-routine developmental nature involving research, process development, small scale "trouble-shooting," and occasionally preparation of various isotopes and isotopic mixtures of plutonium, uranium, americium, and neptunium.

*Halogenation Studies.* A variety of R&D efforts used fluorinating agents to fluorinate samples containing plutonium residues. A gas flow loop was used to pass a fluorinating agent through a gas-solid reactor where plutonium in the solid residue reacted chemically to form solid $PuF_4$ or gaseous $PuF_6$. Gaseous $PuF_6$ was trapped in a cold trap, distilled, and reduced to $PuF_4$. Separation operations involving experimental chlorination processes were similar to the fluorination procedures. A gas loop was used to flow carbon tetrachloride and perchlorocarbons through a gas-solid reactor to chlorinate plutonium oxides to form recoverable plutonium compounds. ~~Once produced, the plutonium compounds and/or plutonium-bearing matrices were subjected to further treatment to achieve complete plutonium recovery.~~

See matl AK report for editing of this section

*Non-Aqueous Dissolution/Extraction Operations.* Non-aqueous dissolution/extraction operations included the dissolution of actinide compounds and actinide-containing matrices in superacid media. The superacid solutions were evaporated to leave solid products that were analyzed by a variety of methods. The study of the organometallic chemistry of uranium and thorium in non-aqueous solvents consisted of a variety of small-scale organoactinide operations involving fundamental research of the synthesis in non-aqueous media of new actinide compounds, their characterization and reaction chemistry, and application to existing actinide processing technology. Other operations comprised a broad range of laboratory activities in support of

to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

*Electrochemistry Experiments.* Electrochemistry methodologies were designed to decontaminate items, replace processes that produce large amounts of waste, or enhance chemical reactions. The process involved uranium decontamination of disassembled weapon components from various sites with various levels of surface contamination with plutonium. The operation was strictly an aqueous process in which an alkaline solution was reacted with the components to precipitate uranium. Significant amounts of metal could be stripped in a short period of time. The precipitated solution comprised either uranyl hydroxide or uranyl sulfate, which was then dried for mass balance.

Insert Metallography from next page

*Waste Management Operations.* P/S code RD was used only in 1984–1986. It allowed for tracking of demonstration drums (one drum each year) that were packaged and prepared in accordance with the TA-55 Attachments to the Certification Plan (TWCP-701) to meet the WIPP requirements at that time. Packaging of these drums did not of itself result in the generation of TRU waste. The waste drums that were packaged contained non-mixed TRU waste.

Operations under P/S code NCD occurred from April 1989 – April 1991 in Room 432. This P/S code was established to provide a mechanism for dealing with TRU drums that did not confirm specifications (e.g., recorded weight or nuclear material content). Non-confirming drums were temporarily set aside until such time as personnel could reprocess them under P/S code WM to correct the nonconfirming condition. After April 1991, nonconfirming drums were dealt with immediately, and P/S code NCD was no longer needed.

P/S code WM is currently limited to waste that arises from the TRU solid waste management operation in Room 432. This situation has been the case since the beginning of 1993. Room trash boxes from Building PF-4 have always been handled as low-level waste; however, the boxes were assayed to verify contamination levels and any that were determined to be TRU waste were diverted to Room 432 for repackaging as such. From May 1987 through 1992, these boxes were created as P/S code XO or X0. These codes were changed to P/S code WM after 1992. Additional controls were placed on room trash after 1992. Trash was assayed with the Multiple Energy Gamma Assay System (MEGAS). When a container was rejected on the basis of MEGAS data, the rejected container was returned to the originator for removal of any "hot" item(s).

This process also allowed for greater control to prevent discarding regulated materials (e.g., RCRA constituents) in room trash.

P/S code X0 was designated for waste materials that could not be associated with a specific room, such as a hallway, mezzanine offices, rest rooms and change rooms, basement, pump rooms, and trolleys. The waste from all these areas, except the pump rooms and trolleys, would be low-level waste and no RCRA constituents would be associated with the waste items.

P/S code XO indicated waste materials that were generated within specific rooms but could not be associated with an individual P/S code in that room.

Move to precede Waste Mgmt

*Metallography.* The purpose of the metallography operation is to characterize the microstructure of metallic or ceramic pieces to verify and establish the quality and effectiveness of welds. Materials examined ~~under this P/S code~~ consist of plutonium and uranium carbides, nitrides, and oxides, as well as zirconium and tantalum alloys, and stainless steel. Metal pieces (pellets) are cut with a diamond saw. Ceramic pieces are subjected to grinding with standard metal grinding media (e.g., papers impregnated with silicon carbides and diamond). The materials are polished with several different chemical compounds.

3.4.5 Special Processing

Insert P/S codes →

A detailed description of special processing is found in *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007, ~~R.1~~).

Special Processing includes processing operations for Material Type (MT) 42, and research and development (R&D) activities for MT 52. (See Section 3.5.1 for a discussion of plutonium material types.) ~~MT 42 processes are smaller scale processes similar to recovery operations utilized for MT 52.~~ Because processing MT 42 is a smaller scale version of the recovery processes used for MT 52, MT 42 processing has five main recovery steps: (1) head-end operations, (2) nitrate ion exchange operations, (3) chloride ion exchange operations, (4) separation and purification by precipitation, and (5) pyrochemical processes. Only head-end operations and separation by purification and precipitation are covered here, since nitrate ion exchange operations, chloride ion exchange operations, and pyrochemical processes are covered briefly elsewhere in this report.

(Reference TWCP-AK-2.1-008 Sect (see table 2)

Head-end operations leach tools, labware, crucibles, rags, etc in nitric acid to remove recoverable plutonium. Plutonium oxide is typically calcined as part of head-end operations.

Separation and purification by precipitation is a method of plutonium removal from aqueous solutions. The most common precipitation methods utilize oxalate, hydroxide, and peroxide anions. By selectively precipitating the plutonium, many of the metals remain in solution, thereby purifying the plutonium.

All wastes generated by MT 52 R&D operations are replicated for MT 42, but carry different P/S codes to differentiate and identify the radionuclide content of the waste. Outputs from Special Processing include high purity metal for casting and machining.

Insert P/S codes →

3.4.6 Metal Operation Processes

A detailed description of metal operation processes is found in *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003, ~~R-1~~).

The processes included in metal operations can be divided into three groups:

- reactor fuel development processes
- on-going metal operation processes
- developmental metal operations

The main goal of metal processes is to take the high purity metal produced by pyrochemical operations and produce shaped metal pieces.

In reactor fuel development, enriched uranium oxide, depleted uranium oxide, and/or plutonium oxide feeds are blended and mixed with graphite, and various operations are performed to convert the feed material into pellets that can be used for fuel. Testing and R&D are done on the fuel pellets. Trichloroethylene was used as a lubricant from 1979 to 1994.

On-going metal operation processes include various R&D activities, alloy development, casting of metals, welding, coating, and machining/metalwork on various metals. In machining, trichloroethylene was used from 1979 to 1992 and from 1997 to the present, for final cleaning. In alloy development, Freon was used from 1989 to 1992 to clean parts. The plutonium sputtering process used arsenic for a short period during 1984 to 1985.

Developmental metal operations include the Advanced Recovery and Integrated Extraction System (ARIES) project, assembly operations, burst testing of shells, experimental laser welding, furnace operations, and various other experimental activities. Waste from burst testing, conducted from 1998 to the present, contains lead. Waste from the Kolsky Bar Test Facility also contains lead and/or lead oxide.

Insert P15 codes →

3.4.7 Pyrochemical Processes

A detailed description of pyrochemical processes is found in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006, R.1).

Pyrochemical processes include metal preparation, metal purification, and ancillary metal production operations. Pyrochemical process outputs are most often high purity metals for metal operations.

Metal preparation processes include the following operations:

*Metal Preparation Line.* The metal preparation line produces plutonium metal from fluoride salts (derived by reacting hydrogen fluoride gas with plutonium oxides obtained from calcination of oxalate or peroxide precipitates from the aqueous nitrate or chloride process lines). ~~In the metal production process,~~ the plutonium compound is further reacted ~~with various chemicals, with the desired end product of~~ to produce plutonium metal, which can then be recovered as a button by breaking the crucible. Although little or no purification of the plutonium occurs, ~~no impurities~~ are introduced and the resulting metal is often satisfactory for high-purity applications.

*Direct Oxide Reduction(DOR) and Multiple-Cycle Direct Oxide Reduction(MCDOR).* In the single pass DOR process, plutonium oxide and calcium *metal* are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible ~~at 820°C to 875°C. The reaction proceeds to completion when excess calcium is present and when sufficient~~ $CaCl_2$ is available to dissolve the calcium oxide (CaO) product.

After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which was sometimes *recovered* by addition of fresh salt plus additional calcium metal.

To minimize the salt waste, the multicycle DOR (MCDOR) process was started ~~in 1988. In this process,~~ the molten salt is regenerated by

in which it

sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated. ~~The salt is chlorinated and reused for MCDOR.~~

Metal purification processes include the following:

*Molten Salt Extraction (MSE).* MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (TWCP-352). This process is employed only if the americium content is greater than 1000 ppm. In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible and heated to 750°C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. In the LANL process, 90 percent of the americium and 10 percent of the plutonium are transferred from the feed metal to the salt. After cooling, the salt and metal are mechanically separated. The salts are transferred to the salt stripping process.

*Electrorefining (ER).* The ER process takes impure metal from the MSE and MCDOR (DOR) processes and produces high purity plutonium metal. Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$. After the anode and salt melt, current is applied to the system, and plutonium at the anode is oxidized to plutonium ions, which travel to the cathode and are reduced back to the metal state. Impurities in the original plutonium anode that are less electroactive than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities more electroactive than plutonium (including barium) are left in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. Anode heels were sent to pyroredox from 1984 to 1986. Currently, salts are sent to chloride operations or carbonate oxidation/distillation.

From 1987 to 1989, secondary solvent metals such as cadmium, bismuth, lead, and gallium were added to experimental studies of the ER process. ~~These particular anode heels are retained in the vault at TA-55, with no plans to reprocess them in the near future.~~

Ancillary metal production operations include the following:

*Salt Stripping.* The MSE and ER salts are further treated by salt stripping, oxygen sparging or carbonate oxidation, and salt distillation. The salt stripping process treats the residue by melting and stirring the salt with calcium metal in a magnesium oxide crucible at 850°C. This treatment reduces the plutonium in the salt to metal and allows the metal to coalesce for physical removal and recovery. After cooling, the crucible is broken and the metal physically separated and recycled to the ER process or burned to oxide and sent back through aqueous recovery. The crucible shards are leached in hydrochloric acid, then discarded.

Oxygen sparging and, since 1996, carbonate oxidation are used to ensure that any plutonium, americium, or metallic sodium or potassium left in the salts are converted to nonpyrophoric oxide forms.

Wastes that potentially contain this ~~V~~ chemical (HWN P120) will be segregated into waste stream lot TA-55-19A (section 4.0).

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping process for a few months in 1998.

*Salt Distillation.* Salt distillation, begun in 1997, allows the recovery of plutonium oxide from the chloride salt and produces purified chloride salt for reuse. ~~NaCl/KCl salt is distilled at 850°C.~~

*Pyroredox.* The pyroredox operation was used to recover plutonium from spent anode heels in the mid to late 1980s. The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements more electroactive than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements less electroactive than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded. The metal phase containing zinc was placed in the vault or further treated, and the plutonium eventually was routed back to ER.

*Ingot Casting.* Metal is melted in a MgO crucible to cast the ingot.

*Metal Coalescence.* Metal coalescence is used for plutonium turnings to coalesce the turnings into a metal button. Calcium metal and $CaCl_2$ are added to a MgO crucible along with the turnings and melted.

*Metal Oxidation.* Small pieces of metal remaining on furnace or crucible surfaces are collected for conversion to the oxide phase. These metal pieces are placed in a furnace for the conversion process. The oxide is then transferred to the vault.

*Neptunium.* A campaign to work off neptunium residues stored in the vault was undertaken in 1993 and was only active that year.

*Pickling.* Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. After a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts. It then becomes necessary to leach the plutonium from these items. In addition, after calcium metal reduction processes such as metal preparation, direct oxide reduction, and molten salt extraction, plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals.

*Plutonium Trichloride Preparation.* An intermediate process in Pu metal production prepared plutonium trichloride by bubbling a carrier gas (chlorine) through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500°–600°C before being absorbed in a 5–6 molar potassium hydroxide solution. The carbon tetrachloride was broken down into ~~hydrogen chloride~~, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991. Feed material was high purity oxides from the vault or from other P/S codes. The product plutonium trichloride was reduced to metal by the MSE or ER processes.

phosgene

## 3.5 Material Inputs to the Waste Generation Processes

Material inputs to the waste generation processes derive from three general sources: (a) feed material, (b) chemical use, and (c) ancillary material inputs such as those related to the use of laboratory equipment and materials and glovebox maintenance activities. The feed materials for TA-55 processes that generate waste in waste streams TA-55-19 and TA-55-20 consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from various P/S codes, or from sources outside TA-55, including other DOE facilities. Chemical use is discussed in Section 3.5.3. Material waste form inputs are discussed in Section 3.5.1. Radionuclide inputs are discussed in Section 3.5.2.

### 3.5.1 Physical Waste Form Identification

Plutonium-processing facilities generate contaminated ~~mixed~~ combustible waste from:

- Plastic materials that result in combustible waste such as Tygon tubing, polyvinyl chloride vials, plastic bags, old bag-out stubs, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Hydroxide cakes (process output from P/S codes CLS, CW, CXL, DO, POSM, PRR) | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | Miscellaneous operations: AD<br>Nitrate operations: CD, HCD, HD, LG2<br>Special processing: DO, POSM |
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters) | May be contaminated with RCRA-regulated heavy metals Ag, Cd, Hg, Pb and possibly Cr (D006, D008, D009, D011, and D007) | Miscellaneous operations: APD<br>Nitrate operations: ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, IS (combustible ~~debris~~ material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD<br>Pyrochemical processes: PK (hardware, metal, anode chips from other P/S codes)<br>Special processing: ACD, DO, SB, SL |
| MSE salts | Typically fairly pure, suspect contaminated with barium but no other RCRA substances present | Chloride operations: MB, MS<br>Miscellaneous operations: XP<br>Nitrate operations: MB, PS |
| Neptunium residues from vault | No RCRA-regulated substances | Pyrochemical processes: Neptunium (only active in 1993) |
| Pu chlorides and fluorides | Variable purity | Miscellaneous operations: FDL, SO<br>Pyrochemical processes: ER, SD, SS<br>Special processing: RM |
| Pu metal or metal alloy from vault or from various P/S codes | High purity, no RCRA-regulated substances, unless noted otherwise | Metal operation processes: AO, ARI, BC, BT, CA, DA, ELW, EVAC, FSPF, ITF, ITF4, JA, KBTF, MA, MBC, MW, PCH (variable purity), PD, PE, PF, PH, RL, SRL, VD, WE, WLT<br>Miscellaneous operations: AC, AC1, AC2, EXT, LIBS, ME, SA, SMP, VS<br>Nitrate operations: ATL, BM, BU, MF, PAF, VP1<br>Pyrochemical processes: CRD (variable purity), MO, SCB, SS, SSMD<br>Special processing: ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes, Listed by Process |
|---|---|---|
| Pu oxalates | Typically fairly pure, no RCRA substances present | Nitrate operations: CC, DF, HC |
| Pu oxides | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008)<br>High purity oxides from P/S codes CA, DO, and MA, and from the vault | Metal operation processes: DOP (high-purity Pu and other radionuclides as oxides)<br>Miscellaneous operations: CK, CV, EOC, EXT, FDL, FLU, IB, IE, LI, LIBS, SO, STF, VS, XP<br>Nitrate operations: ATL, BL, CH, CPOD, DP, ED, FC, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2<br>Pyrochemical processes: MP (generally high purity), OR (variable purity), PTP<br>Special processing: DO, PI, PX, POSM, RM |
| Pu-Be sources | High purity constituents, no RCRA-regulated substances | Chloride operations: PB, PUB |
| Pyrochemical processes:chemical salts | Typically fairly pure, no RCRA substances other than Ba (D005) are present | Chloride operations: MB, MS, PRR<br>Miscellaneous operations: EXT, IB<br>Nitrate operations: COD, COL, MB<br>Special processing: DO |
| Reactor fuel pellets | High purity Pu and U material types, no RCRA-regulated substances | Metal operation processes: ME |
| Stainless steel and/or tantalum residues from decladding of Pu-Be sources | High purity metals, potential leaching of chromium (D007) from stainless steel if subjected to strong acid | Chloride operations: PUB |

- Rubber and Teflon-based products used in the operations, such as rubber gloves, Teflon tape, gaskets, stoppers, etc.

Waste items from several different processes were segregated by physical waste form and packaged into waste containers. The physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for many waste items is also documented on this form, although recording of P/S codes was spotty before about 1990. TRU waste drums containing one or more waste items were packaged by the Nuclear Material Technology Group (NMT-7) according to procedures referenced in the applicable version of the TA-55 Attachments to the Certification Plan (TWCP-697). Sample attachments are referenced as TWCP-701 (for 1987) and TWCP-700 (for 1995). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by quality assurance personnel.

Both the WODFs and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records are included in Attachment 4. Note that this waste container (LA00000056636) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

3.5.2 Radionuclide Content Identification

The primary Pu material type inputs for metal operation processes at TA-55 are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments (Weight %)**

| Material Type (MT) | Plutonium isotope and half-life | | | | | | Upper limits for weight ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 ($8.26 \times 10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

Source: TWCP-698

The primary uranium material type inputs for reactor fuel development activities and for pit disassembly at TA-55 are listed in Table 3.

**Table 3. Average Isotopic Content of Uranium Material Types and Enrichments (Weight %)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Source: TWCP-698

Metal operation processes primarily receive feed material from other P/S codes, particularly P/S code SS (TWCP-AK-2.1-006, R.1) and RM (TWCP-AK-2.1-007, R.1), and are not expected to alter the isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). Many P/S codes processed feed material in which radionuclides other than Pu were present in significant levels:

- Depleted or enriched uranium metal or oxides were the process feed materials for P/S codes CN, FF, GI, MW, OB, PD, RS, SRL, and UA. Of these codes, FF, PD, and SRL are still active.

- P/S code WE worked with radionuclides used as sources from 1978 to the present (Am-241, Am-243, Ce-144, Cm-244, depleted uranium, Pa-231, Np-237, Th-232, Th-232 enriched in Th-230) (TWCP-882).

- P/S codes BC and JA worked with Am-243 (1992 to present), depleted uranium (1990 to present), Np-237 (1983 to present), Pa-231 (1989), and Th-232 enriched in Th-230 (1994 to present). (P/S code JA ended in 1997 or 1998; BC is still active.)

- P/S code DOP worked with Am, Ce-144, Cm-244, Np-237, Th-232, U-233.

- P/S code DA worked with MT 52 alloys.

In some cases, information from subject matter experts has identified several P/S codes in which secondary radionuclides are expected to be present in process wastes, in addition to the cases listed above (TWCP-698):

- Some of the process wastes from P/S codes CA and MA contain Am-241, Am-243 and Np-237 during the period 1984 to 1990.

- Some of the process wastes from P/S code PH contains Am-243 (1993 to present).

Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present mostly in minor amounts in nearly all debris waste from metal operation processes at TA-55, with the exceptions as noted above.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposefully contain uranium. If the waste generator indicates that only Pu is present in the

delete "ful"

feed material, then U-236 and U-238 are not expected to be present in measurable concentrations. U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. On the other hand, U-234 would be present in MT 83 (and to a lesser extent in other Pu material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table I). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total Pu would be about 0.14. After 36 years, this ratio would increase to 0.26.

Additional radionuclides are expected in wastes produced from specific processes. Processes at TA-55, including research and development efforts, are identified by a P/S code that is listed on the WODF by waste item. Additional radionuclides expected to be present in each process have been reviewed by a panel of experts at TA-55 and compiled in a memo according to P/S code (TWCP-882). Note that a waste container may contain items from more than one P/S code, because the bagged-out items from processes were loaded into drums by TA-55 waste management personnel based on physical waste form, volume, and radionuclide loading, not P/S code. For combustible streams generated from TA-55, some of the additional expected radionuclides can be summarized as follows:

- Am-241 and Am-243—P/S codes CA, CD, DOP, EV, HCD, HD, LR, MA, PR, RM, SS, and WE
- Np-237—P/S codes ATL, BC, CA, CF, DOP, ED, EV, IS, MA, RB, RFX, and WE
- D38 (depleted uranium)—very small quantity in P/S codes BC and WE
- Ce-144—very small quantity in P/S codes DOP and WE
- Th-232—very small quantity in P/S codes DOP and WE
- U-233—very small quantity in P/S codes DOP and WE
- Cm-244—very small quantity in P/S codes DOP, IS, PI, and WE
- Pu-238—small quantity in P/S code TDC
- Am-243—very small quantity in P/S codes BC, and PH
- Pa-231—very small quantity in P/S codes BC and WE

- Th-232 enriched with Th-230—very small quantity in P/S codes BC and WE

- U-235 and U-238—expected in all P/S codes applicable to Nitrate Operations (TWCP-AK-2.1-005, R.1)

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). If warranted, this AK report will be updated to incorporate the results of these comparisons.

3.5.3 Chemical Content Identification

Chemical contents of process inputs and outputs were complied from chemical lists contained in procedures reviewed during the process AK search and from SME input. Individual process AK reports contain detailed assessments of these chemical inputs, and of the applicability of EPA HWNs. In this section, discussion of chemical inputs are divided into the following categories: acids and bases, gases and cryogenic fluids, metals, inorganic chemicals that are not included in 40 *Code of Federal Regulations* (CFR) Part 260, inorganic chemicals that are included in 40 CFR Part 260 including Appendix VIII to that regulation, organic chemicals that are not included in 40 CFR Part 261, and organic chemicals that are included in 40 CFR Part 260, including Appendix VIII to that regulation.

*Acids and bases*. Acids used in the TA-55 processes covered in this report are ascorbic acid, formic acid, hydrochloric acid, Hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in these processes are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the TA-55 processes for the following reasons:

- D002 (corrosivity) does not apply to the solid debris waste because there are no free liquids in this waste.

- D001 (ignitability) does not apply to the use of the oxidizers (nitric acid, perchloric acid, and superacids) because there are no free liquids in this waste.

- Formic acid and hydrofluoric acid are listed in Appendix VIII of 40 CFR Part 261, for their corrosive and toxic characteristics, with EPA HWN U123 and U134. However, these HWNs are not applicable to

Perchloric acid in solutions are send to cement fixation. The solids, perchloric salts, are rinsed from rags with water before they are discarded, so and perchloric salts are ended up in cementation.

the manner in which these chemicals were used and discarded in the processes covered by this report.

- None of these are F, K or P-listed chemicals

*Gases and cryogenic fluids.* The following gases and cryogenic fluids used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: argon, carbon dioxide, chlorine, halogen fluorides, hexafluoroethane, hydrogen chloride, krypton fluoride, methane, nitrogen (gas), nitrogen (liquid), perfluoropropane, and tetrafluoromethane.

The following gases used in the TA-55 processes are identified in Appendix VIII of 40 CFR Part 261 as having hazardous characteristics. The chemical name is followed by the listed EPA HWN and the P/S codes in which the gas is used:

- Fluorine (P056) is used in P/S codes CV, FDL, FLU, PI, SO
- Hydrogen fluoride (U134) is used in P/S codes MP, PI
- Nitrogen dioxide (P078) is used in P/S code HRS
- Phosgene gas (P095) is used in P/S code PTP

No EPA HWNs are applicable to the use of these gases in the TA-55 processes. Compressed gas cylinders are kept outside of the gloveboxes; most are even outside the building, and the gases are plumbed into the glovebox. Thus the gas cylinders are not discarded with TRU wastes. Additional reasons are as follows:

- D002 (corrosivity) does not apply to the use of hydrogen fluoride because there are no free liquids in the solid TRU waste.

- D003 (reactivity) does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution.

- P056 (fluorine), P078 (nitrogen dioxide) and P095 (phosgene) are not applicable to the listed TA-55 processes because of the manner in which these gases are used and discarded in the processes covered by this report.

- Hydrogen fluoride (U134) is listed in Appendix VIII of 40 CFR Part 261 for its corrosive and toxic characteristics. However, this code is not applicable to the manner in which this gas is used and discarded in the processes covered by this report.

*Metals*. The following metals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII of that regulation: bismuth, bismuth-tin alloy, calcium, copper wool, gallium (metal, oxide or salt), gold, lanthanides, lutetium, niobium + 1% zirconium metal, platinum, platinum-rhodium alloy, tantalum (metal, alloy, oxide or salt), titanium, uranium powder (depleted), vanadium, and zirconium alloy.

Several metals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. The bullets below list the chemical name, its listed EPA HWN, the P/S codes in which the metal is used, and the applicability of the EPA HWNs to the use of these metals in the TA-55 processes:

- Alkaline earth metals (D003) were used in P/S codes AC, AC1 and AC2; it is possible that one or more of these were pyrophoric. However, EPA HWN D003 does not apply to P/S codes AC, AC1, or AC2 because the metals are consumed or oxidized before discarding.

- Arsenic (D004) was used in P/S code PE between 1984 and 1985, and EPA HWN D004 is applicable to P/S code PE during this period.

- Cadmium (D006) applies to a limited number of anode heels produced in P/S codes ER, PX, and SS using cadmium as a solvent. ~~However, these heels are in the vault, with no plans to purify them in the near future.~~ delete

- Lead (D008) was used in P/S codes ~~BT~~, ER, KBTF, PX, SS, and ~~WE~~. For combustible debris waste, EPA HWN D008 is applicable to ~~P/S code~~ KBTF and PX. For P/S codes ~~BT~~, ER, and SS, D008 is only applicable to the metal waste.

- Tin-lead (D008) solder was used in sensors in P/S code BT, but D008 is only applicable to the metal waste from this P/S code, and not to the combustible debris waste.

- Mercury (D009) applies to P/S code SSMD, in which it was used for about one week in the summer of 1994.

- Nickel powder and nibblets were used in P/S code CO ~~for powder~~. as a sintering aid. This metal is listed in Appendix VIII but no HWN is given.

- Sodium (D003) was used in P/S code EL. However, D003 does not apply in this case because excess Na is dissolved in Dowanol 80.

- Stainless steel (contains chromium, D007) was used in P/S code WE. However, EPA HWN D007 does not apply in this case. There is no potential to leach chromium because stainless steel is not exposed to strong acids in P/S code WE.

*Inorganic chemicals.* The following inorganic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: aluminum bifluoride, aluminum chloride, aluminum fluoride, aluminum nitrate, aluminum oxide, ammonium chloride, antimony pentafluoride, bromine, calcium carbonate, calcium chloride, calcium fluoride, calcium nitrate, cerium nitrate, cesium chloride, cobalt nitrate, ferric ammonium sulfate hydrate, ferric nitrate, ferrous ammonium sulfate, ferrous chloride, ferrous sulfamate, FOOF, graphite, gypsum cement, hydrogen peroxide, hydroxylamine hydrochloride, hydroxylamine nitrate, iodine, lanthanum nitrate, lithium chloride, magnesium chloride, magnesium oxide, magnesium perchlorate, molybdenum oxide, phosphates, Portland cement, potassium chloride, potassium fluoride, potassium permanganate, potassium thiocyanate, silicone lubricant, sodium bicarbonate, sodium carbonate, sodium chloride, sodium chlorite, sodium nitrate, sodium nitrite, sodium oxalate, sodium sulfate, sodium tetraborate, stannous chloride, thorium oxide, uranium oxide (depleted), zinc chloride, zinc stearate, and zirconium carbide. Some processes indicated the use of nitrate, chloride, carbonate, bicarbonate, oxalate, and nitrite salts of sodium, potassium, lithium, magnesium, calcium, and iron.

move DCHP to inorganic chemical list

Several inorganic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 4 lists these chemicals, their HWN, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes:

*Organic chemicals.* The following organic chemicals used in the TA-55 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), ~~dicesium hexachloroplutonate (DCHP)~~, diethyl oxalate, dihexyl n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), diisopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride, hydroxylamine chloride,

**Table 4. Use of RCRA-Regulated Inorganic Chemicals in TA-55 Processes**

| **Inorganic chemicals and P/S codes in which they were used** | **The following summarizes the applicability of RCRA D-listings and P-listings due to metals used in the processes:** |
|---|---|
| Hydrogen peroxide | D001 (ignitability—oxidizer) and D003 (reactivity) do not apply to the use of hydrogen peroxide because there are no free liquids in the TRU solid waste |
| Lead hydroxide, oxide, or nitrate (P/S code AD) | D008 (lead) applies to P/S code AD. |
| Mercuric nitrate (P/S codes VP1 and VP3) | D009 (mercury) applies to P/S codes VP1 and VP3. Mercuric nitrate is used as a catalyst in P/S code VP1; the hydroxide cake produced in VP1 is processed in P/S code VP3. |
| Potassium dichromate (P/S codes AD, CS, CSE, DO, and SE) | D007 (chromium) applies to P/S codes AD, CS, CSE, DO, and SE because of the use of potassium dichromate as a titration endpoint indicator until end of 1993. The solution and precipitates were processed by hydroxide precipitation under the same codes. The chromium was incorporated as a contaminant in the hydroxide cakes. |
| Silver nitrate and other silver salts (P/S codes AC1, CPOD, CS, CSE, DO, SE) | D011 (silver) applies to P/S codes CW and CX due to the use of silver nitrate for chloride titrations under P/S codes CS, CSE and SE until 1993. The solution and precipitates were processed by hydroxide precipitation under P/S codes CW and CX.. Silver was incorporated as a contaminant in the hydroxide cakes.<br><br>D011 (silver) applies to P/S code CPOD due to the use of silver nitrate as a catalyst from 1990 to 1994. D011 (silver) applies to P/S code AC1 due to the use of silver salts. |
| Sodium chromate (P/S code PT) | D007 (chromium) applies to P/S code PT due to the use of sodium chromate in the separation of thorium from plutonium and americium. |
| Uranium nitride, depleted (P/S code FF) | D003 (reactivity) does not apply to the use of uranium nitride in P/S code FF. Although this chemical is pyrophoric, its disposal in an oxic environment eliminates this characteristic because it is converted to uranium oxide. Uranium nitride is oxidized in the passivation furnace (P/S code PA) prior to discard. |
| Vanadium pentoxide (P/S code SS) | P120 (vanadium pentoxide) applies to waste generated under P/S code SD from February to March 1998, and under P/S code SS from May 27, 1998 to June 10, 1998. |

oxidizing

hydroxylamine nitrate, ion exchange resin, isopropanol, kerosene, Metalprep 79 (phosphoric acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl diisobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, perchlorocarbons, phenolphthalein, phosphate buffer solution, phosphine oxide, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sodium citrate retarder, sodium dithionate, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, tetrahydrofuran, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Several organic chemicals used in TA-55 processes are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 5 lists these chemicals, their HWNs, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in TA-55 processes.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

One substream, denoted TA-55-19A, is segregated from TA-55-19. This substream is defined as waste generated between 02/01/98 and 06/10/98 that is assigned the P listing of P120.

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

Waste Streams TA-55-19 and TA-55-20 have been discussed together in this AK Summary Report. These waste streams are similar in physical form and material content of the wastes. They differ only in that TA-55-19 is assigned EPA HWNs based on P/S code information, whereas TA-55-20 contains non-mixed waste. Other waste streams resulting from the same plutonium processing activities at TA-55 but differing in waste matrix code are listed in the Sampling Plan.

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

The waste matrix code S5300 is assigned to the waste streams TA-55-19 and TA-55-20 based on waste generation practices described in the TA-55 Waste Management Procedure, 1996 (TWCP-351), description of past segregation practices (TWCP-701, Section 2.1, page 4 of 43), and TA-55 process AK reports (TWCP-AK-2.1-002, R.1; TWCP-AK-2.1-003, R.1; TWCP-AK-2.1-004, R.1; TWCP-AK-2.1-005, R.1; TWCP-AK-2.1-006, R.1; and TWCP-AK-2.1-007, R.1). A more detailed waste matrix code can

## Table 5. Use of RCRA-Regulated Organic Chemicals in TA-55 Processes

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Acetone (P/S codes FF, ME, and MOX) | • F003 applies to P/S code ME because it may have been used in the glovebox for cleaning.<br>• F003 does not apply to P/S code FF or MOX because it was only used outside the glovebox. |
| Benzene (P/S codes AC, AC1, AC2, and SA) | • D018 (benzene) applies to P/S codes AC, AC1, AC2, and SA<br>• F005 applies to P/S codes AC, AC1, AC2, and SA, in which benzene was used as a solvent |
| Carbon tetrachloride (P/S codes AD, CV, PTP, and PX) | • D019 (carbon tetrachloride) applies to P/S codes AD, CV, PTP and PX. This chemical was used in PTP between 1/87 and 6/89.<br>• F002 does not apply to P/S codes AD, CV, PTP, or PX because it was not used as a solvent or for degreasing. |
| Chloroform (P/S codes AC, AC1, AC2, APD, FF, and XO) | • D022 (chloroform) applies to P/S codes AC, AC1, AC2, APD, FF and XO. Concentrations in P/S code FF are expected to be below RCRA threshold because freeze-drying should have removed most, if not all, of the residual chloroform before the microspheres were taken into the glovebox for sintering. |
| Diethyl ether (P/S code SA) | • F003 applies to P/S code SA because of solvent use. |
| Freon and Freon TF (P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | • F002 applies to P/S codes DA, MA and XO.<br>• F002 does not apply to P/S codes CA, MW, PD, SCB, SRL, UA, VD and WE. Although Freon TF is used as a solvent to clean metal parts, the parts are routinely air-dried to avoid the need for cellulosic wipes.<br>• F002 does not apply to P/S code PF because Freon was used as a coolant for a cutting saw. |
| Methanol (P/S codes AD and SO) | • F003 applies to P/S code AD because it may have been used for cleaning inside the glovebox.<br>• F003 does not apply to P/S code SO because it was used in a cold trap outside the glovebox. |
| Methylene chloride (P/S code AC1) | • F002 applies to P/S code AC1 because this chemical was used as a paint stripper. |
| Methyl ethyl ketone (P/S codes XO) MA and | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO<br>• F005 applies to P/S codes MA and XO, in which methyl ethyl ketone was used as a paint stripper (XO) solvent (MA) and |
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA<br>• F005 applies to P/S codes AC, AC2 and SA, in which pyridine was used as solvent. |
| Tap Magic (contains 1,1,1 trichloroethane) (P/S code MA) | • F002 does not apply to P/S code MA because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Tetrachloroethane (not used) | • No RCRA codes apply to tetrachloroethane, an Appendix VIII chemical. Although it is listed on the chemical inventory for metal operations, it was never used in glovebox operations. |
| Tetrachloroethylene (P/S codes AD, APD, CSE, CV and SE) | • D039 (tetrachloroethylene) applies to P/S codes AD, APD, CSE and SE in which it was used until 1992.<br>• D039 does not apply to P/S code CV because it was used as a coolant outside the glovebox.<br>• F002 applies to P/S codes AD, APD, CSE and SE. Its use as a solvent in P/S code CSE and SE ended in 1992<br>• F002 does not apply to P/S code CV because it was only used as a coolant outside the glovebox. |
| Toluene (P/S codes AC, AC2 and SA) | • F005 applies to P/S codes AC, AC2 and SA because toluene was used as a solvent. |
| Trichloroethylene (P/S codes CK, EL, FF, MA, ME, and XO) | • D040 (trichloroethylene) applies to P/S codes EL, FF, MA, ME, and XO<br>• D040 does not apply to P/S code CK because this chemical was used as a coolant outside the glovebox.<br>• ~~F002~~ F001 applies to P/S code MA, in which trichloroethylene was used during final cleaning of metal parts from 1979 to 1992, resuming again in February 2000.<br>• F002 does not apply to P/S codes EL or FF, in which it was used as a lubricant for a cutting saw, not as a solvent. F001 and or degreaser |
| Tetrahydrofuran | • U213 applies to P/S codes AC, AC2 and SA |

not be assigned to the TA-55-19 and TA-55-20 waste streams because TA-55 waste management personnel did not segregate plastic waste from cellulosic waste.

The following codes also apply to waste streams TA-55-19 and TA-55-20 from the Transuranic Waste Baseline Inventory Report (TWBIR), the TRUPACT II Content Code (TRUCON) (DOE/WIPP-89-004/Rev.13), the Radioactive Solid Waste Disposal (RSWD), and the Item Description Code (IDC) (Sampling Plan).

- TWBIR LA-M16 (TA-55-19) and LA-T16 (TA-55-20)
- TRUCON LA 116A, LA 116B, LA 116C, LA 116D, LA 116E, LA 116F, LA 116H, LA 116I
- ~~RSWD A14, A15, A16, A17, A18, A60~~ slot
- ~~IDC 004 (combustible waste)~~ slot.

copy to AK Summaries

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

The following waste material parameter codes are assigned to waste streams TA-55-19 and TA-55-20 based on (1) waste generation practices described in the TA-55 Waste Management Procedure (TWCP-351); (2) description of past segregation practices

(TWCP-701, Section 2.1, page 4 of 43); (3) TA-55 process ~~acceptable knowledge~~ reports (TWCP-AK-2.1-002, ~~R-1~~; TWCP-AK-2.1-003, ~~R-1~~; TWCP-AK-2.1-004, ~~R-1~~; TWCP-AK-2.1-005, ~~R-1~~; TWCP-AK-2.1-006, ~~R-1~~; and TWCP-AK-2.1-007, ~~R-1~~); and (4) waste characterization data from real-time radiography and visual examination:

- Cellulosics
- Plastics (waste materials)
- Rubber
- Steel (packaging materials)
- Plastics (packaging materials)
- Iron-based metals/alloys (<5% by volume)

## 8.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

### 8.1 F, K, ~~and~~ P Listings

No K-listings apply to any of the debris waste generated by the P/S codes covered by this report.

The following P/S codes require HWN assignments due to the presence or use of F-listed chemicals. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report.

- AC, AC1, AC2 F002, F005
- AD F002, F003
- APD F002, F003
- CF F002, F003
- CLS F002, F003
- CSE F002
- CW F002, F003
- ~~CXL F002, F003~~
- DA F002
- HP F002, F003
- MA F002, F005
- SA F003, F005
- SE F002
- WM, X0, XO F001, F002, F005

In addition, debris waste generated under P/S codes SD and SS between 02/01/98 and 06/10/98 are assigned EPA HWN P120.

Because waste items from any of these P/S codes may be present in any given container of combustible debris waste, waste stream TA-55-19 is conservatively assigned the F-listings of F001, F002, F003, and F005. TA-55-19A is segregated

for waste with the P-listing of P120. Waste containers assigned to waste stream TA-55-20 only contain items with known P/S codes that do not carry any EPA HWNs.

The reliability of this AK information can be assessed in part based on a review of headspace gas analyses (not WIPP-compliant) for 60 containers assigned to waste stream TA-55-19 (Table 6). Measured gas concentrations were above the program required quantitation limit (PRQL) for several regulated volatile organic compounds: acetone, ethyl benzene, methanol, methylene chloride, methyl ethyl ketone, toluene, and xylenes. These results are consistent with the AK information summarized in this waste stream report.

8.2 Toxicity Listings

TA-55-19 (including TA-55-19A) is conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040. TA-55-20 has no listings.

No D-listings are applicable to combustible debris waste generated by the following P/S codes: AC3 (inactive), ACC, AO (Assembly Operation), AO (Americium Processing Calcination), ARI, BA, BAC, BC, BL, BM, BT, CA, CC, CH, CN, CO, COD, CR, CRD, CT, DF, DOP, DP, DT, ELW, EM, EVAC, FA, FC, FSPF, GI, GMS, HC, HG, HRS, ID, IN, ITF, ITF4, JA, LC, LIBS, MAG, MAS, MBC, MF, MO, MOX, MP, MW, NCD, NEPTUNIUM, NR, OB, OM, OR, OY, PA, PAF, PD, PF, PH, PI, PIG, PPD, PR, PS, RAP, RAP2, RB, RBJ, RCM, RD, RFX, RL, RM, RS, SBB, SCB, SMP, SRL, SX, TIGR, UA, UPS, US, US2, VD, VP2, VS, WE,WLT, and ZD.

Based on information in the TA-55 process AK reports, combustible debris waste generated by the following P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate process AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level.

## Table 6. Preliminary Headspace Gas Data For 60 Drums Assigned To Waste Stream TA-55-19

| | AK information | | | Preliminary headspace gas analyses for VOCs | | | |
|---|---|---|---|---|---|---|---|
| ANALYTE | Chemical used in processes | Chemical present in process feed solution | EPA HWN assignment | MDL (ppmv except for hydrogen and methane)* | Mean concentration is above MDL | PRQL | $UCL_{90}$ analysis indicates presence above PRQL |
| Acetone | X | X | F003 | 16.12 | X | 100 | X |
| Benzene | X | | F005, D018 | 1.96 | X | 10 | |
| Bromoform | | | None apply | 2.27 | | 10 | |
| Butanol (n-butyl alcohol) | | | None apply | 8.78 | X | 100 | |
| Carbon Tetrachloride | X | X | D019 | 2.00 | X | 10 | |
| Chlorobenzene | | X | F002, D021 | 1.93 | X | 10 | |
| Chloroform | X | X | D022 | 1.85 | X | 10 | |
| Cyclohexane | | | --- | 1.88 | X | 10 | |
| 1,1-Dichloroethane | | | --- | 1.78 | | 10 | |
| 1,2-Dichloroethane | | | --- | 2.40 | | 10 | |
| 1,1-Dichloroethylene | X | | None apply | 2.74 | X | 10 | |
| cis-1,2-Dichloroethene | | | None apply | 2.06 | X | 10 | |
| Ethyl benzene | See Note | | F003 | 1.72 | X | 10 | X |
| Ethyl ether | X | | F003 | 1.30 | X | 10 | |
| Hydrogen | | | --- | 0.02 % vol | X | 0.1 | |
| Methane | X | | --- | 0.02 % vol | X | 0.1 | |
| Methanol | X | X | F003 | 11.42 | X | 100 | X |
| Methyl ethyl ketone | X | | F005, D035 | 18.42 | X | 100 | X |
| Methyl isobutyl ketone | | | None apply | 16.05 | X | 100 | |
| Methylene chloride | X | X | F002 | 1.97 | X | 10 | X |
| 1,1,2,2-Tetrachloroethane | | | None apply | 1.63 | X | 10 | |
| Tetrachloroethene | X | X | F002, D039 | 1.44 | X | 10 | |
| Toluene | X | Fool | F005 | 1.67 | X | 10 | X |
| 1,1,2-Trichloro-1,2,2-trifluoroethane (also known as Freon TF and Freon 113) | X | | F002 | 1.79 | X | 10 | |
| 1,1,1-Trichloroethane | X | | None apply | 1.82 | X | 10 | |
| Trichloroethene | X | | F002, D040 | 1.31 | X | 10 | |
| 1,2,4-Trimethylbenzene | | | --- | 2.04 | X | 10 | |
| 1,3,5-Trimethylbenzene | | | --- | 2.26 | X | 10 | |
| Xylene (m and p-xylene) | | X | F003 | 3.62 | X | 10 | X |
| Xylene (o-xylene) | | X | F003 | 1.9 | X | 10 | X |

Abbreviations: AK, acceptable knowledge; HWN, Hazardous Waste Number; MDL, Minimum Detection Limit; PRQL, Program-Required Quantitation Limit; VOC, Volatile Organic Compound

--- This chemical is not regulated under 40 CFR Part 261, Subparts C and D, nor is it listed in Appendix VIII of that regulation.

* These MDL values are from the MDL study dated 6/19/00 (TWCP-3248). Different MDL values would have been in effect at the times that the data included in this table were acquired, so the above MDL values should only be considered as an approximate guide.

NOTE: There is no record documenting the use of ethyl benzene under any of the P/S codes covered by this report. However, recent analyses of some vacuum pump oils from TA-55, PF-4, showed it to be present. Consequently, F003 is applicable to this waste stream. Other constituents on the above table that were identified in these analyses included acetone, benzene, chlorobenzene, 1,2-dichloroethane, tetrachloroethene, toluene, Freon-113, trichloroethene, 1,2,4-trimethylbenzene, 1,3,5-trichlorobenzene, m- and p-xylene, and o-xylene.

| | |
|---|---|
| AC, AC1, AC2 | D007, D009, D011, D018, D022 D038 |
| AC1 | D007, D009, D011, D018, D022 |
| AC2 | D007, D009, D011, D018, D022 D038 |
| ACD | D005, D006, D007, D008, D011 |
| ACL | D007, D009 |
| AD | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039 |
| AL | D005, D006, D007, D008, D011 |
| AP | D007, D009 |
| APD | D007, D008, D009, D019, D021, D022, D039 |
| AS | D006, D007, D008, D011 |
| AT | D005, D006, D007, D008, D011 |
| ATL | D005, D006, D007, D008, D011 |
| AX | D007, D009 |
| BF | D006, D007, D008, D011 |
| BU | D006, D007, D008, D011 |
| CD | D006, D007, D008, D009, D011 |
| CF | D007, D008, D009, D011, D019, D021, D022, D039 |
| CK | D005, D006, D007, D008, D009, D011 |
| CL | D007, D008, D009 |
| CLRD | D007, D008, D009 |
| CLS | D007, D008, D009, D019, D021, D022, D039 |
| COL | D005 |
| CPOD | D011 |
| CS | D007, D008, D009 |
| CSE | D007, D008, D009, D039 |
| CV | D005, D006, D007, D008, D009, D011, D019, ~~D039~~ |
| CW | D007, D008, D009, D011, D019, D021, D022, D039 |
| CX | D007, D008, D009, D011 |
| CXL | D007, D008, D009, ~~D019, D021, D022, D039~~ |
| DO | D007, D011 (no D-lists apply after 1993) |
| DS | D006, D007, D008, D009, D011 |
| ED | D005, D006, D007, D008, D011 |
| EDC | D007, ~~D008~~ |
| EL | D040 |
| EOC | D007, D009 |
| ER | D006, D008 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |

DOP → DO
D006

| | |
|---|---|
| EXT | D005, D006, D007, D008, D009, D011 |
| FDL | D004, D005, D006, D007, D008, D009, D011 D010 |
| FF | D022, D040 |
| FLU | D004, D005, D006, D007, D008, D009, D011, D010 |
| FX | D006, D007, D008, D009, D011 |
| HCD | D006, D007, D008, D009, D011 |
| HD | D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| IA | D006, D007, D008, D009, D011 |
| IAM | D005, D006, D007, D008, D011 |
| IB | D005, D006, D007, D008, D009, D011 |
| ICP | D007, D009 |
| IE | D005, D006, D007, D008, D009, D011 |
| IS | D005, D006, D007, D008, D011 |
| IX | D006, D007, D008, D009, D011 |
| KBTF | D008 |
| LD | D007, D008, D009 |
| LG1 | D006, D008 |
| LG2 | D006, D007, D008, D009, D011 |
| LI | D005, D006, D007, D008, D009, D011 |
| LR | D006, D007, D008, D009, D011 |
| MA | D035, D040 |
| MB | ~~D005~~, D007, D008, D009 |
| ME | D007, D040 |
| MELL | D006, D007, D008, D009, D011 |
| ML | D006, D008 |
| MPD | D005, D006, D007, D008, D011 |
| MS | D007, D008, D009 |
| NC | D006, D008 |
| NL | D006, D008 |
| OD | D006, D007, D008 |
| OH | D006, D007, D008, D009, D011 |
| PB | D007, D008, D009 |
| PCH | D007 |
| PE | D004 (1984-85) |
| PK | D006, D007, D008, D011 |
| POSM | D007, D011 |
| PRR | D007, D009 |

| | |
|---|---|
| PT | D007 |
| PTP | D019 |
| PTS | D005, D006, D007, D008, D011 |
| PUB | D007, D008, D009 |
| PX | D006, D008, D019 |
| RA | D005 (applies only to zinc metal buttons) |
| RASS/RSS | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RC | D005, D006, D007, D008, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SA | D007, D009, D018, ~~D038~~ 5 ✓ |
| SB | D005, D006, D007, D008, D011 |
| SC | D005, D006, D007, D008, D011 |
| SE | D007, D008, D009, D039 |
| SL | D005, D006, D007, D008, D011 |
| SO | D004, D005, D006, D007, D008, D009, D010, D011 |
| SP | D007 |
| SS | D006, D008 |
| SSD | D006, D007, D008 |
| SSMD | D009 (D-listing applies only from 6/94 - 8/94) |
| STF | D007 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1, VP3 | D009 (D-listing applies only from 7/85 to 10/85) |
| VU, VUL | D005, D008 |
| * WM, X0, XO | D007, D008, D009, D022, D035, D040 |
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

* Conservative

8.3 Corrosivity, Reactivity, and Ignitability

TA-55-19 has no listings for corrosivity, reactivity, or ignitability.

TA-55-19A has no listings for corrosivity, reactivity, or ignitability.

TA-55-20 has no listings for corrosivity, reactivity, or ignitability.

See Section 10.0

Add. Global statement to

## 9.0 DETERMINATION OF THE RADIOISOTOPIC COMPOSITION

See Section 3.5.2.

## 10.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).
- Chemical Waste Disposal Requests introduced in June 1980 included check boxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.
- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.
- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).
- Explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s.
- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.
- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, or containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 11.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 10.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste items specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from TA-55. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

A chemical compatibility analysis was performed for TRUCON codes 116/216 (combustible waste) which indicated that all chemicals and the waste matrix were compatible at levels greater than trace amounts (DOE/WIPP-89-004). During the process AK search, additional chemicals were identified and are listed in Section 3.5.3; a new compatibility analysis is underway, but since these additional chemicals are all in trace quantities in the TA-55-19 and TA-55-20 waste streams, no incompatibilities should exist.

## 12.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

Administrative and procedural controls on the prohibited pyrophorics in TRU waste and the absence of pyrophorics has been verified through testing.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of LANL direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Chemical Waste Disposal Requests dated as early as June 1980 included boxes that were required to be checked if the waste contained pyrophoric, flammable, corrosive, or explosive materials (see Attachment 5, Chemical Waste Disposal Request).

In addition, for wastes generated after the implementation of the 1987 Certification Plan, Generator Attachments, associated waste packaging procedures, and quality assurance systems, the waste generator has signed a statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The TA-55 Attachment to the Certification Plan describes how these restrictions were verified by waste management personnel (TWCP-701, Sections 3.8.5-3.8.7).

## 13.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into TA-55 processes as documented in the TA-55 procedures reviewed during this AK search (reports (TWCP-AK-2.1-002, R.1; TWCP-AK-2.1-003, R.1; TWCP-AK-2.1-004, R.1; TWCP-AK-2.1-005, R.1; TWCP-AK-2.1-006, R.1; and

TWCP-AK-2.1-007, R.1) and summarized in the process inputs listed in Tables 1 and 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005, R.1, Section 9.0). This oil does not enter the LANL disposal operations.

## 14.0 DETERMINATION THAT THERE IS NO ASBESTOS IN THE WASTE

Asbestos heating mantles were never used at TA-55. Asbestos gloves were used in glovebox operations in P/S codes OR, PX, and RM (TWCP-4162, TWCP-4166), which are discussed in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006, R.1) and *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007, R.1), respectively. Asbestos-bearing transite was widely used until recently for thermal insulation, including as a coverplate over the furnace in glovebox wells, and as part of end plates on Lindberg furnaces. Although many Lindberg furnaces have been replaced with newer asbestos-free furnaces, some are still in use at TA-55. The transite would have been disposed either as metal or as ceramic and glass waste streams.

## 15.0 DETERMINATION OF THE MAXIMUM NUMBER OF CONFINEMENT LAYERS PERMITTED FOR WASTE PACKAGING

Waste streams TA-55-19 and TA-55-20 are primarily generated from operations performed in gloveboxes. The waste material is placed directly into bag-out bags (also called inner bags) through an opening in the glovebox where the bag is attached, and the bag is then closed and detached from the glovebox. Waste streams TA-55-19 and TA-55-20 may also be generated from "hot jobs" outside of the glovebox, such as valve changes, or from decontamination of spills or other releases. In these cases, the waste is placed directly into one (or possibly more) inner bags at the work area. The maximum number of confinement layers in any case is six (TWCP-816).

A minor source of waste streams TA-55-19 and TA-55-20 is room trash that was originally considered to be low-level waste, which is collected in plastic bags inside cardboard boxes. Occasionally, when assayed, these boxes are determined to be TRU waste. These boxes may be sorted to remove the "hot" item, or the whole box may be bagged and sent to the TRU packaging area for placement in drums containing waste streams TA-55-19 or TA-55-20, as appropriate. When this occurs, the P/S code WM is assigned to the waste. Due to the additional layers of plastic that are present when this operation occurs, drums with the P/S code WM are assumed to contain up to two more layers of internal packaging than other drums.

Waste drum packaging procedures for waste streams TA-55-19 and TA-55-20 have gone through several changes since the beginning of operations at TA-55. TRUCON Code

assignments made by the waste generator are compiled in the Sampling Plan. However, in the absence of this information, TRUCON Codes will be assigned to the waste container in accordance with the default packaging configurations and associated TRUCON codes shown in Table 7, that reflect the packaging protocols in effect during different periods of time at TA-55 (TWCP-816).

**Table 7. Maximum Layers of Confinement for be Used for TA-55-19 and TA-55-20 Waste Containers in the Absence of More Specific Waste Characterization Data**

| Time Frame | P/S Code | Layers of Confinement* | TRUCON Code |
|---|---|---|---|
| 01/78–05/87 | all | Maximum of 6 layers:<br>• up to 4 inner bags<br>• up to 2 liner bags<br>• all bag closures by either twist & tie; or twist, tie & tape | LA 116 I |
| 05/87–01/97 | all except WM, XO | Maximum of 4 layers:<br>• up to 2 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded | LA 116 A |
| 05/87–present | WM, XO | Maximum of 6 layers:<br>• up to 4 inner bags<br>• 2 liner bags<br>• bag closures by either twist & tie; twist, tie & tape, folded and taped, or folded | LA 116 I |
| 01/97–present | all except WM, XO | Maximum of 1 layer:<br>• 1 carbon-filter vented inner bag (if initial bag is breached, bag is placed in second bag and first bag is slit open), closed by either twist & tie; or twist, tie & tape<br>• 2 liner bags, folded, no closure | LA 116 E |

* Layers of confinement for these TRUCON Codes are defined in DOE/WIPP-89-004

check description

not closed?

Insert new Section on Re Confirmation

## 16.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- ~~40 CFR Part 260—Hazardous Waste Management System: General~~
- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, Segregation of hazardous materials
- *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3)
- Nonconformance Reporting and Tracking (TWCP-QP-1.1-007)
- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002, R.1)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003, R.1)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004, R.1)
- *Process Acceptable Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005, R.1)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006, R.1)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007, R.1)
- *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004)
- *Waste Analysis Plan, to the Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088, Attachment B)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

italics

move to AK Roadmap

## ACCEPTABLE KNOWLEDGE ROADMAP

Waste Stream: TA-55-19 and TA-55-20.

Documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-351 | B | Procedure for waste management practices at TA-55 | TA-55 document 539-GEN-R02. | Document describes TA-55 waste management practices for solid and liquid wastes | None |
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983. | Los Alamos Certification Plan, 1983 | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1955,* TRUWM-TA55-CPA-03, R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

Add to the roadmap
< Twcp sampling plan
AK reports

1995 ?

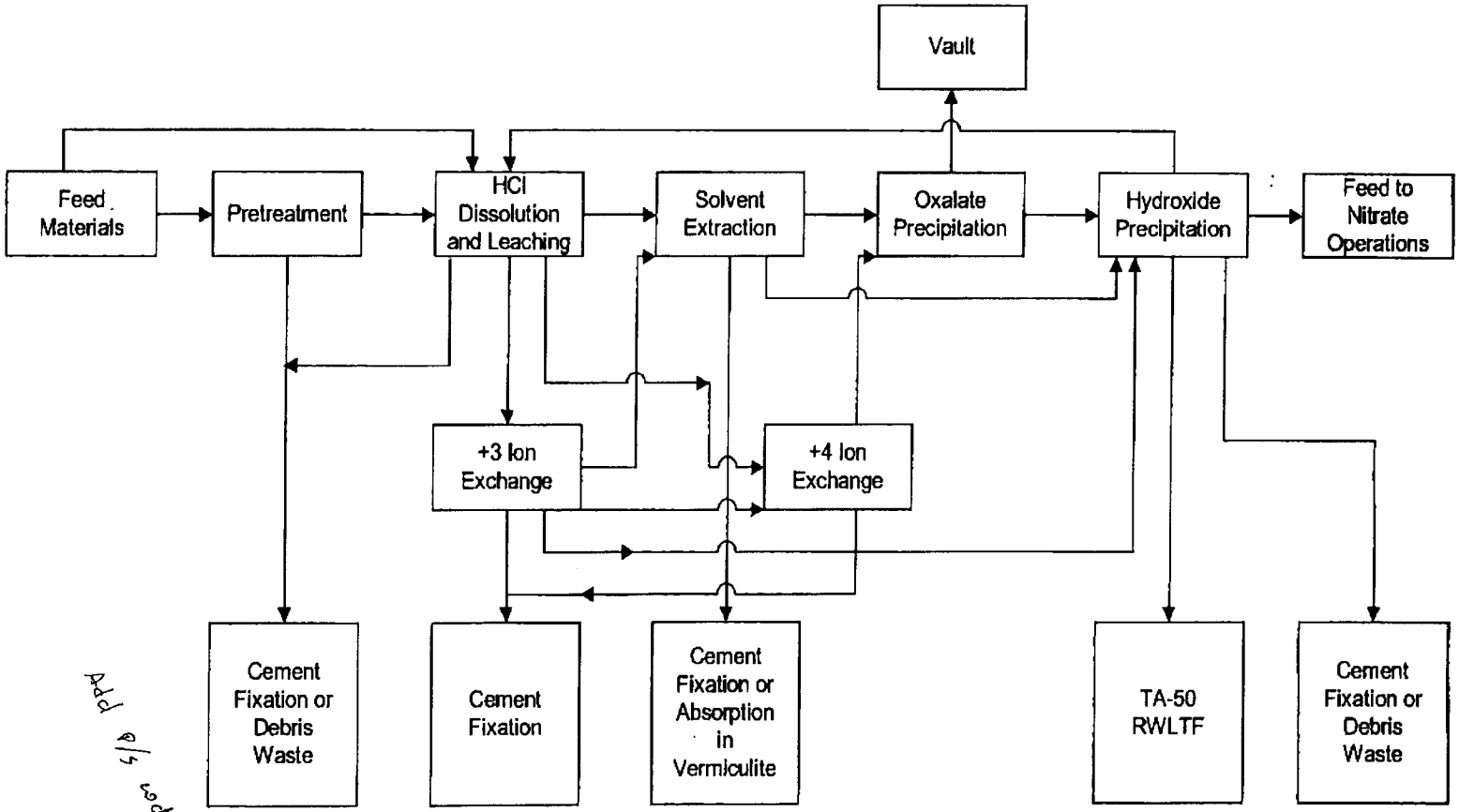
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Provides an explanation of why some waste containers may be packaged with 6 layers of confinement | No Direct way to differentiate between and 6 layers of packaging |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by P/S code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests are on residues rather than waste that is lower in Pu content. Hence they are conservative. |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| ~~TWCP-3941~~ | ~~B~~ | ~~Process AK Report on~~ Miscellaneous Process Operations at TA-55 | Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55 | Contains all information located on miscellaneous processes at TA-55 from 1978 to the present. | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

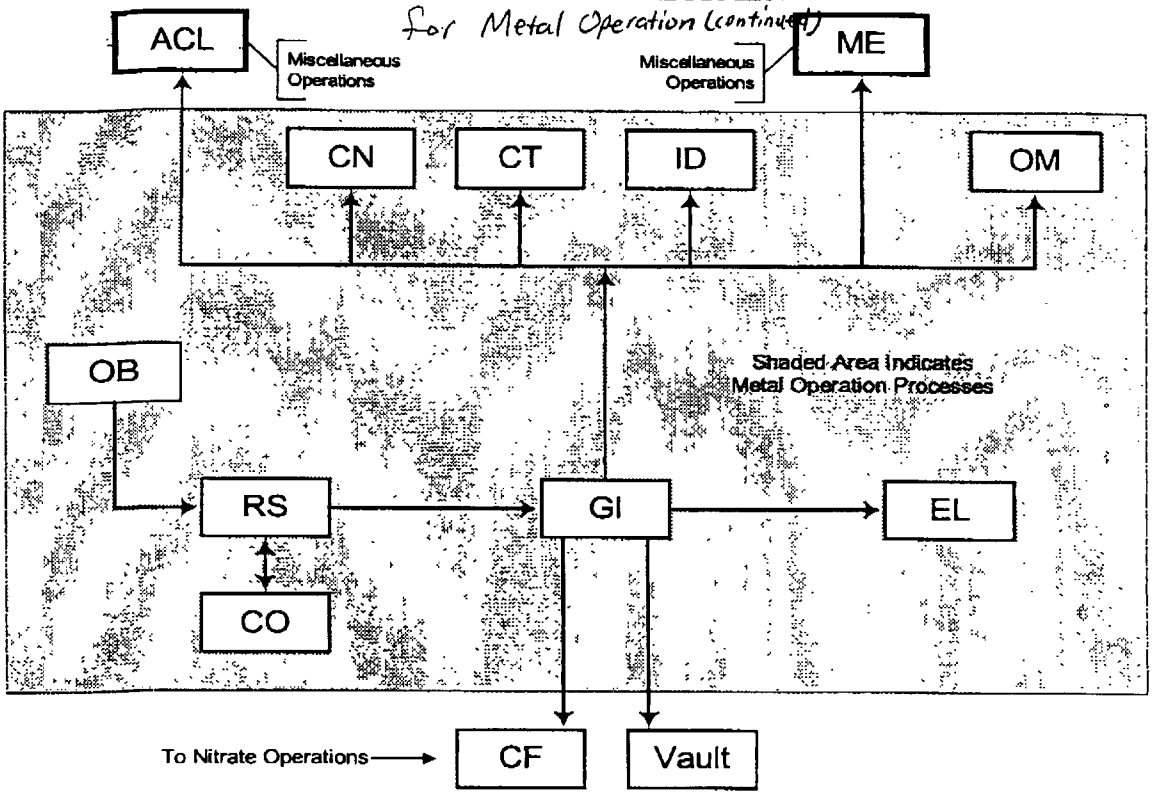
## SIMPLIFIED FLOW DIAGRAMS

### Simplified Process Flow Diagram for Chloride Operations

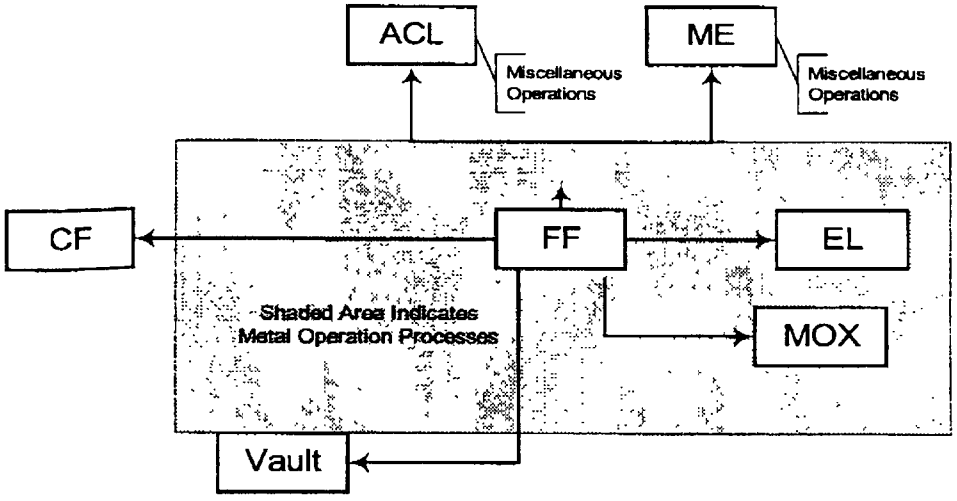



Add P/S codes and a footnote

**SIMPLIFIED PROCESS FLOW DIAGRAM:**
**~~REACTOR FUEL DEVELOPMENT~~**
for Metal Operation (continued)




In 1988, P/S codes CO, GI, ID, OB, and RS were combined into P/S code FF. P/S codes CT, ID, and OM are statuses only, and will not generate TRU waste.




**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

## Attachment 3 - Acceptable Knowledge Source Document Summary

**Waste Stream Number(s):** LA-CIN01.001, LA-MHD01.001

| **Site(s):** Los Alamos National Laboratory | **Source Document Tracking Number:** D023 |
|---|---|
| **Acceptable Knowledge Documentation Type:**<br>☑ TRU Waste Management Program Information<br>☑ Waste Stream-Specific Information<br>☑ Supporting Information | **Category:**<br>☐ C - Correspondence<br>☑ D - Documents<br>☐ M - Miscellaneous<br>☐ P - Procedures<br>☐ DR - Discrepancy Resolution<br>☐ U - Unpublished Documents |

**Title of Source Document:** TA-55 Plutonium Facility Acceptable Knowledge Report

**Source Document Reference Information (author(s), document and revision number, date, publisher):** TWCP-AK-2.1-008, R.2, 05/14/01, LANL

| AK # [a] | Source Doc. Page # [b] | AK Information Summary |
|---|---|---|
| PR5, WS12 | vii | Table: TA-55 Process/Status Code Index: Contains P/S Code, P/S Name, AK Process Report and Primary Report Section in which P/S Code is Described, and RCRA Listings for Combustible Debris |
| WS1, WS9 | xvi-xxiv | Waste stream Number and Title: TA-55-19, Mixed Combustible Debris WasteTA-55-19A, Mixed Combustible Debris Waste with P120, a subset (I.e. lot) of waste stream TA-55-19TA-55-20, Non-mixed Combustible Debris Waste Waste Matrix Code: S5300 (same for all three) |
| S16 | xvi-xxiv | (See limitation at end of this summary) Maximum Layers of Packaging: 6 (same for all three waste streams) |
| PR6, WS3 | xvi-xxiv | Time Period of Generation: TA-55-19, Mixed Combustible Debris Waste: 1978-present, Waste Stream Volume (as stored): 4173 containers (873 m3) (including lot TA-55-19A) Waste Stream Volume (after repackaging): 850 SWBs, 3873 drums (2390 m3) TA-55-19A, Mixed Combustible Debris Waste with P120: 02/98-06/98, Waste Stream Volume (as stored): 12 containers (2.5 m3) Waste Stream Volume (after repackaging): Not yet determinedTA-55-20, Non-mixed Combustible Debris Waste: 1979-present. Waste Stream Volume (as stored): 281 containers (59 m3)Waste Stream Volume (after repackaging): Not yet determined |
| WS4 | xvi | Waste Generasting Processes: (Same for all three waste streams): Plutonium manufacturing, recovery, and research operations at the TA-55 Plutonium Facility, as well as associated maintenance operations, generate TRU wastes. These operations include: Preparation of ultra-pure plutonium metals, alloys, and compounds. Preparation of specific alloys, including casting and machining these materials into specific shapes. Determination of the high-temperature thermodynamic properties of plutoniumReclamation of plutonium from scrap and residues produced by numerous feed sources. Disassembly of components for inspection and analysisManufacturing of parts on a limited basis |
| PR2, WS7 | xvi-xxiv | Defense Waste Status (same for all three waste streams): Defense-related transuranic (TRU) waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| WS12 | xvi-xxiv | RCRA CharacterizationTA-55-19 is conservatively assigned the following EPA Hazardous Waste Numbers (HWNs). Many of the HWNs are time-dependent, and apply only to containers generated by a particular process over a specific period of time, as documented in process AK reports.F001, F002, F003, F005D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, D040TA-55-19A has the same codes and also P120 (for |

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## Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

| Site(s): Los Alamos National Laboratory | | Source Document Tracking Number: D023 |
|---|---|---|
| AK # [a] | Source Doc. Page # [b] | AK Information Summary |
| | | vanadium pentoxide). |
| WS11 | xvi-xxiv | Radionuclide Content: These waste streams predominantly contain a variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptuniump237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium from americium and uranium. The waste will usually be enriched in americium-241 and uranium-234 relative to plutonium, but may also be depleted in some cases. Some waste may contain uranium and its decay products (e.g., uranium-234) from one of several uranium material types used as feed material. In addition, trace levels of cesium-137 and protactinium-231 may be present because of their widespread presence as contaminants in TA-55 operations. Other waste may contain various radionuclides used as feed materials for producing detector materials, including americium-241, americium-243, cerium-144, curium-244, protactinium-231, neptunium-237, thorium-232 enriched in thorium-230, uranium-233, and depleted uranium. |
| WS5 | xxv | See Waste Generation Summary Diagram |
| WS12 | vii-viii | Pg vii contains a table with the TA-55 process/status code index, including the RCRA listings for combustible debris. |
| WS8, WS12 | All | Chemicals identified in report: hydrochloric acid, nitric acid, calcium fluoride, hydrofluoric acid, salts. Acids used in TA-55 are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, phorporic acid, stearic acid, sulfuric acide an dsuperacides. Bases used in TA-55 are calciumhydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. Perschloric acid solutions were sent to cement fixation.<br><br>Table 5 on pg 35 contains a list of the use of RCRA-regulated inorganic chemicals in the TA-55 processes<br><br>Table 6 on pg 37 contains a liste of the use of RCRA-regulated organic chemicals in TA-55 processes.. |
| WS8, WS9 | 23 | Table 1 contains a listing of feed materials for processes contributing to waste streams TA-55-19 and TA-55-20 including presence of RCRA-regualted substanced and P/S codes. |
| WS11 | 29 | Table 4 contains a listing of secondary radionuclides in TA-55 TRU Waste. |

**Source Document Data Limitations (if any):**

1. It is not evident that the three waste streams described in this document are similar, the same, or different from the two waste streams described in this source document database.
2. This document has numerous handwriten changes and the souce is unknown

**Acceptable Knowlege Expert:**

Sheri Nance , Sheri Nance Date: 1/18/07

Print /Sign

[a] Obtain from Acceptable Knowledge Documentation Checklist
[b] For microfilm or microfiche, identify box, tape, reel number and location.

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| Document Number | Title/Description | Record Date | Total Pages |
|---|---|---|---|
| D023 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-6 | ~~9/17/2004~~ 9/23/04 | 2 |
| | TA-55 Plutonium Facility Acceptable Knowledge Report | 5/14/2001 | 600 |
| | | | |
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| Comments |
|---|
| None |

## CCP Records Center
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Records Accepted ☒ Lyn Estrada (Signature) | Lyn Estrada (Printed Name) | 12/4/05 (Date)

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| D023 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-6: TWCP-AK-2.1-008, R.2 - TA-55 Plutonium Facility Acceptable Knowledge Report | 1/11/2008 | 2 |
| | | | |

SN 1/11/08

**Comments**

Supercedes previous summary. Re-evaluated for addition of new waste stream

Acceptance/Rejection Signature and Date

| | | | |
|---|---|---|---|
| Records Accepted ☑ | Jodi Saltzman<br>Signature | JODI SALTZMAN<br>Printed Name | 01/23/08<br>Date |
| Records Rejected ☐ | Signature | Printed Name | Date |

Reason for Rejection:

Re-submittal:

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|---|---|---|
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P. 01

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| D023 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-6: TWCP-AK-2.1-008, R.2 - TA-55 Plutonium Facility Acceptable Knowledge Report | 1/11/2008 | 2 |
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| Attn: | Sheila Pearcy | From: | Amy Johns |
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| | | Company: | Technical Specialists, LLC |
| | | Telephone Number: | 505-302-8669 |
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| D023 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-6 | 1/14/2009 | 2 |
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Acceptance/Rejection Signature and Date

| | | | |
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# RECORDS SUBMITTAL

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TWCP-AK-2.1-015, R.3

Record Date: 4/10/03 Physical Page Count: 165 164 9-16-03 DM ☒ Single Sided ☐ Double Sided

Category Number: (from page two): 07

**RECORD TITLE, SUBJECT, AND/OR KEYWORDS:**

*Deactivate* TWCP-AK-2.1-015, R.3- Acceptable Knowledge Report for Debris Waste Streams Containing Pu-239 - LA-UR-03-2640

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Date: Mon, 15 Sep 2003 16:57:44 -0600
To: pgp@lanl.gov
From: Cathy Smith <chsmith@lanl.gov>
Subject: Retire TWCP-AK-21-015,Rev 3
Cc: humphreb@lanl.gov
X-Scanned-By: MIMEDefang 2.35

Hi Patsy,

Would you please retire TWCP-AK-2.1-015,R.3, Acceptable Knowledge Report for Debris Waste Streams Containing Pu-239, from the controlled documents?

The retired document should be submitted to the RMDC as was done with the other AK reports. Please let us know the record ID when you get it!

Cheers, Cathy

P.S. There is no problem sending this document to Dick Blauvelt as long as it has an LA-UR number.

---

*"The simplest questions are the hardest to answer."*
*Northrop Frye*

Catherine H. Smith
***Project 2010***
RRES-CE Certification Group
Risk Reduction & Environmental Stewardship Division
Phone: 667-0113 Page: 664-7104

To: rubyannf@lanl.gov, mlgarcia@lanl.gov, "Yvonne C. Gibson" <ygibson@lanl.gov>,"Catherine H. Smith" <chsmith@lanl.gov>
From: Patricia G Patton <pgp@lanl.gov>
Subject: Procedure Deactivation Notification
Cc: bailey, lpc, jhuchton
Bcc:
Attached:

The following AK report has been deactivated from the system per Cathy Smith's email dated 9/15/03

**TWCP-AK-2.1-015,R.3** - Acceptable knowledge Report for Debris Waste Streams Containing Pu-239

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

*Patricia G. Patton*
Los Alamos National Laboratory
Risk Reduction & Environmental Stewardship (RRES) Division
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**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

LA-UR-03-2640

# PROJECT 2010
## ACCEPTABLE KNOWLEDGE REPORT

| | |
|---|---|
| **Procedure Title** | Acceptable Knowledge Report for Debris Waste Streams Containing Pu-239 |

| | |
|---|---|
| **Procedure Number** | TWCP-AK-2.1-015,R.3 |

| | |
|---|---|
| **Waste Generated from Debris Waste Streams** | TA-55-19, LA-NCD01, TA-55-30, LANHD01 |

| | |
|---|---|
| **Effective Date** | 04/10/03 |

| | |
|---|---|
| **Next Review Date** | 04/10/06 |

**DOCUMENT PREPARER:**

| | | |
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| Betty J. Humphrey | Betty J Humphrey | 04/09/03 |
| **AK Investigator** [print] | **Signature** | **Date** |

**APPROVAL:**

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| Sandy Wander | Sandy Wander | 4/9/03 |
| **Independent Technical Reviewer/Editor** [print] | **Signature** | **Date** |
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| **Site Project Manager** [print] | **Signature** | **Date** |
| PETER L LINDAHL | Peter L Lindahl | 4/9/2003 |
| **Site Project QA Officer** [print] | **Signature** | **Date** |
| Wayne A. Punjak | Wayne A. Punjak | 4/10/03 |
| **Facility Representative** [print] | **Signature** | **Date** |

## HISTORY OREVISIONS

| Revision No. | Effective Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 03/21/02 | — | New report. Supersedes TWCP-AK-2.1-008 and TWCP-AK-2.1-010 |
| 1 | 08/27/02 | All | Incorporate changes based on process versus operations. |
| 1/IC1 | 09/05/02 | Pages 51 and 52<br><br>Table 3<br><br>Attachment 10 | Add 6 paragraph discussion regarding NDA detection of Sr-90 to section 4.5.2.<br><br>Add all Major and Minor Material Parameters, Update column headers to include "Major and Minor Material Parameters".<br><br>Modify the third column to read "Operations AK Report in which this P/S Code is Described", Delete all section references. |
| 2 | 10/09/02 | All | New revision to incorporate waste stream consolidation. Elimination of the use of the waste code P120 for vanadium pentoxide. |
| 3 | 04/10/03 | All | New revision combining legacy and newly generated debris waste AK |

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## ATTACHMENTS


1 Acceptable Knowledge Roadmap (6 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Simplified Flow Diagram for Generation of TRU Waste: Debris Waste (1 page)
4 Simplified Flow Diagrams (13 pages)
5 Example Waste Generator Forms (10 pages)
6 Example Waste Management System Forms (7 pages)
7 Chemical Waste Disposal Request Form (1 page)
8 Decision/Discrepancy Resolution Documentation (3 pages)
9 TA-55 Process/Status Code Index (8 pages)

## ACRONYMS

| | |
|---|---|
| AEC | Atomic Energy Commission |
| AK | acceptable knowledge |
| AKIS | *Acceptable Knowledge Information Summary for Los Alamos National Laboratory for Transuranic Waste Stream* (TWCP-AK-2.1-019) |
| AKIR | *Acceptable Knowledge for Isotope Ratios* (TWCP-AK-2.1-020) |
| ARIES | Advanced Recovery and Integrated Extraction System |
| BDR | batch data report |
| CBFO | Carlsbad Field Office (DOE) |
| CFR | *Code of Federal Regulations* |
| CMPO | octylphenyl di-isobutyl carbamoylmethyl phosphine oxide |
| C–N–O | carbon–nitrogen–oxygen |
| CSMO | Central Scrap Management Office |
| CST | Chemical Science and Technology Division |
| CTEN | combined thermal epithermal neutron |
| DBBP | dibutyl butylphosphonate |
| DCHP | dicesium hexachloroplutonate |
| DHDCMP | dihexyl N, N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DOT | U.S Department of Transportation |
| DP | defense program |
| DTP | detailed technical procedure |
| DVRS | Decontamination and Volume Reduction System |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| ER | Electrorefining |
| F | RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| FRAM | Fixed Energy Response Function Analysis with Multiple Efficiencies [software program] |
| HENC | high efficiency neutron counter |
| HEPA | high-efficiency particulate air |
| HGAS | headspace gas |
| HSE | Health, Safety, and Environment Division of the EPA |
| HWN | hazardous waste number |
| ICP | inductively coupled plasma |
| ID | item identification |
| IDC | item description code |
| ITF | Impact Test Facility |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |

| | |
|---|---|
| LLW | low-level waste |
| M | molar |
| MASS | Material Accountability and Safeguards System |
| MCDOR | multicycle direct oxide reduction |
| MEGAS | Multiple Energy Gamma Assay System |
| MSE | molten-salt extraction |
| MST | Materials Science and Technology Division |
| MT | material type |
| NDA | nondestructive assay |
| NMT | Nuclear Material Technology |
| P | RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF | Plutonium Facility |
| ppm | parts per million |
| Project 2010 | formerly the Transuranic Waste Characterization/Certification Project |
| PRQL | program required quantitation limit |
| P/S | process/status [code] |
| PU | plutonium |
| PuBe | plutonium–beryllium |
| QA | quality assurance |
| QAPP | *Quality Assurance Program Plan* |
| QP | quality procedure |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| RRES-CE | Risk Reduction and Environmental Stewardship-Certification [Group] |
| RSWD | radioactive solid waste disposal |
| RTR | real-time radiography |
| SME | subject matter expert |
| SOP | safe operating procedure |
| SPM | Site Project Manager |
| SWB | standard waste box |
| TA | technical area |
| TBD | to be determined |
| TBP | tributyl phosphate |
| TIC | tentatively identified compound |
| TOPO | trioctylphosphine oxide |
| TRU | transuranic |
| TRUCON | TRUPACT-II Content Code |
| TRUPACT-II | Transuranic Waste Transporter-Model II |
| TWBIR | Transuranic Waste Baseline Inventory Report |

| | |
|---|---|
| $UCL_{90}$ | 90% upper confidence limit |
| UCNI | unclassified controlled nuclear information |
| VE | visual examination |
| VOC | volatile organic compound |
| WAC | Waste Acceptance Criteria |
| WI | work instructions |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAC | Waste Isolation Pilot Plant Waste Acceptance Criteria |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit for the Waste Isolation Pilot Plant* (EPA ID No. NM4890139088-TSDF) |
| WPF | Waste Profile Form |
| WMC | waste matrix code |
| WMP | waste material parameter |
| WMS | Waste Management System |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request Form |
| WTWBIR | WIPP Transuranic Waste Baseline Inventory Report |
| XES | X-ray energy spectroscopy |

# ACCEPTABLE KNOWLEDGE REPORT FOR DEBRIS WASTE STREAMS CONTAINING Pu-239

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan (WIPP WAP), to the *Hazardous Waste Facility Permit for the Waste Isolation Pilot Plant* (EPA ID No. NM4890139088-TSDF) defines AK information and provides guidelines on how AK should be obtained and documented.

This AK Report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the plutonium recovery and research and development (R&D) process at the Los Alamos National Laboratory (LANL). Currently, most of the waste is from the Plutonium Facility at Technical Area (TA)-55, one of the TRU waste generators. By doing so, this report provides technical support for delineation of waste streams and assignment of specific waste containers to these waste streams.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to these debris waste streams covered:

- Review of the *Acceptable Knowledge Information Summary for Los Alamos National Laboratory Transuranic Waste Streams* (TWCP-AK-2.1-019) (AKIS) that includes information regarding all LANL wastes, including TA-55 wastes, and also includes AK isotope ratio information found in *Acceptable Knowledge for Isotope Ratios* (TWCP-AK-2.1-020) (AKIR) (a subset of the AKIS).
- Review of reports, documents, and databases related to the waste generation and waste management activities as documented in the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management as documented in AK reports listed in the Acceptable Knowledge Roadmap (Attachment 1)
- Review of AK reports for facility operations
- Analysis of the operations generating waste, as discussed in the operations AK reports and in this report

- Existing pre-WIPP WAP data for headspace gas (HGAS) and radiography (RTR) for legacy waste, as listed in the Acceptable Knowledge Roadmap (Attachment 1).

This AK Report is based on detailed information compiled in a set of closely related reports about TRU waste generating activities at LANL. For convenience in organizing AK for the plutonium (Pu)-239 recovery process, the process was categorized into six operational areas. The multiple operations in each area are described in detail in the following six AK reports:

- *Acceptable Knowledge Report for Chloride Operations at LANL* (TWCP-AK-2.1-002)
- *Acceptable Knowledge Report for Metal Operations at LANL* (TWCP-AK-2.1-003)
- *Acceptable Knowledge Report for Miscellaneous Operations at LANL* (TWCP-AK-2.1-004)
- *Acceptable Knowledge Report for Nitrate Operations at LANL* (TWCP-AK-2.1-005)
- *Acceptable Knowledge Report for Pyrochemical Operations at LANL* (TWCP-AK-2.1-006)
- *Acceptable Knowledge Report for Special Processing Operations at LANL* (TWCP-AK-2.1-007)

The AK reports currently contain information on more than 175 individual operations; each assigned a unique identifier called a process/status (P/S) code. These codes are used for the purposes of nuclear material accounting. For example, the nitrate operations report (*Acceptable Knowledge Report for Nitrate Operations at LANL* [TWCP-AK-2.1-005]) covers waste generation operations and characteristics for over 80 different operations, each with its own P/S code. The search and compilation of AK information is based on P/S code, because that is the greatest level of detail recorded in waste generator records. However, as described in Section 3.2, TRU waste items are packaged into drums based on the isotopic material content of the waste and nondestructive assay characteristics without regard to process of origin (i.e., P/S code). The AK information search to determine Resource Conservation and Recovery Act (RCRA) and chemical constituents in the waste is performed based on the operations used at LANL and tracked by the P/S codes, and it is described in the operations AK reports listed above.

This AK report summarizes AK information specific to legacy and newly generated debris waste streams in which Pu-239 is the dominant Pu isotope. These waste streams are listed in Table 1.

Project 2010 (formerly the Transuranic Waste Characterization/Certification Project) Records Management/Document Control (RMDC) Center retains copies of the documents that are referenced in this AK report.

**Table 1. TRU Waste Streams in which Pu-239 is the Dominant Pu Isotope**

| Waste Stream | Designation | Mixed or Non-Mixed Status | Waste Stream Name |
|---|---|---|---|
| TA-55-19 | Debris | Mixed | Mixed combustible debris waste |
| LA-NCD01 | Debris | Non-Mixed | Non-mixed combustible debris waste |
| TA-55-30 | Debris | Mixed | Mixed heterogeneous debris waste |
| LA-NHD01 | Debris | Non-Mixed | Non-mixed heterogeneous debris waste |

Unclassified Controlled Nuclear Information (UCNI) is reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1). When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancy Resolution Documentation (Attachment 8).

## 3.0 DESCRIPTION OF THE WASTE STREAMS

### 3.1 Facility and Mission

Since 1978 the Plutonium Facility (Building PF-4) has been located at TA-55 and used for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other U.S. Department of Energy (DOE) sites in the defense complex. The scrap and residues are processed to recover as much plutonium as practicable before disposal. The recovered plutonium is converted into pure plutonium feedstock. This recovery process, associated maintenance operations, limited manufacture of finished parts from purified plutonium, and plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at LANL. The waste from the plutonium recovery process meets the definition contained in the WIPP WAP, Sec. B-1a, "Plutonium recovery wastes are residues from the recovery of plutonium-contaminated molds, metals, glass, plastics, rags, salts used in electrorefining, precipitates, firebrick, soot, and filters." The plutonium recovery process handles primarily Pu-239 and Pu-242 based samples. These are categorized based upon exact isotopic make-up into various material types. The associated research activities involve other plutonium isotopes, different uranium isotopes, and minor amounts of several other radioisotopes.

Before 1978, wastes were generated from plutonium recovery and purification for defense and non-defense programs although production of heat sources using Pu-238 was and still is the only major non-defense activity. These Pu-238 wastes were generated and produced in the same rooms and gloveboxes and were not

segregated until August 27, 1998 (TWCP-887). Waste is also produced from "special process" and research-related activities. These wastes were not segregated until 1998 and were also commingled in the final waste containers to such an extent that segregation was not possible on the basis of waste generating operation or glovebox location (TWCP-887). The waste was also co-mingled with room trash related to these same operations (both defense and non-defense). The room trash waste was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site assay results showed that it exceeded the low-level waste threshold value (TWCP-816).

A LANL site map and a detailed map of the current Plutonium Facility buildings at TA-55, including Building PF-4, are shown in Attachment 2.

## 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of waste streams is established by the evolving set of LANL waste management plans and facility specific procedures, which date back to the start of operations at the Plutonium Facility at TA-55 in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). Since then, the stated policy and practice is to handle and package all combustible debris, heterogeneous debris, and homogeneous waste in a similar fashion, regardless of the process of origin. Relevant details of these planning and implementation decisions for debris wastes are summarized in this section. The purpose is to provide background information related to the rationale used by Project 2010 to assign waste containers to specific waste streams.

### 3.2.1 Waste Packaging

1978-1995

At TA-55, the inspection, collection, documentation and packaging of solid, certifiable TRU wastes is conducted by a waste management section or team (TWCP-351, TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged by this team initially following Atomic Energy Commission (AEC) requirements (*U.S. Atomic Energy Commission AEC Manual: Chapter 0511, Radioactive Waste Management* [AEC 1973] [AEC 0511-01]) and later DOE Order 5820.1 and 5820.2, *Management of Transuranic Contaminated Material*, DOE, 09/30/82 and 02/06/84. Currently LANL follows DOE Order 435.1, *Radioactive Waste Management, Department of Energy, Environmental Management, 2001*. Materials are considered waste only when they have been received and processed by the waste management team. Waste segregation schemes used by this team have evolved since operations began at the Plutonium Facility in 1978.

In 1978, the standard operating procedure for waste management stated the guiding philosophy of minimizing the amount of waste generated and minimizing the plutonium content of that waste (TWCP-3943).

Discard limits (DLs) for plutonium in various types of waste matrices were established by the waste-generating group, and approved by the LANL division office and the DOE Albuquerque Operations Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of Pu) into classes such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. The AEC Manual Chapter 0511 (1973) mandated segregation of waste items into combustible and noncombustible categories. All liquids, including oils, were required to be sent to recovery operations for processing. Liquids were explicitly prohibited from any container of solid waste materials (TWCP-3943).

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific operations and wastes (Section 9 in TWCP-697). Waste Content Codes were assigned by the LANL Waste Management Group, Health, Safety and Environment Division (HSE-7 at that time). These codes were later known as the Item Description Codes (IDC), and categorized the waste into one of nine categories, as listed in Table 2. TA-55, then operated by Materials Science and Technology (MST) Division, generated debris waste under content codes 004 (combustible solids) and 005 (noncombustible scrap) only. The use of non-destructive assay to determine the plutonium level relative to the DL provided impetus for segregation into combustible (for gamma assay) and noncombustible (for neutron assay).

In March 1987, MST Division finalized its Certification Plan attachment for contact-handled combustible and noncombustible solid waste (TWCP-701; Attachment 3). Other waste forms were addressed as indicated in Table 2. Combustible and noncombustible solid wastes were defined by the MST document as follows (TWCP-701) and were segregated by mixed and non-mixed:

- Combustible waste forms (Waste Content Code 004) included materials that could be reduced to an ash if desired but that did not require further processing to meet the requirements of the *TRU Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (WIPP-DOE-069) (WIPP WAC) (TWCP-701). (This definition is still current.) Subcategories included plastic-based combustibles, cellulose-based combustibles, and miscellaneous (graphite and graphite crucibles). It was acceptable for the combustible waste stream to include some unspecified "small" fraction of noncombustible solids such as scrap metals.

**Table 2. Waste Content Codes in the Los Alamos Certification Plan**

| Item Description Code or Waste Content Code | Description | Facilities Generating Waste |
|---|---|---|
| 001 | Mixed metal scrap and combustibles (primarily metals or metal equipment along with its combustible components and combustibles generated during decommissioning, sectioning equipment, or packaging) | Los Alamos TRU Waste Size Reduction Facility |
| 002 | Cemented sludges (caustic sludge stabilized with Portland cement) | Liquid Waste Treatment Plant |
| 003 | Dewatered sludges (caustic sludge from liquid waste treatment facility using dry Portland cement to stabilize any liquids that may separate) | Liquid Waste Treatment Plant |
| 004 | Combustible solids (may contain small fraction of noncombustible solids) | MST Division Certification Plan Attachment<br>MST Division Attachment for Pu238 Wastes |
| 005 | Noncombustible scrap (may contain small fraction of combustible solids) | MST Division Certification Plan Attachment<br>MST Division Attachment for Pu238 Wastes |
| 006 | Cemented process residues (process-leached solids, filter cakes, evaporator bottoms, etc., stabilized in Portland cement) | MST Division Process Residue Certification |
| 007 | Contact and remote-handled solids from hot-cell operations | MST-14 Contact and Remote-Handled Waste Certification |
| 008 | Cemented incinerator ash (ash stabilized with Portland cement) | Treatment Development Facility |
| 009 | Cemented aqueous liquid wastes (neutralized or caustic aqueous liquids stabilized with Portland cement) | Not addressed |

**NOTE:** Graphite items were historically segregated as combustible waste; current waste management practices identify graphite items as inorganic debris.

- Noncombustible waste forms (Waste Content Code 005) included materials that could not be reduced to ash but that did meet the WIPP WAC without further processing (TWCP-701). The two subcategories were metals and non-metals. The non-metal wastes included glass, fiberglass heating mantles, porcelain crucibles, ceramic furnace tube inserts, and leaded glovebox gloves. It was acceptable for the noncombustible waste stream to include some unspecified "small" fraction of combustible solids, which could be contained in plastics. For WIPP purposes, any waste forms that were chemically compatible and that met the waste acceptance criteria (WAC), could be combined into a single waste container.

It was expected that debris waste from waste management operations would usually be packaged into 55-gal U.S. Department of Transportation (DOT) 17C steel drums, including either two 5-mil plastic bags closed with yellow vinyl tape, or one 90-mil rigid polyethylene liner with lid (Sections 3.2.1 and 3.5.3.2 in TWCP-701). Waste could also be packaged in vented 30-gal drums, or into in-line 30-gal drums attached to a glovebox in the waste management room, and later overpacked into 55-gal DOT 17C drums (Sections 3.2.1 and 3.5.3.1 in TWCP-701).

All drums were to be fitted with a vent clip or carbon filter so as to prevent the accumulation of flammable gases in the waste packages (Section 3.8.15 in TWCP-701). Requirements were also specified for other types of waste containers.

1995-2000

In 1995, a new TRU Waste Certification Plan was adopted, and TRU waste certification activities were shifted to Chemical Science and Technology (CST-7) (presently known as Risk Reduction and Environmental Stewardship-Transuranic Waste Certification Group [RRES-CE]).

Additional AK information regarding the physical form of debris waste (e.g., glass, metal, or plastic) is available from waste item-level descriptions that are assigned for the purposes of special nuclear material (SNM) tracking and accountability. The AK item descriptions provide more detailed information about the waste matrices expected to be present in the combustible and noncombustible waste streams. No further delineation of the combustible and noncombustible waste

streams based on physical form and matrix is made, however, because waste management practices at LANL have been based on SNM processes rather than waste segregation by specific matrices. Debris waste items are packaged based on isotopic material content (Pu-239 or Pu-238), nondestructive assay characteristics, and hazardous constituents.

Changes were also introduced into the packaging procedure used (Section 3.2.1 in TWCP-700). Up to two 5-mil liner bags could still be present, but were to be closed by folding, not by taping. All drums were to be fitted with carbon filters, and standard waste boxes (SWBs) were to be fitted with two carbon filters. Waste placed inside the drums was to be contained in a single plastic bag that was twisted, closed with a plastic tie, and then taped (TWCP-12088). Since 1997, plastic bags with filters are used. Waste with the potential to tear the plastic bag, such as broken glass, was to be placed first in a metal container with a slip lid, taped closed, and then placed into the plastic bag. A summary of the physical form, and description for debris waste is given in Table 3.

2000-2001

In April 2000, the first revision of the waste packaging procedure currently used at TA-55 was issued as a safe operating procedure (SOP), *Inspecting, Packaging, Rejecting, and Remediating Transuranic Waste for WIPP and for TA-54 Safe Storage* (NMT7-SOP-TA55-013), with four detailed Work Instructions (WI):

- *Inspecting, Labeling, and Preparing TRU Waste Containers* (NMT7-WI1-SOP-TA55-013)
- *Performing Visual Examinations of TRU Waste* (NMT7-WI2-SOP-TA55-013)
- *Packing TRU Waste Containers* (NMT7-WI3-SOP-TA55-013)
- *Sealing TRU Waste Containers* (NMT7-WI4-SOP-TA55-013)

2001-Present

Revisions to this SOP and associated work instructions were approved by the Carlsbad Field Office (CBFO) on July 17, 2001. Debris waste packaged by TA-55 after that date is considered to be "newly generated" waste that is packaged in accordance with WIPP WAP-compliant procedures. Waste packaged prior to that date is considered to be "legacy" (retrievably stored) waste, which is subject to more stringent characterization than newly generated waste. Table 4 illustrates the segregation history for debris waste.

**Table 3. Waste Physical Form, Waste Material Parameters, Estimated Volumes, and Content Description for Debris Waste Streams**

| Waste Stream | Waste Physical Form Maximum Layers of Confinement and Estimated Volume | Waste Description and Major and Minor Waste Material Parameters |
|---|---|---|
| TA-55-19 | Combustible debris waste (mixed)<br><br>Legacy:<br>Maximum: 6 layers<br>Volume:1621.42 $m^3$<br>Newly Generated:<br>Maximum: 1 layer<br>FY01[a] Volume: 2.9 $m^3$<br>FY02[b] Volume: 21.8 $m^3$<br>FY03[c] Volume: 29 $m^3$<br>FY04[c] Volume: 33 $m^3$<br>FY05[c] Volume: 33 $m^3$ | Mixed combustible debris waste generated by plutonium recovery, research and development processes at the LANL site, resulting from facility and equipment operations and maintenance. The debris waste includes paper, rags, plastic, rubber, wood-based HEPA filters, and other plastic-based and cellulose-based items. Plastic-based waste includes (but may not be limited to): tape, polyethylene and vinyl; gloves; plastic vials; polystyrene; Tygon® tubing; polyvinyl chloride plastic; Teflon® products; Plexiglas®; and dry-box gloves (unleaded neoprene base). Cellulose-based waste includes (but may not be limited to): rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves; and similar materials. The waste stream may also contain a smaller fraction of noncombustible solids (e.g., scrap metal, salts, crucibles, metal lids, zippers, discarded tools) and a small fraction of homogenous solids (e.g., leached solids, ash, hydroxide cakes, and impure oxides). The waste stream includes retrievably stored and newly generated waste. Major WMPs: R, C, PW, Minor WMPs: IM, OM, AM, OI, OR, IN, S. |
| LA-NCD01 | Combustible debris waste (non-mixed)<br>Legacy:<br>Maximum: 6 layers<br>Volume: 55.56 $m^3$<br>Newly Generated:<br>Maximum: 1 layer<br>FY01[a] Volume: 12.3 $m^3$<br>FY02[b] Volume: 5.7 $m^3$<br>FY03[c] Volume: 8 $m^3$<br>FY04[c] Volume: 9 $m^3$<br>FY05[c] Volume: 9 $m^3$ | Non-mixed combustible waste generated by plutonium recovery, research and development processes at the LANL site, resulting from facility and equipment operations and maintenance. The debris waste includes paper, rags, plastic, rubber, wood-based HEPA filters, and other plastic-based and cellulose-based items. Plastic-based waste includes (but may not be limited to): tape, polyethylene and vinyl; gloves; plastic vials; polystyrene; Tygon® tubing; polyvinyl chloride plastic; Teflon® products; Plexiglas®; and dry-box gloves (unleaded neoprene base). Cellulose-based waste includes (but may not be limited to): rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves; and similar materials. The waste stream may also contain a smaller fraction of noncombustible solids (e.g., scrap metal, salts, crucibles, metal lids, zippers, discarded tools) and a small fraction of homogenous solids (e.g., leached solids, ash, hydroxide cakes, and impure oxides). The waste stream includes retrievably stored and newly generated waste. Major WMPs: R, C, PW, Minor WMPs: IM, OM, AM, OI, OR, IN, S. |

**Table 3. Waste Physical Form, Waste Material Parameters, Estimated Volumes, and Content Description for Debris Waste Streams (continued)**

| Waste Stream | Waste Physical Form Maximum Layers of Confinement and Estimated Volume | Waste Description and Major and Minor Waste Material Parameters |
|---|---|---|
| TA-55-30 | Heterogeneous debris waste (mixed)<br>Legacy:<br>Maximum: 6 layers<br>Volume: 2270.09 $m^3$<br><br>Newly Generated:<br>Maximum: 1 layer<br>FY01[a] Volume: 4 $m^3$<br>FY02[b] Volume: 19.7 $m^3$<br>FY03[c] Volume: 26 $m^3$<br>FY04[c] Volume: 30 $m^3$<br>FY05[c] Volume: 30 $m^3$ | Mixed heterogeneous debris waste generated by plutonium recovery, research and development processes at the LANL site, resulting from facility and equipment operations and maintenance. The waste includes plutonium-contaminated noncombustible and combustible debris waste. The noncombustible debris waste includes (but may not be limited to): small tools and equipment; cans; motors, pumps and process equipment; gloveboxes and glovebox windows; ventilation ductwork; composite HEPA filters; metal pipes; glass; bottles; graphite; salt, slag and crucibles; and miscellaneous lab ware. The waste stream may also contain a smaller fraction of combustible solids (e.g. paper, rags, plastic, rubber, leaded gloves) and a small fraction of homogeneous solids (e.g. leached solids, ash, hydroxide cakes, impure oxides). The waste stream includes retrievably stored and newly generated waste. Major WMPs: IM, AM, OM, OI. Minor WMPs: C, R, PW, OR, IN, S. |
| LA-NHD01 | Heterogeneous debris waste (non-mixed)<br>Legacy:<br>Maximum: TBD<br>Volume:49.19 $m^3$<br><br>Newly Generated:<br>Maximum: 1 layer<br>FY01[a] Volume: 7.2 $m^3$<br>FY02[b] Volume: 8.5 $m^3$<br>FY03[c] Volume: 12 $m^3$<br>FY04[c] Volume: 13 $m^3$<br>FY05[c] Volume: 13 $m^3$ | Non-mixed heterogeneous debris waste generated by plutonium recovery and research and development processes at the LANL site, resulting from facility and equipment operations and maintenance. The waste includes plutonium-contaminated noncombustible and combustible debris waste. The noncombustible debris waste includes (but may not be limited to): small tools and equipment; cans; motors, pumps and process equipment; gloveboxes and glovebox windows; ventilation ductwork; composite HEPA filters; metal pipes; glass; bottles; graphite; salt, slag and crucibles; and miscellaneous lab ware. The waste stream may also contain a smaller fraction of combustible solids (e.g. paper, rags, plastic, rubber, leaded gloves) and a small fraction of homogeneous solids (e.g. leached solids, ash, hydroxide cakes, impure oxides). The waste stream includes retrievably stored and newly generated waste. Major WMPs: IM, AM, OM, OI. Minor WMPs: C, R, PW, OR, IN, S. |

**[a]Actual, [b]Actual through August, September projected, [c]Projected**

**NOTE:** Waste material parameters are: C = cellulose, R = rubber, PW = plastics – waste materials, IM = iron base metal alloys, AM = aluminum base metal alloys, OM = other metal alloys, OI = other inorganic material, IN = inorganic material, OR = organic material; S = soil; all waste material parameters present in varying quantities in these waste streams.

**Table 4. History of Debris Waste Management**

| Date | WIPP WAC Status | WIPP WAC | AEC Manual Chapter 0511 | NDA Requirements |
|---|---|---|---|---|
| 1978-1983 | Not implemented | N/A | Segregate combustibles and noncombustibles | Segregate combustibles and noncombustibles |
| 1984-1987 | Draft Attachment to LANL Certification Plan | Segregate combustibles and noncombustibles<br><br>IDC 004 and 005 | Segregate combustibles and noncombustibles | Segregate combustibles and noncombustibles |
| 1987-1994 | Final Attachment to LANL Certification Plan | Segregate combustibles and noncombustibles<br><br>IDC 004 and 005 | N/A | Segregate combustibles and noncombustibles |
| 1995-2001 | QAPP Released, New LANL Certification Plan, WIPP WAP | Segregate by waste streams to meet WAP requirements | N/A | Segregate by more detailed waste matrix to improve NDA results |
| 2002-present | WIPP WAP, LANL Certification Plan | Segregate by waste streams to meet WIPP requirements | N/A | Consolidate similar waste matrices |

N/A = not applicable

### 3.2.2 Waste Generation Records

From the beginning of operations of the current Plutonium Facility at TA-55, the physical description of each waste item generated is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures (page 24 in TWCP-701; Appendix 1 in TWCP-700; Appendix B in *Inspecting, Packaging, Rejecting, and Remediating Transuranic Waste for WIPP and for TA-54 Safe Storage* [MT7-SOP-TA55-013]. Items are bagged out of gloveboxes and sent to the Waste Management section, where multiple items are placed into drums. Starting in 1987, the Plutonium Facility at TA-55 began its current system of tracking waste items by their nuclear material content, using the computerized Material Accountability and Safeguards System (MASS).

Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to nuclear materials accountability for the operation that produced the waste item.

The P/S code refers to a specific part of an operation within the overall Pu-recovery process, but generally applies to more than one glovebox or to the same operation carried out in multiple locations or gloveboxes in PF-4. Recording the P/S codes was inconsistent until about 1995 (TWCP-351). In the packaging operation for legacy waste, a standard

form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code (page 25 in TWCP-701; Appendix 2 in TWCP-700; Appendix C in NMT7-SOP-TA55-013). This form was signed by the waste packager and approved by quality assurance personnel. Both the WODF and DWLS for each TRU waste drum are maintained as hard copy records by the generator. Many of these waste tracking ID codes for individual items in drums of debris waste are compiled in a list that correlates item codes with containers or in a database maintained as the Waste Management System (WMS) (TWCP-5086). A Process/Status Code Index is given in Attachment 9.

Example copies of legacy container records are included in Attachment 5. Note that this waste container example (LA00000057745) contains waste items associated with seven different P/S codes (BM, EOC, FF, OM, SS, TIGR, and XO). Each of the waste items is linked to a unique WODF. Information encoded in the ID code indicates that five of the seven waste items are metal (MET), while the remaining two from P/S code SS are crucibles (XBL). These and other matrix abbreviations used by waste management personnel are listed in Appendix D of *Performing Visual Examinations of TRU Waste* (NMT7-WI2-SOP-TA55-013)

For newly generated waste, the physical description of each waste item generated is documented on a Waste Origination and Disposition Form (WODF) by the waste generator in accordance with *TA-55 Transuranic Waste Interface Document* (NMT7-AP-TA55-018) and *Performing Visual Examinations of TRU Waste* (NMT7-WI2-HCP-TA55-013). The WODF is generated electronically in the WMS database. The P/S code for waste items is also documented on this form. The Plutonium Facility at TA-55 tracks waste items both by the P/S code from which they originated as well as by their material content, using the computerized Material Accountability and Safeguards System (MASS). Waste items are labeled with a code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the operation that produced the waste item. In the packaging process, the WMS is used to list each ID code and record its matrix material electronically (Appendix B in *Performing Visual Examinations of TRU Waste* [NMT7-WI2-HCP-TA55-013]). This form is electronically signed by the waste packager and approved by quality assurance personnel. The WODF(s) for each item in a TRU waste container are maintained electronically and a hard copy is printed after all approvals are in place.

Example copies of these container records are included in Attachment 6. Note that this waste container (LA00000059359) contains waste items generated by four different P/S codes (ITF, CA, RB, and RBJ), each

waste item with its own completed WODF. (The P/S code of each waste item is listed in the Measurement Information field under PS near the center of the WODF screen). Information encoded in the Item ID indicates that one of the waste items is combustible waste (COM), another is rubber (RUB), and the remaining four are plastics (PLS).

The MASS system and associated P/S codes were developed and are used strictly to track accountable nuclear materials throughout the Pu-recovery process. However, the P/S codes provide the finest level of detail available to associate waste items with a specific operation of origin. Consequently the P/S code system is used extensively in the description and documentation of AK information for RCRA and for chemical constituents for the Pu-recovery process in this report and in the operations AK reports. While a P/S code can be associated with most waste items generated after 1987 and all items generated after 1995, the P/S code does not provide a method of segregating waste or delineating waste streams.

### 3.2.3 Waste Stream Delineation

The LANL procedure for delineating TRU waste streams is described in *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021).

Waste segregation practices separate wastes into combustible (IDC 004) and noncombustible (IDC 005) waste forms based on plans for treatment of the combustible waste by incineration or other thermal decomposition strategies. Generator records list only the single, major component of each waste item, so that segregation by waste matrix appears in the records to be more exact than it was in practice. In particular, since any waste forms that are chemically compatible could be combined in the noncombustible waste form, the noncombustible waste form often contains a larger fraction of combustible waste than would be expected from the IDC description.

TA-55 maintains two separate Pu-recovery process lines, one for Pu-238 based isotopic materials (not covered in this AK report) and one for Pu-239 and other Pu-isotope recovery that is the subject of this report. Generator records distinguish waste from each process using a "material type" notation that is explained in more detail in Section 4.1. Material types based on Pu isotopes other than Pu-239 (for example Pu-242) are processed in the same gloveboxes with the same equipment as the Pu-239 materials. The waste items from the occasional processing of these other material types are expected to be contaminated with carryover Pu-239, so that segregation of waste streams for these minor Pu-isotope types is not feasible. In some special cases, Pu-238 materials are processed in equipment used in Pu-239 operations, so some cross-

contamination of wastes with Pu-238 and Pu-239 is expected. One example of this is the thermal decomposition operation, where Pu-contaminated rags were ashed. Both Pu-238 and Pu-239 based materials were sent through this operation, resulting in waste of mixed material type. However, the majority of Pu-238 and Pu-239 operations are segregated, allowing separate delineation of Pu-238 waste streams.

The hazardous waste status of waste streams from the Pu-239 recovery process are delineated only as non-mixed or mixed with a common set of hazardous waste numbers (HWNs). MASS nuclear material accountability system and P/S codes allow detailed assignment of HWNs associated with each P/S code (see Tables 14 and 15 for a complete list). However, since waste items are packaged into containers based on the physical material content of the waste, without regard to P/S code, each waste container can, and does, include waste items from several P/S codes. For the containers where the P/S code of each item is known, HWNs can be assigned on a container-by-container basis.

The HWN assignment of the waste stream becomes the complete list of HWNs assigned to all P/S codes. A sort on the P/S code of each waste item in a container can determine the special case of containers containing all non-mixed waste items. If the P/S code information is missing for any item in a waste container, the container is conservatively assigned to the mixed waste stream. This is necessary for some of the older waste. In addition, some waste originally assigned to non-mixed waste streams is later discovered to contain lead shielding, and is reassigned to corresponding mixed waste streams (*Acceptable Knowledge Accuracy Report* [TWCP-AK-2.1-012]).

LANL TRU debris waste streams are not delineated beyond the organic (combustible) and heterogeneous categories to more detailed waste matrix codes. Delineation to identify detailed waste streams such as metal or glass waste has been previously attempted (see the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan*, TWCP-PLAN-0.2.7-001,R.0, 1997). However, as supplemental AK information is gathered on specific waste-generating operations, it is apparent that detailed delineation cannot be reliably made because TRU waste management practices at LANL have historically not made such distinctions for waste packaging purposes.

### 3.2.4 Waste Physical Form and Content Description: Assignment of Waste Stream Numbers

#### 3.2.4.1 Waste Segregation Practices

Prior to April 17, 1995, debris waste was segregated only according to Pu isotopic make-up and combustibility. Although individual waste items were tracked (and recorded on WODF and DWLS forms), no attempt was made to separate them along composition or process lines. Thus, numerous waste material parameters and constituents would end up in the same drum. For this reason, all Pu-239 debris waste generated before April 17, 1995 is nominally assigned to two waste streams: TA-55-19 (predominately combustible) and TA-55-30 (predominately heterogeneous).

Between April 17, 1995 and July 17, 2001, additional segregation of debris waste was conducted. Non-combustible items were disposed of according to whether or not RCRA constituents were present (i.e., mixed vs. non-mixed). This resulted in the generation of new waste streams. Combustibles were not segregated according to matrix (i.e., rubber, plastics, cellulose-based materials, etc. were still combined), but were separated on the basis of RCRA constituent content. Therefore, from 1995 through July 16, 2001, combustibles were further categorized as either mixed or non-mixed.

Beginning July 17, 2001, all debris waste generated at TA-55 bears the label "newly generated" and falls into four distinct waste streams:

1. TA-55-19: Mixed combustible
2. LA-NCD01: Non-mixed combustible
3. TA-55-30 Mixed heterogeneous
4. LA-NHD01: Non-mixed heterogeneous

#### 3.2.4.2 Records and Written Evidence

In addition to the segregation protocols described above, records exist that give more detailed information about the contents of some drums. For example, a subset of debris waste drums generated between 1987 and 1995 can be shown to be non-mixed based upon database records. Five primary information sources have been found that significantly augment "procedural" information such as that given in

Section 3.2.5. These are listed in Table 5 in descending order of reliability. The reliability/quality of the data source is determined by how "close" the information is to entries made by the original waste generator. The WMS list contains data entered by the generators and data were entered under a quality assurance program; it is therefore considered the most reliable source of information pertaining to TA-55 wastes. The other data sources in Table 5 provide unique information of one type or another, but the information is considered somewhat less reliable because of occasional discrepancies that arise between listed entries and original generator data (when the latter exist). The non-certified archive database is particularly useful for tracking information pertaining to "S" drums (older drums having a different numbering scheme). The WMS database is used to obtain filter dates, location information, and package dates. The certified archive database contains unique information about waste generated between 1992 and 1996, and the Sampling Plan (Rev. 0) contains information about older "legacy" drums.

**Table 5. Primary Information Sources**

| Source # | Description |
|---|---|
| 1 | TA-55 WMS |
| 2A | Archive certified Microsoft Access database |
| 2B | Archive non-certified Microsoft Access database |
| 3A | Sampling Plan Rev. 0 |
| 3B | LANL TRU Waste Management System Oracle database |

### 3.2.5 Waste Container Labeling

Because the WIPP WAP requires HWN assignment on a waste stream rather than a waste container basis, several HWNs are conservatively assigned to individual waste streams. For the purposes of generator and on-site storage, however, LANL labels waste on a container-by-container basis. For this reason, the hazardous material labels on containers in storage at LANL do not always correspond to the HWNs assigned to the waste stream as described by this AK Report. Hazardous material labels are updated to meet WIPP disposal requirements just before loading waste containers into the Transuranic Package Transporter-Model II (TRUPACT-II) container for shipping to the WIPP.

## 3.3 Waste Generation Operations

### 3.3.1 Overview

#### 3.3.1.1 Plutonium Processing Operations

Waste streams were generated from materials used in the process to recover plutonium from residues, metal fabrication, and R&D activities. The variety of plutonium handling operations includes:

- Preparing ultra-pure plutonium metals, alloys, and compounds
- Preparing (on a large scale) specific alloys, including casting and machining these materials into specific shapes
- Determining high-temperature thermodynamic properties of plutonium
- Reclaiming plutonium from scrap and residues produced by numerous feed sources
- Disassembling components for inspection and analysis
- Manufacturing of parts on a limited basis
- Processing mixtures of plutonium and uranium oxides for reactor fuels.

#### 3.3.1.2 Generation of Plutonium-Contaminated Waste

Plutonium processing operations generate contaminated combustible waste consisting of:

- Plastic materials such as Tygon tubing, polyvinyl chloride vials, plastic bags, etc.
- Cellulose-based cleaning aids and personal protective equipment such as rags, paper wipes, laboratory coats, coveralls, booties, etc.
- Rubber- and Teflon-based products (such as rubber gloves, Teflon tape, gaskets, stoppers, etc.) used in operations

Plutonium processing operations generate contaminated noncombustible waste from:

- Small tools used in operations and glovebox maintenance
- Steel and brass cans used for storage and transfer of material
- Small equipment items such as metal labware
- Motors and pumps from equipment and facility maintenance
- Equipment such as furnaces, foundry parts, machine tools and parts, etc.
- Gloveboxes
- Ventilation ductwork and pipes
- Glass materials such as labware, bottles, windows, etc.
- Miscellaneous items such as slag, salt and crucibles

The following wastes are usually fixed with cement:

- Evaporator salts and evaporator bottoms from nitrate recovery operations
- Aqueous liquid wastes from analytical operations
- Ion-exchange resins
- Nuclear materials such as americium oxide
- Waste oils and organics (may be absorbed on vermiculite instead)
- Fine particulate materials, such as ash, dried filter residues, and hydroxide cake
- Perchloric acid solutions or perchlorate salts

**NOTE**: Large chunks of hydroxide cake may not be cemented, because the purpose of the cementation is to immobilize fine particulates.

Non-routine solid TRU waste items are generally large pieces of equipment that are removed from gloveboxes or laboratories. The items are disassembled if necessary and prepared for disposal.

### 3.3.2 Flow Diagrams

Detailed information about the plutonium recovery process can be found in the operations AK reports. The six operational areas for which AK reports have been prepared include:

- Chloride Operations (TWCP-AK-2.1-002)
- Nitrate Operations (TWCP-AK-2.1-005)
- Miscellaneous Operations (TWCP-AK-2.1-004)
- Special Processing Operations (TWCP-AK-2.1-007)
- Metal Operations (TWCP-AK-2.1-003)
- Pyrochemical Operations (TWCP-AK-2.1-006)

Generalized flow diagrams for legacy and newly generated waste (see Attachment 4) for these six operational areas indicate the P/S codes associated with each of the various sub-processes. A full block flow diagram for plutonium processing and waste management is also available (TWCP-886).

Sections 3.3.3 through 3.3.8 correspond to the six operational areas listed above. Each section describes the operations that generated waste assigned to the debris waste streams.

### 3.3.3 Chloride Operations

A detailed description of chloride operations can be found in *Acceptable Knowledge Report for Chloride Operations at LANL* (TWCP-AK-2.1-002).

The overall goal of chloride operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The primary feed sources are plutonium residues from pyrochemical operations, plutonium-beryllium (PuBe) neutron sources, analytical chemistry laboratory solutions, and residues from other DOE facilities. Chloride operations can be broken down into the following four steps:

- Pretreatment
- Dissolution
- Purification
- Hydroxide precipitation

*Pretreatment* may include sorting, crushing, and/or pulverizing feed materials prior to being fed into later steps of chloride operations. A separate pretreatment procedure is the decladding of plutonium-beryllium sources. The PuBe metal alloy is removed from the sources,

which are then entered into the chloride line for plutonium recovery along with other materials.

*Dissolution* uses hydrochloric acid to leach and dissolve plutonium from scrap, crucibles, residues, and various solutions, including solutions from the analytical chemistry laboratory. Enriched solutions undergo further purification and solid wastes are discarded as debris waste or sent to cement fixation in nitrate operations (Section 3.3.4).

*Purification* may include solvent extraction, ion exchange, and oxalate precipitation, depending on the chemical nature of the material to be purified. Ion exchange columns are used to collect plutonium and to separate plutonium from impurities. Enriched solutions may be further treated with oxalic acid to precipitate plutonium oxalate, which is converted to plutonium oxide.

*Hydroxide precipitation* takes plutonium in filtrate solutions from the purification steps and precipitates it with potassium, magnesium, or sodium hydroxide. Heavy metals are concentrated in the plutonium-rich hydroxide cakes. The sources of heavy metals vary but may include one or more of the following: (a) feed materials that consist of or contain these metals; (b) leaching of chromium from stainless-steel equipment components; or (c) the use of silver salt (until 1994) as an indicator of chloride content. The resulting Pu-enriched hydroxide cakes become feed material for nitrate operations, and liquid meeting the TA-50 WAC is sent to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF) using the caustic waste line. Some hydroxide cakes are returned to the dissolution step for re-processing.

### 3.3.4 Nitrate Operations

A detailed description of nitrate operations can be found in *Acceptable Knowledge Report for Nitrate Operations at LANL* (TWCP-AK-2.1-005).

The overall goal of the nitrate operations is to recover plutonium from scrap and residues, and produce a purified plutonium oxide for conversion into metal. The primary feed sources for the nitrate operations are plutonium residues from other recovery operations (e.g., chloride operations), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities. Nitrate operations can be broken down into the following five steps:

- Pretreatment
- Dissolution
- Purification

- Evaporation
- Cement fixation

*Pretreatment* primarily includes physical processes used to separate scrap and residues for the next step—dissolution. It may include alcinations, caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing, distillation, filtering of liquids or oils, incineration, magnetic separation, passivation, scraping, or sorting.

After pretreatment, solids are sent to dissolution if plutonium concentrations are above the DL. If concentrations are below the DL, solids are sent to solid waste packaging. Solids below the DL are sent to cement fixation or solid packaging. Liquids are sent to purification if plutonium concentrations are above the DL. Liquids with plutonium concentrations less than the DL are sent to the RLWTF if they meet the TA-50 RLWTF WAC or to evaporation and cement fixation. If the liquids do not meet the TA-50 RLWTF WAC, they are further treated until they meet that WAC.

*Dissolution* includes various steps that generate plutonium nitrate solutions for feed into the purification step. Primary chemicals used in dissolution are nitric acid, calcium fluoride, and/or hydrofluoric acid. Filtered solids are returned to the dissolution operation until plutonium concentrations are below the DL. Once the plutonium concentrations are below the DL, the material is sent to cement fixation for disposal. Debris items are disposed after removal of plutonium contamination above the DL. Plutonium-bearing solutions are sent to purification.

*Purification* consists of ion exchange and precipitation operations. The ion exchange operations use resin-filled columns to collect plutonium, which binds to the resin while impurities flow through the columns; an eluting agent is then used to release purified plutonium in solution. The enriched solutions are then sent to oxalate precipitation. Calcination of the oxalate converts the plutonium to oxide form. The depleted liquids are sent to the evaporator or the RLWTF. The calcined plutonium oxides are sent to the vault.

The evaporator processes plutonium-poor liquids in order to re-concentrate plutonium, if possible, or to reduce the volume of liquid waste. Evaporator bottoms are either sent back to ion exchange or discarded to cement fixation, depending on their plutonium content. Heavy metals that might be present are concentrated in this operation.

In the cement fixation step, wastes with low Pu concentrations are collected and immobilized in cement. Most of the wastes generated

under these operations are classified as cemented wastes and would not normally be part of any debris waste streams.

3.3.5 Miscellaneous Operations

A detailed description of miscellaneous operations can be found in *Acceptable Knowledge Report for Miscellaneous Operations at LANL* (TWCP-AK-2.1-004).

R&D projects involve applied techniques and methods designed to study and improve operations associated with the purification, separation, extraction, recovery, and characterization of actinides (primarily plutonium). General types of these miscellaneous operations are described below.

*Extraction/Separation Studies* involve the processing of actinide hydroxide cakes generated from chloride and nitrate operations. Research in this area also contributes to the development of sensors and instrumentation for online chemical analysis, and improvements in the purification operation. The R&D activities are non-routine and developmental in nature. The activities involve research, process development, small scale trouble-shooting, and occasionally preparation of various isotopes and isotopic mixtures of plutonium, uranium, americium, and neptunium.

*Halogenation Studies* involved the fluorination of samples containing plutonium residues. A gas flow loop was used to pass a fluorinating agent through a gas-solid reactor where plutonium in the solid residue reacted chemically to form solid $PuF_4$ or gaseous $PuF_6$. Gaseous $PuF_6$ was trapped in a cold trap, distilled, and reduced to $PuF_4$. Separation operations involving experimental chlorination operations were similar to the fluorination procedures. A gas loop was used to flow carbon tetrachloride and perchlorocarbons through a gas-solid reactor to chlorinate plutonium oxides to form recoverable plutonium compounds. These studies produce only legacy waste.

*Non-Aqueous Dissolution/Extraction Operations* involves the dissolution of actinide compounds and actinide-containing matrices in superacid media. The superacid solutions are evaporated to leave solid products that are analyzed by a variety of methods. The study of the organometallic chemistry of uranium and thorium in non-aqueous solvents consists of a variety of small-scale organoactinide operations. The organoactinide operations are designed to study the synthesis of new actinide compounds in non-aqueous media. These operations also examine the characterization and reaction chemistry, and consider applications to existing actinide processing technology. Other non-

aqueous operations support fundamental and applied actinide chemistry research, by studying the preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation.

*Analytical Operations* include all analytical techniques performed in Room 124 of the Plutonium Facility. Operations involve the analysis of plutonium and americium, RCRA metals, and trace metals. Originators provide samples, which are prepared for further analyses, such as inductively coupled plasma (ICP) and X-ray energy spectroscopy (XES). Unused liquid samples are returned to the originator, sent to radiochemistry for counting, or sent to recovery operations.

*R&D Efforts*. Several small-scale R&D efforts primarily focus on plutonium recovery including the following activities:

- Fluoride sintering of $PuO_2$ takes advantage of the presence of fluoride to aid the formation of a sintered mass of $PuO_2$ powder at temperatures above 700°C.

- Chlorination of Pu oxides involves oxides with tantalum chips from Rocky Flats Environmental Technology Site (RFETS). Chlorination is used to recover plutonium from potassium chloride and sodium chloride matrices.

- Processing of molten-salt extraction (MSE) salts generated at LANL and RFETS.

- Recovery of plutonium from ash involving plutonium/thorium oxide mixtures.

- Processing of neptunium oxide and metal to remove the protactinium daughter in order to use the neptunium for NDA standards.

*Measurement/Detection Operations and Studies* involved the inspection of oxides and metals. Materials were retrieved from the vault, brought to the glovebox, inspected and sampled if necessary, then repackaged and returned to the vault. Assay methods included XES, laser based spectroscopy, and other spectroscopic techniques. In addition to elemental and isotopic analyses, other measurement studies were designed to calculate the surface area and pore size distribution of a sample and to analyze its surface characteristics. These studies produce only legacy waste.

*Pyrochemical Matrix Studies* conducted from 1986-1992 involved rod milling prior to screening. This operation had two objectives: (1) blending large batches of homogeneous plutonium metal oxides for pyrochemical operations, and (2) dissolving plutonium metal oxides for nitrate operations. The operation changed in August 1992 when a need developed to blend oxides to provide feed material for making NDA standards. In February 1995 to the present, the operation changed again, with the objective of determining the effect of pyrochemical salt matrices on the accuracy of NDA measurements. Activities involve crushing, pulverizing, blending, roasting, and sieving pyrochemical salts. The results are used to determine protocols for handling and processing the salts and to correct bias measurements. The feed material consists of high-purity oxides used in the fabrication of standards for use at LANL and throughout the DOE complex.

*Hydrothermal Processing* involves the reaction of aqueous/organic mixtures, pure organic liquids, or contaminated combustible solids (e.g., ion exchange resins, plastic filters, and cellulose rags) under supercritical (high temperature and pressure) conditions. Feed streams include, but are not limited to, carbon tetrachloride, tributyl phosphate, and organic solvents. Effluents are gases, liquids, and salts. Organic components are oxidized to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

*Electrochemistry Experiments* develop methodologies to decontaminate items, replace operations that produce large amounts of waste, and enhance chemical reactions. The operation involves uranium decontamination of disassembled weapon components from various sites with various levels of plutonium surface contamination. The operation is strictly an aqueous activity in which an alkaline solution is reacted with the components to precipitate uranium. Significant amounts of metal can be stripped in a short period. The solution containing the precipitated uranium salts is then dried for mass balance.

*Metallography Operations* characterize the microstructure of metallic or ceramic pieces to verify and establish the quality and effectiveness of welds. Materials examined consist of plutonium and uranium carbides, nitrides, and oxides, as well as zirconium and tantalum alloys, and stainless steel. Metal pieces (pellets) are cut with a diamond saw. Ceramic pieces are subjected to grinding with standard metal grinding media (e.g., papers impregnated with silicon carbides and diamond). The materials are polished with several different chemical compounds.

*Waste Management Operations.* P/S code RD was used in Room 432 from 1984–1986. It allowed for tracking of demonstration drums (one drum each year) that were packaged and prepared in accordance with the TA-55 Attachments to the Certification Plan (TWCP-701) to meet the WIPP requirements at that time. Packaging of these drums did not of itself result in the generation of TRU waste. The waste drums that were packaged contained non-mixed TRU waste.

Operations under P/S code NCD occurred from April 1989–April 1991 in Room 432. This P/S code was established to provide a mechanism for dealing with TRU drums that did not confirm TA-55 characterization information (e.g., recorded weight or nuclear material content). Non-confirming drums were temporarily set aside until such time as personnel could reprocess them under P/S code WM to correct the non-confirming condition. After April 1991, non-confirming drums were dealt with immediately, and P/S code NCD was no longer needed.

P/S code WM is currently limited to waste generated from the TRU solid waste management operation in Room 432. This practice has been in place since the beginning of 1993. Room trash boxes from Building PF-4 have always been handled as low-level waste. However, when the boxes were assayed to verify contamination levels, some were determined to be TRU waste. These boxes of room trash were diverted to Room 432 for repackaging as TRU waste. From May 1987 through 1992, these boxes were tracked using P/S code XO or X0. These codes were changed to P/S code WM after 1992.

Additional controls were placed on room trash after 1992 and continue to the present. Trash is assayed with the Multiple Energy Gamma Assay System (MEGAS). When a container is rejected because of MEGAS data, the rejected container is returned to the originator for removal of any "hot" item(s). This operation also allows greater control to prevent discarding regulated materials (e.g., RCRA constituents) in room trash.

P/S code X0 is designated for waste materials that can not be associated with a specific room, such as a hallway, mezzanine offices, rest rooms, change rooms, basement, pump rooms, and trolleys. The waste from all these areas, except the pump rooms and trolleys, would be low-level waste and no RCRA constituents are associated with the waste items.

P/S code XO indicates waste materials that are generated within specific rooms but cannot be associated with an individual P/S code in that room.

*Material Management Operations.* P/S codes M1, M2, MM, and M4 are used to introduce and remove items from the glovebox line. TRU waste typically associated with bag-out operations (e.g., stubs, tape) is

packaged with other waste items and assigned HWNs based on the P/S code from which the waste originated. Waste generated in the material management rooms is associated with glovebox maintenance operations. No unit operations are conducted in these rooms, therefore no HWNs are assigned to waste originating from them. The exception is lead-lined glovebox gloves assigned HWN D008.

3.3.6 Special Processing Operations

A detailed description of special processing operations is found in *Acceptable Knowledge Report for Special Processing Operations at LANL* (TWCP-AK-2.1-007).

Special Processing includes operations for Material Type (MT) 42 and R&D activities for MT 52. (See Section 4 and Table 10 for descriptions of plutonium material types.) Because processing MT 42 is a smaller-scale version of the recovery processes used for MT 52, MT 42 processing has five main recovery steps:

- Head-end operations
- Nitrate ion exchange operations
- Chloride ion exchange operations
- Separation and purification by precipitation
- Pyrochemical operations

Only head-end operations and separation by purification and precipitation are covered here. Chloride ion exchange operations, nitrate ion exchange operations, and pyrochemical operations are covered in Sections 3.3.3, 3.3.4, and 3.3.8, respectively.

*Head-end Operations* leach tools, labware, crucibles, rags, etc., in nitric acid to remove recoverable plutonium. Plutonium oxide is typically calcined as part of head-end operations.

*Separation andPurification by Precipitation* is a method for removing plutonium from aqueous solutions. The most common precipitation methods utilize oxalate, hydroxide, and peroxide anions. By selectively precipitating the plutonium, many of the metals remain in solution, thereby purifying the plutonium.

All wastes generated by MT 52 R&D operations are replicated for MT 42 but carry different P/S codes to differentiate and identify the radionuclide content of the waste. Outputs from Special Processing include high purity metal for casting and machining.

3.3.7 Metal Operations

A detailed description of metal operations is found in *Acceptable Knowledge Report for Metal Operations at LANL* (TWCP-AK-2.1-003).

The activities included in metal operations can be divided into three groups:

- On-going metal operations
- Developmental metal operations
- Reactor fuel development

The main goal of metal operations is to take the high purity metal produced by pyrochemical operations and produce shaped metal pieces. On-going metal operations include R&D activities, alloy development, metal casting, welding, coating, and machining/metal work on various metals. Developmental metal operations include the Advanced Recovery and Integrated Extraction System (ARIES) project, assembly operations, burst testing of shells, experimental laser welding, furnace operations, and various other experimental activities. In reactor fuel development, enriched uranium oxide, depleted uranium oxide, and/or plutonium oxide feeds are blended and mixed with graphite. Various operations are performed to convert the feed material into pellets that can be used for fuel. Testing and R&D are done on the fuel pellets.

3.3.8 Pyrochemical Operations

A detailed description of pyrochemical operations is found in *Acceptable Knowledge Report for Pyrochemical Operations at LANL* (TWCP-AK-2.1-006).

Pyrochemical operations include metal preparation, metal purification, and ancillary metal production operations. Pyrochemical outputs are most often high-purity metal feed materials for metal operations.

3.3.8.1 Metal preparation includes the following:

*Metal Preparation Line.* The metal preparation line produced plutonium metal from fluoride salts. Hydrogen fluoride gas was reacted with plutonium oxides obtained from calcinations of oxalate or peroxide precipitates from the aqueous nitrate or chloride process lines. The plutonium compound was further reacted with various chemicals to produce plutonium metal, which could then be recovered as a small globule, or button, by breaking the crucible. This operation generated only legacy waste.

*Direct Oxide Reduction (DOR).* In the single pass DOR operation, plutonium oxide and calcium metal is reacted in molten calcium chloride ($CaCl_2$), or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible. After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which is sometimes recovered by addition of fresh salt plus calcium metal.

*Multiple-Cycle Direct Oxide Reduction (MCDOR)* is used to minimize the salt waste. During the MCDOR operation, the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated.

3.3.8.2 Metal purification operations include the following:

*Molten Salt Extraction (MSE)* is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (TWCP-352). This operation is employed only if the americium content is greater than 1000 ppm. In the original operation (from 1979 to 1988), magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible, and heated to 750 °C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988 and continuing to the present, the MSE operation uses plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. Ninety percent of the americium and ten percent of the plutonium are transferred from the feed metal to the salt. After cooling, the salt and metal are mechanically separated. The salts are transferred to the salt stripping operation.

*Electrorefining (ER).* The ER operation takes impure metal from the MSE and MCDOR (DOR) operations and produces high purity plutonium metal. Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$. After the anode and salt are melted, current is applied to the system, and

plutonium at the anode is oxidized to plutonium ions that travel to the cathode and are reduced back to the metal state. Impurities in the original plutonium anode that are less electroactive than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities more electroactive than plutonium (including barium) remain in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. Anode heels were sent to pyroredox from 1984 to 1986. Currently, salts are sent to chloride operations or carbonate oxidation/distillation.

From 1987 to 1989, secondary solvent metals such as cadmium, bismuth, lead, and gallium were added to experimental studies of the ER operation.

3.3.8.3 Ancillary metal production operations include the following:

*Salt Stripping.* The MSE and ER salts are further treated by salt stripping, oxygen sparging or carbonate oxidation, and salt distillation. The salt stripping operation treats the residue by melting and stirring the salt with calcium metal in a magnesium oxide crucible at 850 °C. This treatment reduces the plutonium in the salt to metal and allows the metal to coalesce for physical removal and recovery. After cooling, the crucible is broken and the metal physically separated and recycled to the ER operation or burned to oxide and sent back through aqueous recovery. The crucible shards are leached in hydrochloric acid, and then discarded.

Oxygen sparging and carbonate oxidation (since 1996) are used to ensure that any plutonium, americium, or metallic sodium or potassium left in the salts are converted to nonpyrophoric oxide forms.

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping operation from February to June 1998. Wastes that potentially contain residual $V_2O_5$ were, at one time, assigned the EPA hazardous waste code P120. However, this assignment has been rescinded: see Section 8.1.

*Salt Distillation* allows for the recovery of plutonium oxide from the chloride salt and produces purified chloride salt for reuse.

*Pyroredox.* The pyroredox operation was used to recover plutonium from spent anode heels in the mid- to late 1980s. The anode heel was polished with calcium metal to remove surface oxide, and then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements more electroactive than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements less electroactive than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded. The metal phase containing zinc was placed in the vault or further treated, and the plutonium eventually was routed back to ER. This operation generated only legacy waste.

*Ingot Casting.* Metal is melted in a MgO crucible to cast the ingot.

*Metal Coalescence.* Metal coalescence is used for plutonium turnings to coalesce the turnings into a metal button. Calcium metal and $CaCl_2$ are added to a MgO crucible along with the turnings and melted.

*Metal Oxidation.* Small pieces of metal remaining on furnace or crucible surfaces are collected for conversion to the oxide phase. These metal pieces are placed in a furnace for the conversion operation. The oxide is then transferred to the vault.

*Neptunium.* Neptunium residues stored in the vault were processed in 1993. This operation generated only legacy waste.

*Pickling.* Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. After a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts so it becomes necessary to leach the plutonium from these items. In addition, after calcium metal reduction operations such as metal preparation, direct oxide reduction, and molten salt extraction, plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals.

*Plutonium Trichloride Preparation* was accomplished by bubbling a carrier gas (chlorine) through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500–600 °C before being absorbed in a 5–6 M (molar) potassium hydroxide solution. In this operation (Jan. 1987–Jun. 1989) the carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases. In June 1989 the operation switched to the use of phosgene gas as the carrier gas until the operation ended in May 1991. Feed material was high purity oxides from the vault or from other P/S codes. The product plutonium trichloride was reduced to metal by the MSE or ER operations. This operation only generated legacy waste.

## 3.4 Material Inputs to the Waste Generation Operations

The feed materials for recovery operations that generate TRU waste are listed in Table 6. These feed materials are obtained either from the storage vault, as outputs from various other Pu-recovery operations, or from sources outside LANL, including other DOE facilities.

These feed materials fall into four general categories:

- Pure Pu metal to be recycled from pits and sealed sources or to be reworked into desired shapes or chemical forms
- Intermediate Pu products in purification operations, in the form of solutions, oxides, hydroxides, salts, anode heels, etc.
- A wide variety of matrices contaminated with Pu above the DL, such as ash, salts, equipment, and solutions
- Experimental R&D feed materials

## 3.5 Chemical Inputs to the Waste Generation Operations

Chemical constituents of inputs are compiled from chemical lists contained in procedures and from subject matter expert (SME) input. Individual operations AK reports contain detailed assessments of these chemical inputs and of the applicability of EPA HWNs. In this section, discussion of the chemical inputs are divided into the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

## Table 6. Feed Materials for Operations Contributing to LANL Waste Streams

| Feed Material | Potential Presence of RCRA-Regulated Substances* | P/S Codes and Associated Operation Areas |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• C-AAC (formerly CLS-1) solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (butanol, F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (Cl-25/TWCP-3547). | Chloride operations: CLS, CW (analytical laboratory solutions from LANL Group C-AAC (formally CLS-1);<br>Miscellaneous operations: APD (C-AAC (formerly CLS-1) solutions); ACL, ICP (TA-55 solutions)<br>Nitrate operations: CF, HP |
| Anode heels | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), chromium (D007), lead (D008), and silver (D011). Heavy metals arsenic (D004), mercury (D009), and selenium (D010) are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | Nitrate operations: AS, BF, BU<br>Pyrochemical operations: RA, SS |
| Ash from P/S codes ETD, IS, SB, TDC, or from other DOE facilities | Usually suspect contaminated with barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic (D004), mercury (D009), and selenium (D010) metals are volatilized at high temperatures if present in the oxide and chloride forms. | Miscellaneous operations: CK, CV, FDL, FLU, SO, XP<br>Nitrate operations: AL, AT, ATL, ED, HGMS, HRA, IS, MPD, PTS, RC, SC<br>Special processing operations: ACD, IAM, SB, SL |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | Chloride operations: CL<br>Nitrate operations: MAS, SC<br>Special processing operations: ACD, SL |
| Disassembled weapons components (pit disassembly) | High-purity Pu and U material types, no RCRA substances present | Metal operations: CA, PH, SRL<br>Miscellaneous operations: EDC<br>Nitrate operations: BM, RB, RBJ |
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity; may or may not contain RCRA substances | Miscellaneous operations: AD, CV, EXT, HRS, RASS, SA, XES, XP<br>Nitrate operations: MAS |
| Hydroxide cakes (output from P/S codes CLS, CW, CXL, DO, POSM, PRR) | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), lead (D008), mercury (D009), silver (D011), and possibly chromium (D007) | Miscellaneous operations: AD<br>Nitrate operations: CD, HCD, HD, LG2<br>Special processing operations: DO, POSM |

**Table 6. Feed Materials for Operations Contributing to LANL Waste Streams (continued)**

| Feed Material | Potential Presence of RCRA-Regulated Substances* | P/S Codes and Associated Operation Areas |
|---|---|---|
| Miscellaneous materials contaminated with Pu (e.g., sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters) | May be contaminated with RCRA-regulated heavy metals silver (D011), cadmium (D006), mercury (D009), lead (D008), and possibly chromium (D007) | Miscellaneous operations: APD<br>Nitrate operations: ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TSC (cellulosic material), VC, ZD<br>Pyrochemical operations: PK (hardware, metal, anode chips from other P/S codes)<br>Special processing operations: ACD, DO, SB, SL |
| MSE salts | Typically fairly pure, suspect contaminated with barium (D005) | Chloride operations: MB, MS<br>Miscellaneous operations: XP<br>Nitrate operations: MB, PS<br>Special processing operations: RM |
| Neptunium residues from vault | No RCRA-regulated substances | Pyrochemical operations: Neptunium (only active in 1993) |
| Pu chlorides and fluorides | Variable purity; may or may not contain RCRA substances | Miscellaneous operations: FDL, SO<br>Pyrochemical operations: ER, SD, SS<br>Special processing operations: RM |
| Pu metal or metal alloy from vault or from various operations | High purity, no RCRA-regulated substances, unless noted otherwise | Metal operations: AAP, AO, ARI, BC, BT, CA, DA, ELW, EVAC, FSPF, ITF, ITF4, JA, KBTF, MA, MBC, MW, PCH (variable purity), PD, PE, PF, PH, RL, SRL, VD, WE, WLT<br>Miscellaneous operations: AC, AC1, AC2, EXT, LIBS, ME, SA, SMP, VS<br>Nitrate operations: ATL, BM, BU, MF, PAF, VP1<br>Pyrochemical operations: CRD (variable purity), MO, SCB, SS, SSMD<br>Special processing operations: ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |
| Pu oxalates | Typically fairly pure, no RCRA substances present | Nitrate operations: CC, DF, HC |

**Table 6. Feed Materials for Operations Contributing to LANL Waste Streams (continued)**

| Feed Material | Potential Presence of RCRA-Regulated Substances* | P/S Codes and Associated Operation Areas |
|---|---|---|
| Pu oxides | Variable purity oxides from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals cadmium (D006), chromium (D007), and lead (D008)<br>High purity oxides from P/S codes CA, DO, and MA, and from the vault; may or may not contain RCRA substances | Metal operations: DOP (high-purity Pu and other radionuclides as oxides)<br>Miscellaneous operations: CK, CV, EOC, EXT, FDL, FLU, IB, LI, LIBS, SO, STF, VS, XP<br>Nitrate operations: ATL, BL, CH, CPOD, DP, ED, FC, HRA, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2<br>Pyrochemical operations: MP (generally high purity), OR (variable purity), PTP<br>Special processing operations: DO, PX, POSM |
| Pu-Be sources | High purity constituents, no RCRA-regulated substances | Chloride operations: PB, PUB |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than barium (D005) are present | Chloride operations: MB, MS, PRR<br>Miscellaneous operations: EXT, IB<br>Nitrate operations: COD, COL, MB<br>Special processing operations: DO |
| Reactor fuel pellets | High purity Pu and U material types, no RCRA-regulated substances | Miscellaneous operations: ME |
| Stainless steel and/or tantalum residues from decladding of Pu-Be sources | High purity metals, potential leaching of chromium (D007) from stainless steel if subjected to strong acid | Chloride operations: PUB |

* The information in this column is highly generalized. Applicability of specific HWNs to an operation as a result of the feed material must be determined on a case-by-case basis because the presence and fate of contaminants is time and function dependent. These aspects are discussed in the AK reports.

3.5.1 *Acids and bases.* Acids used in the Pu recovery operations are ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, perchloric acid, phosphoric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$). Bases used in the operations are calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. No EPA HWNs are applicable to the use of these chemicals in the recovery operations for the following reasons:

- D001 (oxidizer), D002 (corrosivity), and D003 (reactivity) do not apply to the solid waste because there are no free liquids in this waste.
- D001, D002, and D003 also do not apply despite the possible production of perchlorate salts in perchloric acid solutions because:
  - Perchloric acid solutions are sent to cement fixation.
  - Perchlorate salts used in P/S code FF were sent to cement fixation (TWCP-5158).

  Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded.
- The EPA HWNs U123 and U134 associated with formic acid and hydrofluoric acid are not applicable to the manner in which these chemicals were used in the operations covered by this report.
- None of the acids or bases are F, K, or P-listed chemicals

Table 7 provides a list of these acids and bases, their HWN, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in the plutonium recovery process.

3.5.2 *Gases and cryogenic fluids.* The following gases and cryogenic fluids used in the recovery operations are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation:

- Argon
- Carbon dioxide
- Chlorine
- Dioxygen difluoride (FOOF)
- Halogen fluorides
- Hexafluoroethane
- Hydrogen chloride
- Krypton fluoride
- Methane

## Table 7. Acids, Bases, and Gases in Operations Contributing to TA-55 Waste Streams

| Acid, Base, or Gas and P/S Code in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| *Appendix VIII Gases*:<br>• Fluorine (P/S CV, FDL, FLU, PI, SO)<br>• Hydrogen fluoride (P/S MP, PI)<br>• Nitrogen dioxide (P/S HRS)<br>• Phosgene gas (P/S PTP) | P056 (fluorine), P078 (nitrogen dioxide) and P095 (phosgene) are not applicable to the use of these gases in the recovery operations. Compressed gas cylinders are kept outside of the gloveboxes; most are even outside the building, and the gases are plumbed into the glovebox (TWCP-4164). Thus, the gas cylinders are not discarded with TRU wastes.<br>D003 (reactivity) does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution. |
| Formic acid (P/S EV) | U123 not applicable because there is no record of unused or unspent chemical in the glovebox. |
| Hydrofluoric acid (P/S AC, AC1, AC2, AC3, AX, SA) | U134 not applicable because there is no record of unused or unspent chemical in the glovebox. |
| Perchloric acid (P/S AD, AC, AC1, AC2, AC3, AX, SA) | D001 (oxidizer), D002 (corrosivity), and D003 (reactivity) do not apply despite the possible production of perchlorate salts in perchloric acid solutions because:<br>• Perchloric acid solutions are sent to cement fixation.<br>• Perchlorate salts used in P/S code FF were sent to cement fixation (TWCP-5158).<br>• Any perchlorate salts that might be present on rags are removed when the rags are rinsed before being discarded. |
| *Non-Appendix VIII Acids:* ascorbic acid, formic acid, hydrochloric acid, hydrofluoric acid, nitric acid, oxalic acid, phosphoric acid, stearic acid, sulfuric acid, and superacids (e.g., $HSO_3F$) (Multiple P/S codes) | D001 (oxidizer), D002 (corrosivity), and D003 (reactivity) do not apply to the solid waste because there are no free liquids in this waste. |
| *Non-Appendix VIII Bases*: calcium hydroxide, magnesium hydroxide, potassium hydroxide, and sodium hydroxide. (Multiple P/S codes) | D001 (oxidizer), D002 (corrosivity), and D003 (reactivity) do not apply to the solid waste because there are no free liquids in this waste. |
| *Non-Appendix VIII Gases*:<br>argon, carbon dioxide, chlorine, dioxygen difluoride (FOOF), halogen fluorides, hexafluoroethane, hydrogen chloride, krypton fluoride, methane, nitrogen (gas), nitrogen (liquid), perfluoropropane, and tetrafluoromethane (Multiple P/S codes) | D001 (oxidizer), D002 (corrosivity), and D003 (reactivity) do not apply to the solid waste because there are no free liquids in this waste. |

- Nitrogen (gas)
- Nitrogen (liquid)
- Perfluoropropane
- Tetrafluoromethane

The following gases used in the recovery operations are identified in Appendix VIII of 40 CFR Part 261 as having hazardous characteristics. The chemical name is followed by the listed EPA HWN and the P/S codes in which the gas is used:

- Fluorine (P056) is used in P/S codes CV, FDL, FLU, PI, SO
- Hydrogen fluoride (U134) is used in P/S codes MP, PI
- Nitrogen dioxide (P078) is used in P/S code HRS
- Phosgene gas (P095) is used in P/S code PTP

No EPA HWNs are applicable to the use of these gases in the recovery operations. Compressed gas cylinders are kept outside of the gloveboxes; most are even outside the building. The gases are plumbed into the glovebox (TWCP-4164).

Table 7 provides a summary of these gases, their HWN, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in the plutonium recovery process.

The gas cylinders are not discarded with TRU wastes. Additional reasons the HWNs are not applicable include:

- D002 (corrosivity) does not apply to the use of hydrogen fluoride because there are no free liquids in the solid TRU waste.

- D003 (reactivity) does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution.

- P056 (fluorine), P078 (nitrogen dioxide) and P095 (phosgene) are not applicable to the listed recovery operations because of the manner in which these gases are used in the operations covered by this report.

- Hydrogen fluoride (U134) is listed in Appendix VIII of 40 CFR Part 261 for its corrosive and toxic characteristics. However, this code is not applicable to the manner in which this gas is used in the operations covered by this report.

3.5.3 *Metals*. The following metals used in the recovery operations are not identified as having hazardous characteristics in 40 CFR Part 261,

including Appendix VIII of that regulation: bismuth, bismuth-tin alloy, calcium, copper wool, gallium (metal, oxide or salt), gold, lanthanides, lutetium, niobium +1 percent zirconium metal, platinum, platinum-rhodium alloy, tantalum (metal, alloy, oxide or salt), titanium, uranium powder (depleted), vanadium, and zirconium alloy.

Several metals used in recovery operations are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. The bullets below list the chemical name, the associated EPA HWN, the P/S codes in which the metal is used, and the applicability of the EPA HWNs for use of these metals in the recovery operations:

- Alkaline earth metals (D003) are used in P/S codes AC, AC1, AC2, and OR; it is possible that one or more of these are pyrophoric. However, EPA HWN D003 does not apply to P/S codes AC, AC1, AC2, or OR because the metals are consumed or oxidized before discarding.

- Arsenic (D004) was used in P/S code PE between 1984 and 1985, and EPA HWN D004 is applicable to P/S code PE during this period.

- Cadmium (D006) applies to a limited number of anode heels produced in P/S codes ER, PX, and SS using cadmium as a solvent.

- Lead (D008) is used in P/S codes DOP, ER, KBTF, PX, and SS. For combustible waste, EPA HWN D008 is applicable to P/S codes DOP, KBTF, and PX. For P/S codes ER and SS, D008 is only applicable to the metal waste (TWCP-5167).

- Tin-lead (D008) solder was used in sensors in P/S code BT, but D008 is only applicable to the metal waste from this P/S code, and not to the combustible waste.

- Mercury (D009) applies to P/S code SSMD, in which it was used for about one week in the summer of 1994.

- Nickel powder was used in P/S code CO as a sintering aid. This metal is listed in Appendix VIII but no HWN is given.

- Sodium (D003) was used in P/S code EL. However, D003 does not apply in this case because excess Na is dissolved in Dowanol 80.

- Stainless steel (contains chromium, D007) was used in P/S code WE. However, EPA HWN D007 does not apply in this case. There is no

potential to leach chromium because stainless steel is not exposed to strong acids in P/S code WE.

Table 8 provides a summary of these metals, their HWN, P/S codes in which they were used, and the applicability of the HWNs to the use of these chemicals in recovery operations.

3.5.4 *Inorganic chemicals.* The following inorganic chemicals used in the recovery operations are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: aluminum chloride, aluminum fluoride, aluminum nitrate, aluminum oxide, ammonium chloride, antimony pentafluoride, bromine, calcium carbonate, calcium chloride, calcium fluoride, calcium nitrate, cerium nitrate, cesium chloride, cobalt nitrate, dicesium hexachloroplatinate (DCHP), ferric ammonium sulfate hydrate, ferric nitrate, ferrous ammonium sulfate, ferrous chloride, ferrous sulfamate, graphite, gypsum cement, hydrogen peroxide, hydroxylamine chloride, hydroxylamine hydrochloride, hydroxylamine nitrate, iodine, lanthanum nitrate, lithium chloride, magnesium chloride, magnesium oxide, magnesium perchlorate, molybdenum oxide, phosphates, Portland cement, potassium chloride, potassium fluoride, potassium permanganate, potassium thiocyanate, silicone lubricant, sodium bicarbonate, sodium carbonate, sodium chloride, sodium chlorite, sodium citrate retarder, sodium dithionate, sodium nitrate, sodium nitrite, sodium oxalate, sodium sulfate, sodium tetraborate, stannous chloride, thorium oxide, uranium oxide (depleted), zinc chloride, zinc stearate, and zirconium carbide. Some operations indicate the use of nitrate, chloride, carbonate, bicarbonate, oxalate, and nitrite salts of sodium, potassium, lithium, magnesium, calcium, and iron.

Several inorganic chemicals used in recovery operations are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 8 lists these chemicals, their HWN, P/S codes in which they are used, and the applicability of the HWNs to the use of these chemicals in recovery operations.

*Organic chemicals.* The following organic chemicals used in the recovery operations are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: 1-propanol, 3-in-1 household oil, alkylating agents (unspecified), bromobenzene, bromocresol purple, carbon tetrafluoride, Citrapeel, DBBP (dibutyl butyl-phosphonate), DBBP (dibutyl butyl-phosphonate)/Isopar (isoparaffinic hydrocarbon solvent), diethyl oxalate, dihexyl n,n-diethylcarbamoylmethyl phosphonate (DHDCMP), di-isopropyl benzene, Dow Corning 2000 Oil, Dowanol 80 (long-chain alcohol), ethanol, ethylene glycol, Fantastic, formamide, Fomblin brand

## Table 8. Use of RCRA-Regulated Metals and Inorganic Chemicals in TA-55 Operations

| Inorganic Chemicals, Metals and P/S Codes in Which They Were Used | Comments on Applicability of RCRA Codes |
|---|---|
| Alkaline earth metals (P/S AC, AC1, AC2, and OR) | D003 does not apply because these potentially pyrophoric metals are consumed or oxidized before discarding. |
| Arsenic (P/S PE between 1984 and 1985) | D004 is applicable to P/S code PE during this period. |
| Barium (various) | D005 is applicable because barium is an impurity in ash feed material, and a suspect impurity in molten salt extraction and pyrochemical salts. |
| Cadmium (anode heels produced in P/S ER, PX, and SS) | D006 applies to a limited number of anode heels produced using cadmium as a solvent. |
| Chromium (various) | D007 is applicable because chromium is an impurity in analytical laboratory solutions, anode heels, hydroxide cakes, ash, and plutonium oxides; leached by strong acid from stainless steel in the evaporators; introduced as potassium dichromate (endpoint indicator) and sodium chromate (used in the separation of plutonium and thorium) |
| Hydrogen peroxide (various) | D001 (ignitability—oxidizer) and D003 (reactivity) do not apply to the use of hydrogen peroxide because there are no free liquids in the TRU solid waste. |
| Lead (P/S DOP, ER, KBTF, PX, and SS) | For combustible waste, EPA HWN D008 is applicable to P/S codes DOP, KBTF, and PX. For P/S codes ER and SS, D008 is only applicable to the metal waste (TWCP-5167). |
| Lead hydroxide, oxide, or nitrate (P/S AD) | D008 (lead) applies to P/S code AD. |
| Magnesium perchlorate (P/S FF) | D001 (oxidizer) does not apply to the use of this chemical in P/S code FF because it was sent to cement fixation (TWCP-5158). |
| Mercuric nitrate (P/S VP1 and VP3) | D009 (mercury) applies to P/S codes VP1 and VP3. Mercuric nitrate is used as a catalyst in P/S code VP1; the hydroxide cake produced in VP1 is processed in P/S code VP3. |
| Mercury (P/S SS, MD) | D009 applies to P/S code SSMD for about one week in the summer of 1994. |
| Nickel powder (P/S CO) | No HWN applies to nickel. |
| Potassium dichromate (P/S AD, CS, CSE, DO, and SE) | D007 (chromium) applies to P/S codes AD, CS, CSE, DO, and SE because of the use of potassium dichromate as a titration endpoint indicator until end of 1993. The solution and precipitates were processed by hydroxide precipitation under the same codes. The chromium was incorporated as a contaminant in the hydroxide cakes. |
| Selenium (various) | D010 applies because selenium is an impurity found in ash (P/S codes IS, SB, and TDC) and in materials processed from other DOE sites. |

## Table 8. Use of RCRA-Regulated Metals and Inorganic Chemicals in TA-55 Operations (continued)

| Inorganic Chemicals, Metals and P/S Codes in Which They Were Used | Comments on Applicability of RCRA Codes |
|---|---|
| Silver, silver nitrate and other silver salts (P/S AC1, CPOD, CS, CSE, DO, SE) | D011 (silver) applies to P/S codes CW and CX due to the use of silver nitrate for chloride titrations under P/S codes CS, CSE and SE until 1993. The solution and precipitates were processed by hydroxide precipitation under P/S codes CW and CX. Silver was incorporated as a contaminant in the hydroxide cakes.<br>D011 (silver) applies to P/S code CPOD due to the use of silver nitrate as a catalyst from 1990 to 1994. D011 (silver) applies to P/S code AC1 due to the use of silver salts. |
| Sodium (P/S EL) | D003 does not apply in this case because excess sodium is dissolved in Dowanol 80 to form a stable sodium salt. |
| Sodium chromate (P/S PT) | D007 (chromium) applies to P/S code PT due to the use of sodium chromate in the separation of thorium from plutonium and americium. |
| Stainless steel (contains chromium, P/S WE) | D007 does not apply in this case, as there is no potential to leach chromium because stainless steel is not exposed to strong acids in P/S code WE. |
| Tin-lead solder (sensors in P/S BT) | D008 is only applicable to the metal waste from this P/S code, and not to the combustible waste. |
| Uranium nitride, depleted (P/S FF) | D003 (reactivity) does not apply to the use of uranium nitride in P/S code FF. Although this chemical is pyrophoric, its disposal in an oxidizing environment eliminates this characteristic because it is converted to uranium oxide. Uranium nitride is oxidized in the passivation furnace (P/S code PA) prior to discard. |

pump oil, GoJo cleaner (kerosene derivative), hexane, hydrazine dihydrochloride, hydrazine hydrochloride, ion exchange resin, isopropanol, kerosene, Metalprep 79 (phosphoric acid-based metal cleaner), MolyKote, n-dodecane, Nuetracleaner #1, Nuetracleaner #2, octylphenyl di-isobutyl carbamoylmethyl phosphine oxide (CMPO), oil (engine), organic liquid emulsifier, Organicstrip, perchlorocarbons (unspecified), phenolphthalein, phosphate buffer solution, phosphine oxide compounds, phthalate buffer solution, polyethylene glycol, polyoxyethylene-20-sorbitan laurate (surfactant), SF-2I (as coolant), silicon adhesive, silicon defoamer, sugar, surfactants, tetraethylamine hydrochloride, tetraethylamine hydroxide, tetraethylammonium hydroxide, Texaco Regal 32 oil (cutting oil), thionyl chloride, tributyl phosphate (TBP), tributyl phosphate (TBP)/Isopar (isoparaffinic hydrocarbon solvent), tributyl phosphate and iodine in kerosene, trioctylphosphine oxide (TOPO), urea, Vactra oil, vacuum grease, vacuum pump oil, WD-40, and Windex.

Several organic chemicals used in recovery operations are identified in 40 CFR Part 261 or in Appendix VIII of that regulation as having hazardous characteristics. Table 9 lists these chemicals, their HWNs, P/S codes in which they are used, and the applicability of the HWNs to the use of these chemicals in recovery operations.

D001 (ignitability) and D003 (reactivity) do not apply to wastes in waste stream TA-55-30 despite the use of spent non-halogenated solvents (HWN F003) for the following reasons:

- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for plutonium.

- Solutions containing spent solvents and above the DL for plutonium are further treated by aqueous recovery activities as part of routine chloride and nitrate operations. Aqueous recovery involves dissolving any solid plutonium in hydrochloric or nitric acid, followed by ion exchange to extract the plutonium.

- The processed solutions are below the DL for plutonium and are either sent to the RLWTF or to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, a waste form for which ignitability is not a concern.

- Rags, if contaminated with spent solvents and above the DL for plutonium, are thermally decomposed, which destroys any organic component.

## Table 9. Use of RCRA-Regulated Organic Chemicals in TA-55 Operations

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Acetone (P/S codes FF, ME, and MOX) | • F003 applies to all debris waste generated by P/S code ME. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical.<br>• F003 does not apply to P/S code FF or MOX because it was only used outside the glovebox. |
| Acetonitrile (P/S code AC2) | • U003 does not apply due to the manner in which this chemical is used in P/S code AC2 (Appendix VIII chemical). |
| Benzene (P/S codes AC, AC1, AC2, and SA) | • D018 (benzene) applies to P/S codes AC, AC1, AC2, and SA, in which it was used as a solvent.<br>• F005 applies to all debris waste generated by P/S codes AC, AC1, AC2, and SA. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste, which could be contaminated with this organic chemical. |
| Butanol (P/S codes CLS, CW, APD, ACL, ICP, CF, and HP) | • F003 does apply to all debris waste generated by P/S codes CLS, CW, APD, ACL, ICP, CF, and HP. |
| Carbon tetrachloride (P/S codes AD, CV, PTP, and PX) | • D019 (carbon tetrachloride) applies to P/S codes AD, CV, PTP and PX. This chemical was used in PTP between 1/87 and 6/89.<br>• F002 does not apply to P/S codes AD, CV, PTP, or PX because it was not used as a solvent or for degreasing. |
| Chlorobenzene (P/S codes CLS, CW, APD, ACL, ICP, CF, and HP) | • F002 does apply to all debris waste generated by P/S codes CLS, CW, APD, ACL, ICP, CF, and HP. |
| Chloroform (P/S codes AC, AC1, AC2, APD, FF, and XO) | • D022 (chloroform) applies to P/S codes AC, AC1, AC2, APD, FF and XO. |
| Ethyl ether (P/S code SA) | • F003 applies to all debris waste generated by P/S code SA. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical. |
| Freon and Freon TF (P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | See entry for 1,1,2-trichloro 1,2,2-trifluoroethane. |

**Table 9. Use of RCRA-Regulated Organic Chemicals in TA-55 Operations (continued)**

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Methanol (P/S codes AD and SO) | • F003 applies to all debris waste generated by P/S code AD, in which methanol may have been used for cleaning inside the glovebox. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical.<br>• F003 does not apply to P/S code SO because it was used in a cold trap outside the glovebox. |
| Methylene chloride (P/S code AC1) | • F002 applies to all debris waste generated by P/S code AC1. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical. |
| Methyl ethyl ketone (P/S codes MA and XO) | • D035 (methyl ethyl ketone) applies to P/S codes MA and XO.<br>• F005 applies to all debris waste generated by P/S codes MA and XO, in which this chemical was used as a solvent. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical. |
| Pyridine (P/S codes AC and SA) | • D038 (pyridine) applies to P/S codes AC, AC2 and SA.<br>• F005 applies to all debris waste generated by P/S codes AC, AC2, and SA, in which this chemical was used as a solvent. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical. |
| Tap Magic (P/S code MA) | See entry for 1,1,1 trichloroethane. |
| Tetrachloroethane (not used) | • No RCRA codes apply to tetrachloroethane, an Appendix VIII chemical. Although it is listed on the chemical inventory for metal operations, it was never used in glovebox operations. |

## Table 9. Use of RCRA-Regulated Organic Chemicals in TA-55 Operations (continued)

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| Tetrachloroethylene (P/S codes AD, APD, CSE, CV and SE) | • D039 (tetrachloroethylene) applies to P/S codes AD, APD, CSE and SE in which it was used until 1992.<br>• D039 does not apply to P/S code CV because it was used as a coolant outside the glovebox.<br>• F002 applies to all debris waste generated by P/S codes AD, APD, CSE and SE, in which this chemical was used as a solvent. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste which could be contaminated with this organic chemical. Its use as a solvent in P/S code CSE and SE ended in 1992.<br>• F002 does not apply to P/S code CV because it was only used as a coolant outside the glovebox. |
| Tetrahydrofuran (P/S codes AC, AC2, and SA) | • U213 is not applicable to the use of this chemical because there is no evidence of a spill or of spill residues entering TA-55 TRU waste streams. |
| Toluene (P/S codes AC, AC2 and SA) | • F005 applies to all debris waste generated by P/S codes AC, AC2 and SA, in which this chemical was used as a solvent. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical. |
| 1,1,1 trichloroethane (ingredient in Tap Magic) (P/S code MA) | • F002 applies to P/S code MA because Tap Magic may have been used as a metal cutting fluid, coolant, or as a solvent. Its use was discontinued in 1992. See the discrepancy documentation on this in Attachment 8. |
| Trichloroethylene (P/S codes CK, EL, FF, MA, ME, and XO) | • D040 (trichloroethylene) applies to P/S codes EL, FF, MA, ME, and XO.<br>• D040 does not apply to P/S code CK because this chemical was used as a coolant outside the glovebox.<br>• F001 applies to all debris waste generated by P/S code MA, in which this chemical was used as a degreaser during final cleaning of metal parts from 1979 to 1992 (resuming again in February 2000). Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical.<br>• F002 does not apply to P/S codes EL or FF, where it was used as a lubricant for a cutting saw, not as a solvent. |

**Table 9. Use of RCRA-Regulated Organic Chemicals in TA-55 Operations (continued)**

| Organic Chemical and P/S Codes in Which It Was Used | Comments on Applicability of RCRA Codes |
|---|---|
| 1,1,2-trichloro 1,2,2-trifluoroethane (ingredient in Freon and Freon TF)<br>(P/S codes CA, DA, MA, MW, PD, PF, SCB, SRL, UA, VD, WE and XO) | • F002 applies to all debris waste generated by P/S codes DA, MA, WM, and XO. Metal and glass are non-porous and do not absorb liquids, and any metal or glass in contact with this chemical would have been air-dried before being discarded as waste. However, these waste streams also contain a small percentage of combustible waste that could be contaminated with this organic chemical.<br>• F002 does not apply to P/S codes CA, MW, PD, SCB, SRL, UA, VD and WE. Although Freon TF is used as a solvent to clean metal parts, the parts are routinely air-dried to avoid the need for cellulosic wipes.<br>• F002 does not apply to P/S code PF, where Freon was used as a coolant for a cutting saw, not as a solvent. |
| Xylene (P/S codes CLS, CW, APD, ACL, ICP, CF, and HP) | • F003 does apply to all debris waste generated by P/S codes CLS, CW, APD, ACL, ICP, CF, and HP. |

- Although contaminated rags that are below the DL for plutonium are discarded as combustible debris, headspace gas analyses support the expectation that the solvents are below the limits established by the WIPP WAC. In addition, 100 percent of the waste containers are subjected to headspace gas analysis. Any container with a total concentration of potentially flammable volatile organic compounds (VOCs) above the limit set by the WIPP WAC is prohibited from being shipped to the WIPP.

## 4.0 RADIONUCLIDE CONTENT OF THE WASTE STREAMS

### 4.1 Pu-238, Pu-239, Pu-240, Pu-241, and Pu-242

The primary Pu material type inputs for the plutonium recovery process are listed in Table 10. The designation *material type* is used to describe the isotopic composition of common blends of radioactive materials used within the DOE complex. The primary material type that feed into the plutonium recovery process is weapons grade plutonium (MT 52). However, the other material types are occasionally introduced as feed material.

Recovery operations are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the operation generating each waste item is documented on generator records; however, in many cases, items of different material types are packaged into the same waste drum, so that a variety of Pu isotopic ratios may be detected by radioassay. In addition, cross-contamination of equipment with different material types can lead to variable material types detected by radioassay, particularly in the thermal decomposition unit (P/S code TDC).

Pu-242 cannot be measured by gamma spectroscopy, so its abundance is calculated based on empirical isotopic correlations for other waste containers with small fractions of Pu-242, such as weapons grade plutonium bearing waste. In some cases, Pu-242 is estimated using an iterative procedure based on active and passive neutron data from a single waste container if the plutonium isotopic ratios are known for the other plutonium isotopes. This second method is used when the result from the correlation is suspect for waste containers with high levels of enriched Pu-242. The Pu-242 in these latter containers may also be derived from process knowledge if necessary.

### 4.2 U-233, U-234, U-235, and U-238

U-233 and U-238 are not normally components of the Pu-239 material types handled at TA-55. U-235 would be present from the decay of Pu-239 only at 0.1% by weight of the total Pu content. However, all three isotopes have been introduced as special material. Generator assays and AK information on the amounts present are not available. Project 2010 assay personnel analyze for and

## Table 10. Average Isotopic Content of Plutonium Material Types and Enrichments

| Material Type (MT) | Plutonium Isotope (Wt. %) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Sources: TWCP-698, TWCP-8003

report U-233, U-235, and U-238 since they are introduced into the plutonium recovery process stream.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposely contain uranium. However, some reactor fuel development and pit disassembly activities have uranium material as the feed material. The primary uranium material type inputs are listed in Table 11.

**Table 11. Average Isotopic Content of Uranium Material Types and Enrichments (Wt. %)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Sources: TWCP-698, TWCP-8003

U-234 content must be estimated since this isotope cannot be reliably measured using NDA techniques (TWCP-9810). The material type provides the basis for estimating an upper bound for U-234 based on the rate of decay of the precursor, Pu-238, and the assumption that there is no other source of uranium in the waste material. The standard uranium material types provide an estimate of the ratio of U-234 to U-235 for the material likely to be input to recovery operations. The content of U-234 in the Pu-239 material types is calculated as the sum of the contributions expected from decay of Pu-238 and from uranium input to the operation, with the value of 0.014 conservatively used for the ratio of abundances of U-234 to U-235 in typical uranium material types.

4.3 Am-241

AK on the material type inputs provides the basis for estimating an upper bound for Am-241 content based on the rate of decay of the precursor, Pu-241. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of Am-241 based on radioassay results for individual waste containers. The calculations assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the legacy waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698). In general, wastes from the plutonium recovery process are enriched in Am-241, because a

primary intent of the recovery process is to reduce the americium content of the retained plutonium.

No correlation is expected among the different radioelements, Pu, Np, U, Pa or Am. The differences in valence states and chemical affinities among these elements are expected to result in substantial fractionation during several recovery operations, including ion exchange, solvent extraction, hydroxide precipitation, and dissolution.

4.4 Other Radionuclides Present Due to Decay

Other radionuclides will be present in most of the wastes from the decay of a Pu isotopic precursor or as a contaminant in the feed material:

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present in minor amounts in most waste from recovery operations.
- Am-243, the decay product of Pu-243 (half-life, 5.0 hr), is expected to be present in minor amounts in most wastes from recovery operations. Pu-243 is produced by neutron capture on Pu-242 during fuel irradiation.
- Protactinium (Pa)-231, the decay-chain daughter of U-235, is expected to be present in trace amounts in some wastes due to its widespread presence as a contaminant in recovery operations (TWCP-5164, TWCP-5165).
- Actinium (Ac)-227, the decay-chain daughter of Pa-231, is expected to be present in trace amounts where Pa-231 is present, but at several orders of magnitude less than Pa-231.

4.5 Cs-137 and Sr-90

4.5.1 Cs-137

Cs-137 is a product of the spontaneous fission of Pu-238, Pu-239, and especially Pu-240. Cs-137 is also a trace contaminant in purified plutonium from the production reactors (TWCP-5164, TWCP-5165). In the latter case the remaining Cs could be on the order of 0.5 ng/g Pu. In the former instance the formation of Cs-137 due to spontaneous fission would lead to about 0.4 pg/g Pu in plutonium that is 10 years old. Because Cs-137 due to spontaneous fission is about a factor of a thousand less than that due to residual contamination from the original separation on the production fuel, the latter is the dominant source of Cs in waste.

4.5.2 Sr-90

Based on interviews of SME, no spent nuclear fuel or other material containing Sr-90 were introduced into the TRU waste streams (TWCP-

882). No references or procedures related to spent fuel processing were located in the AK investigation of records. No generator documents (WODF, DWSR, TWSR, Waste Profile Form [WPF]) identified spent fuel or Sr-90 as inputs or as present in the waste.

During review of WPFs and database records from the waste storage facility (TA-54), use of material containing Sr-90 was identified in 771 drums of waste originating from TA-03 and TA-21. WPFs indicate processing of fuel pins in metallography operations and of samples of Hanford Tank waste in chemistry experiments. These operations and wastes are segregated by facility of origin, and the wastes are not commingled with wastes from LANL. Like Cs-137, Sr-90 is a high yield fission product and is unlikely to be present except as a trace remnant from Pu production/processing. Unlike Cs-137, however, Sr-90 (together with its Y-90 daughter) emits no significant gamma radiation that would allow it to be quantified by direct gamma counting. Therefore, no reliable means exists for the direct NDA of Sr-90. However, because of the requirement that an estimate of Sr-90 content be made, the following approach is taken at LANL.

In Pu production runs, Cs-137 and Sr-90 are produced at approximately the same atom level. These two nuclides have very similar half-lives (~ 30 y) and will therefore be present at roughly the same activity level prior to commencement of any processing operations. If it is assumed that Sr and Cs are not fractionated from one another during chemical processing, Cs-137 may be used as a marker for Sr-90 activity ratio of 1:1, yielding an estimated value for Sr-90. While this cannot be considered a valid assay method, LANL has adopted it as an "operationally defined" means for estimating the Sr-90 content in waste streams.

The assumption that Cs and Sr track one another in operations associated with Pu recovery/processing deserves further elaboration because this is a fundamental tenet of the above method used for the estimation of Sr-90. SMEs have evaluated the fractionation of Cs from Sr in the major operations (i.e., aqueous ion exchange, oxalate/hydroxide precipitation, and pyrochemical processing).

In both nitrate and chloride ion exchange work, the Cs and Sr pass unretained through the columns and are therefore not fractionated. Neither element will precipitate as an oxalate or hydroxide at the concentrations present in process solutions; both remain together in the solution phase. Finally, both elements remain associated with the molton salt phase in a pyrochemical extraction and reduction. Any reduction of Sr by calcium metal ($Ca^0$) in the DOR process will behave like residual $Ca^0$ and remain in the salt (i.e., not with metallic Pu). The formal reduction potential of the $Cs/Cs^+$ to be reduced is significantly more

negative than the reduction potential of the $Ca/Ca^{++}$ couple and therefore, the Cs will largely remain in the salt phase as $Cs^{+}$. Sr and Cs should therefore remain associated with one another throughout processing operations.

Following its production in a reactor, Pu is purified using an extraction-based process (e.g., PUREX) prior to being shipped to other facilities such as Los Alamos. This initial chemistry is particularly effective at removing Cs and Sr (WHC-CM-5-25 "Purex Technical Manual" 8/25/88). Although the exact Sr/Cs ratio is difficult to ascertain, Cs-137 and Sr-90 are both estimated to be at weight fractions around $10^{-9}$ in Pu received into LANL.

From the above discussions LANL assumes that Cs-137 and Sr-90 are each present at about $10^{-7}$ % in freshly isolated Pu, and that they are not fractionated from one another in chemical operations performed at LANL. This supports the conclusion that Sr-90 may be estimated, albeit crudely, from the direct measurement of Cs-137.

4.6 Other Radionuclides Introduced as Feed Material

Secondary radionuclides are also present in the waste due to operations involving feed materials other than Pu (TWCP-698). Additional radionuclides expected to be present in each operation were listed by a panel of experts from LANL. The resulting list is documented in a memorandum linking the radionuclides to P/S codes (TWCP-882, amended by TWCP-5166). The list (see Table 12) includes Am-241, Am-243, cerium (Ce)-144, curium (Cm)-244, Np-237, Pa-231, Pu-238, Th-230, Th-232, U-233, U-235, and U-238.

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of a radioassay instrument to use for optimal results. Cm-244 was introduced in recovery operations in P/S code DOP, which started in 1988 (TWCP-5165). Material outputs from this operation sometimes are sent to P/S codes IS or WE. Cm-244 could also be part of waste under P/S code CA because both operations take place in the 300 Wing of PF-4. Because only one room in this area is available for bagouts, TRU waste from P/S codes DOP and CA are sometimes combined. In addition, because rags from DOP are sent to IS, Cm-244 could be present in the ash produced by this operation, which is then processed through nitrate aqueous recovery operations. Some unknown fraction of the Cm-244 could ultimately end up in the evaporator bottoms, which is then immobilized in cement in P/S code CF. In any case, however, Cm-244 is not expected to be present in any waste generated before 1988.

## Table 12. Secondary Radionuclides in Plutonium Recovery TRU Waste

| Secondary Radionuclide | P/S Code Generating Waste |
|---|---|
| Actinium-227 | AD, ARI, BC, CV, FF, HGMS, LIBS, PF, SRL, WM, XO. |
| Americium-241 | AO, AP, CA, CD, CF, CLX, CXL, DOP, EV, FA, HCD, HD, HP, IA, LR, MA, OH, PI, PR, PRR, PS, SS, SX, WE, XP; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Pu-241 decay. Waste could be either depleted or enriched in Am depending upon whether the source of contamination is the product or the residues. |
| Americium-243 | BC, CA, DOP, JA, MA, PH, PI, SS, WE. |
| Cerium-144 | DOP, WE. |
| Curium-244 | DOP, IS (Mar-Apr 1987), WE. |
| Neptunium-237 | ATL, BC, CA, CF, DOP, ED, EV, IS, JA, MA, Neptunium, PI, RB, RFX, WE; plus trace amounts expected in TRU waste generated by nearly all P/S codes, due to ingrowth from Am-241 decay. |
| Protactinium-231 | BC (1989), JA (1989), WE. |
| Plutonium-238 | AAP, TDC, TSC |
| Plutonium-241 | EV, IS, TDC, TSC |
| Thorium-232 | CF, DOP, PT, WE. |
| Thorium-232 enriched with Thorium-230 | BC, JA, WE. |
| Uranium-233 | DOP, WE. |
| Uranium-235 or enriched uranium | CN, FF, GI, MW, OB, PD, PI, RS, SRL, UA; and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, TSC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD). |
| Uranium-238 or depleted uranium | BC, CN, FF, GI, JA, LC, MW, OB, PD, RC, RS, SRL, UA, UPS, US, WE, and P/S codes in nitrate operations (AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, TSC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD). |

Sources: TWCP-882, TWCP-5166, TWCP-9499, TWCP-AK-2.1-003, TWCP-AK-2.1-005.

During Project 2010 characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge and Acceptable Knowledge Accuracy Reporting* (TWCP-DTP-1.2-064).

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

All of the debris waste streams covered by this AK Report were generated by the same plutonium recovery activities at LANL but differ in physical form, waste matrix code, and hazardous constituents. In addition to these waste streams in which Pu-239 is the dominant Pu isotope, analogous waste streams containing Pu-238 as the dominant Pu isotope were generated during the same time period at the plutonium facility. Homogeneous waste streams were also generated from the Pu-239 recovery process; they are described in a separate report.

Waste containers in a waste stream are characterized as a campaign, in which the targeted group of waste containers to be characterized are selected based on criteria such as availability of the waste containers, waste loading level, availability of waste generator records, and hazardous waste numbers. Waste stream lots selected for convenience of characterization activities are defined in the applicable WSPF.

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

Waste matrix codes are assigned to waste streams based on waste physical form and content and AK reports in accordance with *Assignment of Waste Matrix Codes* (TWCP-DTP-1.2-053). Additional codes apply to these waste streams, based on code descriptions in the *WIPP Transuranic Waste Baseline Inventory Report* (WTWBIR) (CAO-94-1005), the *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004/Rev.13.5), Radioactive Solid Waste Disposal (RSWD) code, and Item Description Code (IDC) (Table 13). RSWD and IDC codes assigned to individual containers by the waste generator are summarized by waste stream in the AKIS.

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

The waste material parameter codes are qualitatively assigned to the waste streams based on AK information and knowledge of waste generation practices described in the Waste Management Procedures (see Section 3.2). These waste material parameter (WMP) codes are confirmed for legacy waste by comparing them against WIPP-compliant waste characterization data from real-time radiography and for newly generated waste by comparing them against WIPP-compliant waste characterization data from visual examination techniques.

## Table 13. Assignment of Waste Codes to Waste Streams Containing Pu-239

| Waste Stream | Mixed or Non-Mixed Status | Waste Stream Name | WMC | WTWBIR Code | TRUCON Code* | RSWD Code* | IDC* |
|---|---|---|---|---|---|---|---|
| TA-55-19 | Mixed | Combustible debris waste | S5300 | LA-W004 | LA116<br>LA154 | A14, A15, A16, A17, A18, A55, A60 | 004 |
| LA-NCD01 | Non-Mixed | Combustible debris waste | S5300 | LA-T004 | LA116<br>LA154 | A14, A15, A16, A17, A18, A55, A60 | 004 |
| TA-55-30 | Mixed | Heterogeneous debris waste | S5400 | LA-W005 | LA116<br>LA117<br>LA118<br>LA123<br>LA125<br>LA154 | A18, A19, A25, A27, A28, A30, A47, A50, A51, A52, A60, A61, A95 | 001<br>005 |
| LA-NHD01 | Non-Mixed | Heterogeneous debris waste | S5400 | LA-T005 | LA116<br>LA117<br>LA118<br>LA123<br>LA125<br>LA154 | A18, A19, A25, A27, A28, A30, A47, A50, A51, A52, A60, A61, A95 | 001<br>005 |

**NOTES**: *These codes are defined in the AKIS. For the majority of legacy waste containers, traceable AK documentation has not been obtained that shows what codes, if any, were assigned by the waste generator. In many cases, the code listed may apply to only one out of thousands of containers in the waste stream.

- Sources: TA-55 TWID, R3, Appendix G; NMT7-WI2-SOP-TA55-013,R4, Appendix D; AKIS, Attachment 6.
- WTWBIR numbers have been assigned to waste streams covered by this AK Report based upon the identifier from CAO-94-1005 that is considered to provide the closest match to the waste stream characteristics, based on the table sources listed above.

## 8.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

### 8.1 F, K, and P Listings

F001, F002, F003 and F005 apply to combustible and non-combustible waste generated by several of the P/S codes covered by this report. In many cases, the applicability of the HWN is limited to waste generated during a specific period, as discussed in the appropriate AK report. All four F codes are conservatively applied to wastes with unknown P/S codes.

The applicability of F-listings to a specific waste stream is determined by the contents of the waste containers and the associated P/S codes (see Table 14). If any F-listing is applicable to combustible debris from a particular P/S code, then it is also assumed to be applicable to non-combustible debris from the same P/S code. Metal and glass are generally non-porous and do not absorb liquids, and any metal or glass in contact with volatile organic chemicals would have been air-dried before being discarded as waste. However, noncombustible waste streams also contain a small percentage of combustible waste that could be contaminated with organic chemicals.

At one time a P120 code was applied to certain drums generated in 1998 because of the temporary use of vanadium pentoxide for about 6 months in that year. Based upon investigation into the way the material was handled, this code is no longer needed. A P120 assignment would be used only if waste resulted from spillage of this material or from disposal of un-reacted/unspent material. No un-reacted/unspent material was disposed of in TRU waste drums. In addition, no significant spill of this material occurred. If a spill had occurred, suitable records would exist (e.g., incident reports, waste profile forms). The absence of such documentation, coupled with information obtained through interviews of people who worked with the material, indicate that a P120 assignment is not necessary (TWCP-12081).

### 8.2 Toxicity Listings

Due to the lack of P/S code information for legacy waste, all mixed waste streams containing Pu-239 as the dominant Pu isotope are conservatively assigned the D-listings of D004, D005, D006, D007, D008, D009, D010, D011, D018, D019, D021, D022, D035, D038, D039, and D040.

Based on information summarized in the AK reports, waste generated by several P/S codes are conservatively assigned EPA HWNs due to the potential presence of D-listed constituents. In many cases, the applicability of the HWN is limited to waste generated during a specific period of time, as discussed in the appropriate operations AK report. If a D-listed constituent is known to be present in the waste at some level, the D-code is conservatively assigned unless analytical data confirm that its concentration is below the regulatory level. The decision to assign

**Table 14. F-Listings Applicable to Specific P/S Codes**

| P/S Code | Applicable F-Listing | Chemical Responsible for Listing |
|---|---|---|
| AAP | F001 | tichloroethylene |
| AC, AC1, AC2 | F002, F005 | benzene, methylene chloride, pyridine, toluene |
| AD | F002, F003 | methanol, tetrachloroethylene |
| APD | F002, F003 | acetone, butanol, chlorobenzene, methanol, methylene chloride, tetrachloroethylene, xylene |
| CF | F002, F003 | acetone, butanol, chlorobenzene, methanol, methylene chloride, tetrachloroethylene, xylene |
| CLS | F002, F003 | acetone, butanol, chlorobenzene, methanol, methylene chloride, tetrachloroethylene, xylene |
| CSE | F002 | Tetrachloroethylene |
| CW | F002, F003 | acetone, butanol, chlorobenzene, methanol, methylene chloride, tetrachloroethylene, xylene |
| DA | F002 | 1,1,2-trichloro 1,2,2-trifluoroethane (Freon ingredient) |
| HP | F002, F003 | acetone, butanol, chlorobenzene, methanol, methylene chloride, tetrachloroethylene, xylene |
| MA | F001, F002, F005 | 1,1,2-trichloro 1,2,2-trifluoroethane (Freon ingredient), methyl ethyl ketone, trichloroethylene |
| ME | F003 | acetone |
| SA | F002, F003, F005 | benzene, diethyl ether, pyridine, toluene |
| SE | F002 | tetrachloroethylene |
| WM (No F-listings apply after 1993) | F001, F002, F005 | 1,1,2-trichloro 1,2,2-trifluoroethane (Freon ingredient), methylene chloride, methyl ethyl ketone, trichloroethylene |
| X0, XO | F001, F002, F005 | 1,1,2-trichloro 1,2,2-trifluoroethane (Freon ingredient), methylene chloride, methyl ethyl ketone, trichloroethylene |

a particular D-code to a waste stream is determined by the P/S codes associated with the operations by which the waste items were generated. Table 15 summarizes the relationship between various D-codes and the TA-55 P/S codes.

The following P/S codes are assigned only D008 due to the presence of leaded gloves: AAP, ACC, AO, BA, BAC, BC, BL, BM, CA, CC, CH, COD, CR, CRD, DA, DF, DP, FA, FC, GMS, HC, HRS, IN, JA, LC, M1, M2, MM, M4, MAG, MAS, MF, MO, MP, MW, OY, PA, PF, PH, PR, PS, RD, RL, RM, SBB, SCB, SMIS, SRL, UA, UPS, US, US2, VD, VP2, VS, WE, and ZD.

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." The waste streams covered by this AK report have no listings for corrosivity, reactivity, or ignitability. Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at LANL when the Plutonium Recovery Facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP)* (406-GEN-R00), stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943). Currently, *TA55 Waste Management* (TA-55-RD-539) requires that no liquids be disposed of as a solid waste unless the liquid has been absorbed into some media (like vermiculite) that does not carry a D001 code (TWCP-3943).

- Chemical Waste Disposal Requests (see Attachment 7), introduced in June 1980, included check boxes that the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials. The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators are required to sign a statement on the WODF documenting that the waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes are also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6) (*Performing Visual Examinations of TRU Waste* [NMT7-WI2-HCP-TA55-013]).

**Table 15. D-Listings Applicable to Specific P/S Codes**

| P/S Code | Applicable D-Listing |
|---|---|
| AAP | *D008 |
| AC | D007, *D008, D009, D011, D018, D022, D038 |
| AC1 | D007, *D008, D009, D011, D018, D022, D038 |
| AC2 | D007, *D008, D009, D011, D018, D022, D038 |
| ACC | *D008 |
| ACD | D005, D006, D007, D008, D009, D011 |
| ACL | D007, *D008, D009 |
| AD | D004, D005, D006, D007, D008, *D008, D009, D010, D011, D019, D039 |
| AL | D005, D006, D007, D008, *D008, D009, D011 |
| AO | D006, D007, D008, *D008, D009, D011 |
| AP | D007, D008, *D008, D009 |
| APD | D007, D008, *D008, D009, D019, D021, D022, D039 |
| ARI | D007 |
| AS | D006, D007, D008, *D008, D011 |
| ASP | *D008 |
| AT | D005, D006, D007, D008, *D008, D011 |
| ATL | D005, D006, D007, D008, *D008, D009, D011 |
| AX | D007, *D008, D009 |
| BA | *D008 |
| BAC | *D008 |
| BC | *D008 |
| BF | D006, D007, D008, *D008, D011 |
| BL | *D008 |
| BM | *D008 |
| BT | D008, *D008 |
| BU | D006, D007, D008, *D008, D011 |
| CA | *D008 |
| CC | *D008 |
| CD | D005, D006, D007, D008, *D008, D009, D011 |
| CF | D006, D007, D008, *D008, D009, D011, D019, D021, D022, D039 |

**Table 15. D-Listings Applicable to Specific P/S Codes (continued)**

| P/S Code | Applicable D-Listing |
|---|---|
| CH | *D008 |
| CK | D005, D006, D007, D008, *D008, D009, D011 |
| CL | D007, D008, *D008, D009 |
| CLRD | D007, D008, *D008, D009 |
| CLS | D007, D008, *D008, D009, D019, D021, D022, D039 |
| COD | *D008 |
| COL | D005, *D008 |
| CPOD | *D008, D011 |
| CR | *D008 |
| CRD | *D008 |
| CS | D007, D008, *D008, D009 |
| CSE | D007, D008, *D008, D009, D039 |
| CV | D005, D006, D007, D008, *D008, D009, D011, D019, D039 |
| CW | D007, D008, *D008, D009, D011, D019, D021, D022, D039 |
| CX | D007, D008, *D008, D009, D011 |
| CXL | D007, D008, *D008, D009 |
| DA | *D008 |
| DF | *D008 |
| DO | D005, D006, D007, D008, *D008, D009, D011 ( |
| DOP | D008, *D008 |
| DP | *D008 |
| DS | D005, D006, D007, D008, *D008, D009, D011 |
| ED | D005, D006, D007, D008, *D008, D009, D011 |
| EDC | D007, *D008, D009 |
| EL | D040 |
| EOC | D007, *D008, D009 |
| ER | D006, D008, *D008 |
| ETD | D005, D006, D007, D008, *D008, D011 |
| EV | D006, D007, D008, *D008, D009, D011 |
| EXT | D005, D006, D007, D008, *D008, D009, D011 |

**Table 15. D-Listings Applicable to Specific P/S Codes (continued)**

| P/S Code | Applicable D-Listing |
|---|---|
| FA | *D008 |
| FC | *D008 |
| FDL | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |
| FF | *D008, D040 |
| FLU | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |
| FX | D006, D007, D008, *D008, D009, D011 |
| GMS | *D008 |
| GPHS | *D008 |
| HC | D008 |
| HCD | D005, D006, D007, D008, *D008, D009, D011 |
| HD | D005, D006, D007, D008, *D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, *D008, D009, D011, D019, D021, D022, D039 |
| HRA | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |
| HRS | *D008 |
| IA | D006, D007, D008, *D008, D009, D011 |
| IAM | D005, D006, D007, D008, *D008, D009, D011 |
| IB | D005, D006, D007, D008, *D008, D009, D011 |
| ICP | D007, *D008, D009 |
| IE | *D008 |
| IN | *D008 |
| IS | D005, D006, D007, D008, *D008, D011 |
| IX | D005, D006, D007, D008, *D008, D009, D011 |
| JA | *D008 |
| KBTF | D008 |
| LC | *D008 |
| LD | D007, D008, *D008, D009 |
| LG1 | D006, D008, *D008 |
| LG2 | D006, D007, D008, *D008, D009, D011 |
| LI | D005, D006, D007, D008, *D008, D009, D011 |

**Table 15. D-Listings Applicable to Specific P/S Codes (continued)**

| P/S Code | Applicable D-Listing |
|---|---|
| LR | D005, D006, D007, D008, *D008, D009, D011 |
| M1, M2, MM, M4 | *D008 |
| MA | *D008, D035, D040 |
| MAG | *D008 |
| MAS | *D008 |
| MB | D007, *D008, D009 |
| MD | D008 |
| ME | D007, *D008, D040 |
| MELL | D006, D007, D008, *D008, D009, D011 |
| MF | *D008 |
| ML | D006, D008, *D008 |
| MO | *D008 |
| MP | *D008 |
| MPD | D005, D006, D007, D008, *D008, D009, D011 |
| MS | D007, D008, *D008, D009 |
| MTL | *D008 |
| MW | *D008 |
| NC | D006, D008, *D008 |
| NL | D006, D008, *D008 |
| OD | D006, D007, D008, *D008 |
| OH | D006, D007, D008, *D008, D009, D011 |
| OR | D005, *D008 |
| OY | *D008 |
| P1 | *D008 |
| PA | *D008 |
| PAF | *D008 |
| PB | D007, D008, *D008, D009 |
| PCH | D007, *D008 |
| PE | D004 (1984–1985), *D008 |
| PF | *D008 |

**Table 15. D-Listings Applicable to Specific P/S Codes (continued)**

| P/S Code | Applicable D-Listing |
|---|---|
| PH | *D008 |
| PI | *D008 |
| PK | D006, D007, D008, *D008, D011 |
| POSM | D005, D006, D007, D008, *D008, D011 |
| PR | *D008 |
| PRR | D007, D009 |
| PS | *D008 |
| PT | D007, D008, *D008 |
| PTP | *D008, D019 |
| PTS | D005, D006, D007, D008, *D008, D011 |
| PUB | D007, D008, *D008, D009 |
| PX | D006, D007, D008, *D008, D011, D019 |
| R8 | D006, D007, D008, *D008, D009, D011 |
| R8 (sucrose) | *D008 |
| RA | D006, D007, D008, *D008, D011 |
| RASS/RSS | D004, D005, D006, D007, D008, *D008, D009, D010, D011, D019 |
| RB | D006, D007, *D008 |
| RBJ | D006, D007, *D008 |
| RC | D005, D006, D007, D008, D011 |
| RCI | *D008 |
| RCM | D005, D006, D007, *D008, D009, D011 |
| RD | *D008 |
| RFX | D005, D006, D007, D008, *D008, D009, D011 |
| RL | *D008 |
| RM | *D008 |
| RO | D006, D008, D040 |
| RR | D005, D006, D007, D008, *D008, D009, D011 |
| SA | D007, D008, *D008, D009, D018, D038 |
| SB | D005, D006, D007, D008, *D008, D011 |
| SBB | *D008 |

**Table 15. D-Listings Applicable to Specific P/S Codes (continued)**

| P/S Code | Applicable D-Listing |
|---|---|
| SC | D005, D006, D007, D008, *D008, D009, D011 |
| SCB | *D008 |
| SCP | *D008 |
| SD | *D008 |
| SE | D007, D008, *D008, D009, D039 |
| SL | D005, D006, D007, D008, *D008, D009, D011 |
| SMIS | *D008 |
| SO | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |
| SP | D006, D007, D008, *D008, D009, D011 |
| SRL | *D008 |
| SS | D006, D008, *D008 |
| SSD | D006, D007, D008, *D008 |
| SSMD | *D008, D009 (D-listed chemicals only used from 06/94 to 08/94) |
| STF | D007, *D008 |
| SX | *D008 |
| TDC | D005, D006, D007, D008, D011 |
| TSC | D005, D006, D007, D008 |
| UA | *D008 |
| UPS | *D008 |
| US | *D008 |
| US2 | *D008 |
| VC | D006, D008, *D008 |
| VD | *D008 |
| VP1 | *D008, D009 (D-listed chemical only used from 09/85 to 10/85) |
| VP2 | *D008 |
| VP3 | *D008, D009, D011 |
| VS | *D008 |
| VU, VUL | D005, D008, *D008 |
| WE | *D008 |
| WM | D007, D008, *D008, D009, D022, D035, D040 (D-listings are not applicable after 1993 with the exception of *D008) |

**Table 15. D-Listings Applicable to Specific P/S Codes (continued)**

| P/S Code | Applicable D-Listing |
|---|---|
| WS | *D008 |
| X0, XO | D007, D008, *D008, D009, D022, D035, D040<br>**NOTE:** The same set of HWNs have been assigned to P/S codes WM, X0, and XO in order to be conservative, as discussed in *Acceptable Knowledge Report for Miscellaneous Operations at LANL* (TWCP-AK-2.1-004,R.2/IC1, Section 3.5.10). |
| XES | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |
| XP | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |
| ZD | *D008 |

*D008 has been assigned to most of the P/S codes because of leaded gloves.

- In addition to the above-mentioned prohibitions on explosives in waste, explosives were altogether prohibited until installation of the Impact Test Facility in the early 1990s. In case of a misfire or unconsumed explosives, a procedure is in place to ensure that explosives do not enter the waste stream (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which is authenticated by the waste generator, that the waste is not ignitable (flash point >200 °F), reactive, or corrosive.

- The Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

- The Project 2010 Certification Plan, current revision, and TWIDs prohibit liquids in waste and verified by waste management.

Hence, since the inception of plutonium recovery operations, corrosive wastes have been excluded from solid wastes through the prohibition of liquids. Controls on reactive wastes are discussed in Sections 3.5.1 and 3.5.2.

Controls have also been in place to ensure the exclusion of ignitable constituents. D001 does not apply to wastes in these waste streams despite the use of spent non-halogenated solvents (HWN F003) for the following reasons:

- Solutions containing spent non-halogenated solvents are sent to the RLWTF if they are below the DL for plutonium.

- If above the DL, the solutions are sent to aqueous activities as part of chloride or nitrate operations. Aqueous recovery steps include dissolution of any solid plutonium in hydrochloric or nitric acid, followed by plutonium recovery by ion exchange. The solutions are then below the DL and are either sent to the RLWTF or to the evaporator.

- Rags that are above the DL for plutonium are thermally decomposed, which destroys any organic component.

- Rags that are below the DL for plutonium are discarded as combustible debris, but headspace gas analyses support the contention that the solvents are below the limits established by the WIPP WAC.

- Finally, 100 percent of the drums are subjected to headspace gas analysis, and drums with total potentially flammable VOC concentrations above the limit established by the WIPP WAC are prohibited from being shipped to the WIPP.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization

activities. Any free liquids are absorbed and discarded in an appropriate waste stream and containerized gases that are found to be present are removed before waste certification.

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the TRUPACT-II shipping containers. Section 9.0 summarizes administrative controls in place that prohibit incompatible chemicals in the waste and measures taken to verify their absence. In addition, all waste containers shipped to TA-54 for storage are evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and are determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste item specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited from the Plutonium Recovery Facility. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

Chemical compatibility analyses were performed for the TRUCON codes, which indicated that all chemicals and the waste matrix are compatible at levels greater than trace amounts (*Content Code Assessments for LANL TRUCON Codes* [DOE/WIPP-89-004]). During the AK search, additional chemicals were identified that necessitated a new compatibility analysis, which has been completed.

## 11.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle is used for an operation inside the building, but these bottles are kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by recovery operations.

Spray cans, especially WD-40, were in common use in gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as noncombustible debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans are no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during Project 2010 characterization activities. Any free liquids are absorbed and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed before waste certification.

The effectiveness of administrative and procedural controls on the prohibition of pyrophorics in TRU waste is verified through audits. For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation are used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the RFETS (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Chemical Waste Disposal Requests dated as early as June 1980 included boxes that were required to be checked if the waste contained pyrophoric, flammable, corrosive, or explosive materials (see Attachment 7, Chemical Waste Disposal Request).

In addition, for wastes generated after the implementation of the 1987 Certification Plan, associated waste packaging procedures, and quality assurance systems, the waste generator has signed a statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The Attachments to the Certification Plan describe how these restrictions are verified by waste management personnel (TWCP-701, Sections 3.8.5 through 3.8.7).

The Project 2010 Certification Plan, current revision, and the TWIDS prohibit compressed gases, free liquids, nonradionuclide pyrophorics, sealed containers greater than four liters in volume, or >1% radionuclide pyrophorics in waste and verified by waste management.

## 12.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the TRU waste streams, based on documentation in procedures reviewed during the AK investigation and summarized in lists of inputs documented in the TA-55 AK reports.

- In the cement fixation operation (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils

used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs.

- All transformers known to contain PCBs have been tracked from initiation of recovery operations in 1978. When any transformer oil is drained, the oil is handled by a subcontractor who is wholly responsible for its disposal; this oil does not enter the LANL disposal operations (TWCP-3568/N-82).

- Ballast in fluorescent light fixtures could contain PCBs, but these light fixtures are outside the gloveboxes and hence would not enter the TRU waste stream.

- Oil-filled capacitors are not known to be used in gloveboxes.

In addition, if the possibility exists for the legacy waste to contain PCBs, RTR operators are required to check for indications of PCB-containing materials or PCB-contaminated materials. If there is reason to suspect that an item may contain PCBs (based on AK, operator training, or previous operator experience), then the operator records this information on the Radiography Data Sheet, which is reviewed before waste certification.

## 13.0 REMEDIATION OF PROHIBITED ITEMS

Prohibited items are known to be present in containers from all of these waste streams. Procedures allowed containers greater than 4L, sealed with tape, to be used for waste packaging until WIPP certification procedures were implemented. Small vials of free liquids and some aerosol cans also have been observed. Lead shielding was often used to increase handling safety, and thick shielding can obscure RTR observations, requiring visual examination of the contents.

Prohibited items are detected by RTR and reported with the RTR results. Waste containers with prohibited items are repackaged, during which time liquids are absorbed, sealed containers greater than 4L are opened, and other items removed and segregated. Project 2010 accomplishes this using Prohibited Item Dispositioning (TWCP-DTP-1.2-076).

## 14.0 DESCRIPTION OF THE NUMBER OF CONFINEMENT LAYERS USED FOR WASTE PACKAGING

The maximum number of layers and default TRUCON codes for each waste stream are provided in the Waste Stream Profile Form packages, which are submitted by Project 2010 to CBFO for approval. This section describes how the default TRUCON codes are determined.

Waste drum packaging procedures for waste streams have been modified several times since the beginning of recovery operations. TRUCON code assignments made by the waste generator are compiled in the AKIS but are not used for drum certification unless they are verified by RTR or were assigned after implementation of procedures approved

by CBFO. When TRUCON codes from AK are absent, they are assigned to the waste container in accordance with the default packaging configurations and associated TRUCON codes indicated in the Waste Stream Profile Forms that reflect the packaging protocols in effect during different periods of time (TWCP-816).

TRU waste streams are primarily generated from operations performed in gloveboxes. The waste material is placed directly into bag-out bags (also called inner bags) through an opening in the glovebox where the bag is attached, and the bag is then closed and detached from the glovebox. TRU waste streams may also be generated from "hot jobs" outside of the glovebox, such as valve changes, or from decontamination of spills or other releases. In these cases, the waste is placed directly into one (or possibly more) inner bag at the work area.

A minor source of waste in some waste streams is room trash that was originally considered to be low-level waste, which is collected in plastic bags inside cardboard boxes. Occasionally, when assayed, these boxes are determined to be TRU waste. These boxes may be sorted to remove the "hot" item, or the whole box may be bagged and sent to the TRU packaging area for placement in drums assigned to an appropriate TRU waste stream. When this occurs, the P/S code WM is assigned to the waste. Due to the additional layers of plastic that are present when this operation occurs, drums with the P/S code WM are assumed to contain one more layer of internal packaging than other drums.

For legacy waste, the letter designator of the TRUCON code is assigned using packaging information from the following sources, which are listed in order of priority of usage:

- Visual Examination (VE)/RPK batch data reports (if available)
- RTR batch data report indication of the observed layers of packaging
- If packaging filter information is indeterminate, use the TRUCON code for "no filters in packaging"
- If RTR information is indeterminate, use the default assignment given in the Waste Stream Profile Form package
- If no default code is assigned, assign code based on most conservative (maximum packaging layers) TRUCON letter designator

This guidance only applies to retrievably stored waste. Newly generated waste is packaged under procedures approved by Project 2010 and CBFO, and are assigned correct TRUCON codes.

## 15.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261—Identification and Listing of Hazardous Wastes

- 49 CFR Part 261, Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, Segregation of hazardous materials
- *Acceptable Knowledge Accuracy Report* (TWCP-AK-2.1-012,R.0)
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Acceptable Knowledge for Isotope Ratios* (TWCP-AK-2.1-020)
- *Acceptable Knowledge Information Summary for LANL Transuranic Waste Streams* (TWCP-AK-2.1-019)
- *Assignment of Waste Matrix Codes* (TWCP-DTP-1.2-053)
- *Calculation of $UCL_{90}$ Values* (TWCP-DTP-1.2-006)
- *Content Code Assessments for LANL TRUCON Codes* (DOE/WIPP-89-004)
- *Determining Isotopic Ratios in Waste Containers Using the RANT PC/FRAM Assay System* (TWCP-DTP-1.2-029)
- *DOE Order 5820.1 and 5820.2,* Management of Transuranic Contaminated Material, U.S. Department of Energy, 09/30/82 and 02/06/84
- *DOE Order 435.1* Radioactive Waste Management, Department of Energy, Environmental Management, 2001
- *Hazardous Waste Facility Permit for the Waste Isolation Pilot Plant* (EPA ID No. NM4890139088-TSDF) (Attachment B, Waste Analysis Plan)
- *Headspace Gas Sampling and Analysis Using an Automated Manifold* (TWCP-DTP-1.2-041)
- *Inspecting, Labeling, and Preparing TRU Waste Containers* (NMT7-WI1-SOP-TA55-013)
- *Inspecting, Packaging, Rejecting, and Remediating Transuranic Waste for WIPP and for TA-54 Safe Storage* (NMT7-SOP-TA55-013), with associated detailed Work Instructions (WI)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Operating the High Efficiency Neutron Counter (HENC) Using INCC* (TWCP-DTP-1.2-059)
- *Packing TRU Waste Containers* (NMT7-WI3-SOP-TA55-013)

- *Performing Nondestructive Testing Using the Mobile Real-Time Radiography System* (TWCP-DTP-1.2-008)
- *Performing Visual Examinations of TRU Waste* (NMT7-WI2-SOP-TA55-013)
- *Purex Technical Manual* (WHC-CM-5-25, 8/25/88)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Records Management* (TWCP-QP-1.1-004)
- *Sealing TRU Waste Containers* (NMT7-WI4-SOP-TA55-013)
- *TA-55 Standard Operation Procedure (SOP)* (406-GEN-R00)
- *TA-55 Transuranic Waste Interface Document* (NMT7-AP-TA55-018)
- *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004)
- *U.S. Atomic Energy Commission AEC Manual:* Chapter 0511, Radioactive Waste Management, AEC 1993
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA-530-R-94-024)
- *Waste Assay System Using the Combined Thermal Epithermal Neutron (CTEN) System* (TWCP-DTP-1.2-061)
- *Waste Assay Using the Passive-Active Neutron Assay System* (PAN) (TWCP-DTP-1.2-009)
- *Waste Assay Using the Tomographic Gamma Scanner* (TGS) (TWCP-DTP-1.2-011)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge and Acceptable Knowledge Accuracy Reporting* (TWCP-DTP-1.2-064)
- *Waste Isolation Pilot Plant Transuranic Waste Baseline Inventory Report* (CAO-94-1005) (TWBIR)
- *Waste Visual Examination and Packaging* (TWCP-DTP-1.2-001)
- *WIPP Transuranic Waste Baseline Inventory Report* (CAO-94-1005)

# ACCEPTABLE KNOWLEDGE ROADMAP

Waste Streams: TA-55-19, LA-NCD01, TA-55-30, LA-NHD01

Copies of these documents are in the TWCP RMDC Center. Refer to *Records Management* (TWCP-QP-1.1-004) for information on requesting copies.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-351 | B | Procedure for waste management practices at TA-55 | TA-55 document 539-GEN-R02. | Document describes TA-55 waste management practices for solid and liquid wastes | None |
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983 | Los Alamos Certification Plan, 1983 | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document – Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste operations. |
| TWCP-700 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1955,* TRUWM-TA55-CPA-03, R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Provides an explanation of why some waste containers may be packaged with 6 layers of confinement. Discusses determination of low-level waste (LLW) versus TRU after packaging. | No direct way to identify which specific containers have 6 layers of packaging |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by P/S code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-operations at TA-55. | Diagram from Jim Foxx | Indicates that inputs are thermally treated and that heavy metals from inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to operations. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests are on residues rather than waste that is lower in Pu content; hence, they are conservative. |
| Cl-25/ TWCP-3547 (UCNI) | D | Answers to questions about chloride processes | Interview with Jim Foxx, 9/23/99 | Answers to questions on Chloride processes; C-AAC solvent list | None |
| TWCP-3568/ N-74 | C | Chemical list; process description (P/S code CF) | Organic Liquid Emulsification, TRU-NMT2-DP-13, R00; TRUWM-TA55-DP-13-R00; 8/30/93 through 9/30/94 | Emulsifying waste oil and other organic liquids for cement fixation. | None |
| TWCP-3568/ N-82 | C | Clarification of specific activities within the nitrate operations at TA-55 | Jim Foxx, SME, response to comments received on the draft *Acceptable Knowledge Report for TA-55 Nitrate Operations*, 2/25/00 | Resolutions to the questions and issues raised by Pam Rogers during her review of the *Acceptable Knowledge Report for TA-55 Nitrate Operations*, 2/25/00 | Information is based on SME knowledge. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of Ag, disposal of ash and resins, and use of gases. | None |
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-5086 | B | P/S Codes for TA-55 Waste items, listed by drum | P/S codes for waste items in individual drums are either from the TA-55 Waste Management System or from the certified database | P/S codes for waste containers from TA-55 | Only some drums are included |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5158 | D | Chemical use in P/S code FF | Interview with Fred Hampel (TA-55 SME) on 4/19/01 | Magnesium perchlorate was used in the glovebox line in P/S code FF, and was the only chemical used there. It was used as a water getter, and was changed once during the period 1987 to 1992. The spent chemical was sent to cement fixation, P/S code CF. | No information after 1992 |
| TWCP-5164 | D | Sources of Cs-137 and Pa-231 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 2, 2001 | Plutonium operations never handled Cs-137 or Pa-231 in any of the Pu processing areas at TA-55. However, Cs-137 is expected to be present in the wastes because it is a fission product of several Pu isotopes. Pa-231 is expected to be present (as a function of the age of the waste) because it is a decay chain daughter of Pu-239 and U-235. | None |
| TWCP-5165 | D | Sources of Cs-137, Pa-231, and Cm-244 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Dominant source of Cs-137 expected to be due to residual contamination from original separation of Pu from production fuel. Cm-244 introduced in P/S code DOP starting in 1988, but could also show up after that date in IS, WE, CA and CF. | None |
| TWCP-5166 | D | Secondary radionuclides used in P/S code PI | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Amendment of Foxx's 1997 memo (TWCP-882): P/S code PI was a user of U, Np and Am isotopes | None |
| TWCP-5167 | D | Use of lead in P/S code DOP | Interview with Jim Foxx (TA-55 SME) on February 7, 2001 | In addition to an encapsulated lead pig, P/S code DOP also used lead shielding (which therefore requires application of HWN D008 to its waste). | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

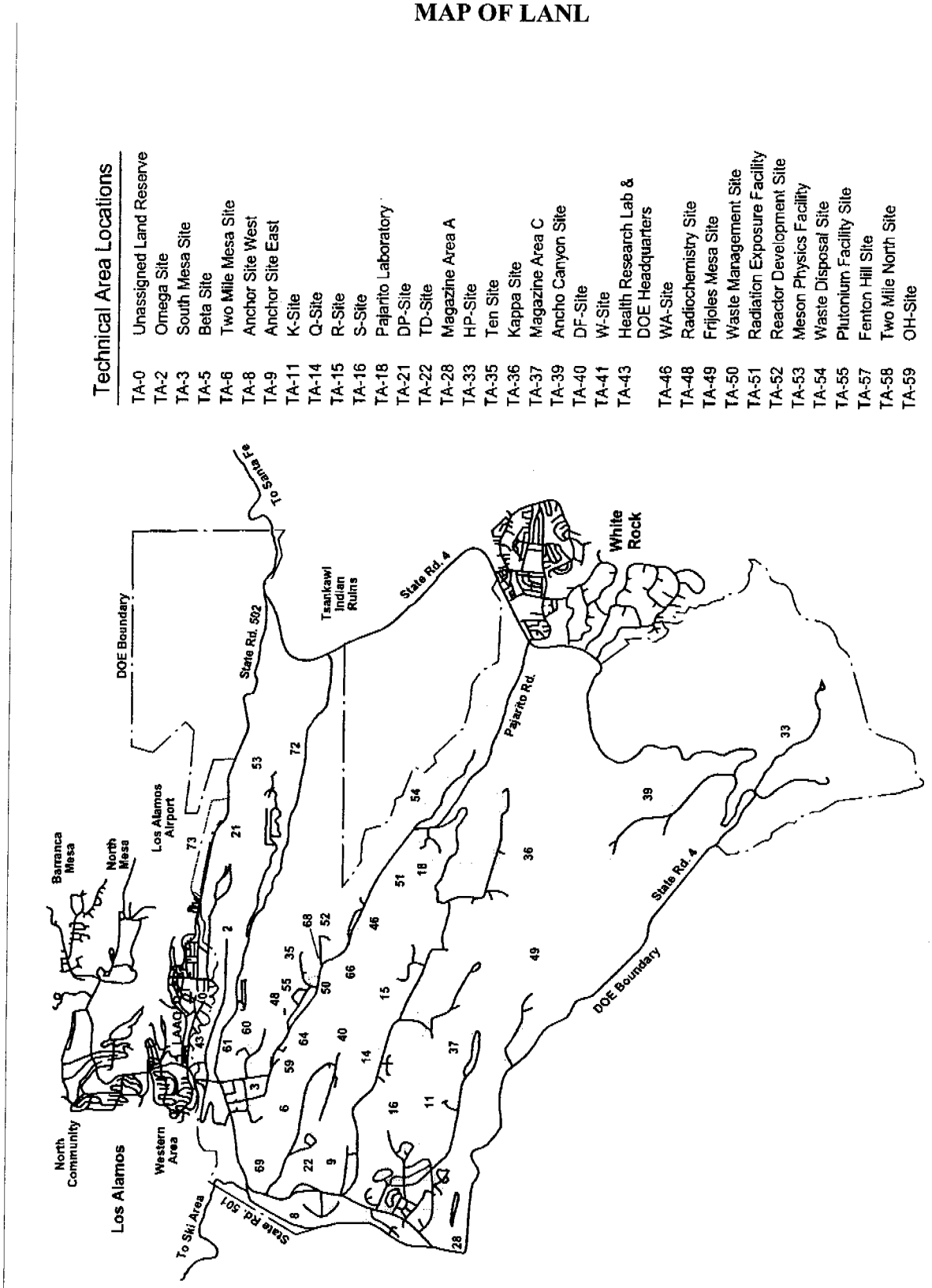
| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5372 | D | Vanadium pentoxide in waste generated by P/S codes SD and SS | Interview with Jim Foxx (TA-55 SME) on May 7, 2001 | Vanadium pentoxide was used between February 1998 and June 1998. SME information indicates that waste from this work would have been packaged into containers that were closed by the end of December 1998. | None |
| TWCP-8003 | D | Description of information developed for database system for tracking waste disposed and/or stored at TA-54, Area G | Report, "Documentation for Rad Waste ORACLE Database's List of Acceptable Radioisotopes, Specific Activities, Categories, and Regulatory Limits" | Information is provided on how specific activities were assigned for different material types | Developed to evaluate waste stored at TA-54, Area G |
| TWCP-9499 | D | Memo regarding Actinium usage | Memo from Wayne Punjak regarding AC-227 usage | Information regarding a previously undocumented use of Actinium. | None |
| TWCP-9810 | D | Memo regarding reporting U-234 | Memo from Mike Baker regarding U-234 assay | Approach for calculating U-234 concentration based on U-235. | None |
| TWCP-11061 | C | Headspace gas data collected prior to WAP becoming effective. | Review of Headspace Gas data from Pre-WAP Analysis for Additions to AK | Detailed information on the tentatively identified compounds found in pre-WAP HGAS batch data reports. | Pre-WAP and limited on waste streams covered. |
| TWCP-11062 | C | Real-time-radiography data collected prior to WAP becoming effective. | Review of RTR Data from Pre-WAP Analysis for TA-55 Debris Waste | Summary information on the waste material parameters and prohibited items for TA-55 debris waste streams. | Only on TA-55 debris waste streams. |
| TWCP-12081 | C | Interview with SME | Interview with Jim Foxx (TA-55 SME) on March 11, 2003 | While vanadium pentoxide was used, no history or information regarding a spill was found. Therefore, the P120 HWN does not apply | None |
| TWCP-12088 | B | Discussion of use of plastic ties | *Memo LAAMEP 2BL-006 To Stanley Kosiewicz* | Documents waste management practices regarding use of ties on bag-out closures. | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-002,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Chloride Operations at LANL* | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Metal Operations at LANL* | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2/IC1 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Miscellaneous Operations at LANL* | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Nitrate Operations at LANL* | Detailed information on each P/S code for nitrate operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Pyrochemical Operations at LANL* | Detailed information on each P/S code for pyrochemical processes at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Special Processing Operations at LANL* | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-AK-2.1-019 AND TWCP-AK-2.1-020 | C | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK references based on generator's original data | *Acceptable Knowledge Information Summary for LANL Transuranic Waste Streams* and *Acceptable Knowledge for Isotopic Ratios* | Detailed information on each waste drum and waste stream | Reliability and completeness of waste generator data is highly variable, and this information summary is continually being updated |

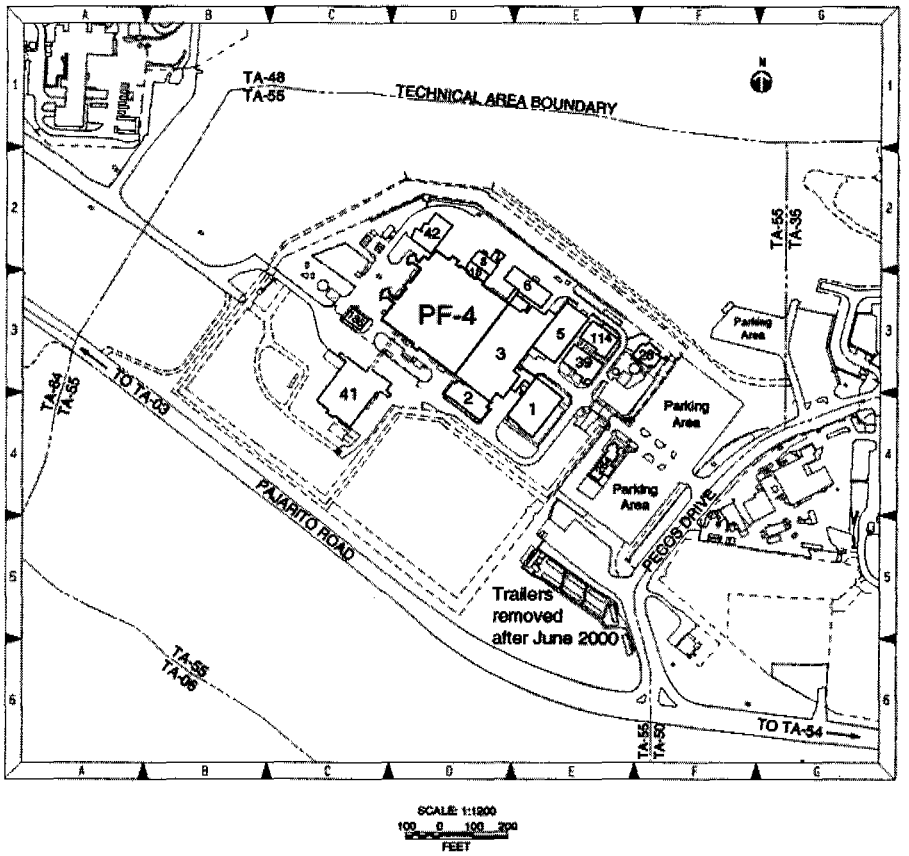
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# MAP OF LANL

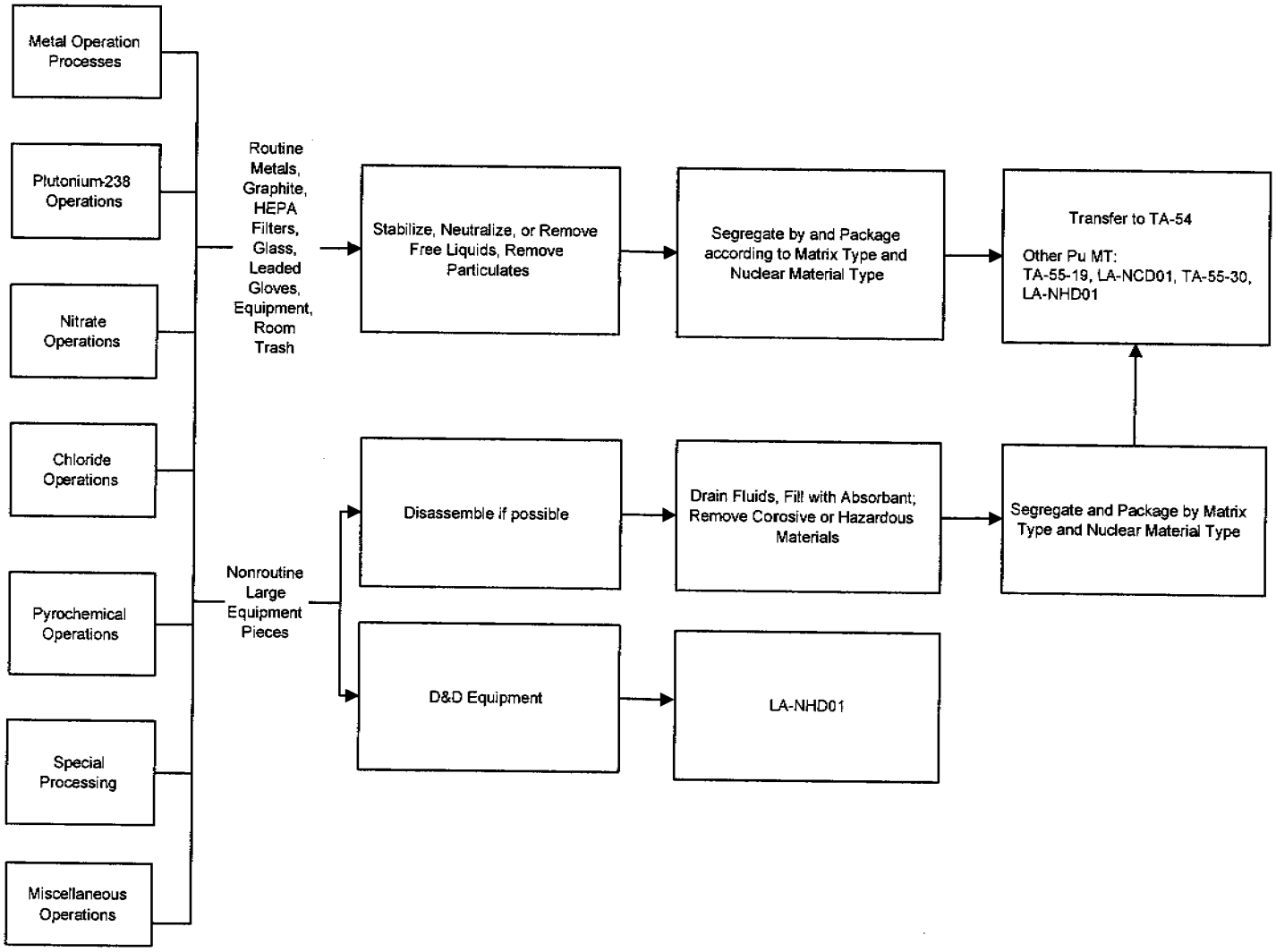

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Barranca Mesa
North Mesa
Los Alamos Airport
LAAO
North Community
Los Alamos
Western Area
To Ski Area
State Rd. 501
DOE Boundary
State Rd. 4

# MAP OF TA-55

**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.

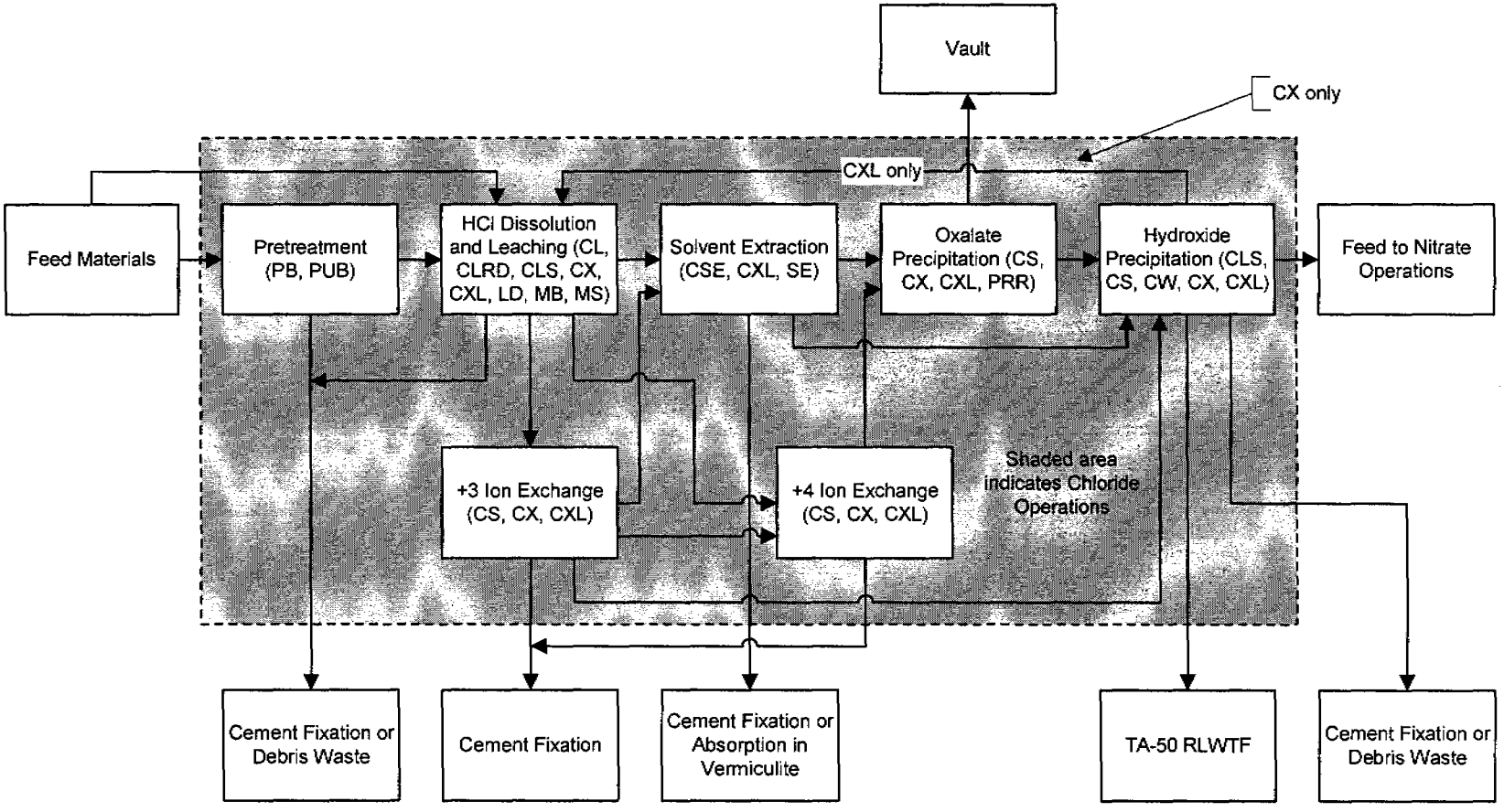


# SIMPLIFIED FLOW DIAGRAM FOR GENERATION OF TRU WASTE: DEBRIS WASTE



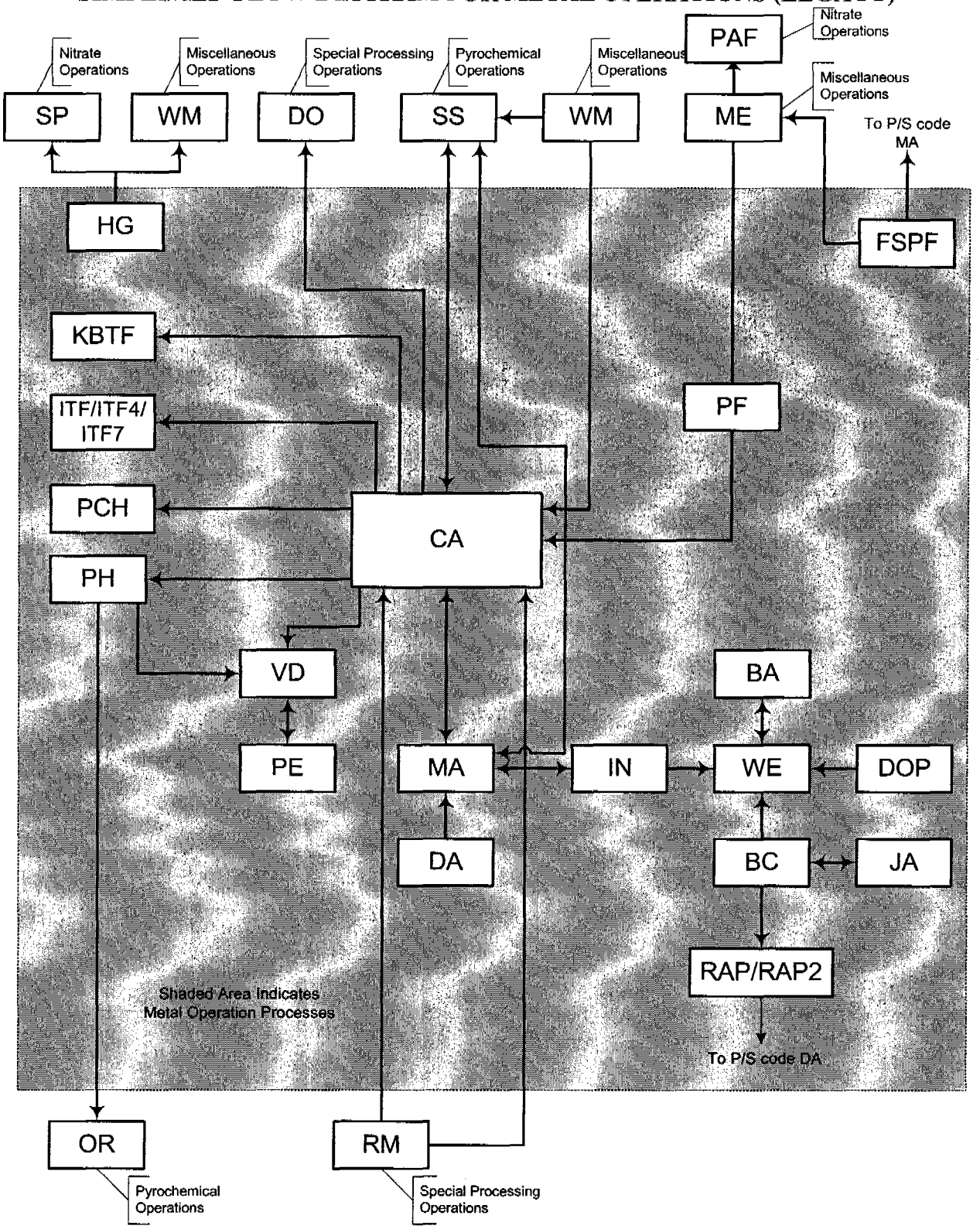
# SIMPLIFIED FLOW DIAGRAMS

## SIMPLIFIED FLOW DIAGRAM FOR CHLORIDE OPERATIONS



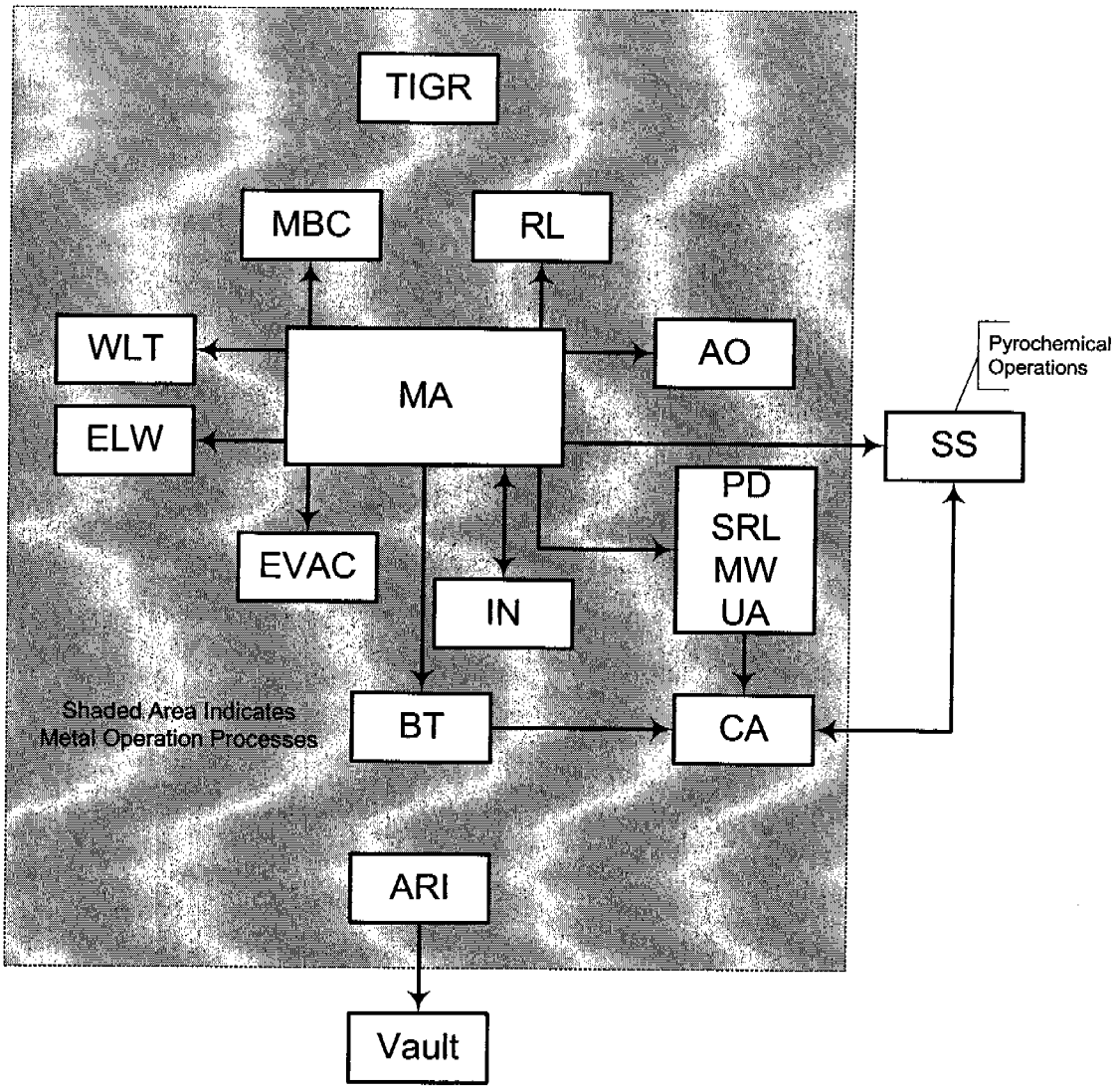

**NOTE:** Many of the P/S codes for chloride operations involve more than one step or activity in the flow diagram. Thus, the same P/S code can appear in more than one box on the flow diagram.

## SIMPLIFIED FLOW DIAGRAM FOR METAL OPERATIONS (LEGACY)




**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

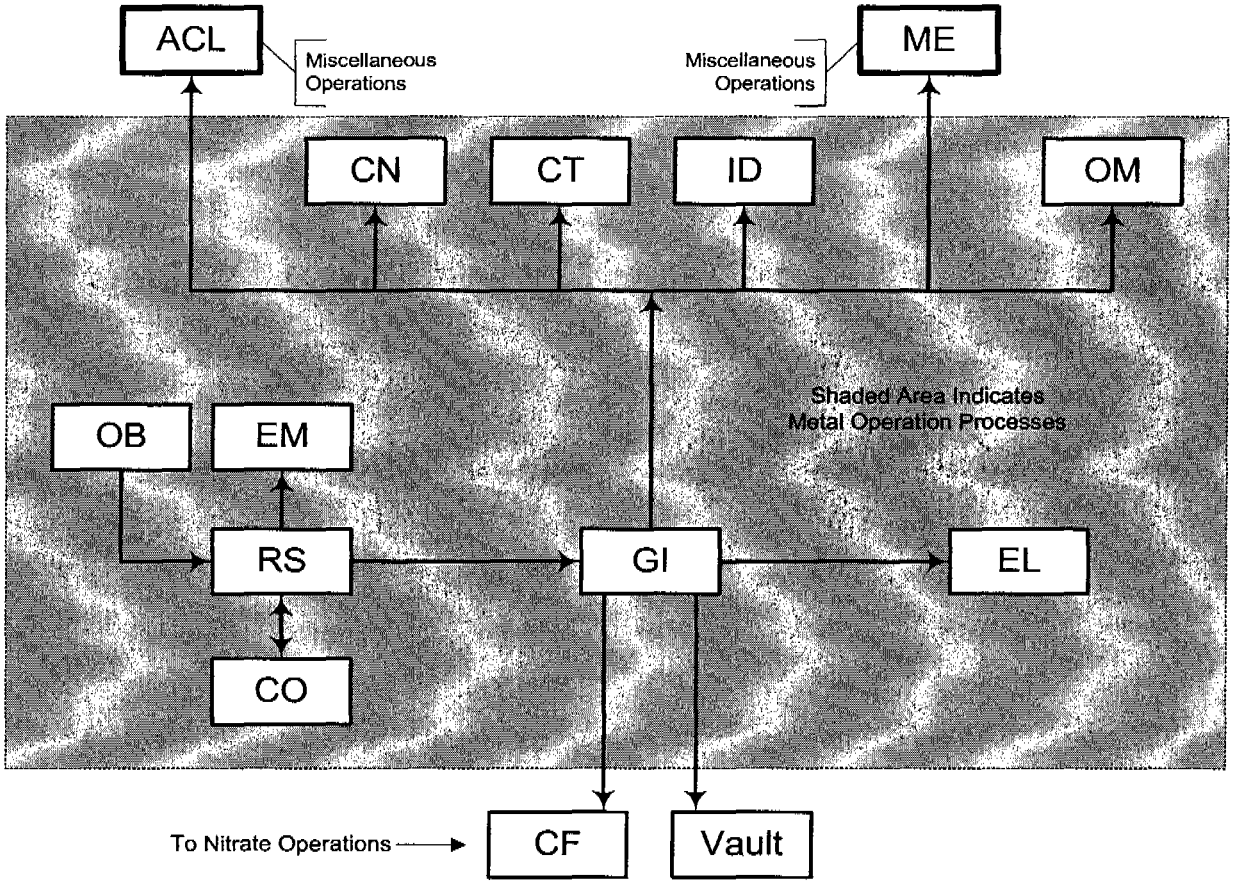
**SIMPLIFIED FLOW DIAGRAM FOR METAL OPERATIONS (LEGACY) (continued)**



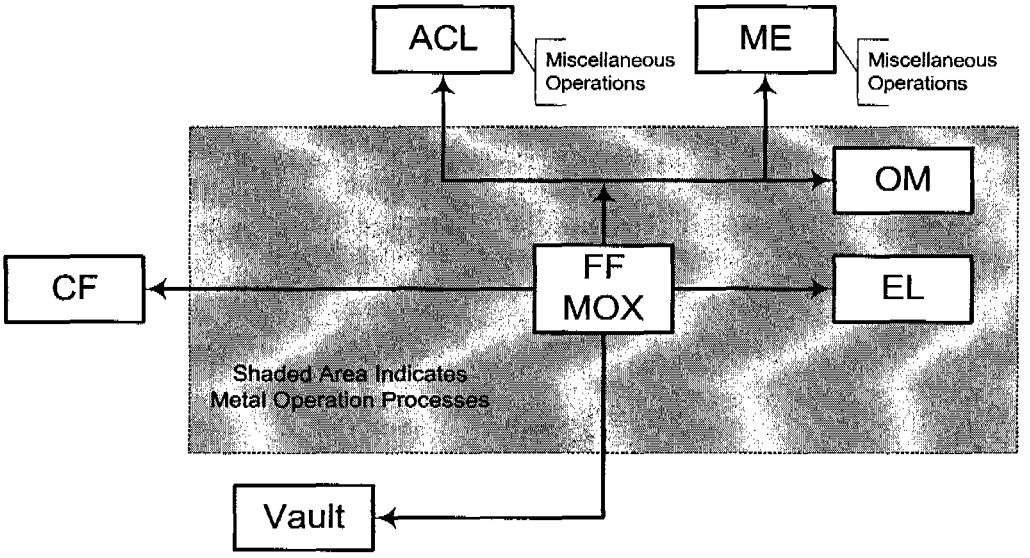

**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

**NOTE:** P/S code UA tracks uranium compounds from Pit Disassembly. Activities under this P/S code would be similar to those under P/S codes IN, MW, and WE.

## SIMPLIFIED FLOW DIAGRAM FOR METAL OPERATIONS (LEGACY) (continued)

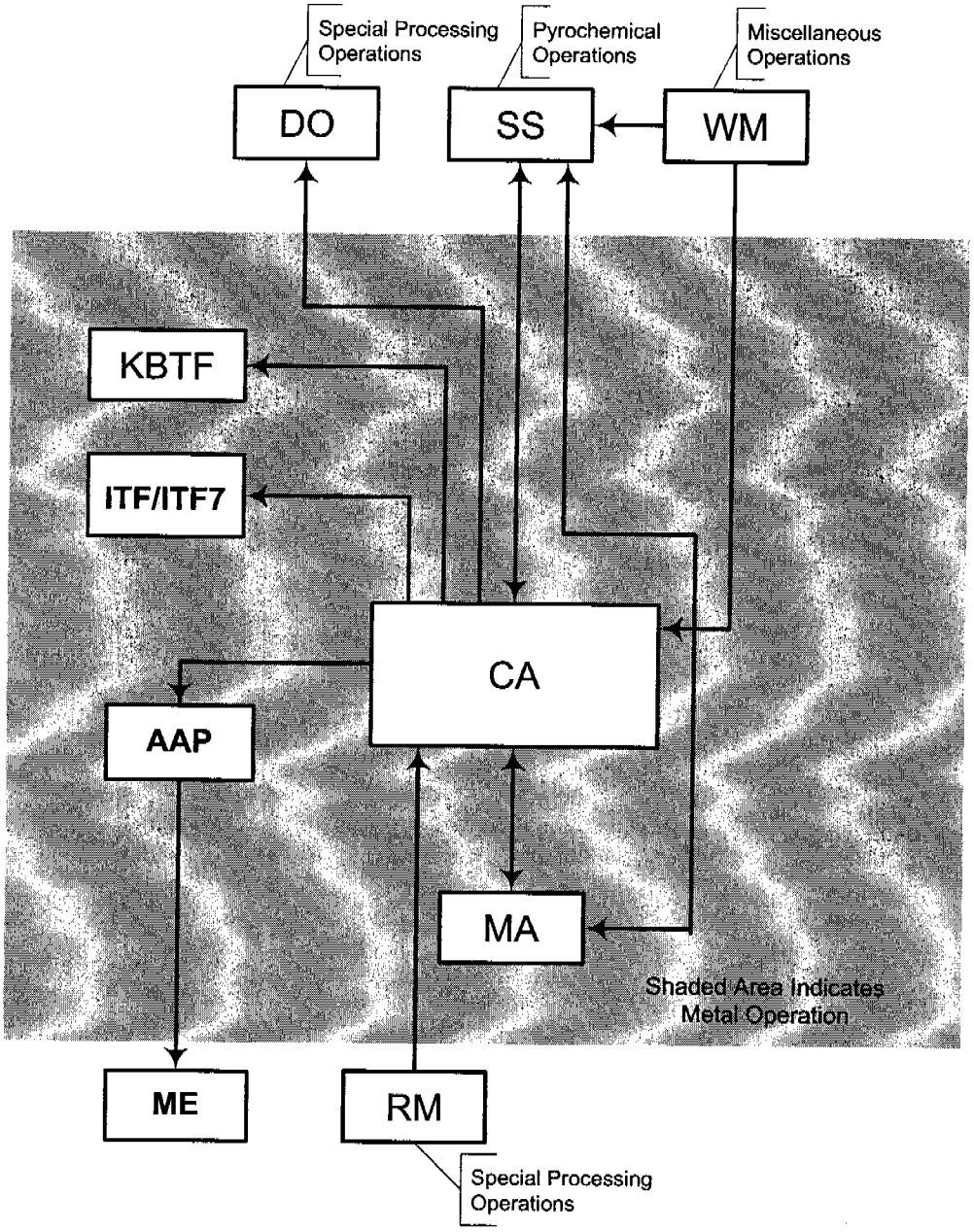



In 1988, P/S codes CO, GI, ID, OB, and RS were combined into P/S code FF. P/S codes CT, ID, and OM are status codes only, and probably do not generate TRU waste.



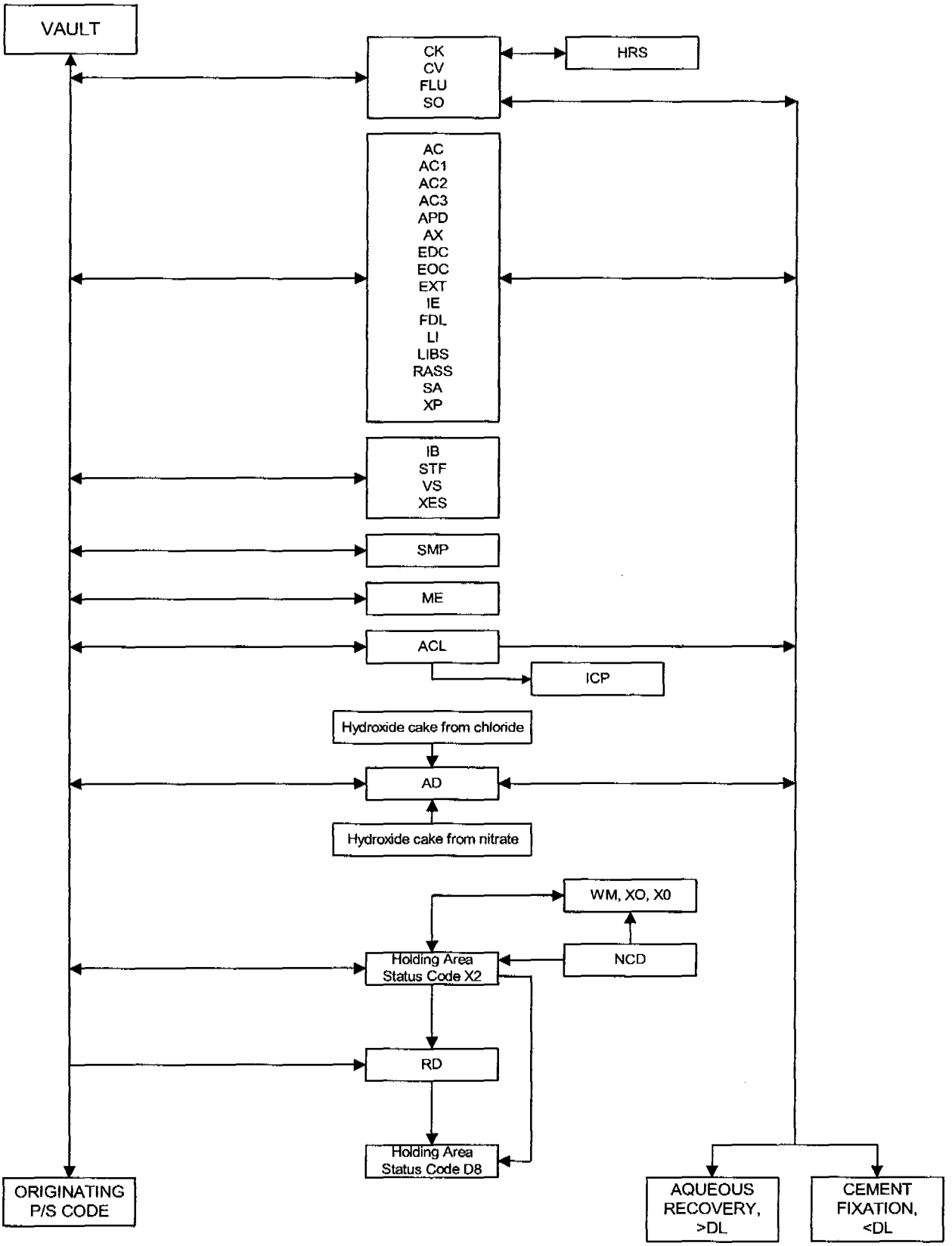

**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

**SIMPLIFIED FLOW DIAGRAM FOR METAL OPERATIONS (NEWLY GENERATED)**

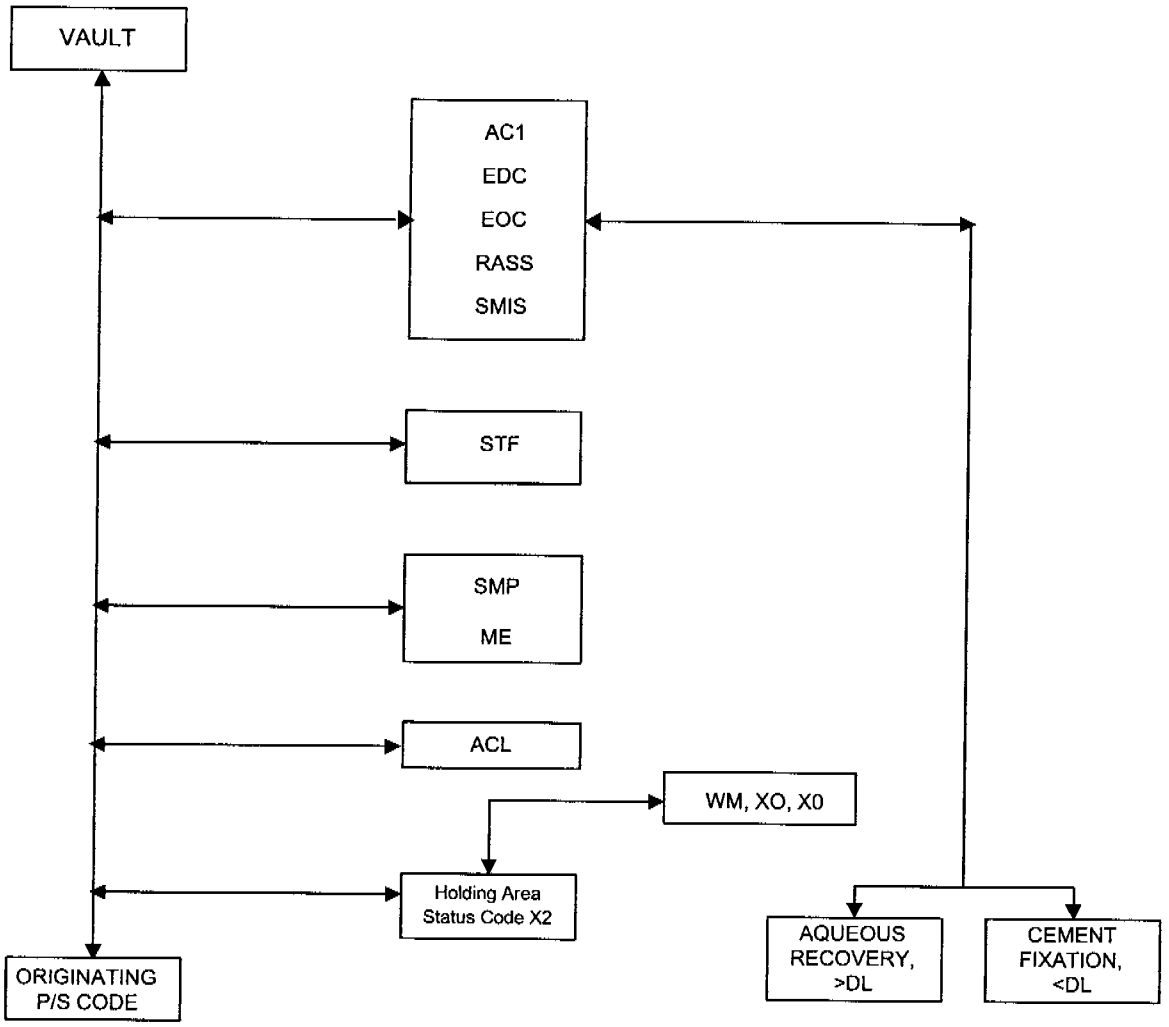



**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

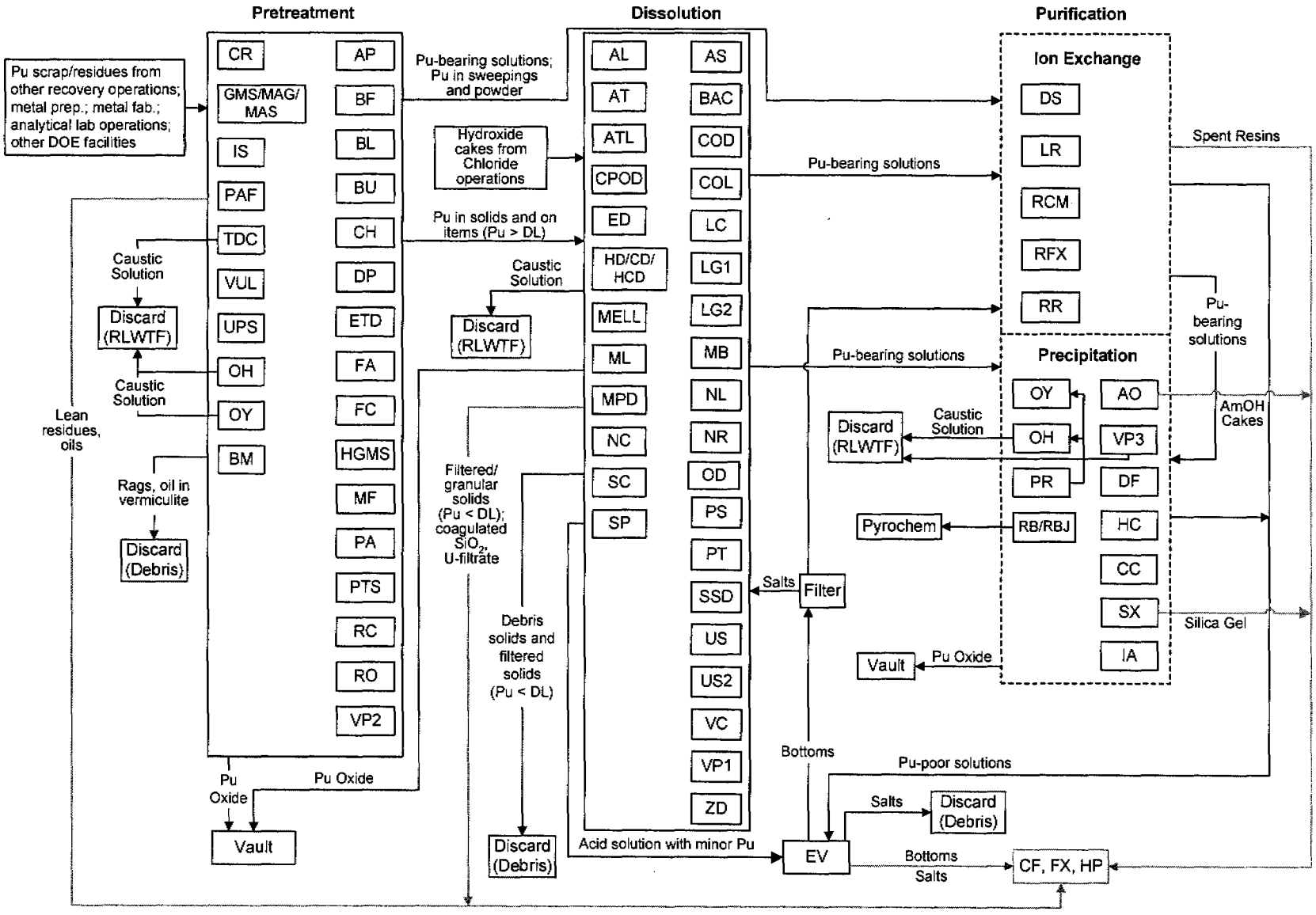
## SIMPLIFIED FLOW DIAGRAM FOR MISCELLANEOUS OPERATIONS (LEGACY)



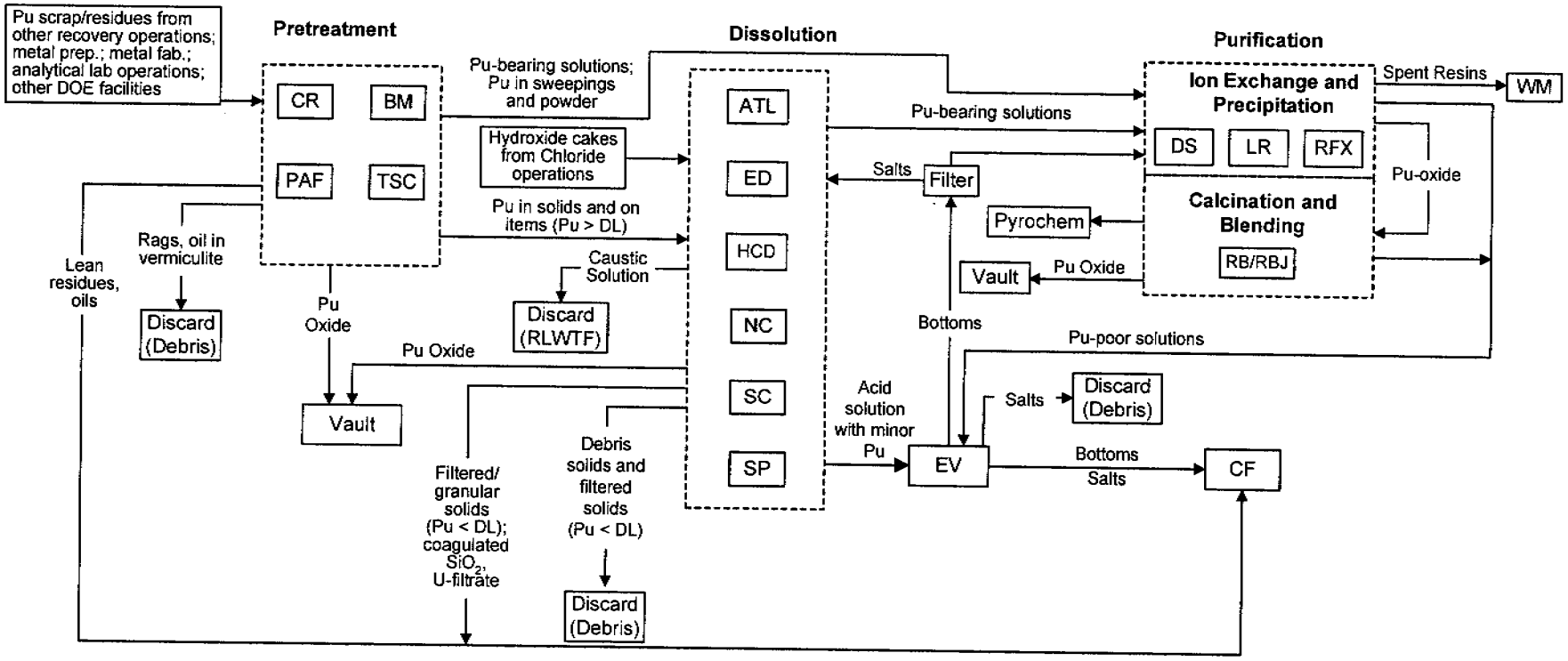
**SIMPLIFIED FLOW DIAGRAM FOR MISCELLANEOUS OPERATIONS (NEWLY GENERATED)**



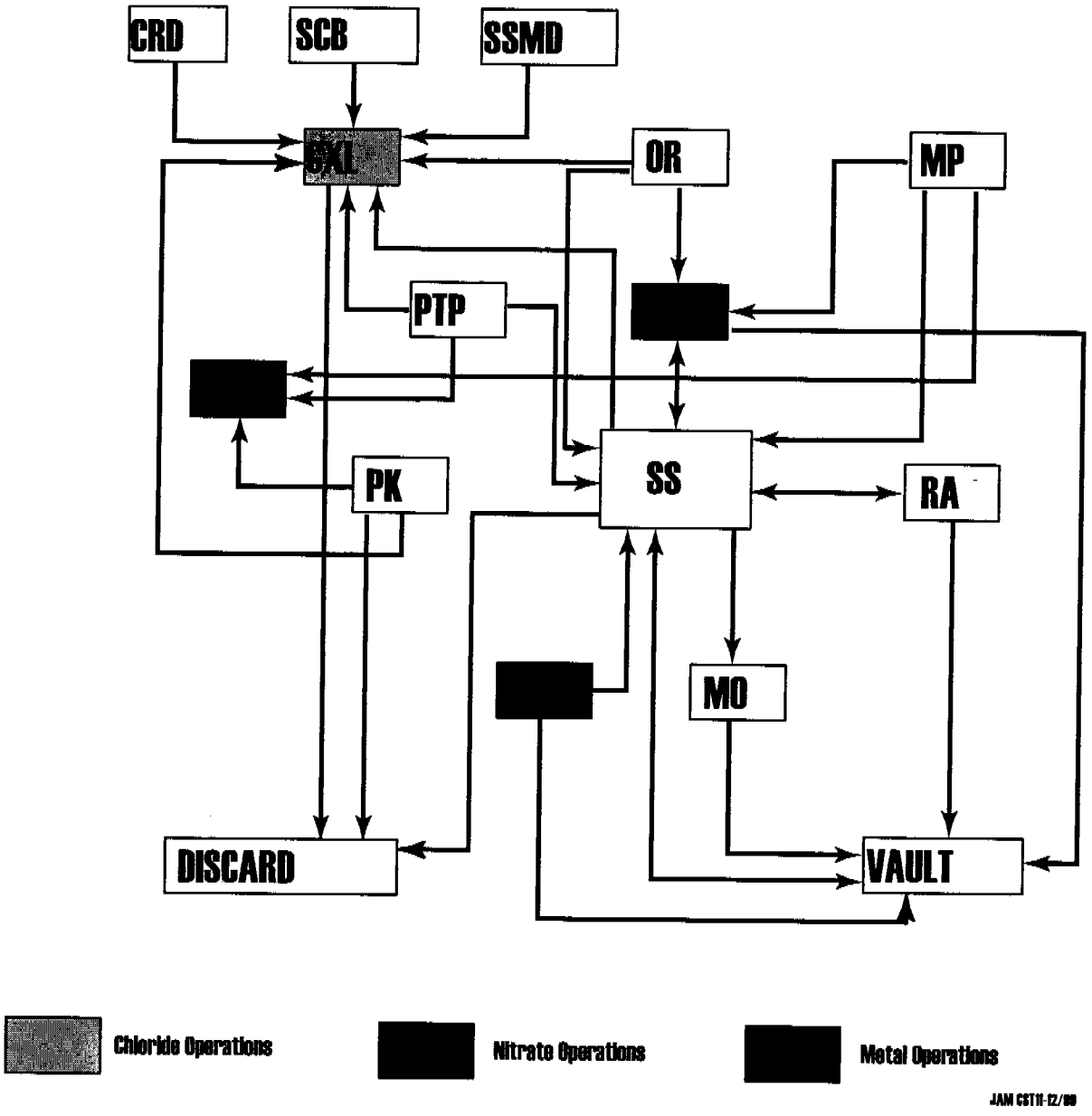
## GENERALIZED PROCESS STATUS DIAGRAM FOR NITRATE PROCESSES (LEGACY)



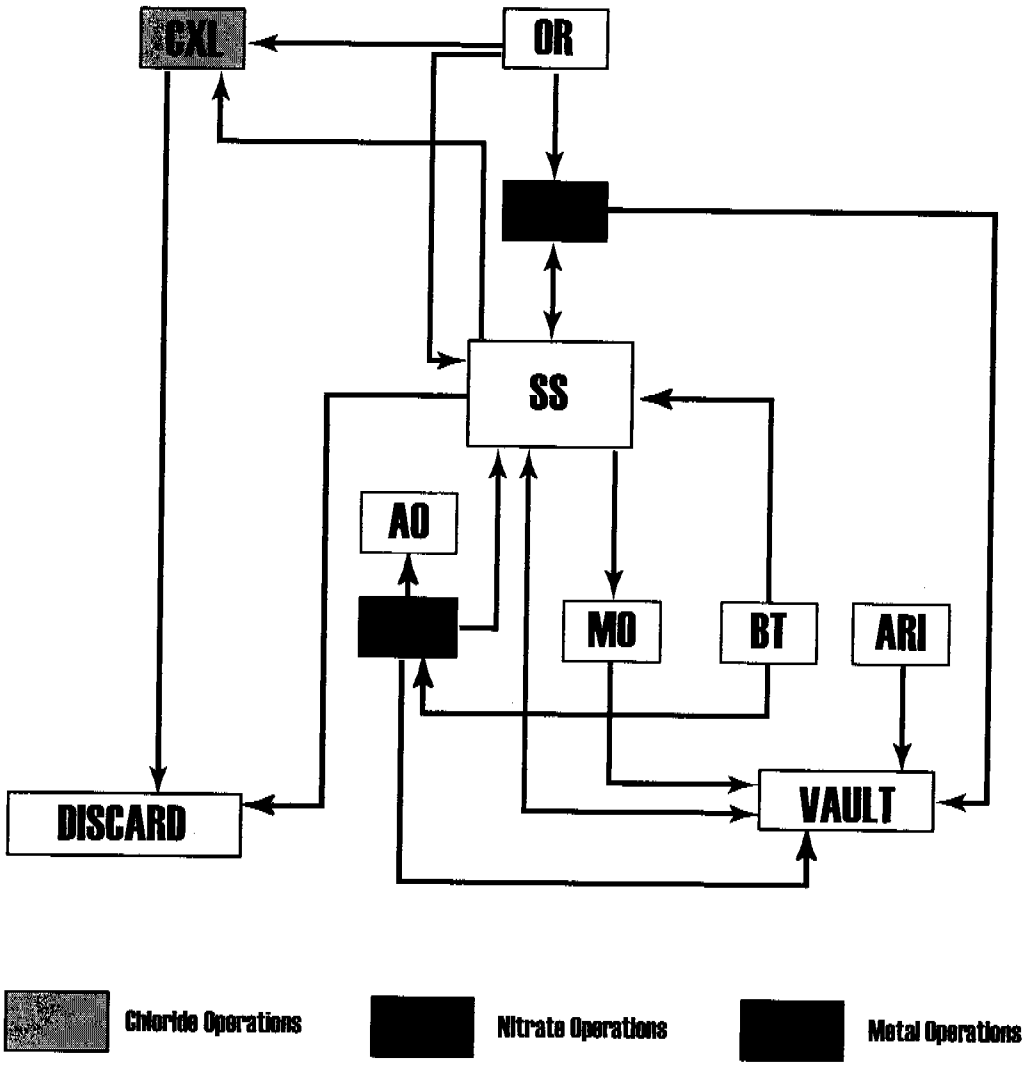
# GENERALIZED DIAGRAM FOR NITRATE OPERATIONS (NEWLY GENERATED)



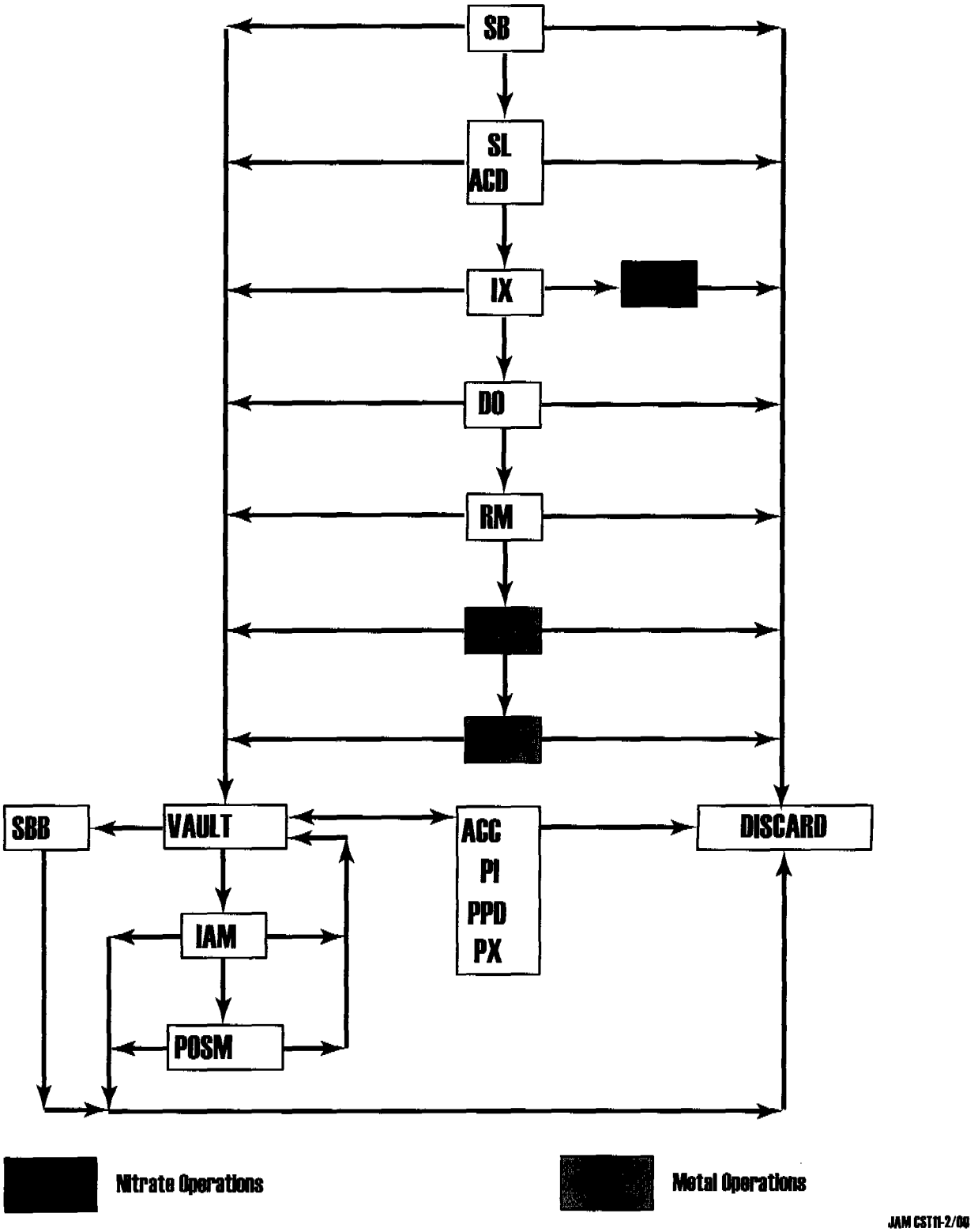
**SIMPLIFIED PROCESS FLOW DIAGRAM
FOR PYROCHEMICAL PROCESSES
(LEGACY)**



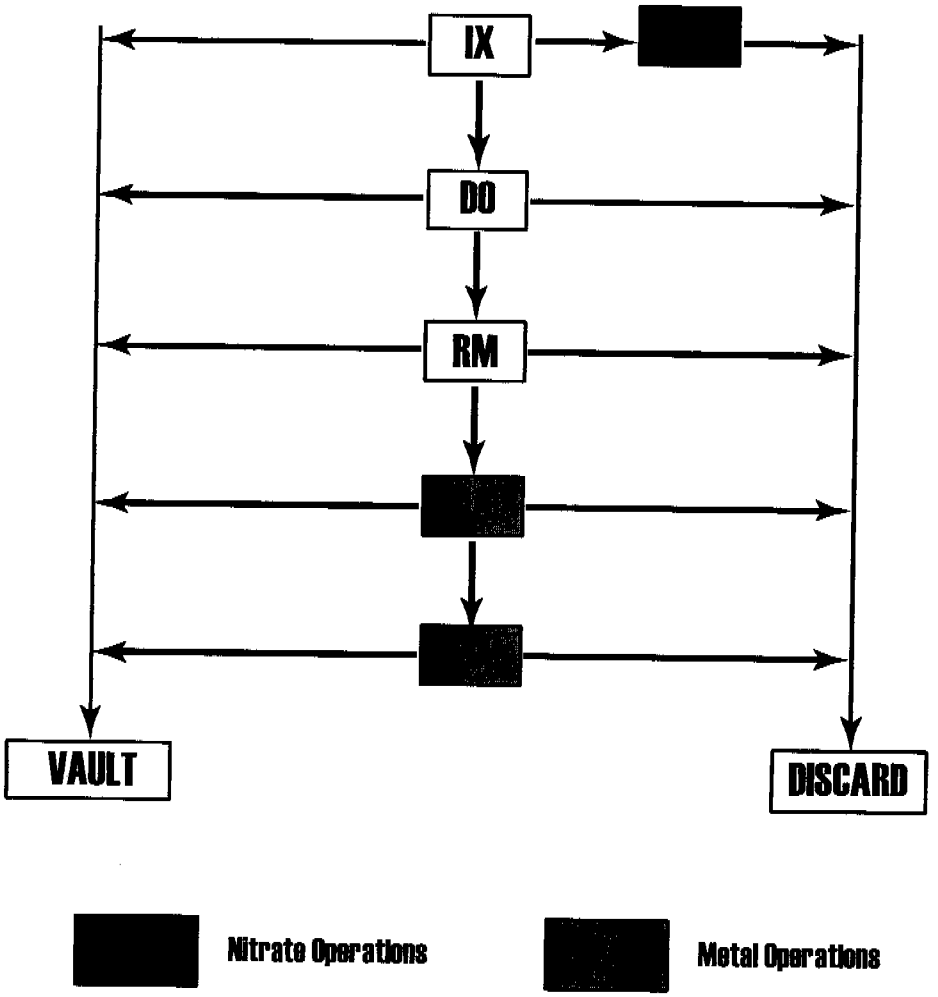
**SIMPLIFIED FLOW DIAGRAM FOR PYROCHEMICAL OPERATIONS (NEWLY GENERATED)**



## SIMPLIFIED PROCESS FLOW DIAGRAM
## FOR SPECIAL PROCESSING (LEGACY)



**SIMPLIFIED FLOW DIAGRAM FOR SPECIAL OPERATIONS (NEWLY GENERATED)**



# EXAMPLE WASTE GENERATOR FORMS

**Los Alamos**
NATIONAL LABORATORY

## TRU WASTE STORAGE RECORD

LA00000057745

### 1. GENERATOR'S PRE-USE VISUAL INSPECTION

| Purchase Order # | 2328415 | Inspected Items | | |
|---|---|---|---|---|
| *This container has been visually inspected according to approved procedures and has been found to be free of damage that would make it unsuitable for TRU waste packaging.* | | [X] Ring, Bolt, and Nut | [X] Chime | [X] Dents |
| | | [X] Lid and Gasket | [X] Gouges | [X] Paint |
| Name | | Znumber 091564 | | Date NOV 23 1998 |

### 2. GENERATOR'S PACKAGE INFORMATION

| Group NMT-7 | Technical Area 55 | Building PF-4 | Program Code 8J0700 KG19 2000 1000 | [ ] Off-Normal |
|---|---|---|---|---|
| Additional Information TID | | | | |

| CONTAINER | LINER | INTERNAL SHIELDING |
|---|---|---|
| [X] Steel Drum (*55 gal.*) | [X] None | [X] None |
| [ ] Steel Drum (*85 gal.*) | [ ] 90 mil liner | |
| [ ] Standard Waste Box | [ ] 125 mil liner | |
| [ ] RH Canister | | |
| [ ] Other (*Call TWCO*) | | |
| [ ] Overpack | Type | Thickness (*in.*) |
| Carbon Filter ID 01 2080 | | |
| Carbon Filter ID 02 | | |

RADIONUCLIDE CONTENT

| Nuclide | Amount | Uncertainty | C = Curie M = Gram |
|---|---|---|---|
| PU-238 | 4.040E-3 | 1.867E-4 | M |
| PU-239 | 3.788E+1 | 1.751E+0 | M |
| PU-240 | 2.424E+0 | 1.120E-1 | M |
| PU-241 | 8.079E-2 | 3.734E-3 | M |
| PU-242 | 8.079E-3 | 3.734E-4 | M |
| AM-241 | 6.423E-2 | 2.989E-3 | M |

| | |
|---|---|
| Waste Profile Request Number | 20283 |
| Process Batch Code | NA |
| Gross Weight (*lb.*) | 2.21E+2 |
| Net Weight (*lb.*) | 1.60E+2 |
| Shipping Category | 2001700110 |
| LANL Waste Stream ID | TA-55-5 |
| TRUCON Code | 117C |
| Date Closed (*MMDDYY*) | DEC 2 1998 |

[ ] PDP Program Tracking No:

NONRADIOACTIVE HAZARDOUS MATERIALS

| Name | EPA Code | Quantity (*g*) |
|---|---|---|
| None | | |
| | | |
| | | |

Accumulation Start Date (*MMDDYY*)

*The data in this section were collected, and the waste described herein was packaged and labeled according to approved procedures.*

Name WULFF DENNIS R | Znumber 093089 | Date DEC 8 1998

### 3. GENERATOR SITE HEALTH PHYSICS INFORMATION

| | | Survey Date | Survey Meter Model | Property | Calibration Void Date |
|---|---|---|---|---|---|
| Gamma Dose Rate (*mrem/h*) (contact) | 4.2E+0 | DEC 8 1998 | RO20 | 006469 | APR 14 1999 |
| Neutron Dose Rate (*mrem/h*) (contact) | 5.0E-1 | Survey Date DEC 8 1998 | Survey Meter Model PNR-4 | Property Number 004904 | Calibration Void Date APR 28 1999 |
| Total Dose Rate (*mrem/h*) (contact) | 4.7E+0 | | | | |
| Total Dose Rate (*mrem/h*) (1 meter) | 2.0E-1 | *The data in this section were collected according to approved procedures.* | | | |
| Alpha Contamination (*dpm/100cm $^2$*) (*rem*) | 0.0E+0 | Name | | | |
| Beta-Gamma Cont. (*dpm/100cm $^2$*) (*rem*) | 0.0E+0 | Znumber 116142 | | | Date DEC 8 1998 |

Form 1562E (7/97) Printed FEB 12 99 11:04:08 by Page 1 of 2

Modifications to Computer Generated Data Invalidate this Form

**Los Alamos**
NATIONAL LABORATORY

## DISCARDABLE WASTE LOG SHEET

LA00000057745

| Item ID | Matrix | Pkg Wt (kg) | Qty | Volume (l) | MT | SNM(g) | Uncert(g) | Pg/Section/Ln OR Memo |
|---|---|---|---|---|---|---|---|---|
| METBM32 | Metal (Non-Pu Scrap) | 8.49 | | | 52 | 10.697 | 1.558 | 8/14 |
| METEOC2 | Metal (Non-Pu Scrap) | 3.18 | | | 52 | 8.760 | 0.480 | 8/14 |
| METFF32 | Metal (Non-Pu Scrap) | 10.28 | | | 52 | 0.775 | 0.423 | 8/14 |
| METOM1 | Metal (Non-Pu Scrap) | 5.05 | | | 52 | 0.635 | 0.329 | 8/14 |
| METTIGR1 | Metal (Non-Pu Scrap) | 23.42 | | | 52 | 1.035 | 0.290 | 8/14 |
| METXO48 | Metal (Non-Pu Scrap) | 20.94 | | | 52 | 21.226 | 0.725 | 8/14 |
| XBLSS44 | MgO Crucible (Chloride) | 0.59 | | | 52 | 1.901 | 0.026 | 8/21 |
| XBLSS45 | MgO Crucible (Chloride) | 0.64 | | | 52 | 3.366 | 0.033 | 8/21 |
| | | | | | | | | |
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| | |
|---|---|
| Total Pkg Wt (lbs) | 160.03 |
| Drum Tare (lbs) | 60.96 |
| Calc Gross Wt (lbs) | 220.99 |
| Meas Gross Wt (lbs) | 221.08 |

| MT | Total SNM | Total Uncert |
|---|---|---|
| 52 | 40.395000 | 3.784000 |
| | | |
| | | |
| | | |
| | | |

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# TRU Waste Origination & Disposition Information

| Itemid | Matrix | | | | | Date |
|---|---|---|---|---|---|---|
| METBM32 | Metal (Non-Pu Scrap) | | | | | NOV 19 1998 |
| **Quantity** | **Gross Wt (kg)** | **Tare Wt** | **Net Wt (kg)** | **Volume (l)** | | **Process Status** |
| | 7.50 | | 7.50 | | | BM |
| **Generator** | | | | **Znumber** | **Room** | **Phone** |
| | | | | 086205 | 208 | 7-2547 |
| **Waste Process** | | **Assay** | | **Combined into** | | **Drumid** |
| Solid Waste Processing | | NDA Laboratory | | | | LA00000057745 |

| | | |
|---|---|---|
| **Beryllium** NO | **Explosives** NO | **PCB's** NO |
| **Compressed Gases** NO | **Free Liquids** NO | **Particulates** NO |
| **Corrosive** NO | **Hazardous** NO | **Pyrophorics** NO |

**Comments**
bagout filter#249

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 10.697000 | 1.558000 | N02 | 3.31 | 1.426 | NOV 24 1998 | |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| NOV 19 1998 | | CERTIFIED | |
| NOV 24 1998 | | PACKED | LA00000057745 |
| NOV 24 1998 | | CERTIFIED | added bagout filter # |

# TRU Waste Origination & Disposition Information

| Itemid | Matrix | | | | | Date |
|---|---|---|---|---|---|---|
| METEOC2 | Metal (Non-Pu Scrap) | | | | | NOV 23 1998 |
| **Quantity** | **Gross Wt (kg)** | **Tare Wt** | **Net Wt (kg)** | **Volume (l)** | | **Process Status** |
| | 2.80 | | 2.80 | | | EOC |
| **Generator** | | | | **Znumber** | **Room** | **Phone** |
| | | | | 082196 | 208 | 7-2547 |
| **Waste Process** | | **Assay** | | **Combined into** | | **Drumid** |
| Solid Waste Processing | | NDA Laboratory | | | | LA00000057745 |

| | | |
|---|---|---|
| **Beryllium** NO | **Explosives** NO | **PCB's** NO |
| **Compressed Gases** NO | **Free Liquids** NO | **Particulates** NO |
| **Corrosive** NO | **Hazardous** NO | **Pyrophorics** NO |

**Comments**
scrap metal Filter 497

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 0.760000 | 0.400000 | N02 | 3.31 | 0.271 | NOV 30 1998 | |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| NOV 23 1998 | | CERTIFIED | |
| DEC 1 1998 | | PACKED | LA00000057745 |
| DEC 1 1998 | | CERTIFIED | add fil |

# TRU Waste Origination & Disposition Information

| Itemid | Matrix | | | | | Date |
|---|---|---|---|---|---|---|
| METFF32 | Metal (Non-Pu Scrap) | | | | | NOV 25 1998 |
| Quantity | Gross Wt (kg) | Tare Wt | Net Wt (kg) | Volume (l) | | Process Status |
| | 9.49 | | 9.49 | | | FF |
| Generator | | | | Znumber | Room | Phone |
| | | | | 083191 | 128 | 7-2587 |
| Waste Process | | Assay | | Combined into | | Drumid |
| Solid Waste Processing | | NDA Laboratory | | | | LA00000057745 |

| | | |
|---|---|---|
| Beryllium NO | Explosives NO | PCB's NO |
| Compressed Gases NO | Free Liquids NO | Particulates NO |
| Corrosive NO | Hazardous NO | Pyrophorics NO |

Comments
hepa spacers and drill motor other scrap bagout filter#228

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 0.775000 | 0.423000 | N02 | 3.31 | 0.082 | DEC 1 1998 | |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| NOV 25 1998 | | CERTIFIED | |
| DEC 1 1998 | | CERTIFIED | |
| DEC 2 1998 | | PACKED | LA00000057745 |
| DEC 2 1998 | | CERTIFIED | added bagout filter |

# TRU Waste Origination & Disposition Information

| ItemId | Matrix | | | | | Date |
|---|---|---|---|---|---|---|
| METOM1 | Metal (Non-Pu Scrap) | | | | | NOV 23 1998 |
| Quantity | Gross Wt (kg) | Tare Wt | Net Wt (kg) | Volume (l) | | Process Status |
| | 4.64 | | 4.64 | | | OM |
| Generator | | | | Znumber | Room | Phone |
| | | | | 106652 | 126 | 7-2370 |
| Waste Process | | Assay | | Combined into | | DrumId |
| Solid Waste Processing | | NDA Laboratory | | | | LA00000057745 |

| | | |
|---|---|---|
| Beryllium NO | Explosives NO | PCB's NO |
| Compressed Gases NO | Free Liquids NO | Particulates NO |
| Corrosive NO | Hazardous NO | Pyrophorics NO |

Comments
balance parts bagout filter#318

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 0.635000 | 0.329000 | N02 | 3.31 | 0.137 | DEC 1 1998 | |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| NOV 23 1998 | | CERTIFIED | |
| DEC 2 1998 | | PACKED | LA00000057745 |
| DEC 2 1998 | | CERTIFIED | added bagout filter # |

# TRU Waste Origination & Disposition Information

| Itemid | Matrix | | | | | Date |
|---|---|---|---|---|---|---|
| METTIGR1 | Metal (Non-Pu Scrap) | | | | | NOV 17 1998 |
| Quantity | Gross Wt (kg) | Tare Wt | Net Wt (kg) | Volume (l) | | Process Status |
| | 20.59 | | 20.59 | | | TIGR |
| Generator | | | | Znumber | Room | Phone |
| | | | | 115490 | 114 | 5-6161 |
| Waste Process | | Assay | | Combined into | | Drumid |
| Solid Waste Processing | | NDA Laboratory | | | | LA00000057745 |

| | | |
|---|---|---|
| **Beryllium** NO | **Explosives** NO | **PCB's** NO |
| **Compressed Gases** NO | **Free Liquids** NO | **Particulates** NO |
| **Corrosive** NO | **Hazardous** NO | **Pyrophorics** NO |

Comments
copper tubing and furnace parts filter 230,234

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 1.035000 | 0.290000 | N02 | 3.31 | 0.050 | NOV 23 1998 | |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| NOV 17 1998 | | CERTIFIED | |
| NOV 23 1998 | | PACKED | LA00000057745 |
| NOV 23 1998 | | CERTIFIED | add filter |

# TRU Waste Origination & Disposition Information

| Itemid | Matrix | | | | | Date |
|---|---|---|---|---|---|---|
| METXO48 | Metal (Non-Pu Scrap) | | | | | NOV 17 1998 |
| Quantity / Gross Wt (kg): 20.04 | Tare Wt | Net Wt (kg): 20.04 | Volume (l) | | | Process Status: XO |
| Generator | | | | Znumber: 110326 | Room: 401 | Phone: 7-2572 |
| Waste Process: Solid Waste Processing | Assay: NDA Laboratory | | Combined into | | Drumid: LA00000057745 | |

| | | |
|---|---|---|
| Beryllium NO | Explosives NO | PCB's NO |
| Compressed Gases NO | Free Liquids NO | Particulates NO |
| Corrosive NO | Hazardous NO | Pyrophorics NO |

Comments
parts from furnaces, motors, pumps bagout filter #90,167

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 21.226000 | 0.725000 | N02 | 3.31 | 1.059 | NOV 30 1998 | |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| NOV 18 1998 | | CERTIFIED | |
| DEC 2 1998 | | PACKED | LA00000057745 |
| DEC 2 1998 | | CERTIFIED | |
| DEC 2 1998 | | CERTIFIED | updated gross wt |

# TRU Waste Origination & Disposition Information

| ItemId | Matrix | | | | | Date |
|---|---|---|---|---|---|---|
| XBLSS44 | MgO Crucible (Chloride) | | | | | JUN 3 1998 |
| **Quantity** | **Gross Wt (kg)** | **Tare Wt** | **Net Wt (kg)** | **Volume (l)** | | **Process Status** |
| | 0.39 | 0.07 | 0.32 | | | SS |
| **Generator** | | | | **Znumber** | **Room** | **Phone** |
| | | | | 084546 | 429 | 7-2577 |
| **Waste Process** | | **Assay** | | **Combined into** | | **DrumId** |
| Solid Waste Processing | | NDA Laboratory | | | | LA00000057745 |

| | | |
|---|---|---|
| **Beryllium** NO | **Explosives** NO | **PCB's** NO |
| **Compressed Gases** NO | **Free Liquids** NO | **Particulates** NO |
| **Corrosive** NO | **Hazardous** NO | **Pyrophorics** NO |

**Comments**
changed Id. to be able to discard, caxbl1035 No filter #s legacy item

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 1.901000 | 0.026000 | PAN1 | 8.30 | 5.941 | JUN 9 1998 | |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| JUN 9 1998 | | CERTIFIED | |
| JUN 9 1998 | | PACKED | LA00000056889 |
| JUN 9 1998 | | CERTIFIED | |
| SEP 29 1998 | | UNPACKED | LA00000056889 |
| SEP 29 1998 | | CERTIFIED | |
| SEP 29 1998 | | PACKED | LA00000056889 |
| SEP 29 1998 | | CERTIFIED | cert |
| NOV 24 1998 | | UNPACKED | LA00000056889 |
| NOV 24 1998 | | PACKED | LA00000057745 |

# TRU Waste Origination & Disposition Information

| Itemid | Matrix | | | | | Date |
|---|---|---|---|---|---|---|
| XBLSS45 | MgO Crucible (Chloride) | | | | | JUN 3 1998 |
| Quantity | Gross Wt (kg) | Tare Wt | Net Wt (kg) | Volume (l) | | Process Status |
| | 0.55 | 0.05 | 0.50 | | | SS |
| Generator | | | | Znumber | Room | Phone |
| | | | | 084546 | 429 | 7-2577 |
| Waste Process | | Assay | | Combined into | | Drumid |
| Solid Waste Processing | | NDA Laboratory | | | | LA00000057745 |

| | | |
|---|---|---|
| Beryllium NO | Explosives NO | PCB's NO |
| Compressed Gases NO | Free Liquids NO | Particulates NO |
| Corrosive NO | Hazardous NO | Pyrophorics NO |

Comments
changed id to be able to discard, caxbl17-98 No filter #s legacy item

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 3.366000 | 0.033000 | PAN1 | 8.30 | 6.732 | JUN 1 1998 | |

## Justification Memos

| Memo ID |
|---|
| NONE |

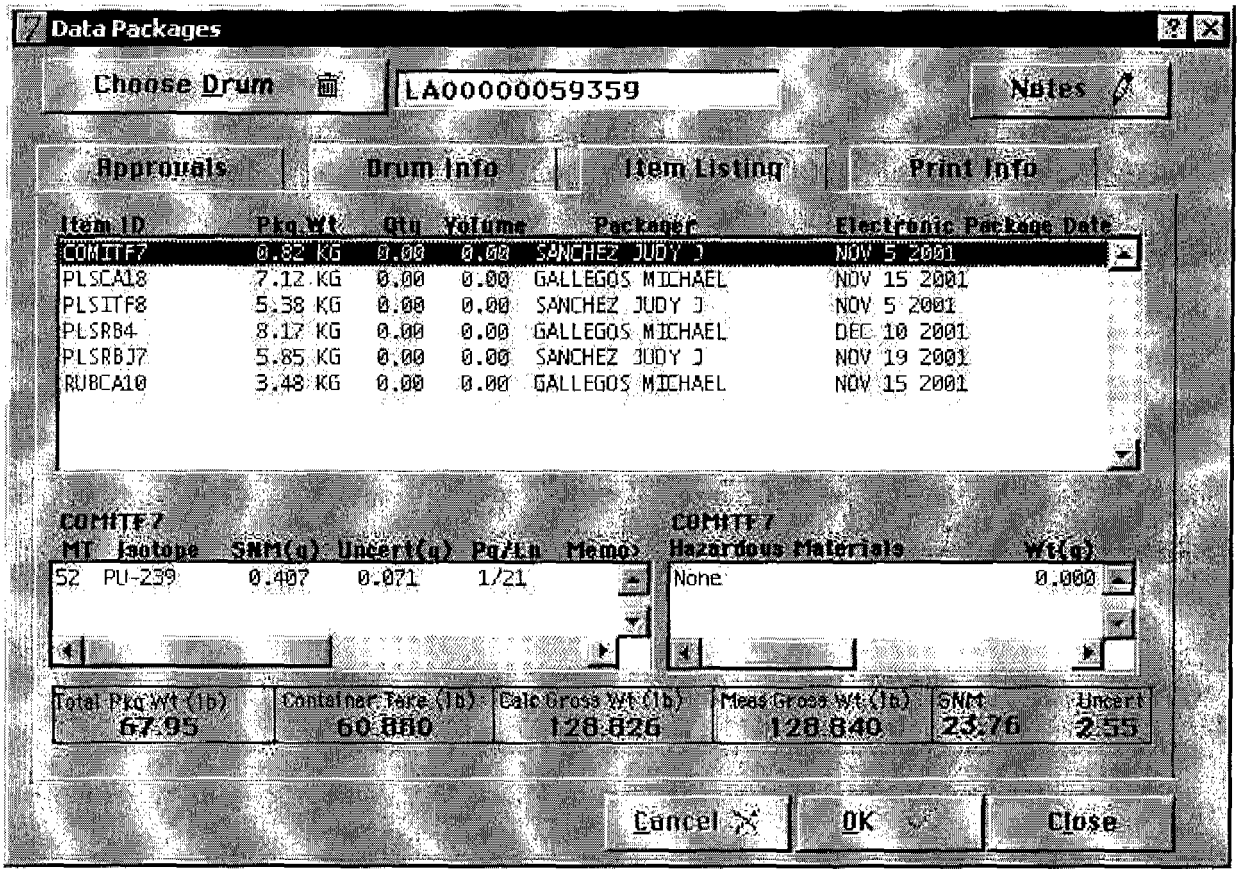
## Hazardous Materials

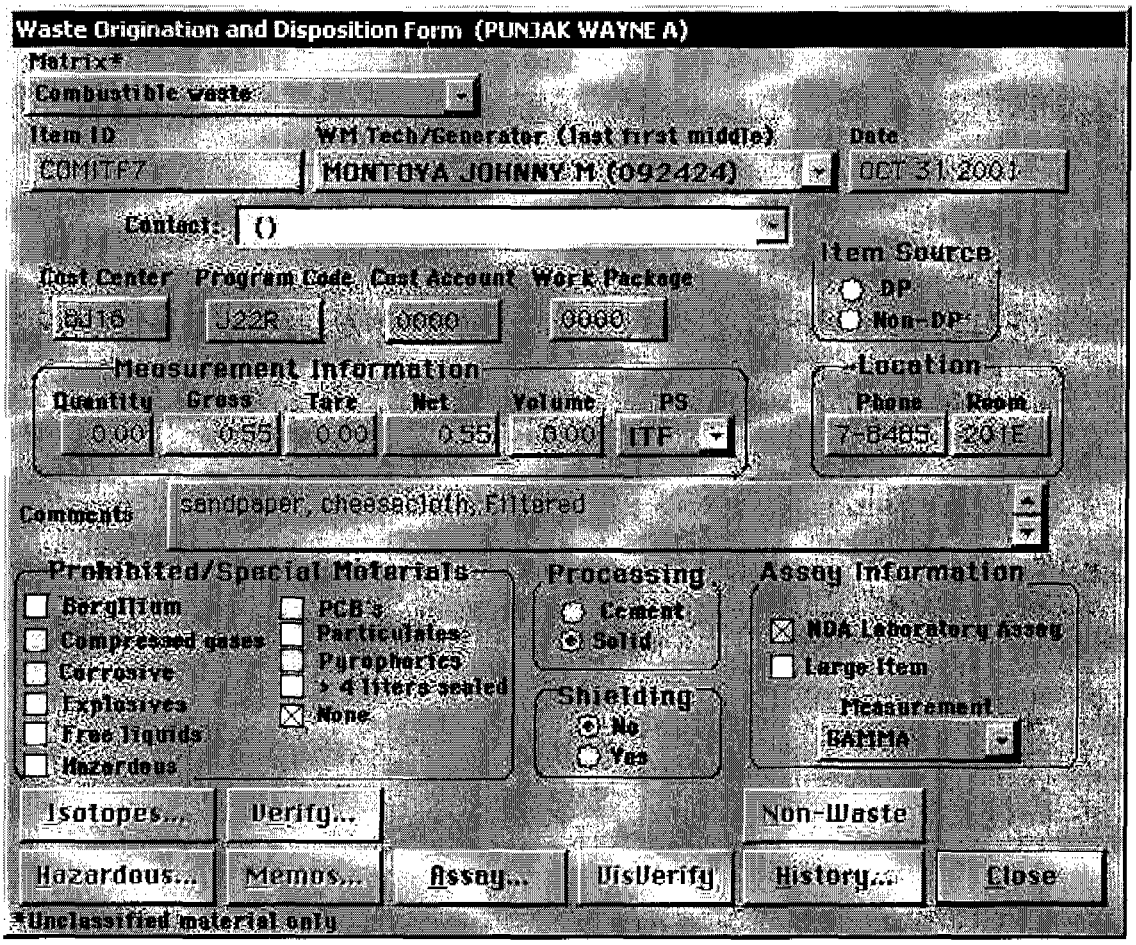
| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

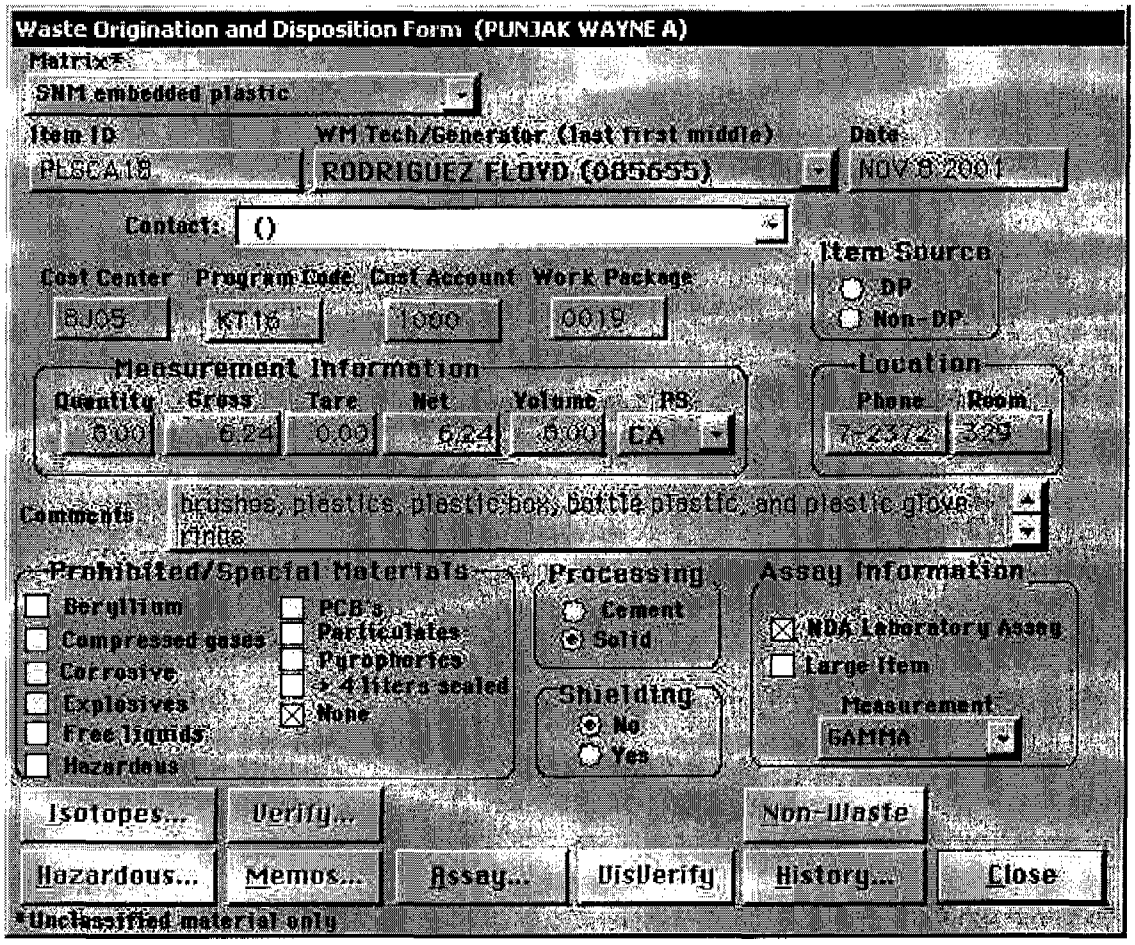
## History

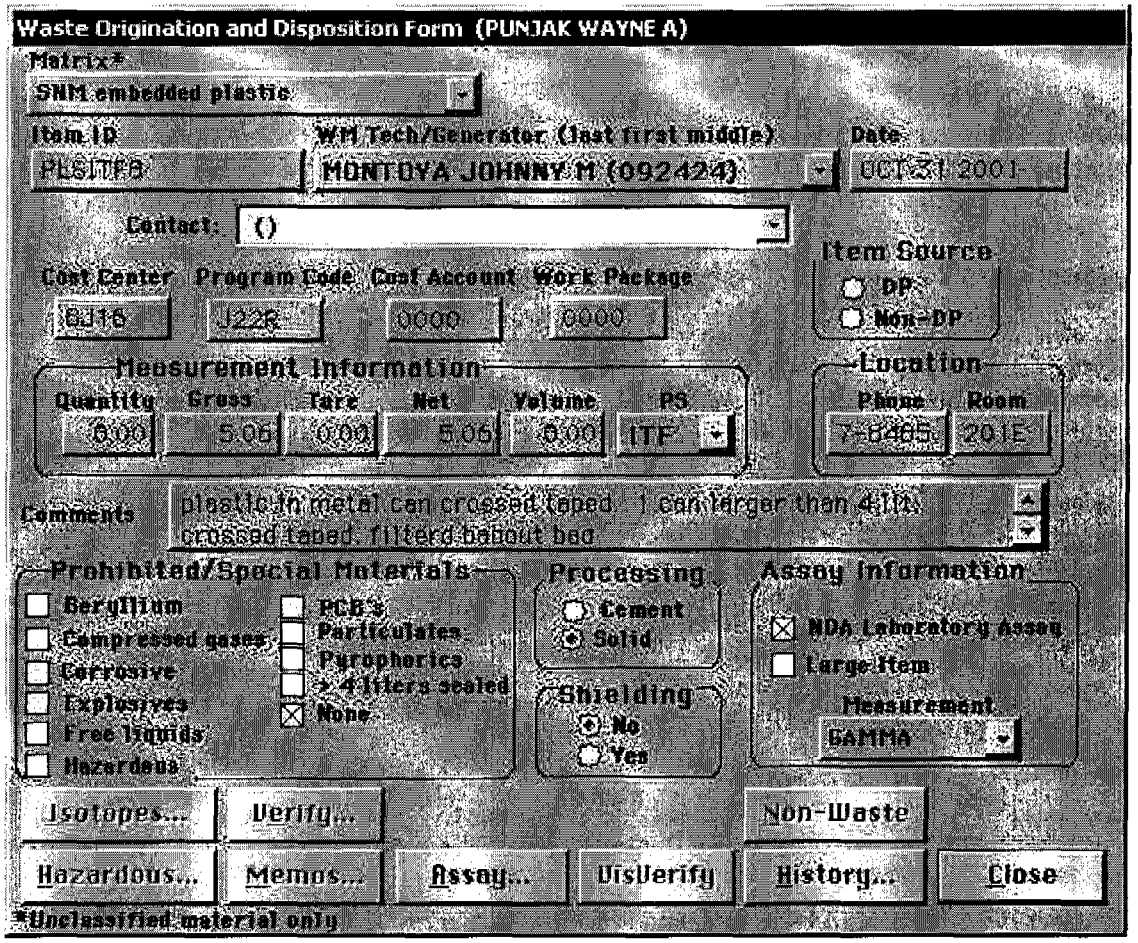
| Date | Name | Event | Comments |
|---|---|---|---|
| JUN 9 1998 | | CERTIFIED | |
| JUN 9 1998 | | PACKED | LA00000056889 |
| JUN 9 1998 | | CERTIFIED | |
| SEP 29 1998 | | UNPACKED | LA00000056889 |
| SEP 29 1998 | | PACKED | LA00000056889 |
| SEP 29 1998 | | UNPACKED | LA00000056889 |
| SEP 29 1998 | | CERTIFIED | |
| SEP 29 1998 | | PACKED | LA00000056889 |
| SEP 29 1998 | | CERTIFIED | cert |
| NOV 24 1998 | | UNPACKED | LA00000056889 |
| NOV 24 1998 | | PACKED | LA00000057745 |

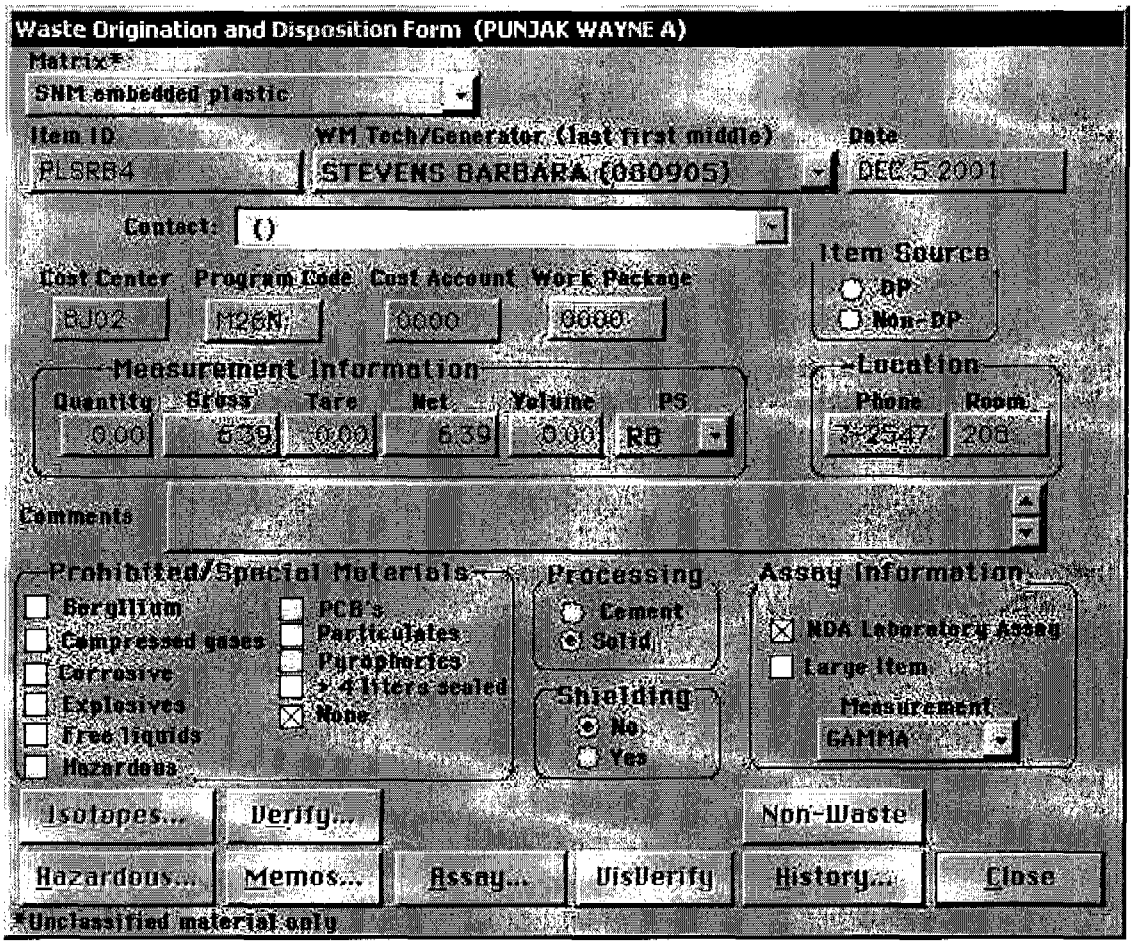
# EXAMPLE WASTE GENERATOR FORMS FOR TRU WASTE

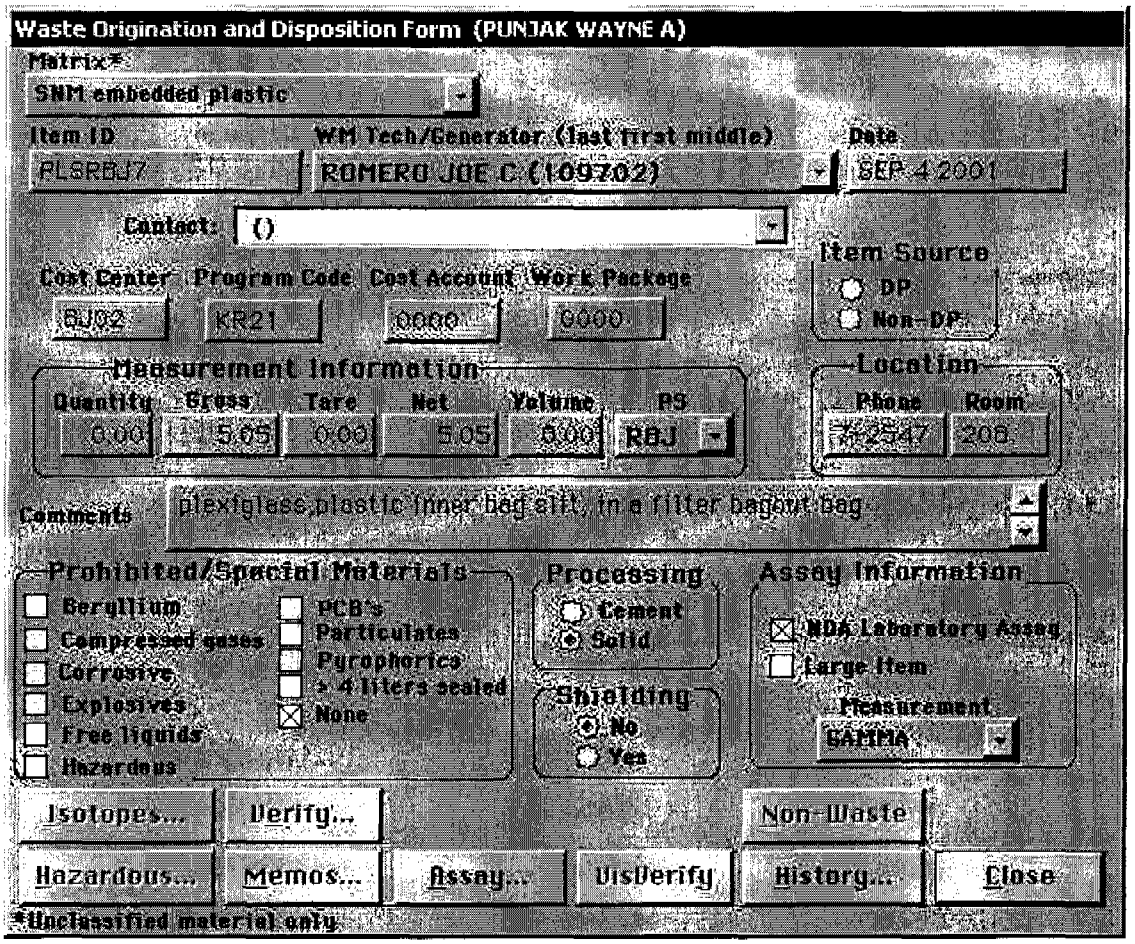


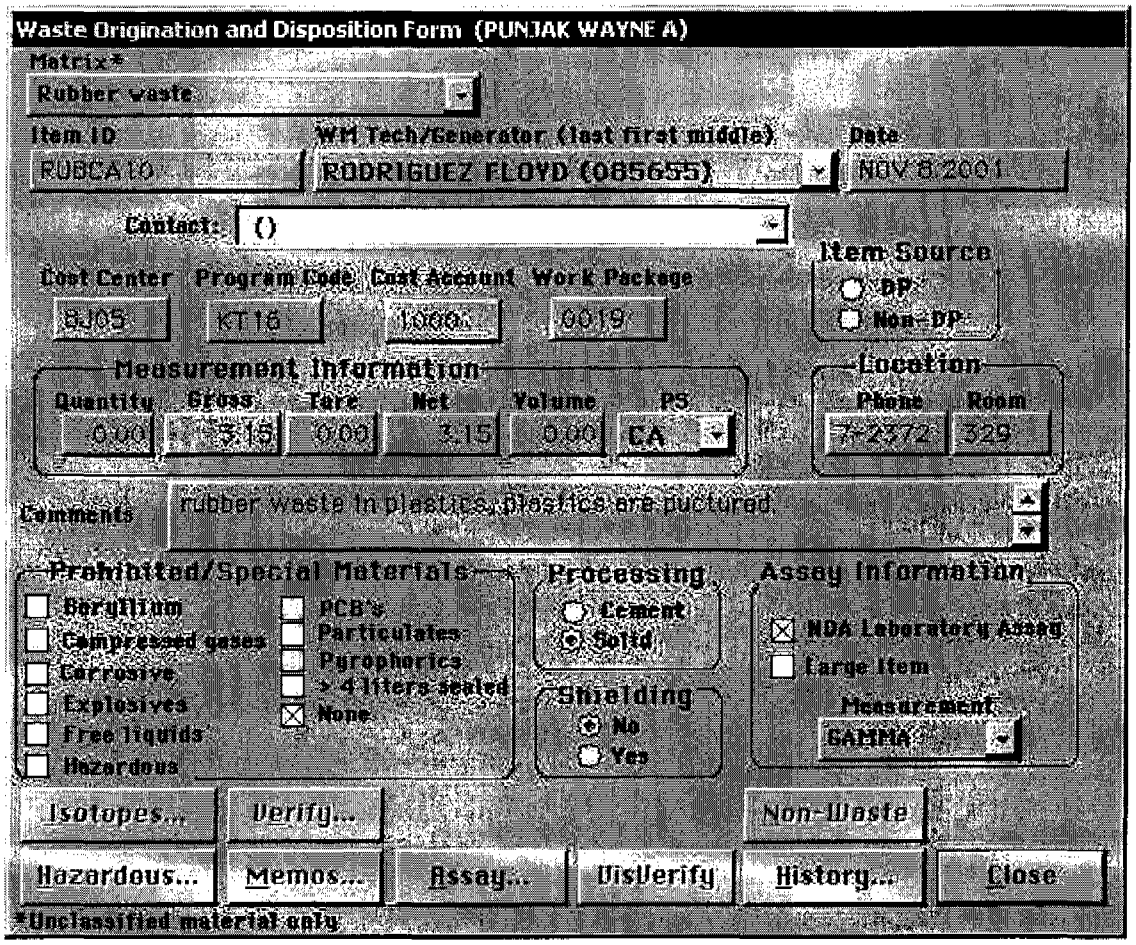

Waste Origination and Disposition Form (PUNJAK WAYNE A)
Matrix*
Combustible waste
Item ID
COMITF7
WM Tech/Generator (last first middle)
MONTOYA JOHNNY M (092424)
Date
OCT 31 2001
Contact:
Cost Center
Program Code
Cost Account
Work Package
GJ18
J22R
0000
0000
Item Source
DP
Non-DP
Measurement Information
Quantity
Gross
Tare
Net
Volume
PS
0.00
0.55
0.00
0.55
0.00
ITF
Location
Phone
Room
7-6465
201E
Comments
sandpaper, cheesecloth, Filtered
Prohibited/Special Materials
Beryllium
Compressed gases
Corrosive
Explosives
Free liquids
Hazardous
PCB's
Particulates
Pyrophorics
> 4 liters sealed
None
Processing
Cement
Solid
Shielding
No
Yes
Assay Information
NDA Laboratory Assay
Large Item
Measurement
GAMMA
Isotopes...
Verify...
Non-Waste
Hazardous...
Memos...
Assay...
DisVerify
History...
Close
*Unclassified material only


Waste Origination and Disposition Form (PUNJAK WAYNE A)
Matrix*
SNM embedded plastic
Item ID
PLSCA18
WM Tech/Generator (last first middle)
RODRIGUEZ FLOYD (0055655)
Date
NOV 8 2001
Contact:
()
Item Source
DP
Non-DP
Cost Center
Program Code
Cost Account
Work Package
8J05
KT1X
1000
0019
Measurement Information
Quantity
Gross
Tare
Net
Volume
RS
6.24
0.00
6.24
CA
Location
Phone
Room
7-2372
329
Comments
brushes, plastics, plastic box, bottle plastic, and plastic glove rings
Prohibited/Spacial Materials
Beryllium
Compressed gases
Corrosive
Explosives
Free liquids
Hazardous
PCB's
Particulates
Pyrophorics
> 4 liters sealed
None
Processing
Cement
Solid
Shielding
No
Yes
Assay Information
NDA Laboratory Assay
Large Item
Measurement
GAMMA
Isotopes...
Verify...
Non-Waste
Hazardous...
Memos...
Assay...
UnVerify
History...
Close
*Unclassified material only


Waste Origination and Disposition Form (PUNJAK WAYNE A)
Matrix*
SNM embedded plastic
Item ID
PLSITF8
WM Tech/Generator (last first middle)
MONTOYA JOHNNY M (092424)
Date
OCT 31 2001
Contact:
()
Item Source
DP
Non-DP
Cost Center
Program Code
Cost Account
Work Package
0J10
J22K
0000
0000
Measurement Information
Quantity
Gross
Tare
Net
Volume
PS
6.00
5.06
0.00
5.06
0.00
ITF
Location
Phone
Room
7-8485
201E
Comments
plastic in metal can crossed taped. 1 can larger than 4 lits, crossed taped, filterd babout bag
Prohibited/Special Materials
Beryllium
Compressed gases
Corrosive
Explosives
Free liquids
Hazardous
PCB's
Particulates
Pyrophorics
> 4 liters sealed
None
Processing
Cement
Solid
Shielding
No
Yes
Assay Information
NDA Laboratory Assay
Large Item
Measurement
GAMMA
Isotopes...
Verify...
Non-Waste
Hazardous...
Memos...
Assay...
DisVerify
History...
Close
*Unclassified material only


Waste Origination and Disposition Form (PUNJAK WAYNE A)
Matrix*
SNM embedded plastic
Item ID
PLSR84
WM Tech/Generator (last first middle)
STEVENS BARBARA (080905)
Date
DEC 5 2001
Contact:
()
Item Source
DP
Non-DP
Cost Center
Program Code
Cost Account
Work Package
8J02
M26N
0000
0000
Measurement Information
Quantity
Gross
Tare
Net
Volume
PS
0.00
6.39
0.00
6.39
0.00
RB
Location
Phone
Room
x2547
208
Comments
Prohibited/Special Materials
Beryllium
Compressed gases
Corrosive
Explosives
Free liquids
Hazardous
PCB's
Particulates
Pyrophorics
> 4 liters sealed
None
Processing
Cement
Solid
Shielding
No
Yes
Assay Information
NDA Laboratory Assay
Large Item
Measurement
GAMMA
Isotopes...
Verify...
Non-Waste
Hazardous...
Memos...
Assay...
VisVerify
History...
Close
*Unclassified material only


Waste Origination and Disposition Form (PUNJAK WAYNE A)
Matrix*
SNM embedded plastic
Item ID
PLSRBJ7
WM Tech/Generator (last first middle)
ROMERO JOE C (109702)
Date
SEP 4 2001
Contact:
()
Item Source
DP
Non-DP
Cost Center
Program Code
Cost Account
Work Package
BJ02
KR21
0000
0000
Measurement Information
Quantity
Gross
Tare
Net
Volume
RS
0.00
5.05
0.00
5.05
0.00
RBJ
Location
Phone
Room
x2547
208
Comments
plexiglass,plastic inner bag slit, in a filter bagout bag
Prohibited/Special Materials
Beryllium
Compressed gases
Corrosive
Explosives
Free liquids
Hazardous
PCB's
Particulates
Pyrophorics
> 4 liters sealed
None
Processing
Cement
Solid
Shielding
No
Yes
Assay Information
NDA Laboratory Assay
Large Item
Measurement
GAMMA
Isotopes...
Verify...
Non-Waste
Hazardous...
Memos...
Assay...
UnVerify
History...
Close
*Unclassified material only


Waste Origination and Disposition Form (PUNJAK WAYNE A)
Matrix*
Rubber waste
Item ID
RUBCAT0
WM Tech/Generator (last first middle)
RODRIGUEZ FLOYD (085655)
Date
NOV 6 2001
Contact:
()
Item Source
DP
Non-DP
Cost Center
Program Code
Cost Account
Work Package
8J05
KT16
1000
0019
Measurement Information
Quantity
Gross
Tare
Net
Volume
PS
0.00
3.15
0.00
3.15
0.00
CA
Location
Phone
Room
7-2372
329
Comments
rubber waste in plastics. Plastics are punctured.
Prohibited/Special Materials
Beryllium
Compressed gases
Corrosive
Explosives
Free liquids
Hazardous
PCB's
Particulates
Pyrophorics
> 4 liters sealed
None
Processing
Cement
Solid
Shielding
No
Yes
Assay Information
NDA Laboratory Assay
Large Item
Measurement
CAPIA
Isotopes...
Verify...
Non-Waste
Hazardous...
Memos...
Assay...
UnVerify
History...
Close
*Unclassified material only

HEALTH-SAFETY-ENVIRONMENT FORM

LOS ALAMOS SCIENTIFIC LABORATORY

DATE

# CHEMICAL WASTE DISPOSAL REQUEST

REQUESTED BY _____ PHONE _____

GROUP _____ LOCATION: TA-_____ BLDG._____ AREA/WING _____ ROOM_____

WASTE VOLUME ($ft^3$)_____

NUMBER OF CONTAINERS (SIZE/TYPE)_____

WASTE FORM (check as appropriate):

☐ SOLID ☐ LIQUID ☐ GAS

COMMON NAMES OF CHEMICALS:_____

POTENTIAL HAZARDS (check as appropriate):

CORROSIVES ☐ Acids _____strong _____mild _____weak

☐ Bases _____strong _____mild _____weak

☐ FLAMMABLE ☐ TOXIC ☐ OTHER:

☐ EXPLOSIVE ☐ CARCINOGEN

☐ PYROPHORIC ☐ INFECTIOUS

☐ OIL ☐ UNKNOWN

CAN MATERIALS REACT VIOLENTLY WHEN EXPOSED TO:

AIR _____ WATER _____ OTHER CHEMICALS_____

If yes, give details: _____

OTHER USEFUL INFORMATION:_____

(TO BE COMPLETED BY H-7)

DISPOSAL RECORD

AREA_____ PIT/SHAFT _____ DATE_____ BY _____

MAIL THIS FORM TO WASTE MANAGEMENT, H-7, MS-~~[illegible]~~ 574

6/80

HSE 7-5A

**DECISION/DISCREPANCY RESOLUTION DOCUMENTATION**
**Acceptable Knowledge Summary Report for**
**Debris TA-55 Waste Streams Containing Pu-239**

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| General | On WPF, all RCRA codes were marked as possible | Waste Profile Forms | Summary reports do not list all codes for all processes | AK Summary Report, TWCP-AK-2.1-015, R.0 | | C- memo dated 03/07/02 from SME stated that none of those codes should be added because the constituents were not part of the process or would be introduced into the process. See attached memo |
| P/S codes CLS and CW | Organic solvents listed for analytical solutions include carbon tetrachloride and chloroform | TWCP-3547/ CL25 | Summary report does not include these in Table 12 | AK Summary Report, TWCP-AK-2.1-015, R.0 | Discrepancy in lists of solvents. | C—In the AK summary report, the codes D019 and D022 are listed in the Table 13. Table 12 should be updated to reflect use of these solvents. |
| General | All TA-55 waste is defense | TWCP-614 | Defense and non-defense were commingled until 8/21/97 | TWCP-887 | Reported the commingling process in the report | B |
| | | | Segregation began in 1997-1998 | TWCP-4162 | Reported the commingling process in the report | B |
| | | | Segregation began in 1998 | TWCP-4167 | Supporting memos attached to this record | C—memo dated 8/27/98 documented segregation had begun. TWCP-4167 |

Sandy Wunder Tech. Reviewer Sandy Wunder 3/21/02
Evaluator (Print Name) Title Signature Date

Pamela Ayers Pamela Ayers 3/21/02
SPM Review (Print Name) Signature Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other (specify)]

## DECISION/DISCREPANCY RESOLUTION TABLE

| Item Identification* | AK No. 1 | Source No. 1 | NDA Results | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|
| 52077 | Drum contains MT-42. | Generator records. | FRAM indicates that drum contains mixed material types. | Used NDA data to determine total Pu content of drum. | B – Use of the FRAM "by correlation" data in conjunction with HENC or CTEN ensures the most conservative estimate of total Pu content. |
| 52930 | Drum contains MT-42. | Generator records. | FRAM indicates that drum contains mixed material types. | Used NDA data to determine total Pu content of drum. | B – Use of the FRAM "by correlation" data in conjunction with HENC or CTEN ensures the most conservative estimate of total Pu content. |
| 56539 | Drum contains MT-42. | Generator records. | FRAM indicates that drum contains mixed material types. | Used NDA data to determine total Pu content of drum. | B – Use of the FRAM "by correlation" data in conjunction with HENC or CTEN ensures the most conservative estimate of total Pu content. |
| 56833 | Drum contains MT-42. | Generator records. | FRAM indicates that drum contains mixed material types. | Used NDA data to determine total Pu content of drum. | B – Use of the FRAM "by correlation" data in conjunction with HENC or CTEN ensures the most conservative estimate of total Pu content. |
| S817519 | Drum contains MT-42. | Generator records. | FRAM indicates that drum contains mixed material types. | Used NDA data to determine total Pu content of drum. | B – Use of the FRAM "by correlation" data in conjunction with HENC or CTEN ensures the most conservative estimate of total Pu content. |
| S818322 | Drum contains MT-42. | Generator records. | FRAM indicates that drum contains mixed material types. | Used NDA data to determine total Pu content of drum. | B – Use of the FRAM "by correlation" data in conjunction with HENC or CTEN ensures the most conservative estimate of total Pu content. |
| S803105 | Drum contains weapons grade Pu. | Generator records. | FRAM indicates that drum contains mixed material types. | Used NDA data to determine total Pu content of drum. | A – Due to the low total content of Pu and low error statistics, FRAM and HENC results are certifiable. |
| S811819 | Drum contains weapons grade Pu. | Generator records. | FRAM indicates that drum contains mixed material types. | Used NDA data to determine total Pu content of drum. | A – Due to the low total content of Pu and low error statistics, FRAM and HENC results are certifiable. |

| Marc Taylor | SPM | Signature on File | 8/23/02 |
|---|---|---|---|
| Evaluator (Print Name) | Title | Signature | Date |

| Pam Rogers | Signature on File | 8/23/02 |
|---|---|---|
| SPM Review (Print Name) | Signature | Date |

* Item identification can be PS Code, waste stream, operation, drum ID, Item ID, or other identification of items affected by discrepancy.
** Rationale code: (A = Professional Judgment; B = Most Conservative Decision; C = Other [specify])

## DECISION/DISCREPANCY RESOLUTION TABLE

Acceptable Knowledge Report for Legacy Debris TA-55
Waste Streams Containing Pu-239

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| P/S codes WM, X0, AD, CV, HGMS, BC, PF, FF, ARI, LIBS, SRL | Actinium was not listed as a radionuclide | *Acceptable Knowledge Report for Debris TA-55 Waste Streams Containing Pu-239,* TWCP-AK-2.1-015, R.0 | Actinium was found while undergoing NDA in several drums | TWCP-9499 | Added Ac-227 to list of radionuclides in AK report | C-actual data |
| General | Waste containers assigned to a non-mixed waste stream | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary,* TWCP-PLAN-0.2.7-001 | Some drums were found to contain lead shielding. Reassigned to a mixed waste stream | *Acceptable Knowledge Accuracy Report,* TWCP-AK-2.1-012,R.0 | Revised AK reports | C-actual data |
| P/S code MA | 1,1,1-trichloroethane not used as solvent | TWCP-AK-2.1-015,R.1, Table 10 | HGAS analysis data showed 1,1,1-trichloro-ethane in very high concentra-tions | HGAS analysis | Add F002 because 1,1,1-trichloroethane may have been used as solvent prior to 1992 | A |

* Item identification can be PS Code, waste stream, operation, drum ID, Item ID, or other identification of items affected by discrepancy.
** Rationale code: (A = Professional Judgment; B = Most Conservative Decision; C = Other [specify])

| Betty J. Humphrey | AK Investigator | Signature on File | 08/23/02 |
|---|---|---|---|
| Evaluator (Print Name) | Title | Signature | Date |

| Pam Rogers | Signature on File | 08/23/02 |
|---|---|---|
| SPM Review (Print Name) | Signature | Date |

# TA-55 PROCESS/STATUS CODE INDEX

| P/S Code | P/S Name | Operations AK Report in which this P/S Code is Described* |
|---|---|---|
| AAP | Accelerated Aging of Plutonium | Metal Operations |
| AC | Actinide chemistry, R&D | Miscellaneous Operations |
| AC1 | Actinide chemistry, R&D | Miscellaneous Operations |
| AC2 | Actinide chemistry, R&D | Miscellaneous Operations |
| AC3 | Actinide chemistry, R&D | Miscellaneous Operations |
| ACC | Ammonium chloride conversion | Special Processing Operations |
| ACD | Cascade dissolver | Special Processing Operations |
| ACL | Analytical chemistry laboratory | Miscellaneous Operations |
| AD | Actinide processing demonstration | Miscellaneous Operations |
| AL | Ash leach | Nitrate Operations |
| AO | Assembly operation | Metal Operations |
| AO | Americium processing calcination | Nitrate Operations |
| AP | Americium purification | Nitrate Operations |
| APD | Actinide processing demonstration | Miscellaneous Operations |
| ARI | ARIES | Metal Operations |
| AS | Anode heel dissolution | Nitrate Operations |
| AT | Ash testing | Nitrate Operations |
| ATL | Advanced test line for actinide separation RD&D | Nitrate Operations |
| AX | Solution assay | Miscellaneous Operations |
| BA | Basement isopress | Metal Operations |
| BAC | Bacterial decomposition of cellulose items | Nitrate Operations |
| BC | Physical properties | Metal Operations |
| BF | Unknown name for P/S code | Nitrate Operations |
| BL | Blending | Nitrate Operations |
| BM | Burning metal | Nitrate Operations |
| BT | Burst testing | Metal Operations |
| BU | Button burning | Nitrate Operations |
| CA | Casting | Metal Operations |
| CC | Calcination | Nitrate Operations |

## TA-55 PROCESS/STATUS CODE INDEX (continued)

| P/S Code | P/S Name | Operations AK Report in which this P/S Code is Described* |
|---|---|---|
| CD | Hydroxide cake dissolution | Nitrate Operations |
| CF | Cement fixation | Nitrate Operations |
| CH | Characterization | Nitrate Operations |
| CK | RD&D volatile fluoride Pu recovery | Miscellaneous Operations |
| CL | Crucible processing | Chloride Operations |
| CLRD | Aqueous chloride R&D | Chloride Operations |
| CLS | Accountable CLS chloride solutions | Chloride Operations |
| CN | C-N-O analysis | Metal Operations |
| CO | Comminution | Metal Operations |
| COD | Chlorinated oxide dissolution | Nitrate Operations |
| COL | Chlorinated oxide leach | Nitrate Operations |
| CPOD | Catalyzed electrochemical plutonium oxide dissolver | Nitrate Operations |
| CR | Crushing and pulverizing | Nitrate Operations |
| CRD | Chlorination/reduction RD&D | Pyrochemical Operations |
| CS | Chloride solutions | Chloride Operations |
| CSE | Chloride solvent extraction | Chloride Operations |
| CT | Compatibility testing | Metal Operations |
| CV | RD&D experimental chlorination processes | Miscellaneous Operations |
| CW | Caustic waste | Chloride Operations |
| CX | Chloride anion exchange | Chloride Operations |
| CXL | Experimental chloride extraction line | Chloride Operations |
| DA | Alloy development Pu items | Metal Operations |
| DF | DS furnace and oxide preparation | Nitrate Operations |
| DO | Dissolution of oxide | Special Processing Operations |
| DOP | Detector oxide preparation | Metal Operations |
| DP | Dry processing | Nitrate Operations |
| DS | Ion exchange | Nitrate Operations |
| DT | John Ward R&D | Metal Operations |
| ED | Cascade dissolver | Nitrate Operations |

## TA-55 PROCESS/STATUS CODE INDEX (continued)

| P/S Code | P/S Name | Operations AK Report in which this P/S Code is Described* |
|---|---|---|
| EDC | Electrolytic decontamination | Miscellaneous Operations |
| EL | Element loading | Metal Operations |
| ELW | Experimental laser welding | Metal Operations |
| EM | Electron microscopy | Metal Operations |
| EOC | Experimental oxide characterization | Miscellaneous Operations |
| ER | Electrorefining | Pyrochemical Operations |
| ETD | Experimental thermal decomposition | Nitrate Operations |
| EV | Evaporator | Nitrate Operations |
| EVAC | Evacuation and bake out | Metal Operations |
| EXT | Extraction RD&D | Miscellaneous Operations |
| FA | Americium processing | Nitrate Operations |
| FC | Canning | Nitrate Operations |
| FDL | FOOF demonstration loop | Miscellaneous Operations |
| FF | Fuel fabrication | Metal Operations |
| FLU | Fluorination RD&D | Miscellaneous Operations |
| FSPF | Special furnace operations | Metal Operations |
| FX | Cement to drum | Nitrate Operations |
| GI | Pellet grinding & inspection | Metal Operations |
| GMS | Open gradient magnetic separation | Nitrate Operations |
| HC | Calcination | Nitrate Operations |
| HCD | Hydroxide cake dissolution | Nitrate Operations |
| HD | Hydroxide cake dissolution | Nitrate Operations |
| HG | Pu removal by mercury | Metal Operations |
| HGMS | High gradient magnetic separation | Nitrate Operations |
| HP | Cement fixation | Nitrate Operations |
| HRA | Hanford Reservation Material | Nitrate Operations |
| HRS | High resolution spectroscopy | Miscellaneous Operations |
| IA | Impure americium holding for discard | Nitrate Operations |
| IAM | Inspection and measurement | Special Processing Operations |

## TA-55 PROCESS/STATUS CODE INDEX (continued)

| P/S Code | P/S Name | Operations AK Report in which this P/S Code is Described* |
|---|---|---|
| IB | Matrix study of pyrochemical salts | Miscellaneous Operations |
| ICP | ICP-AES analysis | Miscellaneous Operations |
| ID | Immersion density | Metal Operations |
| IE | Isotope enrichment | Miscellaneous Operations |
| IN | Inspection | Metal Operations |
| IS | Incinerator | Nitrate Operations |
| ITF | Impact test facility | Metal Operations |
| ITF4 | Impact test facility | Metal Operations |
| ITF7 | Impact test facility | Metal Operations |
| IX | Ion exchange | Special Processing Operations |
| JA | Gas isostatic press | Metal Operations |
| KBTF | Kolsky bar test facility | Metal Operations |
| LC | Uranium plutonium processing | Nitrate Operations |
| LD | Chloride leach & dissolution | Chloride Operations |
| LG1 | Non combustible leach | Nitrate Operations |
| LG2 | Hydroxide cake dissolution | Nitrate Operations |
| LI | XF6 experimental measurements | Miscellaneous Operations |
| LIBS | Laser-induced breakdown spectroscopy system | Miscellaneous Operations |
| LR | Ion exchange | Nitrate Operations |
| M1, M2, MM, M4 | Materials Management | Miscellaneous Operations |
| MA | Machining | Metal Operations |
| MAG | Magnetic separation | Nitrate Operations |
| MAS | RD&D experimental processes | Nitrate Operations |
| MB | Nitric dissolution of molten salts | Chloride Operations<br>Nitrate Operations |
| MBC | Crystal | Metal Operations |
| ME | Metallography | Miscellaneous Operations |
| MELL | Mediated electro-oxidation of LLW | Nitrate Operations |
| MF | Metals furnace | Nitrate Operations |
| ML | Non-Pu metal leach | Nitrate Operations |

## TA-55 PROCESS/STATUS CODE INDEX (continued)

| P/S Code | P/S Name | Operations AK Report in which this P/S Code is Described* |
|---|---|---|
| MO | Metal oxidation, room 429 | Pyrochemical Operations |
| MOX | Mixed oxide fuel production | Metal Operations |
| MP | Metal preparation | Pyrochemical Operations |
| MPD | Cascade dissolver | Nitrate Operations |
| MS | Molten salts purification dissolution | Chloride Operations |
| MW | Metal working | Metal Operations |
| NC | Noncombustible leach | Nitrate Operations |
| NCD | Nonconfirming drums | Miscellaneous Operations |
| NEPTUNIUM | Neptunium | Pyrochemical Operations |
| NL | Noncombustible leach | Nitrate Operations |
| NR | Nitrate recovery | Nitrate Operations |
| OB | Oxide blending | Metal Operations |
| OD | Oxide dissolution | Nitrate Operations |
| OH | Hydroxide precipitation | Nitrate Operations |
| OM | Oxygen to metal ratio determination | Metal Operations |
| OR | Direct oxide reduction | Pyrochemical Operations |
| OY | Oxalate precipitation | Nitrate Operations |
| PA | Passivation | Nitrate Operations |
| PAF | Passivation furnaces | Nitrate Operations |
| PB | Pu-beryllium source recovery | Chloride Operations |
| PCH | Plasma chemistry | Metal Operations |
| PD | Pit disassembly | Metal Operations |
| PE | Sputtering process | Metal Operations |
| PF | Plutonium surfaces | Metal Operations |
| PH | Thermal hydride/dehydride | Metal Operations |
| PI | Preparation of isotopes | Special Processing Operations |
| PIG | Welding | Metal Operations |
| PK | Pickling and nitrate holding | Pyrochemical Operations |
| POSM | Processing out-of-specification material | Special Operations |
| PPD | Pu pellet dissolution | Special Operations |

## TA-55 PROCESS/STATUS CODE INDEX (continued)

| P/S Code | P/S Name | Operations AK Report in which this P/S Code is Described* |
|---|---|---|
| PR | Peroxide precipitation | Nitrate Operations |
| PRR | Pyrochemical residue recovery | Chloride Operations |
| PS | Peroxide precipitation of MSE salts | Nitrate Operations |
| PT | Plutonium-thorium separation | Nitrate Operations |
| PTP | Plutonium trichloride preparation | Pyrochemical Operations |
| PTS | RD&D pretreatment study | Nitrate Operations |
| PUB | Pu/Be source recovery | Chloride Operations |
| PX | Pyrochemical R&D | Special Operations |
| RA | Recovery of anodes | Pyrochemical Operations |
| RAP | Research alloy preparation | Metal Operations |
| RAP2 | Research alloy preparation | Metal Operations |
| RASS/RSS | Raman spectroscopy system | Miscellaneous Operations |
| RB | Roasting and blending | Nitrate Operations |
| RBJ | Roasting and blending Jr | Nitrate Operations |
| RC | Rotary calciner | Nitrate Operations |
| RCM | Rich column material ion exchange | Nitrate Operations |
| RD | Repackaging into retrievable drums | Miscellaneous Operations |
| RFX | Ion exchange | Nitrate Operations |
| RL | Radiochemical coating | Metal Operations |
| RM | Reduction to metal | Special Processing Operations |
| RO | Oil recovery | Nitrate Operations |
| RR | Ion exchange | Nitrate Operations |
| RS | Pellet sintering | Metal Operations |
| SA | Super acid RD&D | Miscellaneous Operations |
| SB | Scrap burning | Special Processing Operations |
| SBB | Ca/Al scrubbing RD&D | Special Processing Operations |
| SC | Cascade dissolver, G437 | Nitrate Operations |
| SCB | Chlorination Ca/Al scrubbing RD&D | Pyrochemical Operations |

## TA-55 PROCESS/STATUS CODE INDEX (continued)

| P/S Code | P/S Name | Operations AK Report in which this P/S Code is Described* |
|---|---|---|
| SD | Salt distillation | Pyrochemical Operations |
| SE | Solvent extraction | Chloride Operations |
| SL | Scrap leaching | Special Processing Operations |
| SMIS | Long-Term Storage/Compatability Testing | Miscellaneous Operations |
| SMP | SP mounting preparation | Miscellaneous Operations |
| SO | Super oxidizer, FOOF program | Miscellaneous Operations |
| SP | Scrap dissolution, G438 | Nitrate Operations |
| SRL | Special recovery line | Metal Operations |
| SS | Salt stripping | Pyrochemical Operations |
| SSD | Special scrap dissolution | Nitrate Operations |
| SSMD | SS material development | Pyrochemical Operations |
| STF | Standard fabrication | Miscellaneous Operations |
| SX | Americium processing silicon removal | Nitrate Operations |
| TSC | Thermal stabilization of cellulosic material | Nitrate Operations |
| TDC | Thermal decomposition of cellulose items | Nitrate Operations |
| TIGR | Thermally induced gallium removal | Metal Operations |
| UA | Uranium fabrication | Metal Operations |
| UCONN | Metal conversion | Metal Operations |
| UPS | Uranium/plutonium separation | Nitrate Operations |
| US | Uranium separation for solid solution feed | Nitrate Operations |
| US2 | Uranium separation for non-solid solutions feed | Nitrate Operations |
| VC | Variable CSMO scrap dissolution | Nitrate Operations |
| VD | Vapor degreaser and sand blasting | Metal Operations |
| VP1 | CSMO scrap dissolution | Nitrate Operations |
| VP2 | Polycube processing | Nitrate Operations |
| VP3 | Hydroxide precipitation | Nitrate Operations |
| VS | Confirmation, inspection & sampling | Miscellaneous Operations |

## TA-55 PROCESS/STATUS CODE INDEX (continued)

| P/S Code | P/S Name | Operations AK Report in which this P/S Code is Described* |
|---|---|---|
| VU | Vessel unloading | Special Processing Operations |
| VUL | Vessel unloading | Nitrate Operations |
| WE | Welding | Metal Operations |
| WLT | Welding leak test | Metal Operations |
| WM | Waste management | Miscellaneous Operations |
| X0 | Inactive or unspecified P/S material | Miscellaneous Operations |
| XES | X-ray energy spectroscopy | Miscellaneous Operations |
| XO | Inactive or unspecified P/S material | Miscellaneous Operations |
| XP | RD&D experimental processes | Miscellaneous Operations |
| ZD | Scrap oxide dissolution | Nitrate Operations |

* Operations AK reports: Chloride Operations (TWCP-AK-2.1-002, R.2), Metal Operation (TWCP-AK-2.1-003,R.2), Miscellaneous Operations (TWCP-AK-2.1-004,R.2/IC1), Nitrate Operations (TWCP-AK-2.1-005,R.2), Pyrochemical Operations (TWCP-AK-2.1-006,R.2), and Special Processing Operations (TWCP-AK-2.1-007, R.2) Timelines for each of the P/S codes can be found in these Operations AK reports.

# TWCP/WRR
# Document Modification/Review Cycle

☒ Revision ☐ Interim Change
Document ID: TWCP-AK-2.1-015 New Rev/IC: R.3
Preparer: Betty J. Humphrey
Document Title:
Acceptable Knowledge Report for Legacy Debris TA-55 Waste Streams Containing Pu-239

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☒ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE, if applicable
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 4/10/2003 Signed Initials: JJS

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 4/10/03

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- N/A Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 1
- ☑ Control Stations Updated - Date: 4/10/03
- ☑ Master Index Updated - Date: 4/10/03
- ☑ Archive old revision (Record)

- ☑ Capture Document: __ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date ✓ LAUR __ Title __ Link ✓ Test
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- N/A CBFO: __ Electronic Copy __ Printed
- ☑ Change Control Notification _____ Sent _____ Printed ✓ NA

Date Completed: 4/10/03 Signed Initials: JJS

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☒ Revision ☐ Interim Change

Date Received: 4/10/2003

Current Rev/IC: R.2

Document ID: TWCP-AK-2.1-015

Rev/IC: R.3

Document Title:

Acceptable Knowledge Report for Legacy Debris TA-55 Waste Streams Containing Pu-239

Preparer: Betty J. Humphrey Date to DP Team: 4/10/2003

## Step 2: [illegible] Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

04/09/03: Made requested changes and routed for signatures
04/10/10: Prepared document for transmittal to Document Control

## Step 3: Preliminary Review Cycle

☐ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
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X

Comments:

## Step 4: Comment Reconciliation Cycle

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# TWCP/WRR
# Document Modification/Review Cycle

Reviewer Comments Incorporated: ..... Comments:

Redline/DRR Given to Preparer: .....

Reconciled Comments Returned: .....

Modifications Made to Document: .....

Preparer Review of Modifications: .....

Signed/Release for Final Signature: .....

## Step 5: Final Signature Cycle ☐ IC - Not Applicable (enter action in comments section)

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|---|---|---|---|---|
| B. Humphrey | | 4/9/2003 | 4/9/2003 | AK Investigator |
| S. Wander | | 4/9/2003 | 4/9/2003 | Independent Technical Reviewer/Editor |
| C. Smith | | 4/9/2003 | 4/9/2003 | Site Project Manager |
| P. Lindahl | | 4/9/2003 | 4/9/2003 | Site Project QA Officer |
| W. Punjak | | 4/10/2003 | 4/10/2003 | Facility Representative |
| | | | | |
| | | | | |
| | | | | |

Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments | |
|---|---|---|---|---|---|
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Comments

## Step 7: Preparation for Document Control

If pages are separated match to Document: TWCP-AK-2.1-015

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Date: Fri, 11 Apr 2003 09:10:35 -0600
To: pgp@lanl.gov
From: Cathy Smith <chsmith@lanl.gov>
Subject: Please Post TWCP-AK-2.1-015,R.3
X-RCPT-TO: <109592@eet-mail.lanl.gov>

HI Patricia,

Please post **TWCP-AK-2.1-015,R.3 on** the TWCP Documents Web page as soon as the signature page is completed.

Please also proceed with obtaining an LA-UR number for this document.

Thank-you!

Cheers, Cathy

Catherine H. Smith
***Project 2010***
RRES-CE Certification Group
Risk Reduction & Environmental Stewardship Division
Phone: 667-0113 Page: 664-7104

To: rubyannf@lanl.gov, mlgarcia@lanl.gov, carmen@lanl.gov,"Yvonne C. Gibson" <ygibson@lanl.gov>, betty.humphrey@westonsolutions.com
From: Patricia G Patton <pgp@lanl.gov>
Subject: Procedure Notification
Cc: bailey, lpc, lindahl, ware
Bcc:
Attached:

The following procedure and has been posted to the Project 2010 web, it is located at http://twcp.lanl.gov/twcp/con_toc.htm and will be effective on the date below

**Effective Date: 4/10/03**

**TWCP-AK-2.1-015,R.3 -** Acceptable Knowledge Report for Debris Waste Streams Containing Pu-239

*

# LOS ALAMOS
NATIONAL LABORATORY - TWCP RMDC

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## TWCP-AK-2.1-015,R.3

**Effective Date** 4-10-2003 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** ACCEPTABLE KNOWLEDGE REPORT FOR DEBRIS WASTE STREAMS CONTAINING Pu-239

**Document Comments**

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## HISTORY OF REVISIONS

| Revision No. | Effective Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 03/21/02 | — | New report. Supersedes TWCP-AK-2.1-008 and TWCP-AK-2.1-010 |
| 1 | 08/27/02 | All | Incorporate changes based on process versus operations. |
| 1/IC1 | 09/05/02 | Pages 51 and 52 | Add 6 paragraph discussion regarding NDA detection of Sr-90 to section 4.5.2. |
| | | Table 3 | Add all Major and Minor Material Parameters, Update column headers to include "Major and Minor Material Parameters". |
| | | Attachment 10 | Modify the third column to read "Operations AK Report in which this P/S Code is Described", Delete all section references. |
| 2 | 10/09/02 | All | New revision to incorporate waste stream consolidation. Elimination of the use of the waste code P120 for vanadium pentoxide. |
| 3 | | All | New revision combining legacy and newly generated debris waste AK |

| | |
|---|---|
| TRUCON | TRUPACT-II Content Code |
| TRUPACT-II | Transuranic Waste Transporter-Model II |
| TWBIR | Transuranic Waste Baseline Inventory Report |
| $UCL_{90}$ | 90% Upper Concentration Limi |
| UCNI | unclassified controlled nuclear i |
| VE | visual examination |
| VOC | volatile organic compound |
| WAC | Waste Acceptance Criteria |
| WI | work instructions |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAC | Waste Isolation Pilot Plant Waste Acceptance Criteria |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WPF | Waste Profile Form |
| WMC | waste matrix code |
| WMP | waste material parameter |
| WMS | Waste Management System |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request Form |
| WTWBIR | WIPP Transuranic Waste Baseline Inventory Report |
| XES | X-ray energy spectroscopy |

UCL90
90-percent upper confidence Limit

# ACCEPTABLE KNOWLEDGE REPORT FOR DEBRIS WASTE STREAMS CONTAINING Pu-239

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK information and provides guidelines on how AK should be obtained and documented.

This AK Report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the plutonium recovery process at the Los Alamos National Laboratory (LANL). Currently, most of the waste is from the Plutonium Facility at Technical Area (TA)-55, one of the TRU waste generators. By doing so, this report provides technical support for delineation of waste streams and assignment of specific waste containers to these waste streams.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to these debris waste streams covered:

- Review of the *Acceptable Knowledge Information Summary* for *Los Alamos National Laboratory Transuranic Waste Streams* (TWCP-AK-2.1-019) (AK ~~Information Summary~~) that includes information regarding all LANL wastes, including TA-55 wastes, and also includes AK isotope ratio information found in *Acceptable Knowledge for Isotope Ratios* (TWCP-AK-2.1-020) (a subset of the AK Information Summary).
- Review of reports, documents, and databases related to the waste generation and waste management activities as documented in the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management as documented in AK reports listed in the Acceptable Knowledge Roadmap (Attachment 1)
- Review of AK reports for facility operations
- Analysis of the operations generating waste, as discussed in the operations AK reports and in this report

**Table 1. TRU Waste Streams in which Pu-239 is the Dominant Pu Isotope**

| Waste Stream | Designation | Mixed or Non-Mixed Status | Waste Stream Name |
|---|---|---|---|
| TA-55-19 | Debris | Mixed | Mixed combustible debris waste |
| LA-NCD01 | Debris | Non-Mixed | Non-mixed combustible debris waste |
| TA-55-30 | Debris | Mixed | Mixed heterogeneous debris waste |
| LA-NHD01 | Debris | Non-Mixed | Non-mixed heterogeneous debris waste |

Unclassified Controlled Nuclear Information (UCNI) is reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1). When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancy Resolution Documentation (Attachment 8).

## 3.0 DESCRIPTION OF THE WASTE STREAMS

### 3.1 Facility and Mission

Since 1978 the Plutonium Facility (Building PF-4) has been located at TA-55 and used for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other U.S. Department of Energy (DOE) sites in the defense complex. The scrap and residues are processed to recover as much plutonium as practicable before disposal. The recovered plutonium is converted into pure plutonium feedstock. This recovery process, associated maintenance operations, limited manufacture of finished parts from purified plutonium, and plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at LANL. The waste from the plutonium recovery process meets the definition contained in the WIPP WAP, Sec. B-1a, "Plutonium recovery wastes are residues from the recovery of plutonium-contaminated molds, metals, glass, plastics, rags, salts used in electrorefining, precipitates, firebrick, soot, and filters." The plutonium recovery process handles primarily Pu-239 and Pu-242 based samples. These are categorized based upon exact isotopic make-up into various material types. The associated research activities involve other plutonium isotopes, different uranium isotopes, and minor amounts of several other radioisotopes.

Before 1978, wastes were generated from plutonium recovery and purification for defense and non-defense programs although production of heat sources using Pu-238 was and still is the only major non-defense activity. These Pu-238 wastes were generated and produced in the same rooms and gloveboxes and were not

Discard limits (DLs) for plutonium in various types of waste matrices were established by the waste-generating group, and approved by the LANL division office and the DOE Albuquerque Operations Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of Pu) into classes such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. The AEC Manual Chapter 0511 (1973) mandated segregation of waste items into combustible and noncombustible categories. All liquids, including oils, were required to be sent to recovery operations for processing. Liquids were explicitly prohibited from any container of solid waste materials (TWCP-3943).

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific operations and waste ~~streams~~ (Section 9 in TWCP-697). Waste Content Codes were assigned by the LANL Waste Management Group, Health, Safety and Environment Division (HSE-7 at that time). These codes were later known as the Item Description Codes (IDC), and categorized the waste into one of nine categories, as listed in Table 2. TA-55, then operated by Materials Science and Technology (MST) Division, generated debris waste under content codes 004 (combustible solids) and 005 (noncombustible scrap) only. The use of non-destructive assay to determine the plutonium level relative to the DL provided impetus for segregation into combustible (for gamma assay) and noncombustible (for neutron assay).

In March 1987, MST Division finalized its Certification Plan attachment for contact-handled combustible and noncombustible solid waste (TWCP-701; Attachment 3). Other waste forms ~~or waste streams~~ were addressed as indicated in Table 2. Combustible and noncombustible solid wastes were defined by the MST document as follows (TWCP-701) and were segregated by mixed and non-mixed:

- Combustible waste forms (Waste Content Code 004) included materials that could be reduced to an ash if desired but that did not require further processing to meet the requirements of the *TRU Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (WIPP-DOE-069) (WIPP WAC) (TWCP-701). (This definition is still current.) Subcategories included plastic-based combustibles, cellulose-based combustibles, and miscellaneous (graphite and graphite crucibles). It was acceptable for the combustible waste stream to include some unspecified "small" fraction of noncombustible solids such as scrap metals.

NOTE: Graphite items were historically segregated as combustible waste; current waste management practices identify graphite items as inorganic debris.

Changes were also introduced into the packaging procedure used (Section 3.2.1 in TWCP-700). Up to two 5-mil liner bags could still be present, but were to be closed by folding, not by taping. All drums were to be fitted with carbon filters, and standard waste boxes (SWBs) were to be fitted with two carbon filters. Waste placed inside the drums was to be contained in a single plastic bag that was twisted, closed with a plastic tie, and then taped (TWCP-12088). Since 1997, plastic bags with filters are used. Waste with the potential to tear the plastic bag, such as broken glass, was to be placed first in a metal container with a slip lid, taped closed, and then placed into the plastic bag. A summary of the physical form, and description for debris waste is given in Table 3.

2000-2001 } No underline.

In April 2000, the first revision of the waste packaging procedure currently used at TA-55 was issued as a safe operating procedure (SOP), *Inspecting, Packaging, Rejecting, and Remediating Transuranic Waste for WIPP and for TA-54 Safe Storage* (NMT7-SOP-TA55-013), with four detailed Work Instructions (WI):

- *Inspecting, Labeling, and Preparing TRU Waste Containers* (NMT7-WI1-SOP-TA55-013)
- *Performing Visual Examinations of TRU Waste* (NMT7-WI2-SOP-TA55-013)
- *Packing TRU Waste Containers* (NMT7-WI3-SOP-TA55-013)
- *Sealing TRU Waste Containers* (NMT7-WI4-SOP-TA55-013)

2001-Present

Revisions to this SOP and associated work instructions were approved by the Carlsbad Field Office (CBFO) on July 17, 2001. Waste packaged by TA-55 after that date is considered to be "newly generated" waste that is packaged in accordance with WIPP WAP-compliant procedures. Waste packaged prior to that date is considered to be "legacy" waste, which is subject to more stringent characterization than newly generated waste. Table 4 illustrates the segregation history for debris waste.

Debris

(retrievably-stored)

3.2.2 Waste Generation Records

From the beginning of operations of the current Plutonium Facility at TA-55, the physical description of each waste item generated is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures (page 24 in TWCP-701; Appendix 1 in TWCP-700; Appendix B in *Inspecting,*

**Table 3. Waste Physical Form, Waste Material Parameters, Estimated Volumes, and Content Description for Debris Waste Streams**

| Waste Stream | Waste Physical Form Maximum Layers of Confinement and Estimated Volume | Waste Description and Major and Minor Waste Material Parameters |
|---|---|---|
| TA-55-19 | Combustible debris waste (mixed)<br><br>Legacy:<br>Maximum: 6 layers<br>Volume:1621.42 $m^3$<br>Newly Generated:<br>Maximum: 1 layer<br>FY01[a] Volume: 2.9 $m^3$<br>FY02[b] Volume: 21.8 $m^3$<br>FY03[c] Volume: 29 $m^3$<br>FY04[c] Volume: 33 $m^3$<br>FY05[c] Volume: 33 $m^3$ | Mixed combustible debris waste generated by plutonium recovery, research and development processes at the LANL site, resulting from facility and equipment operations and maintenance. The debris waste includes paper, rags, plastic, rubber, wood-based HEPA filters, and other plastic-based and cellulose-based items. Plastic-based waste includes (but may not be limited to): tape, polyethylene and vinyl; gloves; plastic vials; polystyrene; Tygon® tubing; polyvinyl chloride plastic; Teflon® products; Plexiglas®; and dry-box gloves (unleaded neoprene base). Cellulose-based waste includes (but may not be limited to): rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves; and similar materials. The waste stream may also contain a smaller fraction of noncombustible solids (e.g. leached solids, ash, hydroxide cakes, and impure oxides). The waste stream includes retrievably-stored and newly-generated waste. Major: R, C, PW, Minor: IM, OM, AM, OI, OR, IN, ~~No soil (S) present in this waste stream.~~ WMPs, SC |
| LA-NCD01 | Combustible debris waste (non-mixed)<br>Legacy:<br>Maximum: 6 layers<br>Volume: 55.56 $m^3$<br>Newly Generated:<br>Maximum: 1 layer<br>FY01[a] Volume: 12.3 $m^3$<br>FY02[b] Volume: 5.7 $m^3$<br>FY03[c] Volume: 8 $m^3$<br>FY04[c] Volume: 9 $m^3$<br>FY05[c] Volume: 9 $m^3$ | Non-mixed combustible waste generated by plutonium recovery, research and development processes at the LANL site, resulting from facility and equipment operations and maintenance. The debris waste includes paper, rags, plastic, rubber, wood-based HEPA filters, and other plastic-based and cellulose-based items. Plastic-based waste includes (but may not be limited to): tape, polyethylene and vinyl; gloves; plastic vials; polystyrene; Tygon® tubing; polyvinyl chloride plastic; Teflon® products; Plexiglas®; and dry-box gloves (unleaded neoprene base). Cellulose-based waste includes (but may not be limited to): rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves; and similar materials. The waste stream may also contain a smaller fraction of noncombustible solids (e.g. scrap metal, salts, crucibles, metal lids, zippers, discarded tools) and a small fraction of homogenous solids (e.g. leached solids, ash, hydroxide cakes, and impure oxides). The waste stream includes retrievably-stored and newly-generated waste. Major: R, C, PW, Minor: IM, OM, AM, OI, ~~OS, IS. No soil (S) present in this waste stream.~~ WMPs, OR, IN, SC |

(e.g. scrap metal, salts, crucibles, metal lids, zippers, discarded tools) and a small fraction of homogeneous solids

**Table 3. Waste Physical Form, Waste Material Parameters, Estimated Volumes, and Content Description for Debris Waste Streams (continued)**

| Waste Stream | Waste Physical Form Maximum Layers of Confinement and Estimated Volume | Waste Description and Major and Minor Waste Material Parameters |
|---|---|---|
| TA-55-30 | Heterogeneous debris waste (mixed)<br>Legacy:<br>Maximum: 6 layers<br>Volume: 2270.09 $m^3$<br><br>Newly Generated:<br>Maximum: 1 layer<br>FY01[a] Volume: 4 $m^3$<br>FY02[b] Volume: 19.7 $m^3$<br>FY03[c] Volume: 26 $m^3$<br>FY04[c] Volume: 30 $m^3$<br>FY05[c] Volume: 30 $m^3$ | Mixed heterogeneous debris waste generated by plutonium recovery, research and development processes at the LANL site, resulting from facility and equipment operations and maintenance. The waste includes plutonium-contaminated noncombustible and combustible debris waste. The noncombustible debris waste includes (but may not be limited to): small tools and equipment; cans; motors, pumps and process equipment; gloveboxes and glovebox windows; ventilation ductwork; composite HEPA filters; metal pipes; glass; bottles; graphite; salt, slag and crucibles; and miscellaneous lab ware. The waste stream may also contain a smaller fraction of combustible solids (e.g. paper, rags, plastic, rubber, leaded gloves) and a small fraction of homogeneous solids (e.g. leached solids, ash, hydroxide cakes, impure oxides). The waste stream includes retrievably-stored and newly-generated waste. Major: IM, AM, OM, OI, Minor: C, R, PW, OR, IN, ~~No soil (S) present in this waste stream.~~ |
| LA-NHD01 | Heterogeneous debris waste (non-mixed)<br>Legacy:<br>Maximum: TBD<br>Volume:49.19 $m^3$<br><br>Newly Generated:<br>Maximum: 1 layer<br>FY01[a] Volume: 7.2 $m^3$<br>FY02[b] Volume: 8.5 $m^3$<br>FY03[c] Volume: 12 $m^3$<br>FY04[c] Volume: 13 $m^3$<br>FY05[c] Volume: 13 $m^3$ | Non-mixed heterogeneous debris waste generated by plutonium recovery and research and development processes at the LANL site, resulting from facility and equipment operations and maintenance. The waste includes plutonium-contaminated noncombustible and combustible debris waste. The noncombustible debris waste includes (but may not be limited to): small tools and equipment; cans; motors, pumps and process equipment; gloveboxes and glovebox windows; ventilation ductwork; composite HEPA filters; metal pipes; glass; bottles; graphite; salt, slag and crucibles; and miscellaneous lab ware. ~~The combustible waste includes paper, rags, plastic, rubber, wood-based HEPA filters, and other plastic-based and cellulose-based items. Plastic-based waste includes (but may not be limited to): tape, polyethylene and vinyl; gloves; plastic vials; polystyrene; Tygon® tubing; polyvinyl chloride plastic; Teflon® products; Plexiglas®; and dry-box gloves (unleaded neoprene base). Cellulose-based waste includes (but may not be limited to): rags, wood, paper, and cardboard; laboratory coats and coveralls; booties and cotton gloves; and similar materials. The waste stream may also contain a smaller fraction of homogeneous solids (e.g. leached solids, ash, hydroxide cakes, impure oxides).~~ The waste stream includes retrievably-stored and newly-generated waste. Major: IM, AM, OM, OI, Minor: C, R, PW, OR, IN, ~~No soil (S) present in this waste stream.~~ |

[a]Actual, [b]Actual through August, September projected, [c]Projected

**NOTE:** Waste material parameters are: C = cellulose, R = rubber, PW = plastics – waste materials, IM = iron base metal alloys, AM = aluminum base metal alloys, OM = other metal alloys, OI = other inorganic material, IN = inorganic material, OR = organic material; all waste material parameters ~~except soil may be present in small~~ varying quantities in these waste streams.

**Table 4. History of Debris Waste ~~Segregation~~ Management**

| Date | WIPP WAC Status | WIPP WAC | AEC Manual Chapter 0511 | NDA Requirements |
|---|---|---|---|---|
| 1978-1983 | Not implemented | N/A | Segregate combustibles and noncombustibles | Segregate combustibles and noncombustibles |
| 1984-1987 | Draft Attachment to LANL Certification Plan | Segregate combustibles and noncombustibles<br><br>IDC 004 and 005 | Segregate combustibles and noncombustibles | Segregate combustibles and noncombustibles |
| 1987-1994 | Final Attachment to LANL Certification Plan | Segregate combustibles and noncombustibles<br><br>IDC 004 and 005 | N/A | Segregate combustibles and noncombustibles |
| 1995-2001 | QAPP Released, New LANL Certification Plan, WIPP WAP | Segregate by waste streams to meet WAP requirements | N/A | Segregate by more detailed waste matrix to improve NDA results |
| 2002-present | WIPP WAP, LANL Certification Plan | Segregate by waste streams to meet WIPP requirements | N/A | Consolidate similar waste matrices |

N/A = not applicable

*Packaging, Rejecting, and Remediating Transuranic Waste for WIPP and for TA-54 Safe Storage* [MT7-SOP-TA55-013]. Items are bagged out of gloveboxes and sent to the Waste Management section, where multiple items are placed into drums. Starting in 1987, the Plutonium Facility at TA-55 began its current system of tracking waste items by their nuclear material content, using the computerized Material Accountability and Safeguards System (MASS).

Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to nuclear materials accountability for the operation that produced the waste item.

The P/S code refers to a specific part of an operation within the overall Pu-recovery process, but generally applies to more than one glovebox or to the same operation carried out in multiple locations or gloveboxes in PF-4. Recording the P/S codes was inconsistent until about 1995 (TWCP-351). In the packaging operation for legacy waste, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code (page 25 in TWCP-701; Appendix 2 in TWCP-700; Appendix C in NMT7-SOP-TA55-013). This form was signed by the waste packager and approved by quality assurance personnel. Both the WODF and DWLS for each TRU waste drum are maintained as hard copy records by the generator. Many of these waste tracking ID codes for individual items in drums of debris waste are compiled in a list that correlates item codes with containers or in a database maintained as the

recovery process. However, the P/S codes provide the finest level of detail available to associate waste items with a specific operation of origin. Consequently the P/S code system is used extensively in the description and documentation of AK information for RCRA and for chemical constituents for the Pu-recovery process in this report and in the operations AK reports. While a P/S code can be associated with most waste items generated after 1987 and all items generated after 1995, the P/S code does not provide a method of segregating waste or delineating waste streams.

3.2.3 Waste Stream Delineation

Waste stream assignment is made on the basis of waste generator information compiled in the AK ~~Information~~ Summary. The summary is based primarily on the TRU Waste Management ~~System (WMS)~~ database, then on hazardous waste status (mixed or non-mixed waste streams). The inventory list currently exceeds ~~15~~ 20,000 containers, with generation dates ranging from the early 1970s to the present, and is the starting point for the delineation of waste streams. Waste generator information is reviewed to identify the types and sources of waste items present in each container. This information is used to determine the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents in that container.

The overall strategy starts by eliminating from consideration containers that are not currently eligible for disposal at WIPP. Ineligible containers include those that are generated by non-defense programs, that are remote-handled, or that contain non-solid waste.

Wastes are assigned to waste streams based on the waste segregation schemes shown in Figure 1.

* [Insert para from p. 14]

TA-55 maintains two separate Pu-recovery process lines, one for Pu-238 based isotopic materials (not covered in this AK report) and one for Pu-239 and other Pu-isotope recovery that is the subject of this report. Generator records distinguish waste from each process using a "material type" notation that is explained in more detail in Section 4.1. Material types based on Pu isotopes other than Pu-239 (for example Pu-242) are processed in the same gloveboxes with the same equipment as the Pu-239 materials. The waste items from the occasional processing of these other material types are expected to be contaminated with carryover Pu-239, so that segregation of waste streams for these minor Pu-isotope types is not feasible. In some special cases, Pu-238 materials are processed in equipment used in Pu-239 operations, so some cross-contamination of wastes with Pu-238 and Pu-239 is expected. One example of this is the thermal decomposition operation, where Pu-

The LANL procedure for delineating TRU waste streams is described in Documentation Acceptable Knowledge (TWCP-QP-1.1-021).

contaminated rags were ashed. Both Pu-238 and Pu-239 based materials were sent through this operation, resulting in waste of mixed material type. However, the majority of Pu-238 and Pu-239 operations are segregated, allowing separate delineation of Pu-238 waste streams.

The hazardous waste status of waste streams from the Pu-239 recovery process are delineated only as non-mixed or mixed with a common set of hazardous waste numbers (HWNs). MASS nuclear material accountability system and P/S codes allow detailed assignment of HWNs associated with each P/S code (see Tables 14 and 15 for a complete list). However, since waste items are packaged into containers based on the physical material content of the waste, without regard to P/S code, each waste container can, and does, include waste items from several P/S codes. ~~For the containers where the P/S code of each item is~~ known, HWNs can be assigned on a container-by-container basis. [Stet]

The HWN assignment of the waste stream becomes the complete list of HWNs assigned to all P/S codes. A sort on the P/S code of each waste item in a container can determine the special case of containers containing all non-mixed waste items. If the P/S code information is missing for any item in a waste container, the container is conservatively assigned to the mixed waste stream. This is necessary for some of the older waste. In addition, some waste originally assigned to non-mixed waste streams is later discovered to contain lead shielding, and is reassigned to corresponding mixed waste streams (*Acceptable Knowledge Accuracy Report* [TWCP-AK-2.1-012]).

~~3.2.4 Delineation by Material Matrix~~

[Move to * on Page 13]

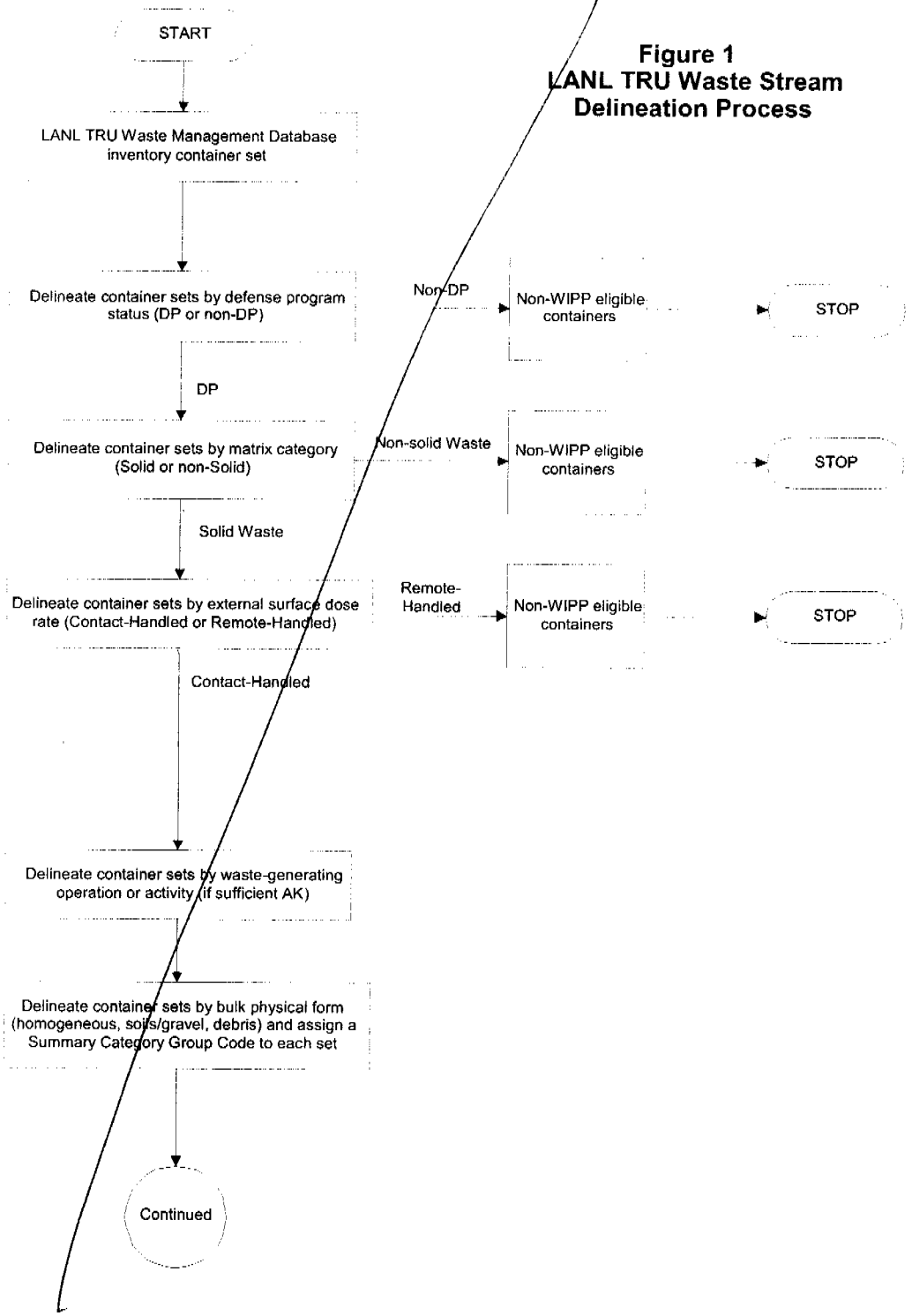
Waste segregation practices separate wastes into combustible (IDC 004) and noncombustible (IDC 005) waste forms based on plans for treatment of the combustible waste by incineration or other thermal decomposition strategies. Generator records list only the single, major component of each waste item, so that segregation by waste matrix appears in the records to be more exact than it was in practice. In particular, since any waste forms that are chemically compatible could be combined in the noncombustible waste form, the noncombustible waste form often contains a larger fraction of combustible waste than would be expected from the IDC description.

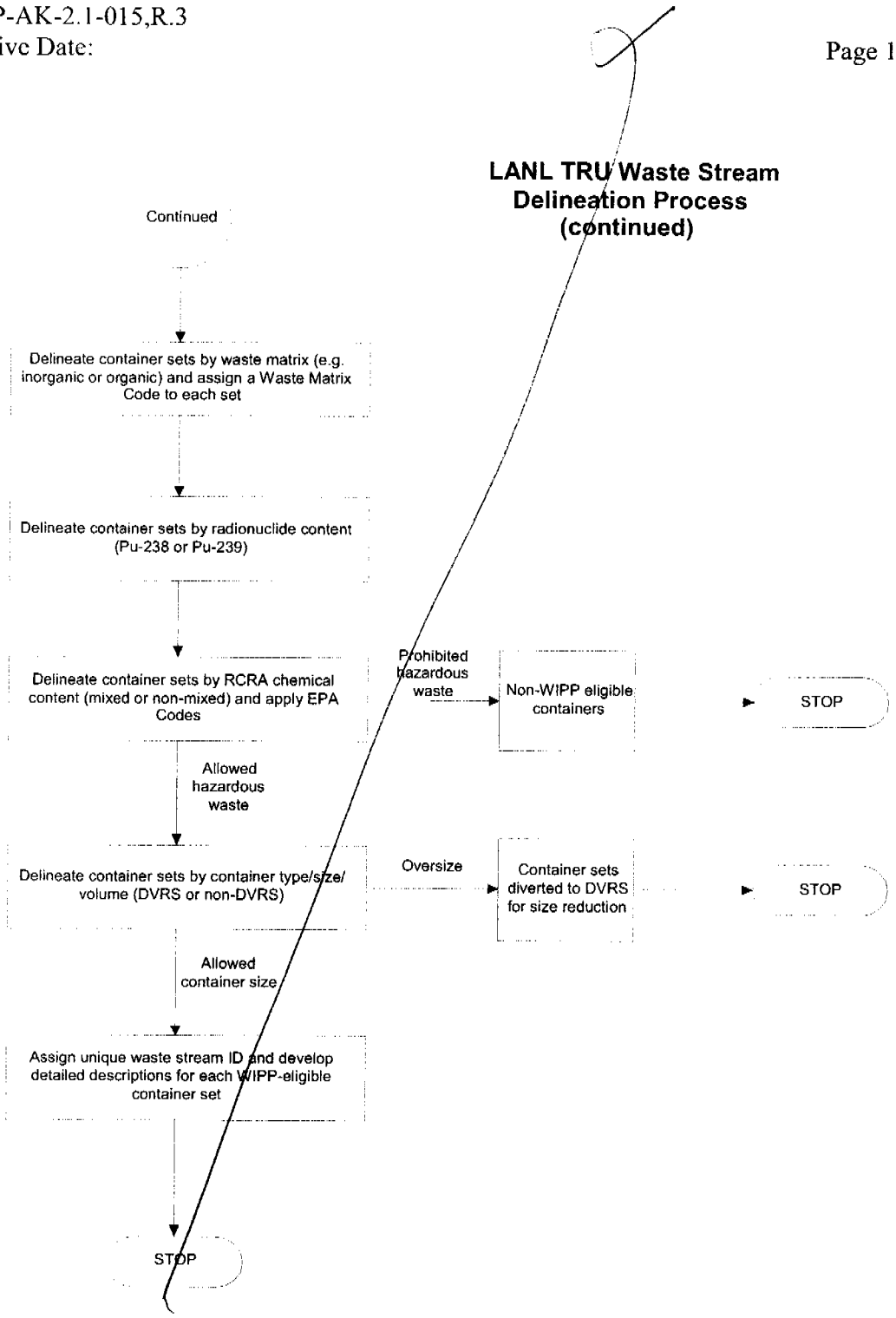
~~3.2.5 Revised TRU Waste Stream Delineation Strategy~~

3.2.5.1 Overview

The LANLTRU waste certification project has recently revised the strategy by which waste streams destined for

**Figure 1**
**LANL TRU Waste Stream**
**Delineation Process**




LANL TRU Waste Stream Delineation Process (continued)
Continued
Delineate container sets by waste matrix (e.g. inorganic or organic) and assign a Waste Matrix Code to each set
Delineate container sets by radionuclide content (Pu-238 or Pu-239)
Delineate container sets by RCRA chemical content (mixed or non-mixed) and apply EPA Codes
Prohibited hazardous waste
Non-WIPP eligible containers
STOP
Allowed hazardous waste
Delineate container sets by container type/size/ volume (DVRS or non-DVRS)
Oversize
Container sets diverted to DVRS for size reduction
STOP
Allowed container size
Assign unique waste stream ID and develop detailed descriptions for each WIPP-eligible container set
STOP

WIPP are delineated using acceptable knowledge (AK) information. LANL has re-evaluated AK waste matrix information, and has consolidated waste streams with similar waste forms. The revised strategy reduces the number of WIPP-eligible waste streams from 109 to 22.

3.2.5.2 Delineation Strategy

Delineation is made based on the waste-generating operation or activity. The container sets are then subdivided by summary category group, waste matrix, radionuclide content, and RCRA hazardous chemical content. Finally, oversize container sets are separated for diversion to LANL's Decontamination and Volume Reduction System.

The resultant container sets are assigned unique waste stream identifiers, and detailed descriptions are developed from supplemental AK sources. The following general waste streams, with the applicable waste matrix codes, have been delineated for containers.

- Heterogeneous debris waste (mixed and non-mixed) (Waste Matrix Code S5400)
- Combustible debris waste (mixed and non-mixed) (Waste Matrix Code S5300)
- Inorganic homogeneous solid waste (mixed and non-mixed) (Waste Matrix Code S3100)
- Organic homogeneous solid waste (mixed) (Waste Matrix Code S3200)
- Soils (mixed and non-mixed) (Waste Matrix Code S4100)

~~3.2.5.3 Rationale~~

LANL TRU debris waste streams are not delineated beyond the heterogeneous categories to more detailed waste matrix codes. Delineation to identify detailed waste streams such as metal or glass waste has been previously attempted (see the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan*, TWCP-PLAN-0.2.7-001,R.0, 1997). However, as supplemental AK information is gathered on specific waste-generating operations, it is apparent that detailed delineation cannot be reliably made

organic (combustible) and

because TRU waste management practices at LANL have historically not made such distinctions for waste packaging purposes.

The majority of the TRU waste originates at TA-55, which is LANL's Plutonium Facility. The delineation of waste streams based on waste matrix is based largely on the TRU waste management practices at TA-55. Historically, TRU debris wastes have been segregated into combustible and noncombustible categories. AK information for the physical form and material content of waste containers reflects this segregation practice. LANL waste management practices allow for the combustible waste to include some unspecified "small" fraction of noncombustible solids, such as scrap metal. Similarly, it is acceptable for the noncombustible waste to include some unspecified "small" fraction of combustible solids such as plastics. Therefore, debris waste that is at least 50 volume percent combustible (organic) items is delineated from waste that contains less than 50 volume percent combustible items (i.e. greater than 50 volume percent noncombustible inorganic items).

3.2.5.4 Reconciliation of Characterization Data with AK Information

For legacy waste, each container in the TRU waste inventory is assigned to a waste stream based on the available container-specific AK information. Each waste stream is associated with a waste matrix code that describes the expected material composition of the waste stream. The waste material parameter (WMP) composition of an individual container, as verified by real-time radiography (RTR) or visual examination (VE), may deviate from the expected composition based on the waste stream description. However, an individual container that deviates from the overall waste stream description may remain in that waste stream as long as the characterization data for the entire population of containers are consistent with the AK description of the waste stream.

In the past, LANL has reconciled the RTR and VE characterization data with AK information for individual containers by changing the waste stream assignment of any container that did not meet the definition of the waste matrix code associated with the AK waste stream. The AK reconciliation process is described in *Waste Characterization Data Reconciliation with Acceptable Knowledge and*

*Acceptable Knowledge Accuracy Reporting* (TWCP-DTP-1.2-064). LANL proposes to alter the AK reconciliation procedure in the following way.

- If the WMP volume percentages for an individual container do not meet the definition of the waste matrix code associated with the AK waste stream, the volume percentage distribution for the entire population of characterized containers in that waste stream is evaluated.

- If the aggregate WMP volume percentage distribution *with the inclusion of the nonconforming container data* meets the waste matrix code definition, the deviant container will not be reassigned to different waste stream.

- If the aggregate WMP volume percentage distribution with the inclusion of the nonconforming container data does *not* meet the waste matrix code definition, the nonconforming container will be reassigned to different waste stream.

For example, the RTR data for a container assigned to an organic debris waste stream indicates that glass comprises 62% of the waste by volume and plastic debris comprises 48%. A nonconformance report is issued for the container because the RTR data do not verify the waste matrix code of S5300 that is assigned to the waste stream. However, the average organic volume percent for 1,700 characterized containers in the waste stream, including the nonconforming container, is 92%. The nonconforming container may remain in the waste stream because the overall description is unchanged: the majority (greater than 50 volume percent) of the waste is organic debris. Verification of proper waste stream delineation is provided with the pre-WAP RTR data, which shows TA-55-19 as basically 100 percent combustibles and shows TA-55-30 as 70 percent heterogeneous. (TWCP-11062).

For newly generated waste, waste items are packaged into waste containers based on the material content of the waste, not by the P/S of origin. Therefore a single waste container may include waste items from several different P/S codes. In the AK Information Summary, wastes are assigned to waste streams based on the following waste segregation schemes:

- First by radioisotope content (Pu-238 or Pu-239 material type)
- Then by material matrix with consideration to the NDA technique to be used (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

Waste stream delineation is performed using waste generator information (such as the WODF) that is compiled in the AK Information Summary. Because waste items from several different P/S codes may be combined into each waste container, a special sort on the P/S code of each waste item in a container is necessary to determine if the container contains all non-mixed items, some or all mixed-waste items, or a special case item.

3.2.~~6~~4 Waste Physical Form and Content Description: Assignment of Waste Stream Numbers

3.2.~~6~~4.1 Waste Segregation Practices

Prior to April 17, 1995, debris waste was segregated only according to Pu isotopic make-up and combustibility. Although individual waste items were tracked (and recorded on WODF and DWLS forms), no attempt was made to separate them along composition or process lines. Thus, numerous waste material parameters and constituents would end up in the same drum. For this reason, all Pu-239 debris waste generated before April 17, 1995 is nominally assigned to two waste streams: TA-55-19 (~~>50%~~ predominantly combustible) and TA-55-30 (~~>50%~~ predominantly heterogeneous).

Between April 17, 1995 and July 17, 2001, additional segregation of debris waste was conducted. Non-combustible items were disposed of according to whether or not RCRA constituents were present (i.e., mixed vs. non-mixed). This resulted in the generation of new waste streams. Combustibles were not segregated according to matrix (i.e., rubber, plastics, cellulose-based materials, etc. were still combined), but were separated on the basis of RCRA constituent content. Therefore, from 1995 through July 16, 2001, combustibles were further categorized as either mixed or non-mixed.

Beginning July 17, 2001, all debris waste generated at TA-55 bears the label "newly generated" and falls into four distinct waste streams:

1. TA-55-19: Mixed combustible
2. LA-NCD01: Non-mixed combustible
3. TA-55-30 Mixed heterogeneous
4. LA-NHD01: Non-mixed heterogeneous

3.2.6.2 Records and Written Evidence

In addition to the segregation protocols described above, records exist that give more detailed information about the contents of some drums. For example, a subset of debris waste drums generated between 1987 and 1995 can be shown to be non-mixed based upon database records. Five primary information sources have been found that significantly augment "procedural" information such as that given in Section 3.2.5. These are listed in Table 5 in descending order of reliability. The reliability/quality of the data source is determined by how "close" the information is to entries made by the original waste generator. The WMS list contains data entered by the generators and data were entered under a quality assurance program; it is therefore considered the most reliable source of information pertaining to TA-55 wastes. The other data sources in Table 5 provide unique information of one type or another, but the information is considered somewhat less reliable because of occasional discrepancies that arise between listed entries and original generator data (when the latter exist). The non-certified archive database is particularly useful for tracking information pertaining to "S" drums (older drums having a different numbering scheme). The ~~TA-54~~ database is used to obtain filter dates, location information, and package dates. The certified archive database contains unique information about waste generated between 1992 and 1996, and the Sampling Plan (Rev. 0) contains information about older "legacy" drums.

LANL TRU Waste Management

**Table 5. Primary Information Sources**

| Source # | Description |
|---|---|
| 1 | TA-55 WMS |
| 2A | Archive certified Microsoft Access database |
| 2B | Archive noncertified Microsoft Access database |
| 3A | Sampling Plan Rev. 0 |
| 3B | ~~TA-54 unofficial~~ database |

LANL TRU Waste Management Oracle

The possible presence of Cm-244 in TRU waste is of particular interest to radioassay operations because it can affect the choice of a radioassay instrument to use for optimal results. Cm-244 was introduced in recovery operations in P/S code DOP, which started in 1988 (TWCP-5165). Material outputs from this operation sometimes are sent to P/S codes IS or WE. Cm-244 could also be part of waste under P/S code CA because both operations take place in the 300 Wing of PF-4. Because only one room in this area is available for bagouts, TRU waste from P/S codes DOP and CA are sometimes combined. In addition, because rags from DOP are sent to IS, Cm-244 could be present in the ash produced by this operation, which is then processed through nitrate aqueous recovery operations. Some unknown fraction of the Cm-244 could ultimately end up in the evaporator bottoms, which is then immobilized in cement in P/S code CF. In any case, however, Cm-244 is not expected to be present in any waste generated before 1988.

During Project 2010 characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge and Acceptable Knowledge Accuracy Reporting* (TWCP-DTP-1.2-064).

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

All of the debris waste streams covered by this AK Report were generated by the same plutonium recovery activities at LANL but differ in physical form, waste matrix code, and hazardous constituents. In addition to these waste streams in which Pu-239 is the dominant Pu isotope, analogous waste streams containing Pu-238 as the dominant Pu isotope were generated during the same time period at the plutonium facility. Homogeneous waste streams were also generated from the Pu-239 recovery process; they are described in a separate report.

Waste containers in a waste stream are characterized as a campaign, in which the targeted group of waste containers to be characterized are selected based on criteria such as availability of the waste containers, waste loading level, availability of waste generator records, and hazardous waste numbers. Waste stream lots selected for convenience of characterization activities are defined in the applicable WSPF.

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

physical form and content

Waste matrix codes are assigned to waste streams based on waste ~~generation practices~~ and AK reports in accordance with *Assignment of Waste Matrix Codes* (TWCP-DTP-1.2-053). Additional codes apply to these waste streams, based on code descriptions in the *WIPP Transuranic Waste Baseline Inventory Report* (WTWBIR) (CAO-94-1005), the *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004/Rev.13.5), Radioactive Solid Waste Disposal (RSWD) code, and Item Description

Code (IDC) (Table 13). RSWD and IDC codes assigned to individual containers by the waste generator are summarized by waste stream in the AK ~~Information Summary~~.

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

The waste material parameter codes are qualitatively assigned to the waste streams based on AK information and knowledge of waste generation practices described in the Waste Management Procedures (see Section 3.2). These waste material parameter (WMP) codes are confirmed for legacy waste by comparing them against WIPP-compliant waste characterization data from real-time radiography and for newly generated waste by comparing them against WIPP-compliant waste characterization data from visual examination techniques.

## 8.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

### 8.1 F, K, and P Listings

F001, F002, F003 and F005 apply to combustible and non-combustible waste generated by several of the P/S codes covered by this report. In many cases, the applicability of the HWN is limited to waste generated during a specific period, as discussed in the appropriate AK report. All four F codes are conservatively applied to wastes with unknown P/S codes.

The applicability of F-listings to a specific waste stream is determined by the contents of the waste containers and the associated P/S codes (see Table 14). If any F-listing is applicable to combustible debris from a particular P/S code, then it is also assumed to be applicable to non-combustible debris from the same P/S code. Metal and glass are generally non-porous and do not absorb liquids, and any metal or glass in contact with volatile organic chemicals would have been air-dried before being discarded as waste. However, noncombustible waste streams also contain a small percentage of combustible waste that could be contaminated with organic chemicals.

At one time a P120 code was applied to certain drums generated in 1998 because of the temporary use of vanadium pentoxide for about 6 months in that year. Based upon investigation into the way the material was handled, this code is no longer needed. A P120 assignment would be used only if waste resulted from spillage of this material or from disposal of un-reacted/unspent material. No un-reacted/unspent material was disposed of in TRU waste drums. In addition, no significant spill of this material occurred. If a spill had occurred, suitable records would exist (e.g., incident reports, waste profile forms). The absence of such documentation, coupled with information obtained through interviews of people who worked with the material, indicate that a P120 assignment is not necessary (TWCP-12081).

**Table 13. Assignment of Waste Codes to Waste Streams Containing Pu-239**

| Waste Stream | Mixed or Non-Mixed Status | Waste Stream Name | WMC | WTWBIR Code | TRUCON Code* | RSWD Code* | IDC* |
|---|---|---|---|---|---|---|---|
| TA-55-19 | Mixed | Combustible debris waste | S5300 | LA-W004 | LA116<br>LA154 | A14, A15, A16, A17, A18, A55, A60 | 004 |
| LA-NCD01 | Non-Mixed | Combustible debris waste<br>Heterogeneous | S5300 | LA-T004 | LA116<br>LA154 | A14, A15, A16, A17, A18, A55, A60 | 004 |
| TA-55-30 | Mixed | ~~Noncombustible~~ debris waste<br>Heterogeneous | S5400 | LA-W005 | LA116<br>LA117<br>LA118<br>LA123<br>LA125<br>LA154 | A18, A19, A25, A27, A28, A30, A47, A50, A51, A52, A60, A61, A95 | 001<br>005 |
| LA-NHD01 | Non-Mixed | ~~Noncombustible~~ debris waste | S5400 | LA-T005 | —<br>[copy] | A18, A19, A25, A27, A28, A30, A47, A50, A51, A52, A60, A61, A95 | 001<br>005 |

**NOTES**: *These codes are defined in ~~Tables F-4, F-5, and F-6~~ of the AK ~~Information~~ ~~Summary~~. For the majority of legacy waste containers, traceable AK documentation has not been obtained that shows what codes, if any, were assigned by the waste generator. In many cases, the code listed may apply to only one out of thousands of containers in the waste stream.

- Sources: TA-55 TWID, R3, Appendix G; NMT7-WI2-SOP-TA55-013,R4, Appendix D; AK ~~Information Summary, R.6, Table 3-1 and Appendix D~~. Attachment b.
- WTWBIR numbers have been assigned to waste streams covered by this AK Report based upon the identifier from CAO-94-1005 that is considered to provide the closest match to the waste stream characteristics, based on the table sources listed above.

- RTR batch data report indication of the observed layers of packaging
- If packaging filter information is indeterminate, use the TRUCON code for "no filters in packaging"
- If RTR information is indeterminate, use the default assignment given in the Waste Stream Profile Form package
- If no default code is assigned, assign code based on most conservative (maximum packaging layers) TRUCON letter designator

This guidance only applies to retrievably stored waste. Newly generated waste is packaged under procedures approved by Project 2010 and CBFO, and are assigned correct TRUCON codes.

## 15.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 49 CFR Part 261, Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, Segregation of hazardous materials
- *Acceptable Knowledge Accuracy Report* (TWCP-AK-2.1-012,R.0)
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Acceptable Knowledge for Isotope Ratios* (TWCP-AK-2.1-020)
- Acceptable Knowledge Information Summary for LANL Transuranic Waste Streams (TWCP-AK-2.1-019) ✓
- *Assignment of Waste Matrix Codes* (TWCP-DTP-1.2-053)
- *Calculation of $UCL_{90}$ Values* (TWCP-DTP-1.2-006)
- *Content Code Assessments for LANL TRUCON Codes* (DOE/WIPP-89-004)
- *Determining Isotopic Ratios in Waste Containers Using the RANT PC/FRAM Assay System* (TWCP-DTP-1.2-029)
- *DOE Order 5820.1 and 5820.2,* Management of Transuranic Contaminated Material, U.S. Department of Energy, 09/30/82 and 02/06/84
- *DOE Order 435.1* Radioactive Waste Management, Department of Energy, Environmental Management, 2001
- *Hazardous Waste Facility Permit Issued to Waste Isolation Pilot Plant* (EPA No. NM4890139088) (Attachment B, Waste Analysis Plan)

- *Headspace Gas Sampling and Analysis Using an Automated Manifold* (TWCP-DTP-1.2-041)
- *Inspecting, Labeling, and Preparing TRU Waste Containers* (NMT7-WI1-SOP-TA55-013)
- *Inspecting, Packaging, Rejecting, and Remediating Transuranic Waste for WIPP and for TA-54 Safe Storage* (NMT7-SOP-TA55-013), with associated detailed Work Instructions (WI)
- ~~*Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001)~~
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Operating the High Efficiency Neutron Counter (HENC) Using INCC* (TWCP-DTP-1.2-059)
- *Packing TRU Waste Containers* (NMT7-WI3-SOP-TA55-013)
- *Performing Nondestructive Testing Using the Mobile Real-Time Radiography System* (TWCP-DTP-1.2-008)
- *Performing Visual Examinations of TRU Waste* (NMT7-WI2-SOP-TA55-013)
- *Purex Technical Manual* (WHC-CM-5-25, 8/25/88)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Records Management* (TWCP-QP-1.1-004)
- *Sealing TRU Waste Containers* (NMT7-WI4-SOP-TA55-013)
- *TA-55 Standard Operation Procedure (SOP)* (406-GEN-R00)
- *TA-55 Transuranic Waste Interface Document* (NMT7-AP-TA55-018)
- *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004)
- *U.S. Atomic Energy Commission AEC Manual:* Chapter 0511, Radioactive Waste Management, AEC 1993
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA-530-R-94-024)

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5372 | D | Vanadium pentoxide in waste generated by P/S codes SD and SS | Interview with Jim Foxx (TA-55 SME) on May 7, 2001 | Vanadium pentoxide was used between February 1998 and June 1998. SME information indicates that waste from this work would have been packaged into containers that were closed by the end of December 1998. | None |
| TWCP-8003 | D | Description of information developed for database system for tracking waste disposed and/or stored at TA-54, Area G | Report, "Documentation for Rad Waste ORACLE Database's List of Acceptable Radioisotopes, Specific Activities, Categories, and Regulatory Limits" | Information is provided on how specific activities were assigned for different material types | Developed to evaluate waste stored at TA-54, Area G |
| TWCP-9499 | D | Memo regarding Actinium usage | Memo from Wayne Punjak regarding AC-227 usage | Information regarding a previously undocumented use of Actinium. | None |
| TWCP-9810 | D | Memo regarding reporting U-234 | Memo from Mike Baker regarding U-234 assay | Approach for calculating U-234 concentration based on U-235. | None |
| TWCP-11061 | C | Headspace gas data collected prior to WAP becoming effective. | Review of Headspace Gas data from Pre-WAP Analysis for Additions to AK | Detailed information on the tentatively identified compounds found in pre-WAP HGAS batch data reports. | Pre-WAP and limited on waste streams covered. |
| TWCP-11062 | C | Real-time-radiography data collected prior to WAP becoming effective. | Review of RTR Data from Pre-WAP Analysis for TA-55 Debris Waste | Summary information on the waste material parameters and prohibited items for TA-55 debris waste streams. | Only on TA-55 debris waste streams. |
| TWCP-12081 | C | Interview with SME | Interview with Jim Foxx (TA-55 SME) on March 11, 2003 | While vanadium pentoxide was used, no history or information regarding a spill was found. Therefore, the P120 HWN does not apply | None |
| TWCP-12088 | B | Discussion of use of plastic ties | *Memo LAAMEP 2BL-006 To Stanley Kasiewicz* | Documents waste management practices regarding use of ties on bag-out closures. | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-002,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Chloride Operations at ~~TA-55~~ LANL* | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Metal Operations at ~~TA-55~~ LANL* | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2/IC1 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Miscellaneous Operations at ~~TA-55~~ LANL* | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Nitrate Operations at ~~TA-55~~ LANL* | Detailed information on each P/S code for nitrate operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Pyrochemical Operations at ~~TA-55~~ LANL* | Detailed information on each P/S code for pyrochemical processes at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | Generator interviews and TWCP AK references | *Acceptable Knowledge Report for Special Processing Operations at ~~TA-55~~ LANL* | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-AK-2.1-019 AND TWCP-AK-2.1-020 | C | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK references based on generator's original data | *~~Los Alamos National Laboratory Transuranic Waste Characterization~~ AK Information Summary [and] Acceptable Knowledge for Isotopic Ratios* | Detailed information on each waste drum and waste stream | Reliability and completeness of waste generator data is highly variable, and this information summary is continually being updated |

do not italicize

for LANL Transuranic Waste Streams

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

QP-00-004,R.0
Effective Date: 06/18/03

TWCP-15415

# RECORDS SUBMITTAL

**INSTRUCTIONS:** This form is prepared by the record source when submitting individual records, batch data reports, or a records package to the RMDC Center. For records packages, a Table of Contents (TOC) must also be submitted. Each record submitted requires a complete form.

**MANDATORY:** X To the best of my knowledge, the record(s) have no radioactive contamination.

Signature: _____

**RECORD TYPE:**

X Project 2010 ☐ Facility (RRES)

☐ Other: _____ ☐ UCNI ☐ Proprietary

**RECORD SOURCE:**

Submittal Date: 7/25/03___ Z No.: 109592_____ Name/Org: PATRICIA PATTON – RRES-CE_____

Originator: JOHN MUSGRAVE_____ Organization: NMT_____

**TYPE OF RECORD/ACTION TO BE TAKEN**

X Individual Record ☐ Batch Data Report ☐ Records Package (+ TOC)

X New ☐ Revision* ☐ Addition* ☐ Supersedes*

*Record Barcode Number: _____ *Review Cycle (if applicable): ☐ Yes ☐ No ☐ NA

**RECORD ID NUMBER**: (e.g., memo symbol number, procedure (include revision), deficiency number, batch data report number, unique record identifier if applicable):

TWCP-AK-2.1-006, R.2 7/25/03

Record Date: 5/18/01____ Physical Page Count: 112 X Single Sided ☒ Double Sided

Category Number: (from page two): 07_____

**RECORD TITLE, SUBJECT, AND/OR KEYWORDS:**

TWCP-AK-2.1-006, R.2/IC1 Process AK Report for Pyrochemical Processes at TA-55 (INCLUDES INTERIM CHANGE 1) - LA-UR-01-2558 – LA-UR-02-1713

**RECORD CENTER USE ONLY**

☑ Accepted Date: 7-25-03 ☐ Return Date: _____

Signature: _____ Resubmitted: _____

RIDs Type: LT

Scan Date: _____ By: _____ QC Date: _____

X-Sender: chsmith@norris-mail.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.1
Date: Thu, 24 Jul 2003 10:37:16 -0600
To: pgp@lanl.gov
From: Cathy Smith <chsmith@lanl.gov>
Subject: Please retire Process AK Reports
Cc: sgw@lanl.gov
X-Scanned-By: MIMEDefang 2.35

Hi Patsy,

As we discussed yesterday, here is the list of Process AK Reports that we would like to retire as controlled documents and submit as records to RMDC. Could you let Betty Humphrey and myself know when you have the record IDs - we need to update the references in the main AKIS document.

Thanks a million!

Cheers, Cathy

The following can be turned into Records, to be referenced in our AKIS or AK Summaries...

1. TWCP-AK-2.1-002, R.2/IC1 Process AK Report for Chloride Operations at TA-55

2. TWCP-AK-2.1-003, R.2/IC1 Process AK Report for Metal Operations Processes at TA-55

3. TWCP-AK-2.1-004, R.2/IC2 Process AK Report for Miscellaneous Operations at TA-55

4. TWCP-AK-2.1-005, R.2/IC1 Process AK Report for Nitrate Operations at TA-55

5. TWCP-AK-2.1-006, R.2/IC1 Process AK Report for Pyrochemical Processes at TA-55

6. TWCP-AK-2.1-007, R.2/IC1 Process AK Report for Special Processing at TA-55

7. TWCP-AK-2.1-009, R.0/IC1 Process AK Report for Pu-238 Operations at TA-55

8. TWCP-AK-2.1-013, R.0 AK Report for NG Waste from Nitrate Operations at TA-55

9. TWCP-AK-2.1-014,R.0 AK Report for NG Waste from Miscellaneous Operations at TA-55

10. TWCP-AK-2.1-016,R.0 AK Report for NG Waste from Special Processing Operations at TA-55

11. TWCP-AK-2.1-017,R.0 AK Report for NG Waste from Metal/Pyrochemical Operations at TA-55

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*"The simplest questions are the hardest to answer."*
*Northrop Frye*

Catherine H. Smith
***Project 2010***
RRES-CE Certification Group
Risk Reduction & Environmental Stewardship Division
Phone: 667-0113 Page: 664-7104

LA-UR-02-1713



# INTERIM CHANGE REQUEST

| ☑ TWCP ☐ WRR ☐ Other<br>If Other, please identify: _____ | IC Number: 1 |
|---|---|
| **Person Requesting this Interim Change:** Sandy Wander | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55 | **Document No./Revision:** TWCP-AK-2.1-006,R.2/IC1 (LA-UR-1713) |
| **Effective Date of Current Document:** 05/18/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| Title Page and p. 1 | Delete "Summary" from title to read:<br>"Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55" | Clarification |
| Global | Change all occurrences of "AK Information Summary" to "AK Information Summary" | Document title change |
| Note and 3rd column heading / p. vi | Delete "summary" from "NOTE" at top if page vi and from "*" note at bottom of page viii<br>Change 3rd column heading on page vi and vii to read:"Process AK Report*"<br>Delete entire 4th column | Clarification |
| RCRA Constituents/ EPA Hazardous Waste Numbers: / p. viii of viii | Change first bullet to read: "D005 (barium) applies to salt waste generated under P/S code RA discarded under P/S code OR<br>In bullet beginning D008 (lead), add "*" after D008, and "except Neptunium after "P/S codes" and before "in pyrochemical processes" | Per SME, chemically D005(barium) would stay only in the salt which is discarded under P/S code OR, not P/S code RA.<br>* due to typo error. Per SME, P/S code Neptunium did not generate any waste. |
| Global search and delete / pp. 2 and 6 | From all references to "process AK summary report," delete "summary" to read "process AK report.<br>From all titles that previously read "Process Acceptable Knowledge Summary Report, " delete "Summary" to read "Process Acceptable Knowledge Report." | Clarification |
| Attach. 3 / pp. 1 and 2 of 3 | In timeline for OR, add D005; in timeline for RA, delete D005<br>Add "*D008" to PK timeline, "two asterisks" to D019 in PTP timeline and P120 in SD and SS timelines and Notes, and "D008" to SS timeline. Add "*" to D008 in footnotes. | See justification above regarding D005 to timeline for OR and deleting in RA timeline.<br>Typo errors found upon review. |

| | | |
|---|---|---|
| Attach. 4 / pp. 1, 2, 3, and 4 of 4 | In row for OR, add D005 to "EPA Codes" column; in row for RA, delete D005<br>Add "*" to all P/S codes, add "P120" to ER<br>Add "*D008 due to leaded gloves" as footnote | See justification above regarding D005 to timeline for OR and deleting D005 in RA in Attachment 4.<br>Typo errors found upon review. |
| Attach. 6, pp. 1, 2 | Add new Attachment 6 and update "Contents" page to reflect addition<br>Add following paragraph to end of Section 2.0:<br>"When discrepancies in AK information are discovered, they are documented and resolved in accordance with Acceptable Knowledge Documentation (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6)." | New TWCP-QP-1.1-021 requirement |

**Date changes submitted**: 02/12/02 | **Desired effective date for changes**:

**INTERIM CHANGE APPROVAL**

| | | | |
|---|---|---|---|
| Document Preparer: S Wander | | Reviewer (if applicable): Facility Rep | |
| Signature: Sandy Wander | Date: 3/19/02 | Signature: Wayne A. Dunfee | Date: 3/20/02 |
| Site Project QA Officer: MA Gorett | | LAAO (if implementing WAP requirements): N/A | |
| Signature: MA Gorett | Date: 3/21/02 | Signature: | Date: |
| ☑ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | | Do changes affect WAP data collection, data quality, or performance criteria? | |
| Site Project Mgr/Line Mgr: P Rogers | | ☐ Yes ☑ No | |
| Signature: Pamela Rogers | Date: 3/19/02 | If yes, date of CBFO approval: _____ (documentation attached) | |
| USQ Screener (if applicable): NA | | | |
| Signature: John Rr | Date: 3.25.02 | | |

**NOTE:** Changes can be designated on the document and attached to this form.

**Effective date for this interim change:** 3/21/02

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-006,R.2 (LA-UR-01-2558)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

**EFFECTIVE DATE:** 05/18/01

**NEXT REVIEW DATE:** 05/18/03

**DOCUMENT PREPARER:**

Tom Musgrave — NAME — 5/7/01 — DATE

**APPROVALS:**

June Fabryka-Martin — INDEPENDENT TECHNICAL REVIEWER/EDITOR — 5/7/01 — DATE

Mavis R. Lo — SITE PROJECT MANAGER — 5/10/01 — DATE

Sandy Wander — WASTE CERTIFICATION OFFICIAL — 5/14/01 — DATE

SITE PROJECT QA OFFICER — 5/14/01 — DATE

Charles L. Fox — FACILITY REPRESENTATIVE — 5/7/01 — DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 07/13/00 | — | New report (TWCP-03939) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | 05/18/01 | All | Respond to CBFO comments and update to include new AK information |
| 2/IC1 | 03/21/02 | Title page, vi, viii, 1–5 Att. 3, 4 | Clarification and update to include new information. |

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3 Timeline for Pyrochemical Processes (3 pages)
4 Process Inputs and Outputs (4 pages)
5 Simplified Process Status Diagram (1 page)
6 Decision/Discrepancies Resolution Documentation (1 page)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| AK Information Summary | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001,R.5) |
| CFR | Code of Federal Regulations |
| D | EPA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction (process conducted under P/S code OR) |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| ER | electrorefining |
| F | EPA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| K | EPA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| MCDOR | multicycle direct oxide reduction |
| MPL | metal preparation line |
| MSE | molten salt extraction |
| MT | Material Type |
| NMT | Nuclear Material Technology |
| OSWER | Office of Solid Waste and Emergency Response (EPA) |
| P | EPA hazardous waste number prefix for discarded commercial chemical products, off-specification species, container residues, and spill residues, defined in 40 CFR Subpart D, Section 261.33 |
| P/S [code] | process/status [code] |
| PCB | polychlorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| PYRO | pyrochemical [designator for individual documents in pyrohemical processes reports in Attachment 1, Acceptable Knowledge Roadmap] |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development and demonstration |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | records management/document control |
| SME | subject matter expert |
| SOP | safe/standard operating procedure |

| | |
|---|---|
| TA | technical area |
| TCLP | toxicity characteristic leaching procedure |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization/Certification Program |
| UCNI | Unclassified Controlled Nuclear Information |
| WAC | waste acceptance criteria |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WIPP | Waste Isolation Pilot Plant |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request form |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**Note:** This index indicates the main process AK report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| CA | Casting | Metal Operation Processes |
| CRD | Chlorination/reduction RD&D | Pyrochemical Processes |
| CX | Chloride Anion Exchange | Chloride Operations |
| CXL | Experimental Chloride Extraction Line | Chloride Operations |
| DO | Dissolution of Oxide | Special Processing |
| DS | Ion Exchange | Nitrate Operations |
| ED | Cascade Dissolver | Nitrate Operations |
| ER | Electrorefining | Pyrochemical Processes |
| LR | Ion Exchange | Nitrate Operations |
| MA | Machining | Metal Operation Processes |
| MO | Metal Oxidation, Room 429 | Pyrochemical Processes |
| MP | Metal Preparation | Pyrochemical Processes |
| NEPTUNIUM | Neptunium | Pyrochemical Processes |
| OR | Direct Oxide Reduction | Pyrochemical Processes |
| PK | Pickling and Nitrate Holding | Pyrochemical Processes |
| PTP | Plutonium Trichloride Preparation | Pyrochemical Processes |
| RA | Recovery of Anodes | Pyrochemical Processes |
| RB | Roasting and Blending | Nitrate Operations |
| RBJ | Roasting and Blending Jr | Nitrate Operations |
| SC | Cascade Dissolver, G437 | Nitrate Operations |
| SCB | Chlorination Ca/Al Scrubbing RD&D | Pyrochemical Processes |
| SD | Salt Distillation | Pyrochemical Processes |
| SS | Salt Stripping | Pyrochemical Processes |
| SSMD | SS Material Development | Pyrochemical Processes |
| WM | Waste Management | Miscellaneous Operations |

* Process AK reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Metal Operation Processes (TWCP-AK-2.1-003,R.2), Miscellaneous Operations (TWCP-AK-2.1-004,R.2), Nitrate Operations (TWCP-AK-2.1-005,R.2), Pyrochemical Processes (this report), Special Processing (TWCP-AK-2.1-007,R.2)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Pyrochemical Processes

**P/S codes**: CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed pyrochemical salts and debris.

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from pyrochemical operations are generated from plutonium metal preparation and purification for defense programs; these wastes may have been generated and produced in the same rooms as were used for non-defense activities and so were not segregated from non-defense waste until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

TA-55 Plutonium Facility (Building PF-4), 400 Wing. Pyrochemical operations include processes for the preparation and purification of plutonium metal.

**Description of the process waste (physical form and typical content description):**

Waste from pyrochemical operations consists primarily of slag containing chloride salts, calcium fluoride and calcium oxide salts; crucibles; debris waste including cellulosic, plastic, rubber, glass, and metal items. Liquid waste is sent to the Radioactive Liquid Waste Treatment Facility at TA-50.

***Summary Category Groups:*** S3000, S5000

***Waste Matrix Codes:*** S3100, S3200, S5100, S5300, S5400

**Description of the waste-generating process:**

The overall goal of the pyrochemical operations is to prepare plutonium from impure metal, metal alloys, oxides, scrap, and residues and produce a purified plutonium metal. Processes include the metal preparation line, single-pass and multicycle direct oxide reduction, electrorefining, molten salt extraction, salt stripping, salt distillation, carbonate oxidation, oxygen sparge, and pyroredox.

**Process feed:**

Plutonium metal, metal alloys, or oxides; plutonium scrap; Np-237 (briefly in 1993).

**Radioisotopic content of the waste:**

Variety of plutonium material types with different well-defined isotopic compositions. Am-241, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some processes separate plutonium and americium, or plutonium and uranium, so that the waste will usually be enriched in Am-241 or U-234, but may also be depleted in some cases. Np-237 may be the dominant radionuclide in some cases. Pa-231 and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D005 (barium) applies to salt waste discarded under P/S code OR
- D006 (cadmium) and D008 (lead) apply to P/S codes ER and SS
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): zinc metal waste from P/S code RA
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): waste from P/S code PK
- D008* (lead): metal waste debris from all P/S codes except Neptunium in pyrochemical processes due to disposal of leaded gloves; after May 1992, leaded gloves were separated from other metal debris
- D009 (mercury): waste from P/S code SSMD during the summer of 1994
- D019 (carbon tetrachloride): waste from P/S code PTP (1986 to June 1989)
- No F or K codes
- P120 (vanadium pentoxide): waste from P/S code SD from 02/98 to 03/98; and P/S code SS from 05/27/98 to 06/10/98

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR PYROCHEMICAL PROCESSES AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes that generate TRU waste in the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for several waste stream AK reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to TA-55 waste streams resulting from pyrochemical processes covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001) (AK Information Summary) that includes information regarding all TRU waste streams
- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to pyrochemical processes is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No. TWCP-3542. Individual documents in this record have been assigned a separate identifier, PYRO-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

present in the process wastes, based on subject matter expert (SME) interviews and any relevant data

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) is contained in these records, and will not be included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK report is part of a set of closely related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six operational areas. The multiple processes in each area are described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006 [this report])
- *Process Acceptable Knowledge Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, pyrochemical processes include 13 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6).

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in pyrochemical processes, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Processes in pyrochemical operations were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (TWCP-816).

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the AK Information Summary. Waste generator information is reviewed to identify the types and sources of

waste items present in each drum, to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

3.3 Waste Physical Form and Content Description

Wastes generated during pyrochemical operations contain a variety of pyrochemical chloride salts as well as mixtures of calcium fluoride and calcium oxide salts, that were generated as byproducts of the operations and that met the discard limit for plutonium content. Debris wastes and caustic liquid wastes sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50 are also covered by this process AK report. General debris waste categories from pyrochemical processes include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles
- Metal debris (for example, tantalum crucibles, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from pyrochemical processes.

3.4 Waste Volume and Time Period of Generation

This report covers waste streams generated from 1979, when pyrochemical processes first began in Building PF-4, to the present. Wastes from the pyrochemical processes have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding RCRA codes are shown graphically in Attachment 3, Timeline for Pyrochemical Processes.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

3.5 Waste Generation Processes

The following subsections describe the generation of waste by pyrochemical processes, as well as product and waste outputs to other processes or operations.

Manufacturing and research operations performed at TA-55 results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities. The metal production and purification operations as well as associated maintenance operations are the sources of most TRU waste generated from pyrochemical processing. Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352 and TWCP-886).

This report focuses on metal preparation and purification processes (pyrochemical processes). Pyrochemical operations for plutonium include the following processes:

- metal preparation line (MPL) (P/S code MP),
- single-pass direct oxide reduction (DOR) and multiple-cycle direct oxide reduction (MCDOR) with in-situ regeneration (P/S code OR),
- electrorefining (ER) (initially P/S code ER; but now part of P/S code SS),
- molten salt extraction (MSE) (P/S code SS),
- salt stripping (salt stripping, salt distillation, carbonate oxidation, and oxygen sparging) (P/S code SS),
- pyroredox (P/S code RA),
- pickling (P/S code PK) and metal oxidation (P/S code MO).

**NOTE:** In contrast with most P/S codes, P/S code SS has grown over the years to encompass several activities that are different steps in the metal refining process, rather than representing a single distinct operation. As such, discussion of this P/S code is covered under more than one subsection.

Several research and development (R&D) processes also took place in pyrochemical operations:

- Chlorination/Reduction R&D (P/S code CRD),
- Chlorination Ca/Al Scrubbing R&D (P/S code SCB) (PYRO-24/ TWCP-3542), and
- Salt Stripping Materials Development (P/S code SSMD) (PYRO-22/TWCP-3542).

Each of these processes is described below. A complete listing of P/S codes for pyrochemical processes, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. A simplified process flow diagram for pyrochemical processes is found in Attachment 5.

3.5.1 Metal Preparation Line (P/S code MP)

The MPL (conducted under P/S code MP) produced plutonium metal from $PuF_4$ until 1992 (TWCP-352, TWCP-2539). Plutonium oxides derived from the calcination of oxalate or peroxide precipitates (in nitrate operations) were reacted with hydrogen fluoride gas to form plutonium tetrafluoride. Because the plutonium oxide feed material had been purified in previous aqueous processes, it contained less than trace amounts of RCRA-regulated metal impurities. Input material came from the vault or P/S codes RB or RBJ (in nitrate operations). In the metal production process, plutonium oxide was converted to plutonium tetrafluoride, which in turn was reacted at high temperature (600 °C to 2000 °C) with metallic calcium in a magnesium oxide crucible. Iodine was added as a reaction initiator. The desired product was plutonium metal, which was recovered as a button by breaking the crucible and mechanically separating the contents. The metal was transferred to P/S codes SS or CA or sent to the vault.

The waste products were calcium fluoride ($CaF_2$) and calcium iodide ($CaI_2$), which formed a slag, magnesium oxide sand, and magnesium oxide crucible pieces. These were discarded under P/S code MP if the plutonium content was below the discard limit (DL). If the plutonium content was above the DL, the slag and crucible pieces were sent to nitrate operations (*Process Acceptable Knowledge Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005]) to be dissolved in nitric acid ($HNO_3$) and aluminum oxide ($Al_2O_3$). The leached materials were then discarded under P/S codes ED or SC, with the waste described as leached solids. The leachate was also treated in nitrate operations under P/S code DS to recover the plutonium. The magnesium oxide sand was reused if possible.

Little or no purification of the plutonium occurred during this process. However, because the reagents introduced no impurities and the highest purity feed material was used, the resulting metal was often satisfactory for high-purity applications. In this process, any trace metals were below the toxicity characteristic levels, so that the associated debris and slag wastes were below the toxicity characteristic levels in RCRA metal content (TWCP-2502).

3.5.2 DOR and MCDOR (P/S codes OR and SCB)

Prior to the multiple-cycle DOR process, a single pass DOR process was used for plutonium oxide (TWCP-2507, PYRO-14/TWCP-3542). Plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible at 820°C to 875°C. Any arsenic, mercury or selenium present in the impure plutonium oxide would be driven off due to their volatility at this high temperature (TWCP-1258). The reaction proceeds to completion when excess calcium is present and when sufficient $CaCl_2$ is available to dissolve the calcium oxide (CaO) product.

After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which was sometimes recovered by addition of fresh salt plus additional calcium metal. The process was then rerun. If the unreacted oxide and metal shot did not process after the second run, the material was sent to aqueous recovery. The product plutonium metal contains significant impurities, including additional metal impurities derived from the calcium metal and calcium chloride reagents. It must be further purified by ER. All DOR salts were oxygen sparged, which would have oxidized any pyrophoric metals that might have been present. The salt is then either routed through aqueous chloride operations to recover the plutonium, or else discarded as waste along with the remaining calcium metal and MgO crucible pieces. After May 1987, spent salts above the DL were sent to controlled oxidation to oxidize the pyrophoric metals.

The feed oxide, reagent salts and reductant are of the highest purity available because the process is non-purifying. In fact, the plutonium metal produced from this operation is always less pure than the feed material due to impurities derived from the reductants. Plutonium metal from this process typically requires further processing to meet purity requirements.

To minimize the salt waste, the MCDOR process was started in 1988 (TWCP-2502, PYRO-16/TWCP-3542). In this process, the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated. The salt is chlorinated and reused for MCDOR. The salt is discarded under P/S code OR if the plutonium concentration is below the DL. The salts above the DL are returned to P/S code CXL for dissolution and recovery. Before 1987, the salts may have been discarded under P/S code OR or routed to chloride operations. The chlorine off-gas is passed through a caustic scrubber, with the caustic solution going to the RLWTF at TA-50 for disposal if the solution meets this facility's Waste Acceptance Criteria (WAC). If the solution does not meet the WAC, it is returned to P/S code CXL for additional treatment.

MCDOR process inputs are low in contaminants. Only high-purity reagent chemical salts are used in the process, and the plutonium oxide feed materials are also of high purity, with absorbed water being the main impurity. MCDOR metal feed material analytical samples were analyzed for cadmium, chromium, lead, and silver. A review of 100 analyses showed that, even in the most impure sample, these D-listed toxicity characteristic metals were well below RCRA regulatory limits (TWCP-2540), as follows:

| Metal | Totals Analysis | Calculated TCLP Result | Regulatory Level |
|---|---|---|---|
| Cadmium | <10 ppm | <0.5 mg/L | 1 mg/L |
| Chromium | 30 ppm | 1.5 mg/L | 5 mg/L |
| Lead | 20 ppm | 1 mg/L | 5 mg/L |
| Silver | 2 ppm | 0.1 mg/L | 5 mg/L |

All metal impurities except barium would be reduced to the metal state and remain with the plutonium metal phase rather than be transferred into the molten salt phase. Hence, the molten salt phase is purified of regulated metals except for barium. These regulated metals will be present in the waste salt at levels below the toxicity characteristic levels. Because the salts are reused, only the initial reduction in fresh salt would contain any of the salt feed impurities.

The waste salt, crucibles, and debris waste items associated with this process are discarded under P/S codes OR or CXL. Asbestos gloves

were also used in glovebox operations under P/S code OR, and were disposed as part of ceramic and glass debris wastes.

P/S code SCB was an R&D effort examining the feasibility of this process at extracting Pu (MT 52) from salt before discarding the salt. Pu was chlorinated then reduced to the metal with calcium metal (similar to DOR).

3.5.3 Molten Salt Extraction (P/S code SS)

MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (PYRO-4/TWCP-3542, TWCP-352). This process is employed only if the americium content is greater than 1000 ppm (TWCP-2506). In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible and heated to 750°C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. In the LANL process, 90 percent of the americium and 10 percent of the plutonium are transferred from the feed metal to the salt. After cooling, the salt and metal are mechanically separated. The salts are transferred to the salt stripping process under P/S code SS.

In the late 1980s, several chloride salt systems were studied, including lithium chloride (LiCl), potassium chloride (KCl), calcium chloride ($CaCl_2$), and NaCl/$CaCl_2$.

3.5.4 Electrorefining (currently part of P/S code SS, historically P/S code ER)

The ER process was introduced in 1962 at TA-21 and was moved to TA-55 in 1979. This process takes impure metal from the MSE and MCDOR (DOR) processes and produces high purity plutonium metal (PYRO-2, PYRO-3, PYRO-4, PYRO-6, PYRO-17 [all in TWCP-3542], TWCP-2505). Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$ (TWCP-2505). After the anode and salt melt, current is applied to the system, and plutonium at the anode is oxidized to plutonium ions, which travel to the cathode and are reduced back to the metal state. Impurities in the original plutonium anode that are easier to be reduced than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities easier to be oxidized than plutonium

(including barium) are left in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. Anode heels were sent to pyroredox (P/S code RA) from 1984 to 1986. Currently, salts are sent to P/S code CXL (chloride operations) or carbonate oxidation/distillation (section 3.5.5).

From 1987 to 1989, secondary solvent metals such as cadmium, bismuth, lead, and gallium were added to experimental studies of the electrorefining process (PYRO-15/TWCP-3542). The salts and crucibles from those ER runs may be contaminated with additional cadmium and lead, although those metals should have remained in the anode heels. However, these particular anode heels are retained in the vault at TA-55, with no plans to reprocess them in the near future. Crucible wastes were discarded under P/S code SS. Salts are stored in the vault; very little salt from this process met the DL.

3.5.5 Salt Stripping (P/S codes SD and SS)

The MSE and ER salts are further treated by salt stripping, oxygen sparging or carbonate oxidation, and salt distillation (PYRO-7, PYRO-8, PYRO-9, PYRO-10 [all in TWCP-3542], TWCP-2498). The salt stripping process treats the residue by melting and stirring the salt with calcium metal in a magnesium oxide crucible at 850°C (TWCP-2502). This treatment reduces the plutonium in the salt to metal and allows the metal to coalesce for physical removal and recovery. After cooling, the crucible is broken and the metal physically separated and recycled to the ER process or burned to oxide and sent back through aqueous recovery. The crucible shards are transferred to P/S code CXL, leached in hydrochloric acid, then discarded under CXL. During the salt stripping, the RCRA-regulated metals, except for barium, will be reduced with plutonium into the metal product, so that the salt is essentially free of heavy metals but may still contain barium, although this element is unlikely to be present above RCRA threshold levels.

Oxygen sparging and, since 1996, carbonate oxidation are used to ensure that any plutonium, americium, or metallic sodium or potassium left in the salts are converted to nonpyrophoric oxide forms. The NaCl/KCl salt is either discarded under P/S code SS or distilled for recycle and discarded under P/S codes SS or SD. $CaCl_2$ salts are routed to aqueous chloride processing for further plutonium recovery before being discarded under P/S code CXL.

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping process for a few months in 1998. $V_2O_5$ was used in experiments under P/S code SD from early February to early March of 1998 and under P/S code SS from May 27 to

June 10 of 1998 (PYRO-27/TWCP-3542). Molybdenum oxide was used for the same purpose during the same period of time.

Salt distillation, begun in 1997, allows the recovery of plutonium oxide from the salt and produces purified salt for reuse (PYRO-23/TWCP-3542, TWCP-2498]). NaCl/KCl salt is distilled at 850°C. Process wastes from the salt distillation are the bottoms from the distillation, which are composed of metal oxides, including any RCRA heavy metals originally present in the salt. These metal oxides are rerouted for plutonium recovery. The purified salts are reused or discarded under P/S code SD or SS. However, at the present time salt distillation is on hold awaiting the installation of a new still (PYRO-18/TWCP-3542). In the meantime, the salts and crucibles from ER and MSE are dissolved in P/S code CXL.

3.5.6 Pyroredox (P/S code RA)

The pyroredox operation was used to recover plutonium from spent anode heels in the mid to late 1980s (TWCP-2541). The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements more electroactive than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. Any of the residual RCRA-regulated heavy metals that may have been present in the spent anode heel (barium, cadmium, chromium, lead, and silver), with the exception of barium, would be present in the zinc button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements less electroactive than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded under P/S code RA. The metal phase containing zinc was placed in the vault or further treated (TWCP-2540), and the plutonium eventually was routed back to ER. In the ER process, the RCRA-regulated metals are concentrated in the anode heel, which then may be treated in the pyroredox process to transfer these RCRA metals to the zinc button, or may be roasted in air to form metal oxides and then be dissolved in nitrate operations. Thus, the zinc button output could contain RCRA-regulated heavy metals (D006, D007, D008, D011) above the toxicity characteristic limits. Salt waste could contain barium (D005) above the limit.

3.5.7 Ingot Casting (P/S code SS)

Metal is melted in an MgO crucible to cast the ingot. If the plutonium content of the crucible is greater than the DL, the crucible goes to CXL

for plutonium recovery. If its plutonium content is less than the DL, the crucible is discarded under P/S code SS.

3.5.8 Metal Coalescence (P/S code SS)

Metal coalescence is used for plutonium turnings to coalesce the turnings into a metal button. Calcium metal and $CaCl_2$ are added to a MgO crucible along with the turnings and melted. Turnings may contain Freon from the machining process, but any Freon would be destroyed and volatilized by the high temperatures. Residues are handled in the same manner as MCDOR/DOR residues (section 3.5.2). Metal coalescence is conducted under P/S code SS.

3.5.9 Metal Oxidation (P/S code MO)

Small pieces of metal remaining on furnace or crucible surfaces are collected for conversion to the oxide phase in P/S code MO. These metal pieces are placed in a furnace for the conversion process. The oxide is then transferred to the vault (PYRO-11/TWCP-3542).

3.5.10 Neptunium (P/S code Neptunium)

A campaign to work off neptunium residues stored in the vault was undertaken in 1993 (PYRO-21/TWCP-3542). This operation was only active during 1993. Any debris wastes generated from this operation would carry the P/S code Neptunium. SME information indicates that wastes generated under P/S code Neptunium would not contain RCRA-listed constituents nor would they have any RCRA hazardous characteristics (PYRO-21/TWCP-3542).

3.5.11 Pickling and Nitrate Holding (P/S code PK)

Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. However, P/S code PK is included in this report because, after a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts. It then becomes necessary to leach the plutonium from these items. In addition, after calcium metal reduction processes such as the metal preparation line (section 3.5.1), direct oxide reduction (section 3.5.2), and molten salt extraction (section 3.5.3), plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals. The plutonium-bearing leachate solution is transferred to P/S codes CX or CXL in chloride operations, or to P/S code LR in nitrate operations (PYRO-12/TWCP-3542). P/S code PK has not been active since 1992 and may have been incorporated into P/S code SS at that time (PYRO-28/TWCP-3542). Due to the potential for

leaching heavy metals from the items treated, D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to waste produced from P/S code PK

3.5.12 Plutonium Trichloride Preparation (P/S code PTP)

P/S code PTP was an intermediate process used in Pu metal production (PYRO-13/TWCP-3542). Under this code, carbon tetrachloride was used to prepare plutonium trichloride by bubbling a carrier gas through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500°–600°C before being absorbed in a 5–6 molar potassium hydroxide solution. The scrubber solution went in the caustic waste line to the RLWTF at TA-50. The carrier gases were argon, hydrogen chloride gas, and chlorine gas. The carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991.

Feed material for P/S code PTP was high purity oxides from the vault or from P/S codes CA and MA. The product plutonium trichloride was sent to P/S code SS to be reduced to metal by the MSE or ER processes.

3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for pyrochemical processes at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for pyrochemical processes consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites.

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

3.6.1 Physical Waste Form Identification

Solid waste from pyrochemical processes primarily consists of spent salts, magnesium oxide crucibles, and debris waste. Debris waste contains glassware, plastics, ceramic materials, paper, rags, high-efficiency particulate air (HEPA) filters, metal containers, and small tools. Asbestos and leaded gloves may also be generated as process

**Table 1. Process Feed Materials for Pyrochemical Operations**

| Feed Materials | Potential Presence of RCRA-Regulated Substances | P/S Codes in Pyrochemical Processes |
|---|---|---|
| Anode heels from P/S codes ER or SS (electrorefining step) | Typically contaminated with RCRA-regulated heavy metals Cd, Cr, Pb and Ag (D006, D007, D008, D011). Heavy metals As, Hg, and Se are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | ER, RA, SS |
| Miscellaneous materials with Pu contamination | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | MO: Pu scrap and crucible pieces from P/S code SS<br>PK: hardware, metal, anode chips from other P/S codes |
| Neptunium residues from vault | No RCRA-regulated substances | Neptunium (only active in 1993) |
| Pu chlorides and fluorides from various P/S codes | Variable purity; may or may not contain RCRA-regulated substances | ER, SD, SS |
| Pu metal or metal alloy from vault or from various P/S codes | High purity, no RCRA-regulated substances, unless noted otherwise | CRD (variable purity), MO, SCB, SS, SSMD |
| Pu oxalates | Typically fairly pure, no RCRA substances present | MP |
| Pu oxides from vault or from P/S codes CA, MA, RB, or RBJ | High purity oxides from P/S codes CA and MA.<br>Variable purity oxides from P/S codes RB and RBJ; suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008). | MP (generally high purity), OR (variable purity), PTP (generally high purity) |

waste. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item identifier code and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance (QA) personnel. Example forms for one drum of waste generated by pyrochemical processes can be viewed in record TWCP-2513.

### 3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for plutonium feed materials at Building PF-4 are listed in Table 2. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers. The results of these calculations are tabulated in the last three columns of Table 2. The calculations assume that (a) none of these isotopes were initially present in the material, (b) the oldest plutonium material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698)

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope Wt.% and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest plutonium material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in americium depending on whether the source of contamination is the process product or the process residues (TWCP-882).

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from pyrochemical processes at TA-55, and may be enriched in some cases, such as in MSE process waste from P/S code SS from 1992 to the present (TWCP-882). Am-241, Am-243, and Np-237 are present as secondary radionuclides in process waste from P/S code SS from 1984 to 1990 (TWCP-882). Np-237 is expected to be the dominant radionuclide in waste from P/S code Neptunium.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all. U-238 would only be present if purposefully added to the feed material. U-235 ingrowth from the decay of plutonium-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. U-234 would be present in MT 83 as a decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total plutonium would be about 0.14. Pa-231 and Cs-137 may be present in trace amounts because of their widespread presence as contaminants in TA-55 operations (TWCP-5164, TWCP-5165).

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). If warranted, this AK report will be updated to incorporate the results of these comparisons.

3.6.3 Chemical Content Identification

Chemical inputs to pyrochemical processes are listed in Table 3. The use of strong acids, bases, or oxidizers does not result in RCRA listings for solid wastes from these processes because of the absence of free liquids in this waste. However, D006, D008, D009, D019 and P120 codes apply to some of the pyrochemical process wastes, as noted in Table 3.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA hazardous waste numbers (HWNs) to process wastes from pyrochemical operations is summarized below, as well as on the process timelines in Attachment 3, and the table of process inputs and outputs in Attachment 4. These assignments take into account the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

4.1 F, K, and P Listings

P120 (vanadium pentoxide) applies to waste generated under P/S code SD from February to March 1998, and under P/S code SS from May 27, 1998 to June 10, 1998. To be conservative, this HWN is assigned to waste containers with packaging dates extending to the end of December 1998 (TWCP-5372).

No F or K codes apply to solid wastes generated by pyrochemical processes. Although used for cleaning metal parts, Freon would not be present in the waste because the parts were air-dried. Carbon tetrachloride was used as a chlorination reagent, and not as a solvent. No K-listed chemicals were present in the feed materials, chemicals or equipment used in these processes.

4.2 Toxicity Listings

No D001 (ignitable), D002 (corrosive), or D003 (reactive) listings apply to solid wastes from pyrochemical processes because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 5.0).

D005 (barium) applies to salt waste generated under P/S code RA.

D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to the zinc metal waste produced from P/S code RA. In the ER process, these RCRA-regulated heavy metals concentrate in the anode heel, which then may be treated in the pyroredox process (P/S code RA) to transfer them to the zinc button, or may be roasted in air to form metal oxides and then be dissolved in nitrate operations. Thus, only the zinc button output could contain RCRA-regulated metals above the toxicity characteristic limits.

## Table 3. Chemical Inputs to Processes Described in This Report

| Chemical Input | P/S Codes in Which RCRA-Listed Chemical Is Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| **Gases** | | |
| Chlorine gas<br>Hydrogen chloride<br>Hydrogen fluoride<br>Phosgene gas | | D001 and D002 do not apply to these gases because there are no free liquids in this waste. Also the gas cylinders are outside the building, and the gases are plumbed into the glovebox. D003 does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution. |
| **Acids** | | |
| Hydrochloric acid<br>Nitric acid | | D002 does not apply to the solid wastes because there are no free liquids in this waste |
| **Bases** | | |
| Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the solid wastes because there are no free liquids in this waste |
| **Inorganic chemicals** | | |
| Aluminum oxide<br>Calcium chloride<br>Calcium fluoride<br>Iodine<br>Lithium chloride<br>Molybdenum oxide<br>Potassium chloride<br>Sodium chloride<br>Vanadium pentoxide<br><br><br>Zinc chloride | SD, SS | P120 applies to waste generated under P/S code SD from February to March 1998, and under P/S code SS from May 27, 1998 to June 10, 1998 |
| **Metals** | | |
| Bismuth metal<br>Cadmium metal<br><br><br><br>Calcium metal<br>Gallium metal<br>Lead metal<br><br><br><br>Mercury metal | ER, SS<br><br><br><br><br><br>ER, SS<br><br><br><br>SSMD | D006 applies to a limited number of anode heels produced in P/S codes ER and/or SS using cadmium as a solvent. However, these heels are in the vault, with no plans to purify them in the near future.<br><br>D008 applies to a limited number of anode heels produced in P/S codes ER and/or SS using lead as a solvent. However, these heels are in the vault, with no plans to purify them in the near future<br>D009 applies to P/S code SSMD, in which it was used for about one week in the summer of 1994. |
| **Organic chemicals** | | |
| Carbon tetrachloride<br><br><br><br>Freon | PTP<br><br><br><br>SCB | D019 applies to P/S code PTP in which this chemical was used between 1/87 and 6/89. F002 does not apply because carbon tetrachloride was used as a chlorination reagent, not as a solvent.<br>F002 does not apply to debris waste from P/S code SCB. While freon may have been used to clean parts (PYRO-24/TWCP-3542), the parts were air dried , and no free liquids are present in the waste. |

D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to waste produced from P/S code PK.

D006 (cadmium) and D008 (lead) apply to waste from P/S codes ER and SS due to their use as secondary solvent metals.

D008 (lead) is assigned to metal waste debris from all P/S codes in pyrochemical processes due to the disposal of leaded gloves. Prior to May 1992, leaded gloves were disposed as metal debris without otherwise being segregated. Since May 1992, however, these gloves have been routinely segregated from other metal debris although they are still discarded under the originating P/S code (TWCP-4166).

D009 (mercury) is assigned to wastes generated under P/S code SSMD during the summer of 1994, when a week-long set of experiments contacted small amounts of plutonium with mercury (under 10 grams) (PYRO-22/TWCP-3542). At the end of these experiments, the mercury was solidified to allow disposal.

D019 (carbon tetrachloride): Until sample analyses become available, debris waste items from P/S code PTP (1986 to early 1988) are conservatively assigned D019 although the carbon tetrachloride was probably destroyed in the process.

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes that the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200 °F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids. Corroborative data are provided by screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501, page WF-34-10). These tests yielded liquid with pH greater than 3, so the wastes cannot be considered corrosive, and demonstrated that the liquid does not corrode steel at a rate greater than 0.25 inch per year.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, (3) and no sparking. Experimental results on the reactivity of LANL DOR salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 5.0 and 6.0.

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the pyrochemical processes, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 3, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. Any organic compounds present in the process materials would be destroyed or vaporized by the high temperatures of the pyrochemical processes

that dominate pyrochemical processing. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005,R.2, Section 8.0). This oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.5)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Records Management* (TWCP-QP-1.1-004)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan (Attachment B) to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## ACCEPTABLE KNOWLEDGE ROADMAP

P/S codes: CRD, ER, MO, MP, OR, Neptunium, PK, PTP, RA, SCB, SD, SS, and SSMD.

Copies of these documents are in the TWCP RMDC Center. Refer to *Records Management* (TWCP-QP-1.1-004) for information on obtaining copies.

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | Budget information may not be acceptable. |
| TWCP-697 | C | Waste management requirements to meet WIPP WAC requirements were formalized in 1984. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste management requirements to meet WIPP WAC requirements. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents how controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents how controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Waste was co-mingled with room trash, and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits. | None |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process status code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-1258 | B | "Waste Determination Report for Waste Stream TA-55-43, Lot No.1" | LANL internal report | Table B-1 lists the decomposition and vaporization temperatures of Hg, Se, and As and their oxides and chlorides. | None |
| TWCP-2498 | C | Procedure for Salt Distillation in Room 429, PF-4 | TA-55 Document, 103-MPP-R02 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests were conducted on residues rather than on waste. |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-2502 | D | "Acceptable Knowledge Personnel Interview Form" for Waste Stream TA-55-39 (pyrochemical salts) and P/S codes MP, OR, SS, PX, PY, ER and RM | Jim Foxx, NMT-7 | Answers to miscellaneous questions on pyrochemical processes. | Not a good overview |
| TWCP-2505 (UCNI) | C | Procedure for Plutonium Electrorefining (P/S code SS) | TA-55 Document, 432-MPP-R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-2506 (UCNI) | C | Procedure for Fused Salt Extraction of Americium and Plutonium Metal (P/S code SS) | TA-55 Document, 440-MPP-R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-2507 (UCNI) | C | Procedure for Direct Oxide Reduction (P/S code OR) | TA-55 Document, 426-MPP-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-2513 | A | Example of Generator Reports for Drum 54856 | TA-55 Records Management Center | Example of generator records including WPRF #07045 and WODF form showing the waste generator certification statement. | Older forms are often hard to read |
| TWCP-2539 (UCNI) | C | Preparation of Pu Metal by the Fluoride Reduction Process | TA-55 Document, 487-REC-R01 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-2540 (UCNI) | A | Answers to questions about pyrochemical processes | Jim Foxx, NMT-7-WM/EC-99-118 | Also contains old records of analysis of DOR salts | None |
| TWCP-2541 (UCNI) | C | Procedure for Pyroredox Processing of Spent Electrorefining Anodes (P/S code RA) | TA-55 Document, 460-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-1) | C | Procedure for Metal Breaking Press (P/S code SS) | TA-55 Document, 408-MPP-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-2) | C | Procedure for Electrorefining Plutonium Metal - CRAC Cell (P/S code SS) | TA-55 Document, 410-MPP-R03 | Contains materials used in the process | No RCRA analyses documents |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3542 (UCNI) (PYRO-3) | C | Procedure for Electrorefining of Plutonium Metal, Nominal Four Kg Scale (P/S code SS) | TA-55 Document, 430-MPP-R02 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-4) | C | Procedure for Chloride Melt Preparation for Electrorefining and Fused Salt Extraction (P/S code SS) | TA-55 Document, 431-MPP-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-6) | C | Procedure for Reverse Cell Electrorefining (P/S code SS) | TA-55 Document, 435-MPP-R02 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-7) | C | Procedure for In-Situ Chlorination of Plutonium Metal (P/S code SS) | TA-55 Document, 437-MPP-R02 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-8) | C | Procedure for Coalescence of Plutonium Metal (P/S code SS) | TA-55 Document, 445-MPP-R06.1 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-9) | C | Procedure for Salt Stripping of Electrorefining Salts (P/S code SS) | TA-55 Document, 450-MPP-R04 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-10) | C | Procedure for Salt Stripping of Electrorefining Salts Using Oxygen/Argon Sparging (P/S code SS) | TA-55 Document, 453-MPP-R07 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-11) | C | Procedure for Actinide Metal and Alloy Oxidation (P/S code MO) | TA-55 Document, 497-MPP-R04 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-12) | C | Procedure for Pickling of Plutonium Metal and Pyrochemical Process Equipment (P/S code PK) | TA-55 Document, 405-MPP-R03 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-13) | C | Procedure for Chlorination of Plutonium Compounds (P/S code PTP) | TA-55 Document, 407-MPP-R04 | Contains materials used in the process | No RCRA analyses documents |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3542 (UCNI) (PYRO-14) | C | Procedure for Reduction of PuO2 to Metal, 700g Scale (P/S code OR) | TA-55 Document, 420-MPP-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-15) | C | See Special Processing reference SP-29 in TWCP-3543 | TA-55 Document, 434-MPP-R01 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-16) | C | Procedure for Semi-continuous DOR with Salt Regeneration (P/S code OR) | TA-55 Document, 426-MPP-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-17) | C | Procedure for Electrorefining of Pu Metal, Nominal 6 kg Scale (P/S code SS) | TA-55 Document, 432-MPP-07 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-18) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Jim McNeese, NMT-2 | SME review of Pyrochemical Processing AK Report | Generally good comments, but SME couldn't always recall specific information about an aspect of a process. |
| TWCP-3542 (UCNI) (PYRO-19) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Jim Foxx, NMT-7 | SME review of Pyrochemical Processing AK Report | None |
| TWCP-3542 (UCNI) (PYRO-21) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Sammi Owens, NMT-2 | Answers to questions about P/S code Neptunium | Classified nature of information places limitations on information |
| TWCP-3542 (UCNI) (PYRO-22) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Peter Lopez, NMT-5<br>Walt Griego, NMT-2 | Answers to questions about P/S code SSMD | Project occurred long enough in the past that SMEs had difficulty recalling details. |
| TWCP-3542 (UCNI) (PYRO-23) | C | Procedure for Salt Distillation (P/S code SD) | TA-55 Document, 102-MPP-R01 | Contains materials used in the process | No RCRA analyses documents |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3542 (UCNI) (PYRO-24) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Mike West, NMT-2<br>Greg Bird, NMT-2 | Answers to questions regarding P/S codes SBB and SCB. No RCRA-listed metals used in processes, Freon may have been used to clean parts. | SMEs couldn't recall some specific information. |
| TWCP-3542 (UCNI) (PYRO-25) | C | Procedure for Fused Salt Extraction of Americium from Plutonium Metal | TA-55 Document 440-MPP-R00 – R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-27) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Jim Foxx, NMT-7 | Answers to questions regarding usage timeframe for vanadium pentoxide | Answers to specific questions or topics |
| TWCP-3542 (UCNI) (PYRO-28) | C | Acceptable Knowledge Interview Form for Pyrochemical Processing | Jim Foxx, NMT-7 9/23/99 | Answers to questions regarding processes done in Special Processing and Pyrochemical Processes | Answers to specific questions |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | D | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4162 | D | Answers to questions about P/S codes PB, PuBe, CC, MB, MS, FF, BF, and other issues | Interview with Jim Foxx, 10/12/00 | Answers to questions on use of asbestos at TA-55, non-defense activities, and specific P/S codes in chloride operations. | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of silver, disposal of ash and resins, and use of gases. | None |
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of chromium and silver, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of silver from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that silver in ash is below limits of regulatory concern | None |
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-5164 | D | Sources of Cs-137 and Pa-231 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 2, 2001 | Plutonium operations never handled Cs-137 or Pa-231 in any of the Pu processing areas at TA-55. However, Cs-137 is expected to be present in the wastes because it is a fission product of several Pu isotopes. Pa-231 is expected to be present (as a function of the age of the waste) because it is a decay chain daughter of Pu-239 and U-235. | None |

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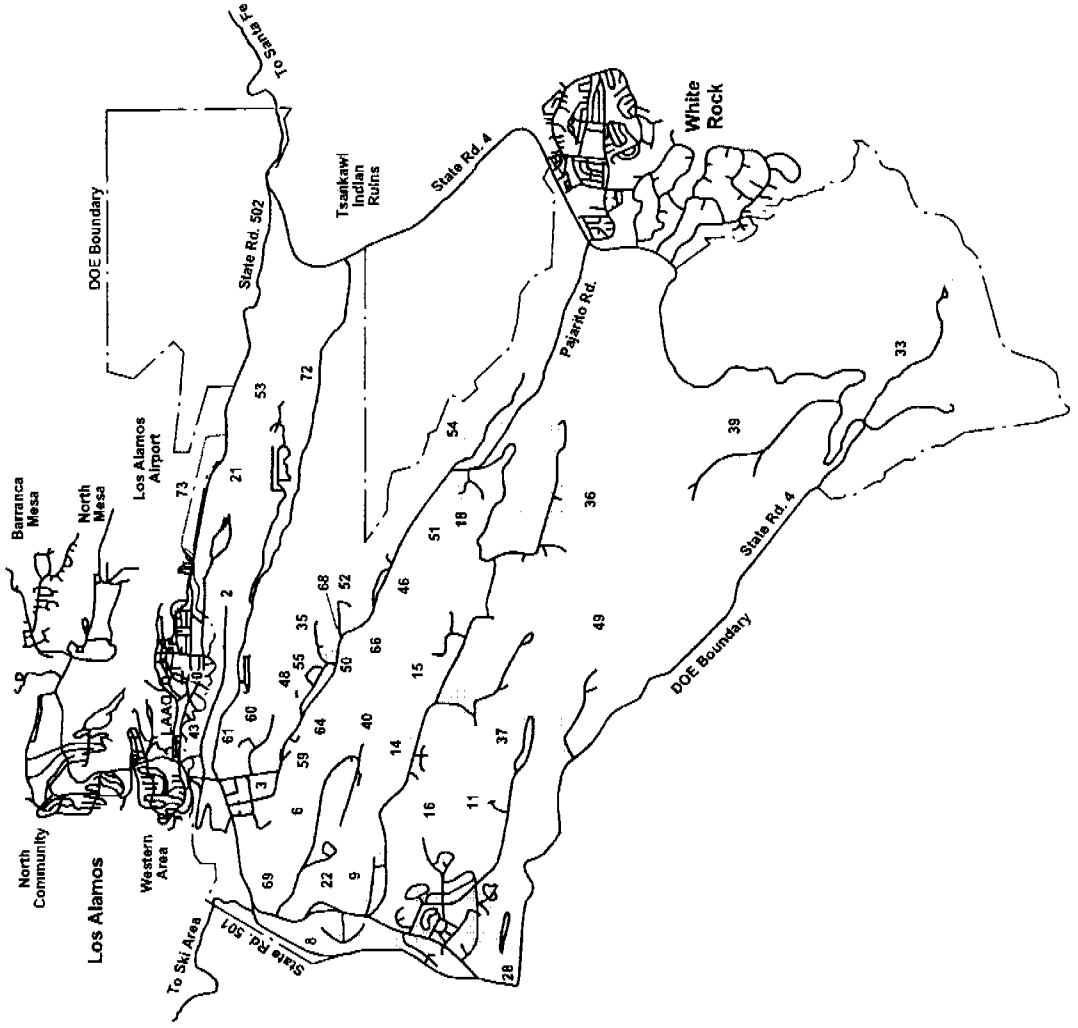
| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5165 | D | Sources of Cs-137, Pa-231, and Cm-244 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Dominant source of Cs-137 expected to be due to residual contamination from original separation of Pu from production fuel. Cm-244 introduced in P/S code DOP starting in 1988, but could also show up after that date in IS, WE, CA and CF. | None |
| TWCP-5372 | D | Applicability of P120 to waste generated by P/S codes SD and SS | Interview with Jim Foxx (TA-55 SME) on May 7, 2001 | Vanadium pentoxide was used between February 1998 and June 1998. SME information indicates that waste from this work would have been packaged into containers that were closed by the end of December 1998. | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2 | A | *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | A | *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for nitrate operations at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | *Process Acceptable Knowledge Report for Special Processing Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for special processing operations at TA-55 | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-PLAN-0.2.7-001,R.5 | C | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK reference base on generator's original data | Detailed information on each waste drum and waste stream | None |

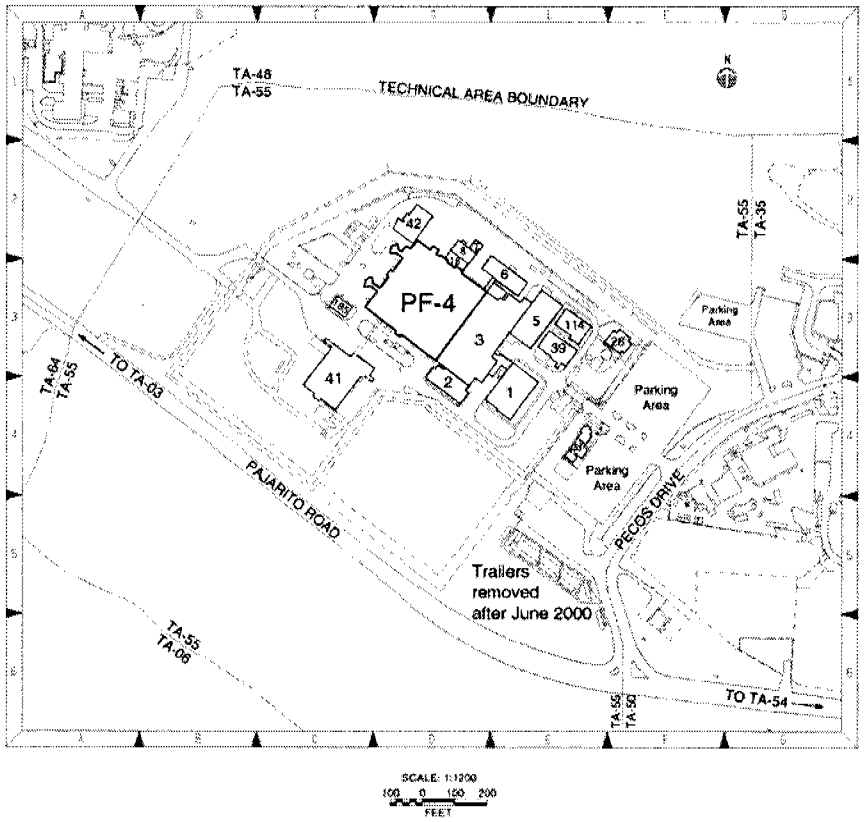
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# MAP OF LANL

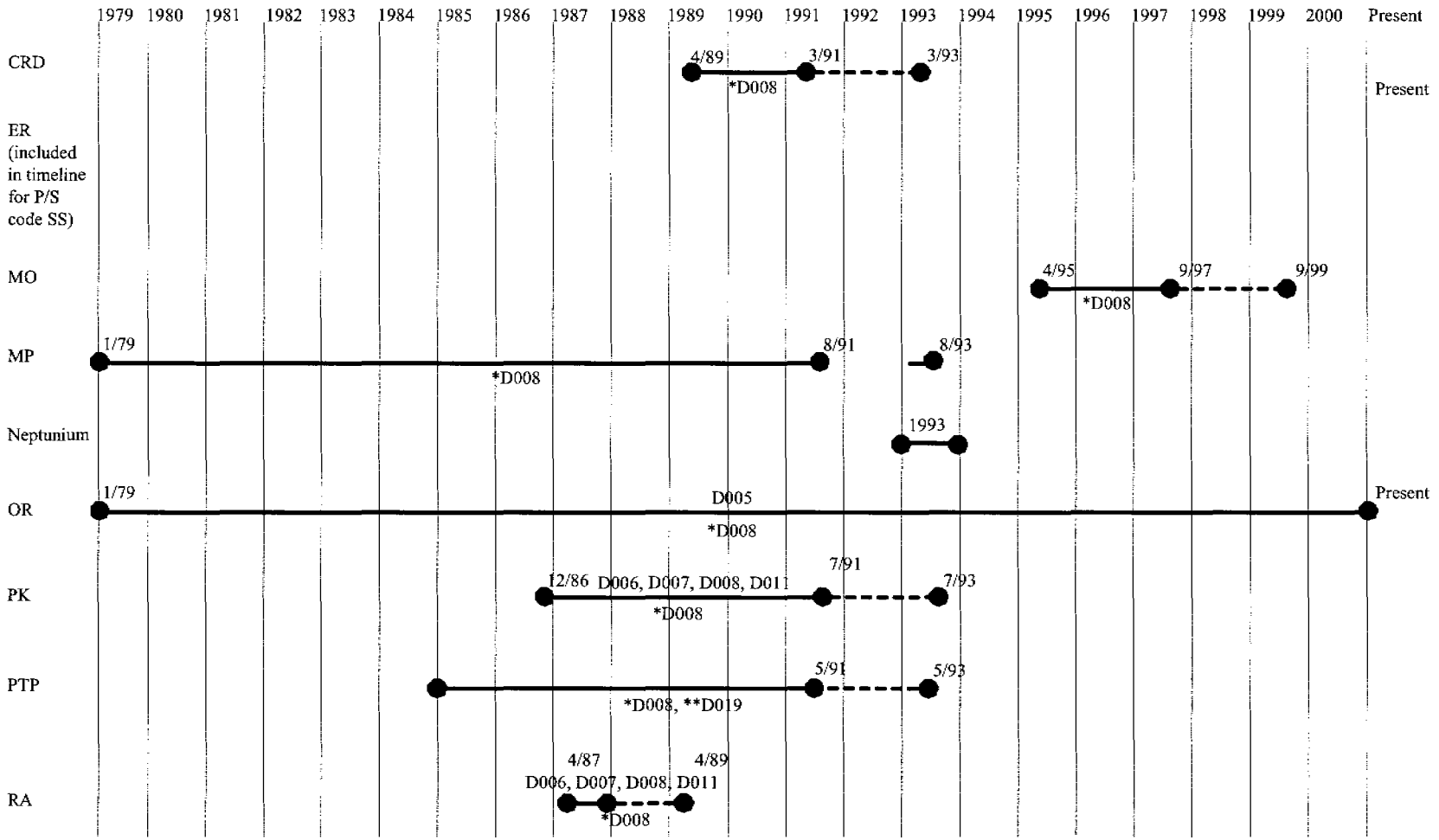

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Barranca Mesa
North Mesa
Los Alamos Airport
LAAO
North Community
Los Alamos
Western Area
To Ski Area
State Rd. 501
DOE Boundary
State Rd. 4

## MAP OF TA-55

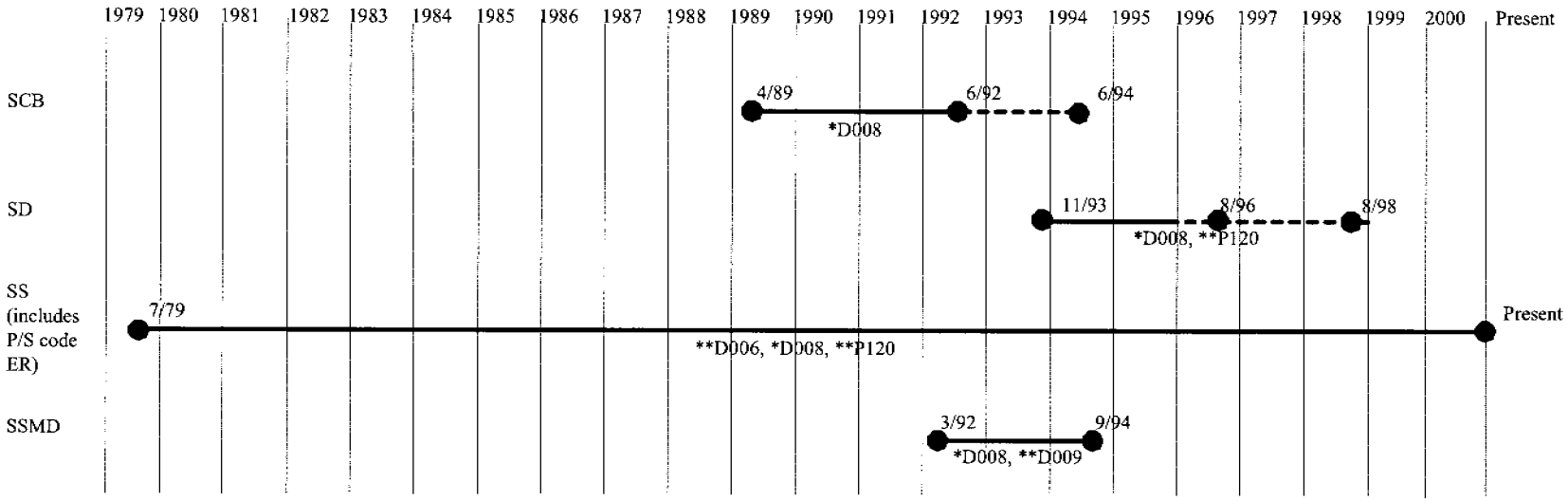
**Note:** The Plutonium Facility, Building PF-4, is labeled PF- 4 on this map.



## TIMELINE FOR PYROCHEMICAL PROCESSES



**TIMELINE FOR PYROCHEMICAL PROCESSES (continued)**




* D008 applies to leaded gloves which where discarded in a separate waste stream after 1992, still under the originating P/S code; also, D008 applies to crucibles and salts discarded under P/S codes ER and/or SS from 1987 to 1989

** Notes on time-dependence of RCRA codes. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

P120 = applies to waste generated under P/S code SD from 2/98 - 3/98 and under P/S code SS from 5/27/98 - 6/10/98
D006 = applies to crucibles and salts discarded under P/S codes ER and/or SS from 1987 to 1989
D009 = applies to waste discarded under P/S code SSMD from 06/94–08/94
D019 = applies to waste discarded under P/S code PTP from 01/87–06/89

## TIMELINE EXPLANATION



The P/S code is established either in the P/S diagrams and/or in the procedures designating the start and end dates.



Extrapolate out two (2) years beyond the last revision date for the procedure to next possible review date.

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| CRD | Chlorination/reduction RD&D | plutonium metal (varying purity) | Calcium metal, chlorine gas | Pu to vault; salt and crucibles to vault if >DL. | Salt and crucibles to discard if <DL<br><br>Rags, tools, labware, gloves to discard | *D008 | TWCP-3542 (PYRO-18) |
| ER (currently included in P/S code SS) | Electrorefining | Impure Pu metal from P/S code OR | Magnesium chloride, cadmium metal, bismuth metal, lead metal, gallium metal | Pu metal (high purity); anode heels sent to vault or to P/S code RA; molten salts sent to vault or to P/S code CXL (1984-86) or to carbonate oxidation/distillation | Magnesia crucibles, metal cathodes (usually tungsten) | D006<br>D008<br>*D008,<br>P120 | |
| MO | Metal Oxidation, Room 429 | plutonium scrap and crucibles from P/S code SS | No chemicals used. | Pu oxide to vault. Crucible >DL to vault | Crucibles <DL to discard.<br><br>Labware, gloves, rags to discard | *D008 | TWCP-3542 (PYRO-11) |
| MP | Metal Preparation | Pu oxide (varying purity, generally high), from vault or from P/S codes RB or RBJ | Calcium metal, iodine, hydrogen fluoride gas, magnesium oxide | Pu metal to vault or to P/S codes CA or SS. Slag and crucibles to P/S codes ED or SC if > DL. MgO sand reused if possible. | Labware, tools, rags, gloves to discard. Slag (calcium fluoride and calcium iodide), magnesium oxide sand, and crucible pieces sent to P/S codes ED or SC if < DL, to be leached and discarded | *D008 | TWCP-352, TWCP-2502, TWCP-2506, TWCP-2539 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| Neptunium | Neptunium | Neptunium residues from vault; no RCRA-regulated constituents or characteristics | Chemicals used not described, but no RCRA-regulated constituents or characteristics were used. | Classified | Waste description is classified, but does not contain any RCRA-regulated constituents or characteristics | | TWCP-3542 (PYRO-21) |
| OR | Direct Oxide Reduction | plutonium oxide (varying purity) | Calcium metal, oxygen gas, chlorine gas | Pu metal to P/S CA or SS depending on purity. Salts and crucibles >DL to vault or P/S code SS or CXL. Chlorine off-gas sent through scrubber, and caustic solution to P/S code CXL if > DL | Salts and crucibles <DL sent to chloride operations and discarded under P/S code CXL or DO after 1988 (or under OR before 1988); caustic solution < DL sent to RLWTF | D005, *D008 | TWCP-1258, TWCP-2502, TWCP-2507; TWCP-3542 (PYRO-14, PYRO-15, PYRO-16, PYRO-18, PYRO-19) |
| PK | Pickling and Nitrate Holding | Hardware, metal, anode chips. | Hydrochloric acid, nitric acid | Pu metal to originating P/S. HCl leach solution to P/S CX or CXL, nitric acid leach solution to P/S LR. | Hardware to discard | D006<br>D007<br>D008<br>*D008<br>D011 | TWCP-3542 (PYRO-12) |
| PTP | Plutonium Trichloride Preparation | Plutonium dioxide | Chlorine gas, hydrogen chlorine gas, carbon tetrachloride, phosgene gas, calcium metal, aluminum metal, calcium chloride, sodium chloride, potassium chloride, sodium hydroxide, potassium hydroxide, hydrochloric acid, nitric acid | Pu metal to P/S code SS, CA, or vault. HCl leach solution to P/S CX, nitric acid leach solution to P/S LR. | Salt, crucibles < DL to discard.<br><br>Tools, labware, rags, gloves to discard | *D008<br>D019 | TWCP-3542 (PYRO-13) |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| RA | Recovery of Anode | Anode heels from vault | Calcium metal, zinc chloride, potassium chloride | Pu metal to vault or to P/S code ER, zinc metal (containing any RCRA heavy metals) to vault or further treated | Salt<br><br>Labware, gloves, rags to discard | D006<br>D007<br>D008<br>*D008<br>D011 | TWCP-2541 |
| SCB | Chlorination Ca/Al Scrubbing RD&D | Pu samples from P/S codes OR or SS | Calcium metal, aluminum metal, calcium chloride, sodium chloride, potassium chloride, chlorine gas | Pu to Vault. Salt, crucibles > DL to vault. | Salt, crucibles < DL to discard<br><br>Tools labware, rags, gloves to discard | *D008 | TWCP-3542 (PYRO-25) |
| SD | Salt Distillation | Salts from various P/S codes | Vanadium pentoxide, molybdenum oxide | Calcium chloride salts to P/S CXL or vault. Sodium and potassium chloride salts to vault or distillation. Pu residue to vault | Distilled salts to discard<br><br>Crucible pieces to discard | *D008<br>P120 | TWCP-2498, TWCP-3542 (PYRO-23, PYRO-24) |
| SS | Salt Stripping | Pu oxide or metal from the vault or from P/S codes DO, CA, MA (Pu turnings) | Calcium metal, calcium chloride, sodium chloride, potassium chloride, chlorine gas, vanadium pentoxide, oxygen gas, molybdenum oxide, magnesium chloride, lithium chloride | Pu metal (high purity) to P/S CA. Impure metal pieces to P/S MO. Salt and crucibles to P/S codes CXL or WM. Labware, tools to aqueous recovery or vault if >DL. | Labware, tools, magnesium oxide crucible to discard if <DL | D006<br>D008<br>*D008<br>P120 | TWCP-352, TWCP-2498, TWCP-2505, TWCP-2506; TWCP-3542 (PYRO-1 through -4, and -6 through -10, PYRO-17, PYRO-18, PYRO-28) |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| SSMD | SS Material Development | Samples of Pu from P/S codes CA and SS. | Calcium chloride, sodium chloride, potassium chloride, mercury metal, | Pu metal returned to P/S codes CA and SS. | Salt residue to P/S code SS and vault.<br><br>Crucible residue to vault or discard. | *D008<br>D009 | TWCP-3542 (PYRO-22) |

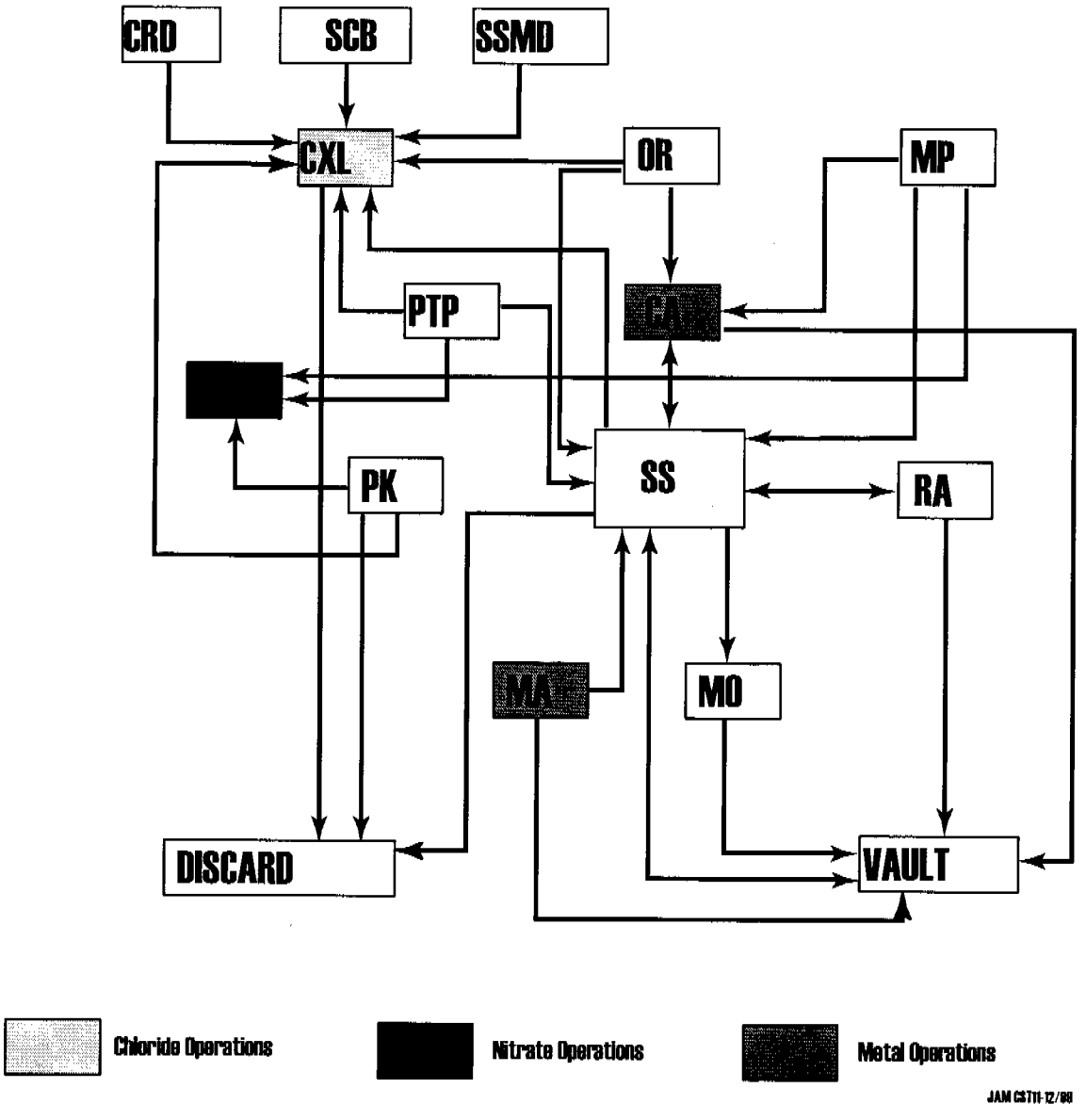
[1] All P/S codes generate routine laboratory debris waste which typically consists of glassware, plastics, ceramic materials, paper, rags, high-efficiency particulate air filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated from other metal debris.

[2] See discussion in Section 4.0 for details on the applicability of the EPA HWNs listed in this column. The EPA HWNs listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation). The resulting treated waste stream is evaluated for hazardous waste constituents and assigned the applicable EPA HWNs. All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other metal debris waste and are assigned EPA HWN D008 under the originating P/S code.

[3] Refer to the Acceptable Knowledge Roadmap in Attachment 1.

* D008 due to leaded gloves

**SIMPLIFIED PROCESS STATUS DIAGRAM**



# Decision/Discrepancy Resolution Documentation
## TA-55 Pyrochemical Processes

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| SBB and SCB, and General | Procedure review form indicates possible use of Freon TF for R01-R04 | TWCP-3542/Pyro-8 | Interview with Jim Foxx, doesn't recall use of Freon, said it could have been used to clean tantalum or tungsten parts. Then not TRU | TWCP-3542/Pyro-18 | Freon not listed in report | C—SME indicated Freon could have been used but the cleaning takes place outside the glovebox before the TRU process took place. TRU waste would have no Freon TF. See attached meeting notes. |
| | | | Interview with Mike West and Greg Bird-SBB an SCB- no RCRA metals, but Freon may have been used. | TWCP-3542/Pyro-24 | | |
| OR and SCB | Per Jim Foxx, Ba (D005) possible in some batches of waste stream | TWCP-2540 | Report assigns D005 to P/S code RA only | Process Report | | C—SME said D005(AR grade used) would stay in salt Need to remove D005 from the RA. See attached meeting notes. |

Sandy Wander — Evaluator (Print Name)
Alt Investigator — Title
Sandy Wander — Signature
2/25/02 — Date

P Rogers — SPM Review (Print Name)
Pamela Lopez — Signature
2/26/02 — Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other (Specify)]



Source: TWCP-07908

# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-006 New Rev/IC: R.2/IC1

Preparer: Sandy Wander

Document Title:
Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedu AK-[illegible] effective date 3/21/02 – posted to web on 3/28/02, delay in posting was due to pending response from CBFO per Jim Bailey.
- ☒ Paginati
- ☒ Docume
- ☒ Attachm RMDC 3/28/02
- ☐ Hazard
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE, if applicable
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 3/27/2002 Signed Initials: JAD

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 3/28/02

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 3/28/02
- ☑ Master Index Updated - Date: 3/28/02
- ☒ Archive old revision (Record)

- ☑ Capture Document: __ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☐ Verify Signatures ___ Signature Dates ___
- ☑ Dates: ✓ Cover ✓ Rev. History ___ Review Date
- ☑ Web Page TOC: ___ No/Rev ___ Effective Date ✓ LAUR ✓ Title ✓ Link ___ Test
- ☐ On-line test: ✓ Open Doc
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- ☒ CBFO: __ Electronic Copy __ Printed
- ☑ Change Control Notification ___ Sent ___ Printed ✓ NA

Date Completed: 3/28/02 Signed Initials: [signature]

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☐ Revision ☒ Interim Change

Date Received: 3/21/2002

Current Rev/IC: R.2

Document ID: TWCP-AK-2.1-006

Rev/IC: R.2/IC1

Document Title:

Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55

Preparer: Sandy Wander Date to DP Team: 3/21/2002

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

03/27/02: Prepared document for transmittal to Document Control

## Step 3: Preliminary Review Cycle

☒ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
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Comments:

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle

☒ IC - Not Applicable (enter action in comments section)

| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

## Step 5: Final Signature Cycle

☒ IC - Not Applicable (enter action in comments section)

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
| Change Control | G M Polley | 3/21/2002 | 3/25/2002 | NA |
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Comments

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TWCP-AK-2.1-006,R.2/IC1

**Effective Date** 3-21-2002 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR PYROCHEMICAL PROCESSES AT TA-55 (LA-UR-02-1713)

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
| ☐ RAMROD | | | | | |
| ☐ RANT | | | | | |
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To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: Procedure Notification
Cc: fabi,bailey, lpc
Bcc:
Attached:

The following are revised AK reports.

Effective Date: 3/21/02

**TWCP-AK-2.1-004,R.2/IC1 -** Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55 (LA-UR-02-1714)

**TWCP-AK-2.1-005,R.2/IC1 -** Process Acceptable Knowledge Report for Nitrate Operations at TA-55 (LA-UR-02-1715)

**TWCP-AK-2.1-006,R.2/IC1** - Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55 (LA-UR-02-1713)

**TWCP-AK-2.1-007,R.2/IC1** - Process Acceptable Knowledge Report for Special Processing at TA-55 (LA-UR-02-1712)

**TWCP-AK-2.1-009,R.0/IC1** - Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55 (LA-UR-02-1709)

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

*Patricia G. Patton*
Los Alamos National Laboratory
E-ET / TWCP
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MS M319
Phone: (505) 667-2071
Email: pgp@lanl.gov

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☒ Revision ☐ Interim Change  Document ID: TWCP-AK-2.1-006  New Rev/IC: R.2

Preparer: John Musgrave

Document Title:
Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed  Date to DC: 5/17/2001  Signed Initials: JSS

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 5/18/01

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- NA Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 1
- ☑ Control Stations Updated - Date: 5/18
- ☑ Master Index Updated - Date: _____
- ☑ Archive old revision (Record)

- ☑ Capture Document: ✓ Word ✓ PDF
- ☑ Forms: ___ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- NA Add: Controlled Document Original Signatures on File at the RMDC
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- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date NA LAUR ✓ Title ✓ Link ✓ Test
- ☑ On-line test: ✓ Open Doc NA Password
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- ☐ CAO: ✓ Electronic Copy ___ Printed

Date Completed: 5/18/01  Signed Initials: LG

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle

☐ IC - Not Applicable (enter action in comments section)

| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

## Step 5: Final Signature Cycle

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| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
| J. Fabryka-Martin | Technical | 5/7/2001 | 5/7/2001 | Independent Technical Reviewer/Editor |
| M. Lin | SPM | 5/10/2001 | 5/10/2001 | Site Project Manager |
| S. Wander | QA | 5/14/2001 | 5/14/2001 | Waste Certification Official |
| M. Gavett | QA | 5/14/2001 | 5/14/2001 | Site Project QA Officer |
| C. Foxx | Fac Mgr | 5/7/2001 | 5/7/2001 | Facility Representative |
| | | | | |
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Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
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| Classification | | | 5/16/2001 | LA-UR-01-2558 |
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Comments

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☒ Revision ☐ Interim Change

Date Received: 4/1/2001

Current Rev/IC: R.1

Document ID: TWCP-AK-2.1-006

Rev/IC: R.2

Document Title:

Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55

Preparer: John Musgrave Date to DP Team: 4/1/2001

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

04/01/01 through 05/16/01: Incorporated changes made by author, reviewers, and auditors

## Step 3: Preliminary Review Cycle

☐ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
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Comments:

To: rubyannf@lanl.gov, mlgarcia@lanl.gov, prmtz@lanl.gov
From: Louise Garcia <louise@lanl.gov>
Subject: For Training Distribution
Cc: fl@lanl.gov, manmtz@lanl.gov
Bcc:
Attached:

The following are revised AK Reports.

**TWCP-AK-2.1-006,R.2 - Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55**

**TWCP-AK-2.1-007,R.2 - Process Acceptable Knowledge Summary Report for Special Processing at TA-55**

To: wipp.notify@wipp.carlsbad.nm.us
From: Louise Garcia <louise@lanl.gov>
Subject: [Procedure]
Cc: Tammy.Bowden@wipp.carlsbad.nm.us
Bcc: fl@lanl.gov
Attached: K:\twcp\RMDC\AK\TWCP-AK-2.1-006\TWCP-AK-2^1-006R2.pdf;
K:\twcp\RMDC\AK\TWCP-AK-2.1-007\TWCP-AK-2^1-007R2.pdf;

The following are revised AK Reports.

**TWCP-AK-2.1-006,R.2 - Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55**

**TWCP-AK-2.1-007,R.2 - Process Acceptable Knowledge Summary Report for Special Processing at TA-55**

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## TWCP-AK-2.1-006,R.2

**Effective Date** 5-18-2001 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR PYROCHEMICAL PROCESSES AT TA-55

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
| ☐ RAMROD | | | | | |
| ☐ RANT | | | | | |
| ☐ DECON | | | | | |
| ☐ QA | | | | | |

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Draft #1

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-006,R.1 (LA-UR-00-5862)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

**EFFECTIVE DATE:** 12/04/00

**NEXT REVIEW DATE:** 12/04/02

**DOCUMENT PREPARER:**

John Musgrave — NAME
12/04/00 — DATE

**APPROVALS:**

June Fabryka-Martin — INDEPENDENT TECHNICAL REVIEWER/EDITOR
12/04/00 — DATE

Pamela Rogers — SITE PROJECT MANAGER
12/04/00 — DATE

Matt J. Riggs — WASTE CERTIFICATION OFFICIAL
12/04/00 — DATE

M A Gavett — SITE PROJECT QA OFFICER
12/04/00 — DATE

Charles L. Foxx — FACILITY REPRESENTATIVE
12/04/00 — DATE

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**Radioisotopic content of the waste:**

Variety of plutonium material types with different isotopic compositions. Am-241, Am-243, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some processes separate plutonium and americium so that the waste will usually be enriched in americium, but may also be depleted in some cases. Np-237 may be the dominant radionuclide in some cases.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D005 (barium) applies to salt waste generated under P/S code RA
- D006 (cadmium) and D008 (lead) apply to P/S codes ER and SS
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): zinc metal waste from P/S code RA
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): waste from P/S code PK
- D008 (lead): metal waste debris from all P/S codes in pyrochemical processes due to disposal of leaded gloves; after May 1992, leaded gloves were separated from other metal debris
- D009 (mercury): waste from P/S code SSMD during the summer of 1994
- D019 (carbon tetrachloride): waste from P/S code PTP (1986 to early 1988) June 1989 — Section 3.4.12
- No F or K codes
- P120 (vanadium pentoxide): waste from P/S code SD from 02/98 to 03/98; and P/S code SS from 5/27/98 to 6/10/98

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

- Metal preparation and purification (pyrochemical processes)
- Aqueous waste treatment

This report focuses on metal preparation and purification processes (pyrochemical processes). Pyrochemical operations for plutonium include the following processes:

- metal preparation line (MPL) (P/S code MP),
- single-pass direct oxide reduction (DOR) and multiple-cycle direct oxide reduction (MCDOR) with in-situ regeneration ~~and electrorefining~~ (P/S code OR),
- electrorefining (ER) (initially P/S code ER; but now part of P/S code SS),
- molten salt extraction (MSE) (P/S code SS),
- salt stripping (salt stripping, salt distillation, carbonate oxidation, and oxygen sparging) (P/S code SS),
- pyroredox (P/S code RA),
- pickling (P/S code PK) and metal oxidation (P/S code MO).

**NOTE:** In contrast with most P/S codes, P/S code SS has grown over the years to encompass several activities that are different steps in the metal refining process, rather than representing a single distinct operation. As such, discussion of this P/S code is covered under more than one subsection.

Several research and development (R&D) processes also took place in pyrochemical operations:

- Chlorination/Reduction R&D (P/S code CRD),
- Chlorination Ca/Al Scrubbing R&D (P/S code SCB) (PYRO-24/ TWCP-3542), and
- Salt Stripping Materials Development (P/S code SSMD) (PYRO-22/TWCP-3542).

Each of these processes is described below. A complete listing of P/S codes for pyrochemical processes, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. A simplified process flow diagram for pyrochemical processes is found in Attachment 5.

use past verb tense

### 3.4.1 Metal Preparation Line (P/S code MP)

The MPL (conducted under P/S code MP) produced plutonium metal from the tetrafluoride salt until 1992 (TWCP-352). Plutonium oxides derived from the ~~calcination~~ of oxalate or peroxide precipitates (in nitrate operations) were reacted with hydrogen fluoride gas to form plutonium tetrafluoride. Because the plutonium oxide feed material had been purified in previous aqueous processes, it contained less than trace amounts of RCRA-regulated metal impurities. Input material came from the vault or P/S codes RB or RBJ (in ~~nitrate~~ operations). In the metal production process, plutonium oxide ~~is converted~~ was to plutonium tetrafluoride, which in turn was reacted at high temperature (600°C to 2000°C) with metallic calcium in a magnesium oxide crucible. Iodine was added as a reaction initiator. The desired product was plutonium metal, which was recovered as a button by breaking the crucible and mechanically separating the contents. The metal was transferred to P/S codes SS or CA or sent to the vault.

The waste products were calcium fluoride ($CaF_2$) and calcium iodide ($CaI_2$), which formed a slag, magnesium oxide sand, and magnesium oxide crucible pieces. These were discarded under P/S code MP if the plutonium content was below the discard limit (DL). If the plutonium content was above the DL, the slag and crucible pieces were sent to nitrate operations (TWCP-AK-2.1-005,R.1) to be dissolved in nitric acid ($HNO_3$) and aluminum oxide ($Al_2O_3$). The leached materials were then discarded under P/S codes ED or SC, with the waste described as leached solids. The leachate was also treated in nitrate operations under P/S code DS to recover the plutonium. The magnesium oxide sand was reused if possible.

Little or no purification of the plutonium occurred during this process. However, because the reagents introduced no impurities and the highest purity feed material was used, the resulting metal was often satisfactory for high-purity applications. In this process, any trace metals were below the toxicity characteristic levels, so that the associated debris and slag wastes were below the toxicity characteristic levels in RCRA metal content (TWCP-2502).

### 3.4.2 DOR and MCDOR (P/S codes OR and SCB)

Prior to the multiple-cycle DOR process, a single pass DOR process was used for plutonium oxide (TWCP-2507, PYRO-14/TWCP-3542). Plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium

**Table 1. Process Feed Materials for Pyrochemical Operations**

| Feed Materials | Potential Presence of RCRA-Regulated Substances | P/S Codes in Pyrochemical Processes |
|---|---|---|
| Anode heels from P/S codes ER or SS (electrorefining step) | Typically contaminated with RCRA-regulated heavy metals Cd, Cr, Pb and Ag (D006, D007, D008, D011). Heavy metals As, Hg, and Se are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | ER, RA, SS |
| Miscellaneous materials with Pu contamination | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | MO: Pu scrap and crucible pieces from P/S code SS<br>PK: hardware, metal, anode chips from other P/S codes |
| Neptunium residues from vault | No RCRA-regulated substances | Neptunium (only active in 1993) |
| Pu chlorides and fluorides from various P/S codes | Variable purity | ER, SD, SS |
| Pu metal or metal alloy from vault or from various P/S codes | High purity, no RCRA-regulated substances, unless noted otherwise | CRD (variable purity), MO, SCB, SS, SSMD |
| Pu oxalates | Typically fairly pure, no RCRA substances present | MP |
| Pu oxides from vault or from P/S codes CA, DO, MA, RB, or RBJ | High purity oxides from P/S codes CA and MA.<br>Variable purity oxides from P/S codes RB and RBJ; suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008). | MP (generally high purity), OR (variable purity), PTP (generally high purity) |

### 3.5.2 Radionuclide Content Identification

The primary plutonium material type inputs for plutonium feed materials at Building PF-4 are listed in Table 2. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized. The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively.

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

(Weight %)

bounds dimensionless

| Material Type (MT) | Plutonium isotope and half-life | | | | | | Upper limits for weight ratios | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 ($8.26 \times 10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

Source: TWCP-698

Footnote: (see AK-02)

## Table 3. Chemical Inputs to Processes Described in This Report

| Chemical input | P/S codes in which RCRA-listed chemical is used | Comments on applicability of RCRA hazardous waste numbers (if any) |
|---|---|---|
| **Gases** | | |
| Chlorine gas<br>Hydrogen chloride<br>Hydrogen fluoride<br>Phosgene gas | PTP, CRD, SCB, SS<br>MP<br>MP<br>PTP | D001 and D002 do not apply to these gases because there are no free liquids in this waste. Also the gas cylinders are outside the building, and the gases are plumbed into the glovebox. D003 does not apply to phosgene because any excess chemical was passed through a solution of sodium hydroxide or potassium hydroxide, thereby producing a chloride salt solution. |
| **Acids** | | |
| Hydrochloric acid<br>Nitric acid | | D002 does not apply to the solid wastes because there are no free liquids in this waste |
| **Bases** | | |
| Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the solid wastes because there are no free liquids in this waste |
| **Inorganic chemicals** | | |
| Aluminum oxide<br>Calcium chloride<br>Calcium fluoride<br>Iodine<br>Lithium chloride<br>Molybdenum oxide<br>Potassium chloride<br>Sodium chloride<br>Vanadium pentoxide<br><br><br>Zinc chloride | <br><br><br><br><br><br><br><br>SD, SS | <br><br><br><br><br><br><br><br>P120 applies to waste generated under P/S code SD from February to March 1998, and under P/S code SS from May 27, 1998 to June 10, 1998 |
| **Metals** | | |
| Bismuth metal<br>Cadmium metal<br><br><br>Calcium metal<br>Gallium metal<br>Lead metal<br><br><br>Mercury metal | <br>ER, SS<br><br><br><br><br>ER, SS<br><br><br>SSMD | <br>and/or SS<br>D006 applies to a limited number of anode heels produced in P/S code ER using cadmium as a solvent. However, these heels are in the vault, with no plans to purify them in the near future.<br><br><br>and/or SS<br>D008 applies to a limited number of anode heels produced in P/S code ER using lead as a solvent. However, these heels are in the vault, with no plans to purify them in the near future<br>D009 applies to P/S code SSMD, in which it was used for about one week in the summer of 1994. |
| **Organic chemicals** | | |
| Carbon tetrachloride<br><br><br>Freon | PTP<br><br><br>SCB | D019 applies to P/S code PTP in which this chemical was used between 1/87 and 6/89. F002 does not apply because carbon tetrachloride was used as a chlorination reagent, not as a solvent.<br>F002 does not apply to debris waste from P/S code SCB. While freon may have been used to clean parts (PYRO-24/TWCP-3542), the parts were air dried , and no free liquids are present in the waste. |

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6). see (AK-02)

- ~~Explosives were prohibited from TA-55 until installation of the Impact Test Facility~~ in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning.

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids. Corroborative data are provided by screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501, page WF-34-10). These tests yielded liquid with pH greater than 3, so the wastes cannot be considered corrosive, and demonstrated that the liquid does not corrode steel at a rate greater than 0.25 inch per year.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 7.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 6.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated

## 9.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the pyrochemical processes, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 3, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. Any organic compounds present in the process materials would be destroyed or vaporized by the high temperatures of the pyrochemical processes that dominate pyrochemical processing. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005,R.1, Section 9.0). This oil does not enter the LANL disposal operations.

## 10.0 VERIFICATION THAT THERE IS NO ASBESTOS IN THE WASTE

Asbestos heating mantles were never used at TA-55. Asbestos gloves were used in glovebox operations in P/S codes OR and RM (TWCP-4162, TWCP-4166), which are discussed in section 3.4.2 of this report and in the *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007,R.1), respectively. Asbestos-bearing transite was widely used until recently for thermal insulation, including as a coverplate over the furnace in glovebox wells, and as part of end plates on Lindberg furnaces (TWCP-4162, TWCP-4166). Although many Lindberg furnaces have been replaced with newer asbestos-free furnaces, some are still in use at TA-55. The transite would have been disposed either as metal or as ceramic and glass waste.

## 11.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.5)
- ~~*Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan*~~ (TWCP-PLAN-0.2.7-001,R.3)

Delete

- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002,R.1)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003,R.1)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004,R.1)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005,R.1)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007,R.1)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan (Attachment B) to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## ACCEPTABLE KNOWLEDGE ROADMAP

P/S codes: CRD, ER, MO, MP, OR, Neptunium, PK, PTP, RA, SCB, SD, SS, and SSMD.

Copies of these documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | Budget information may not be acceptable. |
| TWCP-697 | C | Waste management requirements to meet WIPP WAC requirements were formalized in 1984. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste management requirements to meet WIPP WAC requirements. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents how controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents how controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

Add to the roadmap: TWCP-sampling plan (AK reports. See AK-02.

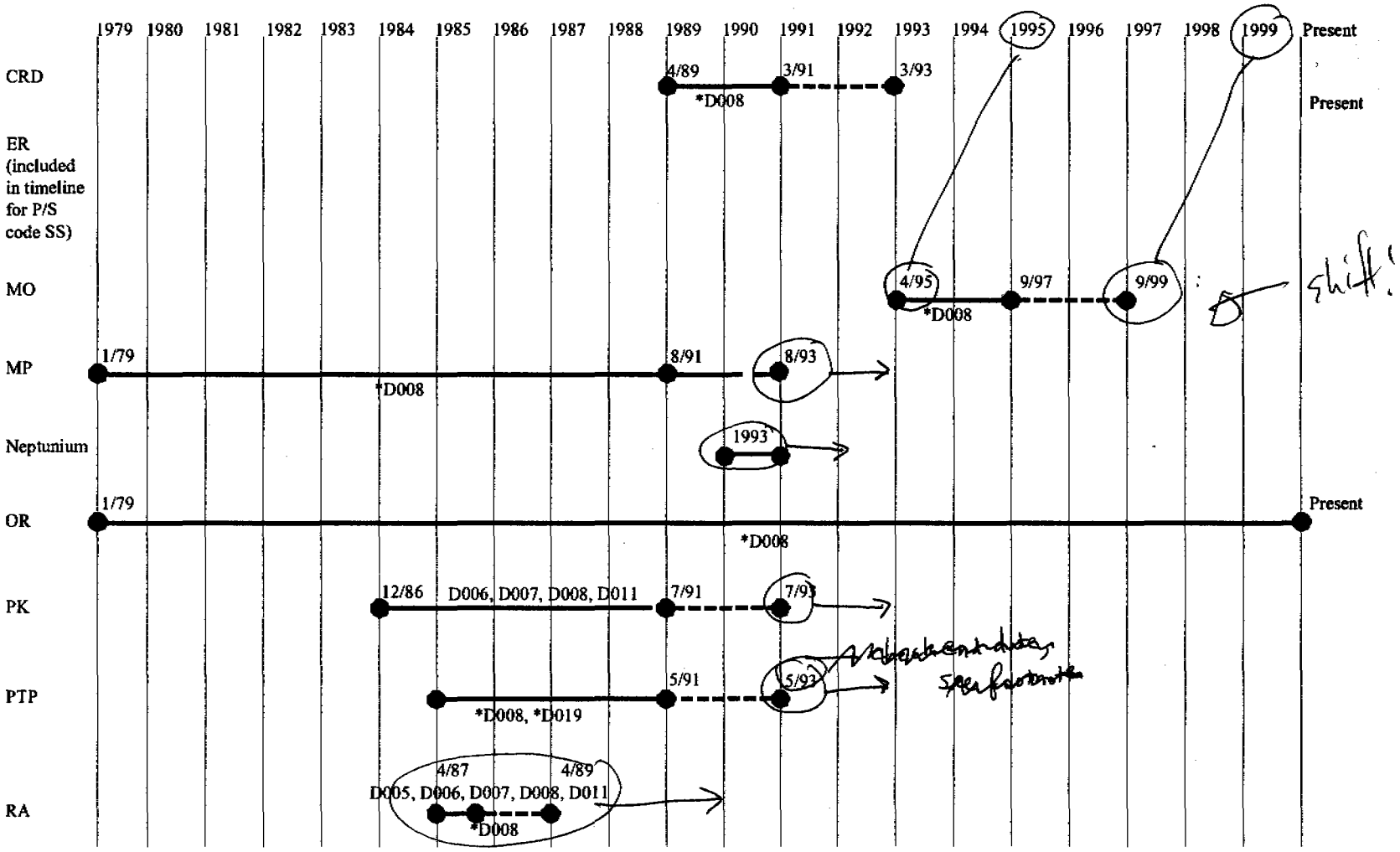
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3542 (UCNI) (PYRO-22) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Peter Lopez, NMT-5<br>Walt Griego, NMT-2 | Answers to questions about P/S code SSMD | Project occurred long enough in the past that SMEs had difficulty recalling details. |
| TWCP-3542 (UCNI) (PYRO-23) | C | Procedure for Salt Distillation (P/S code SD) | TA-55 Document, 102-MPP-R01 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-24) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Mike West, NMT-2<br>Greg Bird, NMT-2 | Answers to questions regarding P/S codes SBB and SCB. No RCRA-listed metals used in processes, Freon may have been used to clean parts. | SMEs couldn't recall some specific information. |
| TWCP-3542 (UCNI) (PYRO-25) | C | Procedure for Fused Salt Extraction of Americium from Plutonium Metal | TA-55 Document 440-MPP-R00 – R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-27) | D | Acceptable Knowledge Interview Form for Pyrochemical Processing | Jim Foxx, NMT-7 | Answers to questions regarding usage timeframe for vanadium pentoxide | Answers to specific questions or topics |
| TWCP-3542 (UCNI) (PYRO-28) | C | Acceptable Knowledge Interview Form for Pyrochemical Processing | Jim Foxx, NMT-7 9/23/99 | Answers to questions regarding processes done in Special Processing and Pyrochemical Processes | Answers to specific questions |
| TWCP-3543 (~~SP-40~~) (UCNI) | D | Acceptable Knowledge Interview Form for ~~Pyrochemical~~ Processing | Jim Foxx, NMT-7 | Answers to questions regarding ~~processes done in Special~~ Processing and Pyrochemical operations | Answers to specific questions or ~~topics~~ |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |

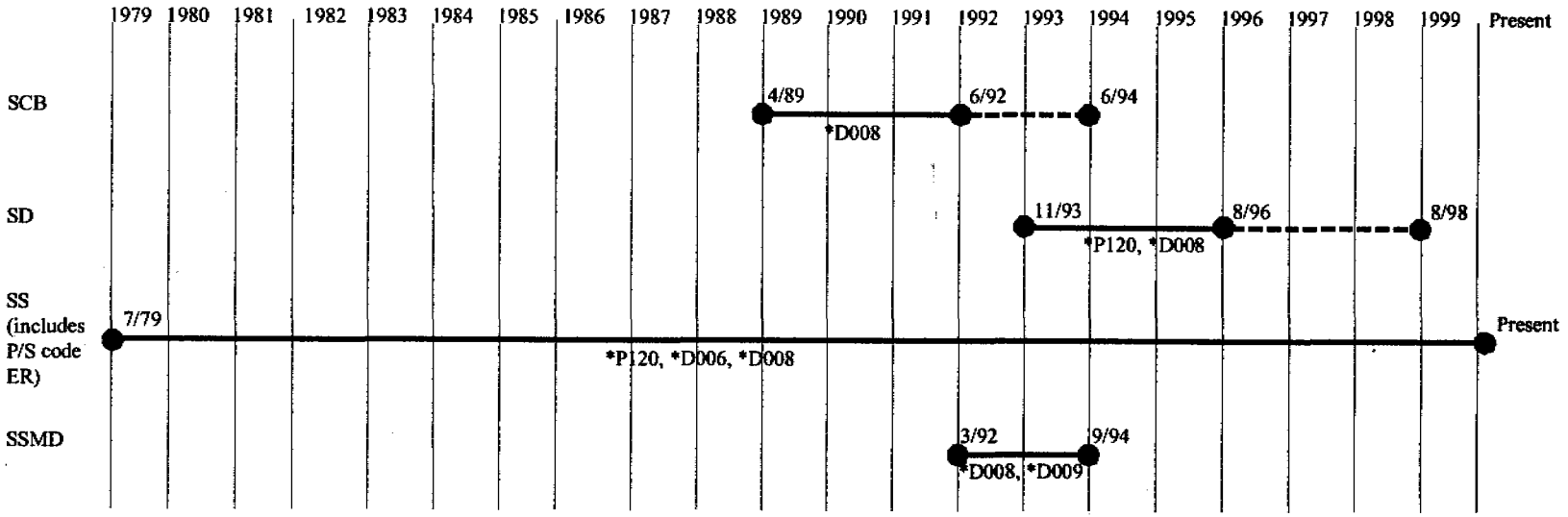
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* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

## TIMELINE FOR PYROCHEMICAL PROCESSES



## TIMELINE FOR PYROCHEMICAL PROCESSES (continued)




*Notes on time-dependence of RCRA codes
P120 = applies to waste generated under P/S code SD from 2/98 - 3/98 and under P/S code SS from 5/27/98 - 6/10/98
D006 = applies to crucibles and salts discarded under P/S code ER from 1987 to 1989
D008 = applies to leaded gloves which where discarded in a separate waste stream after 1992, still under the originating P/S code
D009 = applies to waste discarded under P/S code SSMD from 6/94 - 8/94
D019 = applies to waste discarded under P/S code PTP from 1/87 - 6/~~88~~ 89

and/or SS

; also D008 applies to [copy from D006 footnote]

RD: RTR inactive after 6/89 on timeline

~~6/88~~ 6/89

Draft #2
5/1/01 JTM

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-006,R.2 (LA-UR-01-)

checked against Draft #3 JTM 5-6-01

**WASTE GENERATED FROM PROCESS/STATUS CODES:** CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 07/13/00 | — | New report (TWCP-03939) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | | All | Respond to CBFO comments, ~~and~~ update |
| | | | with new AK information ~~and~~ |
| | | | ~~to~~ |
| | | | |
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3 Timeline for Pyrochemical Processes (3 pages)
4 Process Inputs and Outputs (4 pages)
5 Simplified Process Status Diagram (1 page)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| CFR | Code of Federal Regulations |
| D | EPA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction (process conducted under P/S code OR) |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| ER | electrorefining |
| F | EPA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| HEPA | high-efficiency particulate air |
| K | EPA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| MCDOR | multicycle direct oxide reduction |
| MPL | metal preparation line |
| MSE | molten salt extraction |
| MT | Material Type |
| NMT | Nuclear Material Technology |
| P | EPA hazardous waste number prefix for discarded commercial chemical products, off-specification species, container residues, and spill residues, defined in 40 CFR Subpart D, Section 261.33 |
| P/S [code] | process/status [code] |
| PCB | polychlorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| QA | quality assurance |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development and demonstration |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | records management/document control |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) |
| SME | subject matter expert |
| SOP | safe/standard operating procedure |
| TA | technical area |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization/Certification Program |
| UCNI | Unclassified Controlled Nuclear Information |
| WAC | waste acceptance criteria |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |

TA-55 **PROCESS/STATUS (P/S) CODE INDEX**

Change all sections 3.4.. to 3.5..

**Note:** This index indicates the main process AK summary report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| CA | Casting | Metal Operation Processes | 3.4.2, Att. 4 |
| CRD | Chlorination/reduction RD&D | Pyrochemical Processes | 3.4, Att. 4 |
| CX | Chloride Anion Exchange | Chloride Operations | 3.4.2, 3.4.3, 3.4.4, Att. 4 |
| CXL | Experimental Chloride Extraction Line | Chloride Operations | 3.4.2, 3.4.3, Att. 4 |
| DO | Dissolution of Oxide | Special Processing | 3.4.3, 3.4.5, 3.4.7, Att. 4 |
| DS | Ion Exchange | Nitrate Operations | 3.4.3, Att. 4 |
| ED | Cascade Dissolver | Nitrate Operations | 3.4.2, Att. 4 |
| ER | Electrorefining | Pyrochemical Processes | 3.4.4, Att. 4 |
| LR | Ion Exchange | Nitrate Operations | 3.4.3, Att. 4 |
| MA | Machining | Metal Operation Processes | 3.4.2, Att. 4 |
| MO | Metal Oxidation, Room 429 | Pyrochemical Processes | 3.4.9, Att. 4 |
| MP | Metal Preparation | Pyrochemical Processes | 3.4.1, Att. 4 |
| NEPTUNIUM | Neptunium | Pyrochemical Processes | 3.4.10, Att. 4 |
| OR | Direct Oxide Reduction | Pyrochemical Processes | 3.4.2, Att. 4 |
| PK | Pickling and Nitrate Holding | Pyrochemical Processes | 3.4.11, Att. 4 |
| PTP | Plutonium Trichloride Preparation | Pyrochemical Processes | 3.4.12, Att. 4 |
| RA | Recovery of Anodes | Pyrochemical Processes | 3.4.6, Att. 4 |
| RB | Roasting and Blending | Nitrate Operations | 3.4.3, Att. 4 |
| RBJ | Roasting and Blending Jr | Nitrate Operations | 3.4.3, Att. 4 |
| SC | Cascade Dissolver, G437 | Nitrate Operations | 3.4.2, Att. 4 |
| SCB | Chlorination Ca/Al Scrubbing RD&D | Pyrochemical Processes | 3.4.2, Att. 4 |
| SD | Salt Distillation | Pyrochemical Processes | 3.4.5, Att. 4 |
| SS | Salt Stripping | Pyrochemical Processes | 3.4.3, 3.4.4, 3.4.5, 3.4.7, 3.4.8, Att. 4 |
| SSMD | SS Material Development | Pyrochemical Processes | 3.4, Att. 4 |
| WM | Waste Management | Miscellaneous Operations | 3.4.9, Att. 4 |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002,R.1), Metal Operation Processes (TWCP-AK-2.1-003,R.1), Miscellaneous Operations (TWCP-AK-2.1-004,R.1), Nitrate Operations (TWCP-AK-2.1-005,R.1), Pyrochemical Processes (this report), Special Processing (TWCP-AK-2.1-007,R.1)

R.2

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Pyrochemical Processes

**P/S codes**: CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed pyrochemical salts and debris.

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from pyrochemical operations are generated from plutonium metal preparation and purification for defense programs; these wastes may have been generated and produced in the same rooms as were used for non-defense activities and so were not segregated from non-defense waste until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

TA-55 Plutonium Facility (Building PF-4), 400 Wing. Pyrochemical operations include processes for the preparation and purification of plutonium metal.

**Description of the process waste (physical form and typical content description):**

Waste from pyrochemical operations consists primarily of slag containing chloride salts, calcium fluoride and calcium oxide salts; crucibles; debris waste including cellulosic, plastic, rubber, glass, and metal items. Liquid waste is sent to the Radioactive Liquid Waste Treatment Facility at TA-50.

**Description of the waste-generating process:**

The overall goal of the pyrochemical operations is to prepare plutonium from impure metal, metal alloys, oxides, scrap, and residues and produce a purified plutonium metal. Processes include the metal preparation line, single-pass and multicycle direct oxide reduction, electrorefining, molten salt extraction, salt stripping, salt distillation, carbonate oxidation, oxygen sparge, and pyroredox.

**Process feed:**

Plutonium metal, metal alloys, or oxides; plutonium scrap; Np-237 (briefly in 1993).

Summary Category Groups: S3000, S5000
Waste Matrix Codes:
S3000, S5100, S5300, S5400

Pa-231 and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations.

**Radioisotopic content of the waste:**

Variety of plutonium material types with different isotopic compositions. Am-241, ~~Am-243~~, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some processes separate plutonium and americium so that the waste will usually be enriched in ~~americium~~, but may also be depleted in some cases. Np-237 may be the dominant radionuclide in some cases.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D005 (barium) applies to salt waste generated under P/S code RA
- D006 (cadmium) and D008 (lead) apply to P/S codes ER and SS
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): zinc metal waste from P/S code RA
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): waste from P/S code PK
- D008 (lead): metal waste debris from all P/S codes in pyrochemical processes due to disposal of leaded gloves; after May 1992, leaded gloves were separated from other metal debris
- D009 (mercury): waste from P/S code SSMD during the summer of 1994
- D019 (carbon tetrachloride): waste from P/S code PTP (1986 to June 1989)
- No F or K codes
- P120 (vanadium pentoxide): waste from P/S code SD from 02/98 to 03/98; and P/S code SS from 05/27/98 to 06/10/98

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

# ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR PYROCHEMICAL PROCESSES AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021, R.5). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes ~~used by one of the TRU waste generators~~ at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for ~~one~~ several ~~or more~~ waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to ~~Technical Area~~ (TA)-55 waste streams resulting from pyrochemical processes covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001, R.3) (Sampling Plan) that includes information regarding all TRU waste streams
- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to pyrochemical processes is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No. TWCP-3542. Individual documents in this record have been assigned a separate identifier, PYRO-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in pyrochemical processes, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Processes in pyrochemical operations were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (TWCP-816).

Insert new 3.2 Basis, Rationale, and Assumptions used to Delineate the waste streams [See file Process AK Section 3-2.doc]

### 3.2 Waste Physical Form and Content Description

Wastes generated during pyrochemical operations ~~are defined as retrievably stored TRU waste. The waste~~ contains a variety of pyrochemical chloride salts as well as mixtures of calcium fluoride and calcium oxide salts, that were generated as byproducts of the operations and that met the discard limit for plutonium content. Debris wastes and caustic liquid wastes sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50 are also covered by this process AK report. General debris waste categories from pyrochemical processes include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles

Do add rubber

- Metal debris (for example, tantalum crucibles, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from pyrochemical processes.

3.4 Waste Volume and Time Period of Generation

EPA hazardous waste numbers (HWNs)

This report covers waste streams generated from 1979, when pyrochemical processes first began in Building PF-4, to the present. Wastes from the pyrochemical processes have different associated ~~RCRA codes~~ depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding RCRA codes are shown graphically in Attachment 3, Timeline for Pyrochemical Processes.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

3.5 Waste Generation Processes

The following subsections describe the generation of waste by pyrochemical processes, as well as product and waste outputs to other processes or operations.

Manufacturing and research operations performed at TA-55 results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities. The metal production and purification operations as well as associated maintenance operations are the sources of most TRU waste generated from pyrochemical processing.

Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352 and TWCP-886).

This report focuses on metal preparation and purification processes (pyrochemical processes). Pyrochemical operations for plutonium include the following processes:

- metal preparation line (MPL) (P/S code MP),
- single-pass direct oxide reduction (DOR) and multiple-cycle direct oxide reduction (MCDOR) with in-situ regeneration (P/S code OR),
- electrorefining (ER) (initially P/S code ER; but now part of P/S code SS),
- molten salt extraction (MSE) (P/S code SS),
- salt stripping (salt stripping, salt distillation, carbonate oxidation, and oxygen sparging) (P/S code SS),
- pyroredox (P/S code RA),
- pickling (P/S code PK) and metal oxidation (P/S code MO).

**NOTE:** In contrast with most P/S codes, P/S code SS has grown over the years to encompass several activities that are different steps in the metal refining process, rather than representing a single distinct operation. As such, discussion of this P/S code is covered under more than one subsection.

Several research and development (R&D) processes also took place in pyrochemical operations:

- Chlorination/Reduction R&D (P/S code CRD),
- Chlorination Ca/Al Scrubbing R&D (P/S code SCB) (PYRO-24/ TWCP-3542), and
- Salt Stripping Materials Development (P/S code SSMD) (PYRO-22/TWCP-3542).

Each of these processes is described below. A complete listing of P/S codes for pyrochemical processes, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. A simplified process flow diagram for pyrochemical processes is found in Attachment 5.

5
3.4.1 Metal Preparation Line (P/S code MP)

The MPL (conducted under P/S code MP) produced plutonium metal from the tetrafluoride salt until 1992 (TWCP-352). Plutonium oxides derived from the calcination of oxalate or peroxide precipitates (in nitrate operations) were reacted with hydrogen fluoride gas to form plutonium tetrafluoride. Because the plutonium oxide feed material had been purified in previous aqueous processes, it contained less than trace

amounts of RCRA-regulated metal impurities. Input material came from the vault or P/S codes RB or RBJ (in nitrate operations). In the metal production process, plutonium oxide was converted to plutonium tetrafluoride, which in turn was reacted at high temperature (600 °C to 2000 °C) with metallic calcium in a magnesium oxide crucible. Iodine was added as a reaction initiator. The desired product was plutonium metal, which was recovered as a button by breaking the crucible and mechanically separating the contents. The metal was transferred to P/S codes SS or CA or sent to the vault.

The waste products were calcium fluoride ($CaF_2$) and calcium iodide ($CaI_2$), which formed a slag, magnesium oxide sand, and magnesium oxide crucible pieces. These were discarded under P/S code MP if the plutonium content was below the discard limit (DL). If the plutonium content was above the DL, the slag and crucible pieces were sent to nitrate operations (*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005]) to be dissolved in nitric acid ($HNO_3$) and aluminum oxide ($Al_2O_3$). The leached materials were then discarded under P/S codes ED or SC, with the waste described as leached solids. The leachate was also treated in nitrate operations under P/S code DS to recover the plutonium. The magnesium oxide sand was reused if possible.

Little or no purification of the plutonium occurred during this process. However, because the reagents introduced no impurities and the highest purity feed material was used, the resulting metal was often satisfactory for high-purity applications. In this process, any trace metals were below the toxicity characteristic levels, so that the associated debris and slag wastes were below the toxicity characteristic levels in RCRA metal content (TWCP-2502).

5

3.4.2 DOR and MCDOR (P/S codes OR and SCB)

Prior to the multiple-cycle DOR process, a single pass DOR process was used for plutonium oxide (TWCP-2507, PYRO-14/TWCP-3542). Plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible at 820°C to 875°C. Any arsenic, mercury or selenium present in the impure plutonium oxide would be driven off due to their volatility at this high temperature (TWCP-1258). The reaction proceeds to completion when excess calcium is present and when sufficient $CaCl_2$ is available to dissolve the calcium oxide (CaO) product.

toxicity characteristic metals were well below RCRA regulatory limits (TWCP-2540), as follows:

| Metal | Totals Analysis | Calculated TCLP Result | Regulatory Level |
|---|---|---|---|
| Cadmium | <10 ppm | <0.5 mg/L | 1 mg/L |
| Chromium | 30 ppm | 1.5 mg/L | 5 mg/L |
| Lead | 20 ppm | 1 mg/L | 5 mg/L |
| Silver | 2 ppm | 0.1 mg/L | 5 mg/L |

All metal impurities except barium would be reduced to the metal state and remain with the plutonium metal phase rather than be transferred into the molten salt phase. Hence, the molten salt phase is purified of regulated metals except for barium. These regulated metals will be present in the waste salt at levels below the toxicity characteristic levels. Because the salts are reused, only the initial reduction in fresh salt would contain any of the salt feed impurities.

The waste salt, crucibles, and debris waste items associated with this process are discarded under P/S codes OR or CXL. Asbestos gloves were also used in glovebox operations under P/S code OR, and were disposed as part of ceramic and glass debris wastes.

P/S code SCB was an R&D effort examining the feasibility of this process at extracting Pu (MT 52) from salt before discarding the salt. Pu was chlorinated then reduced to the metal with calcium metal (similar to DOR).

5

3.4.3 Molten Salt Extraction (P/S code SS)

MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (PYRO-4/TWCP-3542, TWCP-352). This process is employed only if the americium content is greater than 1000 ppm (TWCP-2506). In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible and heated to 750°C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. In the LANL process, 90 percent of the americium and 10 percent of the plutonium are transferred

from the feed metal to the salt. After cooling, the salt and metal are mechanically separated. The salts are transferred to the salt stripping process under P/S code SS.

In the late 1980s, several chloride salt systems were studied, including lithium chloride (LiCl), potassium chloride (KCl), calcium chloride ($CaCl_2$), and NaCl/$CaCl_2$.

3.4.4 Electrorefining (currently part of P/S code SS, historically P/S code ER)

The ER process was introduced in 1962 at TA-21 and was moved to TA-55 in 1979. This process takes impure metal from the MSE and MCDOR (DOR) processes and produces high purity plutonium metal (PYRO-2, PYRO-3, PYRO-4, PYRO-6, PYRO-17 [all in TWCP-3542], TWCP-2505). Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$ (TWCP-2505). After the anode and salt melt, current is applied to the system, and plutonium at the anode is oxidized to plutonium ions, which travel to the cathode and are reduced back to the metal state. Impurities in the original plutonium anode that are less electroactive than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities more electroactive than plutonium (including barium) are left in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. Anode heels were sent to pyroredox (P/S code RA) from 1984 to 1986. Currently, salts are sent to P/S ~~code CXL~~ (chloride operations) or carbonate oxidation/distillation (section 3.4.5).

From 1987 to 1989, secondary solvent ~~metals~~ such as cadmium, bismuth, lead, and gallium were added to experimental studies of the electrorefining process (PYRO-15/TWCP-3542). The salts and crucibles from those ER runs may be contaminated with additional cadmium and lead, although those metals should have remained in the anode heels. However, these particular anode heels are retained in the vault at TA-55, with no plans to reprocess them in the near future. Crucible wastes were discarded under P/S code SS. Salts are stored in the vault; very little salt from this process met the DL.

3.4.5 Salt Stripping (P/S codes SD and SS)

The MSE and ER salts are further treated by salt stripping, oxygen sparging or carbonate oxidation, and salt distillation (PYRO-7, PYRO-8, PYRO-9, PYRO-10 [all in TWCP-3542], TWCP-2498). The salt stripping process treats the residue by melting and stirring the salt with calcium metal in a magnesium oxide crucible at 850°C (TWCP-2502).

This treatment reduces the plutonium in the salt to metal and allows the metal to coalesce for physical removal and recovery. After cooling, the crucible is broken and the metal physically separated and recycled to the ER process or burned to oxide and sent back through aqueous recovery. The crucible shards are transferred to P/S code CXL, leached in hydrochloric acid, then discarded under CXL. During the salt stripping, the RCRA-regulated metals, except for barium, will be reduced with plutonium into the metal product, so that the salt is essentially free of heavy metals but may still contain barium, although this element is unlikely to be present above RCRA threshold levels.

Oxygen sparging and, since 1996, carbonate oxidation are used to ensure that any plutonium, americium, or metallic sodium or potassium left in the salts are converted to nonpyrophoric oxide forms. The NaCl/KCl salt is either discarded under P/S code SS or distilled for recycle and discarded under P/S codes SS or SD. $CaCl_2$ salts are routed to aqueous chloride processing for further plutonium recovery before being discarded under P/S code CXL.

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping process for a few months in 1998. $V_2O_5$ was used in experiments under P/S code SD from early February to early March of 1998 and under P/S code SS from May 27 to June 10 of 1998 (PYRO-27/TWCP-3542). Molybdenum oxide was used for the same purpose during the same period of time.

Salt distillation, begun in 1997, allows the recovery of plutonium oxide from the salt and produces purified salt for reuse (PYRO-23/TWCP-3542, TWCP-2498]). NaCl/KCl salt is distilled at 850°C. Process wastes from the salt distillation are the bottoms from the distillation, which are composed of metal oxides, including any RCRA heavy metals originally present in the salt. These metal oxides are rerouted for plutonium recovery. The purified salts are reused or discarded under P/S code SD or SS. However, at the present time salt distillation is on hold awaiting the installation of a new still (PYRO-18/TWCP-3542). In the meantime, the salts and crucibles from ER and MSE are dissolved in P/S code CXL.

5
3.4.6 Pyroredox (P/S code RA)

The pyroredox operation was used to recover plutonium from spent anode heels in the mid to late 1980s (TWCP-2541). The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements more electroactive than zinc

(including barium) were oxidized into the salt phase, and the zinc formed a metal button. Any of the residual RCRA-regulated heavy metals that may have been present in the spent anode heel (barium, cadmium, chromium, lead, and silver), with the exception of barium, would be present in the zinc button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements less electroactive than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded under P/S code RA. The metal phase containing zinc was placed in the vault or further treated (TWCP-2540), and the plutonium eventually was routed back to ER. In the ER process, the RCRA-regulated metals are concentrated in the anode heel, which then may be treated in the pyroredox process to transfer these RCRA metals to the zinc button, or may be roasted in air to form metal oxides and then be dissolved in nitrate operations. Thus, the zinc button output could contain RCRA-regulated heavy metals (D006, D007, D008, D011) above the toxicity characteristic limits. Salt waste could contain barium (D005) above the limit.

5

3.4.7 Ingot Casting (P/S code SS)

Metal is melted in an MgO crucible to cast the ingot. If the plutonium content of the crucible is greater than the DL, the crucible goes to CXL for plutonium recovery. If its plutonium content is less than the DL, the crucible is discarded under P/S code SS.

5

3.4.8 Metal Coalescence (P/S code SS)

Metal coalescence is used for plutonium turnings to coalesce the turnings into a metal button. Calcium metal and $CaCl_2$ are added to a MgO crucible along with the turnings and melted. Turnings may contain Freon from the machining process, but any Freon would be destroyed and volatilized by the high temperatures. Residues are handled in the same manner as MCDOR/DOR residues (section 3.4.2). Metal coalescence is conducted under P/S code SS. 5

5

3.4.9 Metal Oxidation (P/S code MO)

Small pieces of metal remaining on furnace or crucible surfaces are collected for conversion to the oxide phase in P/S code MO. These metal pieces are placed in a furnace for the conversion process. The oxide is then transferred to the vault (PYRO-11/TWCP-3542).

### 3.4.10 Neptunium (P/S code Neptunium)

A campaign to work off neptunium residues stored in the vault was undertaken in 1993 (PYRO-21/TWCP-3542). This operation was only active during 1993. Any debris wastes generated from this operation would carry the P/S code Neptunium. SME information indicates that wastes generated under P/S code Neptunium would not contain RCRA-listed constituents nor would they have any RCRA hazardous characteristics (PYRO-21/TWCP-3542).

### 3.4.11 Pickling and Nitrate Holding (P/S code PK)

Pickling (i.e., leaching metal with a strong acid) is typically a head-end operation. However, P/S code PK is included in this report because, after a few furnace runs, plutonium metal begins to accumulate on tools and furnace parts. It then becomes necessary to leach the plutonium from these items. In addition, after calcium metal reduction processes such as the metal preparation line (section 3.4.1), direct oxide reduction (section 3.4.2), and molten salt extraction (section 3.4.3), plutonium metal will have an adherent skin of calcium metal. Hydrochloric acid is used to dissolve Pu from tantalum furnace parts, and nitric acid is used to pickle Pu from other metals. The plutonium-bearing leachate solution is transferred to P/S codes CX or CXL in chloride operations, or to P/S code LR in nitrate operations (PYRO-12/TWCP-3542). P/S code PK has not been active since 1992 and may have been incorporated into P/S code SS at that time (PYRO-28/TWCP-3542). Due to the potential for leaching heavy metals from the items treated, D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to waste produced from P/S code PK

### 3.4.12 Plutonium Trichloride Preparation (P/S code PTP)

P/S code PTP was an intermediate process used in Pu metal production. Under this code, carbon tetrachloride was used to prepare plutonium trichloride by bubbling a carrier gas through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500°–600°C before being absorbed in a 5–6 molar potassium hydroxide solution. The scrubber solution went in the caustic waste line to the RLWTF at TA-50. The carrier gases were argon, hydrogen chloride gas, and chlorine gas. The carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991.

Feed material for P/S code PTP was high purity oxides from the vault or from P/S codes CA and MA. The product plutonium trichloride was sent to P/S code SS to be reduced to metal by the MSE or ER processes.

3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for pyrochemical processes at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for pyrochemical processes consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites.

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

6
3.6.1 Physical Waste Form Identification

Solid waste from pyrochemical processes primarily consists of spent salts, magnesium oxide crucibles, and debris waste. Debris waste contains glassware, plastics, ceramic materials, paper, rags, high-efficiency particulate air (HEPA) filters, metal containers, and small tools. Asbestos and leaded gloves may also be generated as process waste. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

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Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item identifier code and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance (QA) personnel. Example forms for one drum of waste generated by pyrochemical processes can be viewed in record TWCP-2513.

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for plutonium feed materials at Building PF-4 are listed in Table 2. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized. The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. ~~Continue # same # from next page~~

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The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radio assays of individual waste containers.

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope Weight (%) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 ($8.26 \times 10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

Superscript (a) These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

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The results of these bounding calculations are [also] stet tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest plutonium material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in americium depending on whether the source of contamination is the process product or the process residues (TWCP-882). or uranium

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from pyrochemical processes at TA-55, and may be enriched in some cases, such as in MSE process waste from P/S code SS from 1992 to the present (TWCP-882). Am-241, Am-243, and Np-237 are present as secondary radionuclides in process waste from P/S code SS from 1984 to 1990 (TWCP-882). Np-237 is expected to be the dominant radionuclide in waste from P/S code Neptunium.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all. U-238 would only be present if purposefully added to the feed material. U-235 ingrowth from the decay of plutonium-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. U-234 would be present in MT 83 as a decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total plutonium would be about 0.14. ~~No U-236 is present.~~ Pa-231 and Cs-137 may be present in trace amounts because of their widespread presence as contaminants in TA-55 operations (TWCP-5164, TWCP-5165). During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). If warranted, this AK report will be updated to incorporate the results of these comparisons.

### 3.6.3 Chemical Content Identification

Chemical inputs to pyrochemical processes are listed in Table 3. The use of strong acids, bases, or oxidizers does not result in RCRA listings for

solid wastes from these processes because of the absence of free liquids in this waste. However, D006, D008, D019 and P120 codes apply to some of the pyrochemical process wastes, as noted in Table 3.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA hazardous waste numbers (HWNs) to process wastes from pyrochemical operations is summarized below, as well as on the process timelines in Attachment 3, and the table of process inputs and outputs in Attachment 4. These assignments take into account the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

### 4.1 F, K, and P Listings

P120 (vanadium pentoxide) applies to waste generated under P/S code SD from February to March 1998, and under P/S code SS from May 27, 1998 to June 10, 1998.

No F or K codes apply to solid wastes generated by pyrochemical processes. Although used for cleaning metal parts, Freon would not be present in the waste because the parts were air-dried. Carbon tetrachloride was used as a chlorination reagent, and not as a solvent. No K-listed chemicals were present in the feed materials, chemicals or equipment used in these processes.

### 4.2 Toxicity Listings

No D001 (ignitable), D002 (corrosive), or D003 (reactive) listings apply to solid wastes from pyrochemical processes because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 5.0).

D005 (barium) applies to salt waste generated under P/S code RA.

D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to the zinc metal waste produced from P/S code RA. In the ER process, these RCRA-regulated heavy metals concentrate in the anode heel, which then may be treated in the pyroredox process (P/S code RA) to transfer them to the zinc button, or may be roasted in air to form metal oxides and then be dissolved in nitrate operations. Thus, only the zinc button output could contain RCRA-regulated metals above the toxicity characteristic limits.

D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to waste produced from P/S code PK.

D006 (cadmium) and D008 (lead) apply to waste from P/S codes ER and SS due to their use as secondary solvent metals.

D008 (lead) is assigned to metal waste debris from all P/S codes in pyrochemical processes due to the disposal of leaded gloves. Prior to May 1992, leaded gloves were disposed as metal debris without otherwise being segregated. Since May 1992, however, these gloves have been routinely segregated from other metal debris although they are still discarded under the originating P/S code (TWCP-4166).

D009 (mercury) is assigned to wastes generated under P/S code SSMD during the summer of 1994, when a week-long set of experiments contacted small amounts of plutonium with mercury (under 10 grams) (PYRO-22/TWCP-3542). At the end of these experiments, the mercury was solidified to allow disposal.

D019 (carbon tetrachloride): Until sample analyses become available, debris waste items from P/S code PTP (1986 to early 1988) are conservatively assigned D019 although the carbon tetrachloride was probably destroyed in the process.

4.3 Corrosivity, Reactivity, and Ignitability

See Section 6.0.

## 5.0 DETERMINATION OF THE RADIONUCLIDE ISOTOPIC COMPOSITION

See Section 3.5.2.

## 5 6.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. ~~Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning.~~ In case of a misfire or unconsumed explosives, a procedure is in place at TA-55 to ensure that explosives do not enter the waste stream.

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids. Corroborative data are provided by screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501, page WF-34-10). These tests yielded liquid with pH greater than 3, so the wastes cannot be considered corrosive, and demonstrated that the liquid does not corrode steel at a rate greater than 0.25 inch per year.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 6.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In

addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7 8.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, (3) and no sparking. Experimental results on the reactivity of LANL DOR salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 8.0 and 7.0.

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## 8 9.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the pyrochemical processes, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 3, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. Any organic compounds present in the process materials would be destroyed or vaporized by the high temperatures of the pyrochemical processes that dominate pyrochemical processing. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005,R.X, Section 9.0). This oil does not enter the LANL disposal operations. (2) 8

## 9 10.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.5)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan (Attachment B) to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3943 | D | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4162 | D | Answers to questions about P/S codes PB, PuBe, CC, MB, MS, FF, BF, and other issues | Interview with Jim Foxx, 10/12/00 | Answers to questions on use of asbestos at TA-55, non-defense activities, and specific P/S codes in chloride operations. | None |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of silver, disposal of ash and resins, and use of gases. | None |
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of chromium and silver, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of silver from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that silver in ash is below limits of regulatory concern | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Summary Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2 | A | *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |

Insert TWCP-4720, 5164, 5165 → (Copy from TWCP-AK-2.1-008, R.2 AK Roadmap)

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

MAVIS

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-006,R.2 (LA-UR-01-)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** CRD, ER, MO, MP, Neptunium, OR, PK, PTP, RA, SCB, SD, SS, and SSMD

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 07/13/00 | — | New report (TWCP-03939) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | | All | Respond to CBFO comments and update to include new AK information |
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group, waste matrix code, and potential for the presence of hazardous constituents. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- ~~First~~ by radioisotope content (Pu-238 or Pu-239 material type)
- ~~Then~~ by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- ~~Then~~ by hazardous waste status (mixed, non-mixed, or special case waste streams)

3.3 Waste Physical Form and Content Description

Wastes generated during pyrochemical operations contain a variety of pyrochemical chloride salts as well as mixtures of calcium fluoride and calcium oxide salts, that were generated as byproducts of the operations and that met the discard limit for plutonium content. Debris wastes and caustic liquid wastes sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50 are also covered by this process AK report. General debris waste categories from pyrochemical processes include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles
- Metal debris (for example, tantalum crucibles, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from pyrochemical processes.

3.4 Waste Volume and Time Period of Generation

This report covers waste streams generated from 1979, when pyrochemical processes first began in Building PF-4, to the present. Wastes from the pyrochemical processes have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding RCRA codes are shown graphically in Attachment 3, Timeline for Pyrochemical Processes.

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in pyrochemical processes, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Processes in pyrochemical operations were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (TWCP-816).

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Stream(s)

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the Sampling Plan. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, in order to evaluate the most appropriate waste summary

Several research and development (R&D) processes also took place in pyrochemical operations:

- Chlorination/Reduction R&D (P/S code CRD),
- Chlorination Ca/Al Scrubbing R&D (P/S code SCB) (PYRO-24/ TWCP-3542), and
- Salt Stripping Materials Development (P/S code SSMD) (PYRO-22/TWCP-3542).

Each of these processes is described below. A complete listing of P/S codes for pyrochemical processes, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. A simplified process flow diagram for pyrochemical processes is found in Attachment 5.

3.5.1 Metal Preparation Line (P/S code MP)

$PuF_4$

The MPL (conducted under P/S code MP) produced plutonium metal from the ~~tetrafluoride salt~~ until 1992 (TWCP-352). Plutonium oxides derived from the calcination of oxalate or peroxide precipitates (in nitrate operations) were reacted with hydrogen fluoride gas to form plutonium tetrafluoride. Because the plutonium oxide feed material had been purified in previous aqueous processes, it contained less than trace amounts of RCRA-regulated metal impurities. Input material came from the vault or P/S codes RB or RBJ (in nitrate operations). In the metal production process, plutonium oxide was converted to plutonium tetrafluoride, which in turn was reacted at high temperature (600 °C to 2000 °C) with metallic calcium in a magnesium oxide crucible. Iodine was added as a reaction initiator. The desired product was plutonium metal, which was recovered as a button by breaking the crucible and mechanically separating the contents. The metal was transferred to P/S codes SS or CA or sent to the vault.

The waste products were calcium fluoride ($CaF_2$) and calcium iodide ($CaI_2$), which formed a slag, magnesium oxide sand, and magnesium oxide crucible pieces. These were discarded under P/S code MP if the plutonium content was below the discard limit (DL). If the plutonium content was above the DL, the slag and crucible pieces were sent to nitrate operations (*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005]) to be dissolved in nitric acid ($HNO_3$) and aluminum oxide ($Al_2O_3$). The leached materials were then discarded under P/S codes ED or SC, with the waste described as leached solids. The leachate was also treated in nitrate operations under P/S code DS to recover the plutonium. The magnesium oxide sand was reused if possible.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

## 3.5 Waste Generation Processes

The following subsections describe the generation of waste by pyrochemical processes, as well as product and waste outputs to other processes or operations.

Manufacturing and research operations performed at TA-55 results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities. The metal production and purification operations as well as associated maintenance operations are the sources of most TRU waste generated from pyrochemical processing. Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352 and TWCP-886).

This report focuses on metal preparation and purification processes (pyrochemical processes). Pyrochemical operations for plutonium include the following processes:

- metal preparation line (MPL) (P/S code MP),
- single-pass direct oxide reduction (DOR) and multiple-cycle direct oxide reduction (MCDOR) with in-situ regeneration (P/S code OR),
- electrorefining (ER) (initially P/S code ER; but now part of P/S code SS),
- molten salt extraction (MSE) (P/S code SS),
- salt stripping (salt stripping, salt distillation, carbonate oxidation, and oxygen sparging) (P/S code SS),
- pyroredox (P/S code RA),
- pickling (P/S code PK) and metal oxidation (P/S code MO).

**NOTE:** In contrast with most P/S codes, P/S code SS has grown over the years to encompass several activities that are different steps in the metal refining process, rather than representing a single distinct operation. As such, discussion of this P/S code is covered under more than one subsection.

Little or no purification of the plutonium occurred during this process. However, because the reagents introduced no impurities and the highest purity feed material was used, the resulting metal was often satisfactory for high-purity applications. In this process, any trace metals were below the toxicity characteristic levels, so that the associated debris and slag wastes were below the toxicity characteristic levels in RCRA metal content (TWCP-2502).

3.5.2 DOR and MCDOR (P/S codes OR and SCB)

Prior to the multiple-cycle DOR process, a single pass DOR process was used for plutonium oxide (TWCP-2507, PYRO-14/TWCP-3542). Plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible at 820°C to 875°C. Any arsenic, mercury or selenium present in the impure plutonium oxide would be driven off due to their volatility at this high temperature (TWCP-1258). The reaction proceeds to completion when excess calcium is present and when sufficient $CaCl_2$ is available to dissolve the calcium oxide (CaO) product.

After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and metal shot, which was sometimes recovered by addition of fresh salt plus additional calcium metal. The process was then rerun. If the unreacted oxide and metal shot did not process after the second run, the material was sent to aqueous recovery. The product plutonium metal contains significant impurities, including additional metal impurities derived from the calcium metal and calcium chloride reagents. It must be further purified by ER. All DOR salts were oxygen sparged, which would have oxidized any pyrophoric metals that might have been present. The salt is then either routed through aqueous chloride operations to recover the plutonium, or else discarded as waste along with the remaining calcium metal and MgO crucible pieces. After May 1987, spent salts above the DL were sent to controlled oxidation to oxidize the pyrophoric metals.

The feed oxide, reagent salts and reductant are of the highest purity available because the process is non-purifying. In fact, the plutonium metal produced from this operation is always less pure than the feed material due to impurities derived from the reductant reagents. Plutonium metal from this process typically requires further processing to meet purity requirements.

To minimize the salt waste, the MCDOR process was started in 1988 (TWCP-2502, PYRO-16/TWCP-3542). In this process, the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated. The salt is chlorinated and reused for MCDOR. The salt is discarded under P/S code OR if the plutonium concentration is below the DL. The salts above the DL are returned to P/S code CXL for dissolution and recovery. Before 1987, the salts may have been discarded under P/S code OR or routed to chloride operations. The chlorine off-gas is passed through a caustic scrubber, with the caustic solution going to the RLWTF at TA-50 for disposal if the solution meets this facility's Waste Acceptance Criteria (WAC). If the solution does not meet the WAC, it is returned to P/S code CXL for additional treatment.

Mavis:
What method was used to analyze the metals?
~~Jane is Looking up the answer~~
Stet
(No information in record)
JTM

MCDOR process inputs are low in contaminants. Only high-purity reagent chemical salts are used in the process, and the plutonium oxide feed materials are also of high purity, with absorbed water being the main impurity. MCDOR metal feed material analytical samples were analyzed for cadmium, chromium, lead, and silver. A review of 100 analyses showed that, even in the most impure sample, these D-listed toxicity characteristic metals were well below RCRA regulatory limits (TWCP-2540), as follows:

| Metal | Totals Analysis | Calculated TCLP Result | Regulatory Level |
|---|---|---|---|
| Cadmium | <10 ppm | <0.5 mg/L | 1 mg/L |
| Chromium | 30 ppm | 1.5 mg/L | 5 mg/L |
| Lead | 20 ppm | 1 mg/L | 5 mg/L |
| Silver | 2 ppm | 0.1 mg/L | 5 mg/L |

All metal impurities except barium would be reduced to the metal state and remain with the plutonium metal phase rather than be transferred into the molten salt phase. Hence, the molten salt phase is purified of regulated metals except for barium. These regulated metals will be present in the waste salt at levels below the toxicity characteristic levels. Because the salts are reused, only the initial reduction in fresh salt would contain any of the salt feed impurities.

The waste salt, crucibles, and debris waste items associated with this process are discarded under P/S codes OR or CXL. Asbestos gloves

were also used in glovebox operations under P/S code OR, and were disposed as part of ceramic and glass debris wastes.

P/S code SCB was an R&D effort examining the feasibility of this process at extracting Pu (MT 52) from salt before discarding the salt. Pu was chlorinated then reduced to the metal with calcium metal (similar to DOR).

3.5.3 Molten Salt Extraction (P/S code SS)

MSE is used to separate americium and the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals from plutonium metal (PYRO-4/TWCP-3542, TWCP-352). This process is employed only if the americium content is greater than 1000 ppm (TWCP-2506). In the original process, which operated from 1979 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a molten salt of sodium chloride (NaCl) and potassium chloride (KCl), contained in a MgO crucible and heated to 750°C. The magnesium chloride oxidized americium to $AmCl_3$, although some plutonium was also converted to the chloride salt form. In 1988, the MSE process was converted to use plutonium chloride ($PuCl_3$) produced by in-situ chlorination in a tantalum crucible. In the LANL process, 90 percent of the americium and 10 percent of the plutonium are transferred from the feed metal to the salt. After cooling, the salt and metal are mechanically separated. The salts are transferred to the salt stripping process under P/S code SS.

In the late 1980s, several chloride salt systems were studied, including lithium chloride (LiCl), potassium chloride (KCl), calcium chloride ($CaCl_2$), and NaCl/$CaCl_2$.

3.5.4 Electrorefining (currently part of P/S code SS, historically P/S code ER)

The ER process was introduced in 1962 at TA-21 and was moved to TA-55 in 1979. This process takes impure metal from the MSE and MCDOR (DOR) processes and produces high purity plutonium metal (PYRO-2, PYRO-3, PYRO-4, PYRO-6, PYRO-17 [all in TWCP-3542], TWCP-2505). Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$ (TWCP-2505). After the anode and salt melt, current is applied to the system, and plutonium at the anode is oxidized to plutonium ions, which travel to the cathode and are reduced back to the metal state. easier to be reduced
Impurities in the original plutonium anode that are ~~less electroactive~~ than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities ~~more electroactive~~ than plutonium (including easier to be oxidized.

barium) are left in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. Anode heels were sent to pyroredox (P/S code RA) from 1984 to 1986. Currently, salts are sent to P/S code CXL (chloride operations) or carbonate oxidation/distillation (section 3.5.5).

From 1987 to 1989, secondary solvent metals such as cadmium, bismuth, lead, and gallium were added to experimental studies of the electrorefining process (PYRO-15/TWCP-3542). The salts and crucibles from those ER runs may be contaminated with additional cadmium and lead, although those metals should have remained in the anode heels. However, these particular anode heels are retained in the vault at TA-55, with no plans to reprocess them in the near future. Crucible wastes were discarded under P/S code SS. Salts are stored in the vault; very little salt from this process met the DL.

3.5.5 Salt Stripping (P/S codes SD and SS)

The MSE and ER salts are further treated by salt stripping, oxygen sparging or carbonate oxidation, and salt distillation (PYRO-7, PYRO-8, PYRO-9, PYRO-10 [all in TWCP-3542], TWCP-2498). The salt stripping process treats the residue by melting and stirring the salt with calcium metal in a magnesium oxide crucible at 850°C (TWCP-2502). This treatment reduces the plutonium in the salt to metal and allows the metal to coalesce for physical removal and recovery. After cooling, the crucible is broken and the metal physically separated and recycled to the ER process or burned to oxide and sent back through aqueous recovery. The crucible shards are transferred to P/S code CXL, leached in hydrochloric acid, then discarded under CXL. During the salt stripping, the RCRA-regulated metals, except for barium, will be reduced with plutonium into the metal product, so that the salt is essentially free of heavy metals but may still contain barium, although this element is unlikely to be present above RCRA threshold levels.

Mavis: oxidation by long-chain alcohol?

Stet – this is correct per John Musgrave

John

Oxygen sparging and, since 1996, carbonate oxidation are used to ensure that any plutonium, americium, or metallic sodium or potassium left in the salts are converted to nonpyrophoric oxide forms. The NaCl/KCl salt is either discarded under P/S code SS or distilled for recycle and discarded under P/S codes SS or SD. $CaCl_2$ salts are routed to aqueous chloride processing for further plutonium recovery before being discarded under P/S code CXL.

Vanadium pentoxide ($V_2O_5$) was used in place of carbonate to convert metals to oxide as part of the salt stripping process for a few months in 1998. $V_2O_5$ was used in experiments under P/S code SD from early

transferred to P/S codes CX or CXL in chloride operations, or to P/S code LR in nitrate operations (PYRO-12/TWCP-3542). P/S code PK has not been active since 1992 and may have been incorporated into P/S code SS at that time (PYRO-28/TWCP-3542). Due to the potential for leaching heavy metals from the items treated, D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to waste produced from P/S code PK

3.5.12 Plutonium Trichloride Preparation (P/S code PTP)

P/S code PTP was an intermediate process used in Pu metal production. Under this code, carbon tetrachloride was used to prepare plutonium trichloride by bubbling a carrier gas through carbon tetrachloride and passing the mixed gas stream through a bed of plutonium oxide at 500°–600°C before being absorbed in a 5–6 molar potassium hydroxide solution. The scrubber solution went in the caustic waste line to the RLWTF at TA-50. The carrier gases were argon, hydrogen chloride gas, and chlorine gas. The carbon tetrachloride was broken down into phosgene, carbon monoxide, and carbon dioxide gases in this process, which was active between January 1987 and June 1989, at which time the process switched to the use of phosgene gas until the process ended in May 1991. Excess phosgene gas

excess phosphene passed thru water or base? John Musgrave is checking

Feed material for P/S code PTP was high purity oxides from the vault or from P/S codes CA and MA. The product plutonium trichloride was sent to P/S code SS to be reduced to metal by the MSE or ER processes.

3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for pyrochemical processes at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for pyrochemical processes consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites.

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

3.6.1 Physical Waste Form Identification

Solid waste from pyrochemical processes primarily consists of spent salts, magnesium oxide crucibles, and debris waste. Debris waste contains glassware, plastics, ceramic materials, paper, rags, high-efficiency particulate air (HEPA) filters, metal containers, and small tools. Asbestos and leaded gloves may also be generated as process

waste. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item identifier code and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance (QA) personnel. Example forms for one drum of waste generated by pyrochemical processes can be viewed in record TWCP-2513.

would be destroyed or vaporized by the high temperatures of the pyrochemical processes that dominate pyrochemical processing. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005,R.2, Section 8.0). This oil does not enter the LANL disposal operations.

## 9.0 ~~9.0~~ CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)

- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*

- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*

- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.5)

- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)

- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)

- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)

- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)

- Waste Analysis Plan (Attachment B) to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)

- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

# ACCEPTABLE KNOWLEDGE ROADMAP

P/S codes: CRD, ER, MO, MP, OR, Neptunium, PK, PTP, RA, SCB, SD, SS, and SSMD.

Copies of these documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | Budget information may not be acceptable. |
| TWCP-697 | C | Waste management requirements to meet WIPP WAC requirements were formalized in 1984. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste management requirements to meet WIPP WAC requirements. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents how controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents how controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

## Attachment 3 - Acceptable Knowledge Source Document Summary

**Waste Stream Number(s):** LA-CIN01.001, LA-MHD01.001, LA-MIN02-V.001, LA-MIN04-S.001

| **Site(s):** Los Alamos National Laboratory | **Source Document Tracking Number:** D029 |
|---|---|
| **Acceptable Knowledge Documentation Type:**<br>✔ TRU Waste Management Program Information<br>✔ Waste Stream-Specific Information<br>Supporting Information | **Category:**<br>C - Correspondence<br>✔ D - Documents<br>M - Miscellaneous<br>P - Procedures<br>DR - Discrepancy Resolution<br>U - Unpublished Documents |

**Title of Source Document:** Process Acceptable Knowledge Report for Metal Operation Processes at TA-55

**Source Document Reference Information (author(s), document and revision number, date, publisher):** John Musgrave, TWCP-AK-2.1-003 (LA-UR-01-2556), 2, 5/17/01

| AK # [a] | Source Doc. Page # [b] | AK Information Summary |
|---|---|---|
| WS8, WS12 | 27 | See Table 4. Chemical Inputs to Processes ...Section 4.2 Toxicity ListingsD004 applies to P/S code PE, in which arsenic was used in 1984 and perhaps into 1985... |
| WS7 | 12, 3 | TA-55 extracts and recovers plutonium from residues and scraps generated from operations at various LANL and other DOE sites in the defense complex. This is the source of TRU waste contaminated scrap, residues and debris. The scrap and residues are processed to recover as much plutonium as possible. Waste from metal operations are generated from plutonium recovery and purification for defense and non-defense programs. These wastes were generated and produced in the same rooms and gloveboxes and were not segregated until August 1998. |
| WS7, WS9 | vii | Solid TRU waste from metal operation processes consisted of graphite and debris waste including cellulosic, ceramic, plastic, rubber, metal and glass debris. Typical items were rags, gloves (leaded and non-leaded), small tools, steel storage containers, magnesium oxide crucibles, HEPA filters, paper, cardboard, strain gauges, plastic items, and scrap stainless steel. |
| WS1, WS3, WS8, WS9, WS10, WS11, WS12 | ix | Summary Category Groups: S3000, S5000<br><br>Waste Matrix Codes: S3100, S3200s S5100, S5120s, S5300, S5311 an dS5400<br><br>Description: The overall defense related goal of the metal operaion process is to cast and machine plutonium metal. Reactor fuel development is also part of metal operation processes.<br><br>Feed: Plutonium metal or metal alloys and oxides, disassembled weapons components (pits), other actinide metals or metal alloys and oxides, reactor fuel pellets.<br><br>Dates of Generation: 1979 to 2001<br><br>Radioisotpic content:<br>Am-241, Am-243, Co-144, Cm-244, Pa-231, Np-237, Th-232, Th-232 enriched in Th-230, U-233 and depeleted uranium. Am-241, Np-237 and U-234 may be present at detectabel concentrations as decay products.<br><br>RCRA Codes: D004, D007, D008, D035, D040, F001, F002, F005 |
| WS8, WS11, WS12 | 22 | Table 1 contains the Process Feed Materials for Metal Operations Processes including the potential presence of RCRA-regulated substandes and P/S codes used in metal operations. |

ORIGINAL

## Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

| Site(s): Los Alamos National Laboratory | | Source Document Tracking Number: D029 |
|---|---|---|
| **AK # [a]** | **Source Doc. Page # [b]** | **AK Information Summary** |
| WS11 | 24 | Table 2 contains the average isotopic content of plutonium material types and enrichments.<br>Table 3 contains the average isotopic content of uranium material types and enrichments. |
| PR1 | Att 2 | Attachment 2 contains maps of LANL and TA-55. |
| WS3, WS11 | Att. 3 | Attachment 3 contains a detailed time line for metal operations which is broken down by P/S code and hazardous waste numbers |

**Source Document Data Limitations (if any):**

1. Waste volume was not tracked for the P/S codes.

**Acceptable Knowlege Expert:**

Amy Johns Amy Johns Date: 1/14/2009

**Print** **/Sign**

[a] **Obtain from Acceptable Knowledge Documentation Checklist**
[b] **For microfilm or microfiche, identify box, tape, reel number and location.**

## Attachment 3 - Acceptable Knowledge Source Document Summary

| | |
|---|---|
| **Waste Stream Number(s):** LA-CIN01.001, LA-MHD01.001, LA-MIN02-V.001 | |
| **Site(s):** Los Alamos National Laboratory | **Source Document Tracking Number:** D029 |
| **Acceptable Knowledge Documentation Type:**<br>✔ TRU Waste Management Program Information<br>✔ Waste Stream-Specific Information<br>Supporting Information | **Category:**<br>C - Correspondence<br>✔ D - Documents<br>M - Miscellaneous<br>P - Procedures<br>DR - Discrepancy Resolution<br>U - Unpublished Documents |
| **Title of Source Document:** Process Acceptable Knowledge Report for Metal Operation Processes at TA-55 | |
| **Source Document Reference Information (author(s), document and revision number, date, publisher):** John Musgrave, TWCP-AK-2.1-003 (LA-UR-01-2556), 2, 5/17/01 | |

| AK # [a] | Source Doc. Page # [b] | AK Information Summary |
|---|---|---|
| WS8, WS12 | 27 | See Table 4. Chemical Inputs to Processes ...Section 4.2 Toxicity ListingsD004 applies to P/S code PE, in which arsenic was used in 1984 and perhaps into 1985... |
| WS7 | 12, 3 | TA-55 extracts and recovers plutonium from residues and scraps generated from operations at various LANL and other DOE sites in the defense complex. This is the source of TRU waste contaminated scrap, residues and debris. The scrap and residues are processed to recover as much plutonium as possible. Waste from metal operations are generated from plutonium recovery and purification for defense and non-defense programs. These wastes were generated and produced in the same rooms and gloveboxes and were not segregated until August 1998. |
| WS7, WS9 | vii | Solid TRU waste from metal operation processes consisted of graphite and debris waste including cellulosic, ceramic, plastic, rubber, metal and glass debris. Typical items were rags, gloves (leaded and non-leaded), small tools, steel storage containers, magnesium oxide crucibles, HEPA filters, paper, cardboard, strain gauges, plastic items, and scrap stainless steel. |
| WS1, WS3, WS8, WS9, WS10, WS11, WS12 | ix | Summary Category Groups: S3000, S5000<br><br>Waste Matrix Codes: S3100, S3200s S5100, S5120s, S5300, S5311 an dS5400<br><br>Description: The overall defense related goal of the metal operaion process is to cast and machine plutonium metal. Reactor fuel development is also part of metal operation processes.<br><br>Feed: Plutonium metal or metal alloys and oxides, disassembled weapons components (pits), other actinide metals or metal alloys and oxides, reactor fuel pellets.<br><br>Dates of Generation: 1979 to 2001<br><br>Radioisotpic content:<br>Am-241, Am-243, Co-144, Cm-244, Pa-231, Np-237, Th-232, Th-232 enriched in Th-230, U-233 and depeleted uranium. Am-241, Np-237 and U-234 may be present at detectabel concentrations as decay products.<br><br>RCRA Codes: D004, D007, D008, D035, D040, F001, F002, F005 |
| WS8, WS11, WS12 | 22 | Table 1 contains the Process Feed Materials for Metal Operations Processes including the potential presence of RCRA-regulated substandes and P/S codes used in metal operations. |

ORIGINAL

## Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

| Site(s): Los Alamos National Laboratory | | Source Document Tracking Number: D029 |
|---|---|---|
| **AK # [a]** | **Source Doc. Page # [b]** | **AK Information Summary** |
| WS11 | 24 | Table 2 contains the average isotopic content of plutonium material types and enrichments.<br>Table 3 contains the average isotopic content of uranium material types and enrichments. |
| PR1 | Att 2 | Attachment 2 contains maps of LANL and TA-55. |
| WS3, WS11 | Att. 3 | Attachment 3 contains a detailed time line for metal operations which is broken down by P/S code and hazardous waste numbers |

**Source Document Data Limitations (if any):**

1. Waste volume was not tracked for the P/S codes.

**Acceptable Knowlege Expert:**

Amy Johns — Amy Johns — Date: 3/6/08

Print /Sign

[a] Obtain from Acceptable Knowledge Documentation Checklist
[b] For microfilm or microfiche, identify box, tape, reel number and location.

LA-UR-02-1716 ~~D009(AK5)~~
LA-UR-01-2556 D029-AK-6



## INTERIM CHANGE REQUEST

TWCP 15412

| ☑ TWCP ☐ WRR ☐ Other<br>**If Other, please identify:** _____ | **IC Number:** 1 |
|---|---|
| **Person Requesting this Interim Change:** Sandy Wander | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Process Acceptable Knowledge Report for Metal Operation Processes at TA-55 | **Document No./Revision:** TWCP-AK-2.1-003,R.2 (LA-UR-02-1716) |
| **Effective Date of Current Document:** 05/17/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| Title Page, p.1 | Delete "Summary" from title to read:<br>"Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55" | Clarification |
| Global | Change all occurrences of "Sampling Plan" to "AK Information Summary" | document title change |
| Note and 3rd column heading / pp. vi and viii | Delete "summary" from "NOTE" at top if page vi and from "*" note at bottom of page viii<br>Change 3rd column heading on page vi and vii to read:"Process AK Report*"<br>Delete entire 4th column | Clarification |
| Global search and delete / p. 2. | From all references to "process AK summary report," delete "summary" to read "process AK report"<br>From all titles that previously read "Process Acceptable Knowledge Summary Report, " delete "Summary" to read "Process Acceptable Knowledge Report" | Clarification |
| RCRA Constituents/ EPA Hazardous Waste Numbers / p. ix | Add "ARI" to bullet beginning "D007 (chromium)" | Per SME:<br>Code added due to possible stainless steel leaching. |
| | Delete bullet beginning "D022 (chloroform)" | D022 does not apply because high temperature processing would vaporize all chloroform. |
| | Add "(between 1979 through 1984)" to bullet beginning "D035 (methyl ethyl ketone)" | Update date-information to reflect time usage. |
| | Add "MA (from 1995 to the present)" to bullet beginning "F002" | Update report to reflect timeline information |
| | Add "(between 1979 through 1984)" to bullet beginning "F005" | Update report to reflect timeline information |

| | | |
|---|---|---|
| 3.5.1 / p. 8 | In third paragraph-on p. 8, insert "at 1200 °C" at end of next to last sentence. Insert "and carry D022 in P/S code CF in nitrate operations" to end of last sentence.<br><br>In fifth paragraph on p. 8, insert ", thus carrying the D040 code" to end of last sentence. | Per SME:<br>The sintering is a high temperature process, updating report to reflect information.<br><br>P/S code FF carries code D040. Update report to reflect information. |
| 3.5.2.3 / p. 11 | In next to last paragraph, insert ", but no TRU waste is generated" to the end of the next to last sentence. | Per SME, Freon TF used to clean, but no TRU waste generated in this process, therefore no F code. |
| Table 4 / p. 28 | In the "Chloroform" row, change the last sentence in the third column to read: "D022 **does not** apply~~ies~~ to P/S code FF ~~although concentrations are expected to be below RCRA threshold because freeze-drying should have~~ **because sintering** removed ~~most, if not all, of~~ the residual chloroform ~~before the microspheres were taken into the glovebox for sintering~~. | Per SME, D022 does not apply to P/S code FF because high temperature processing would vaporize all chloroform. |
| 4.1 / p. 29 | Insert ", and to P/S code MA from 1995 to the present" at the end of the second bullet<br><br>Insert "from 1970 through 1984" to the end of the third bullet | Per SME, clarification of timelines, update report to reflect changes. |
| 4.2 / p. 29 | Insert "and ARI after 1996 to the end of the third paragraph | Per SME, D007 added after 1996 to P/S code due to possible stainless steel leaching. |
| 4.2 / p. 30 | Delete fourth paragraph from bottom, beginning "D022 applies"<br><br>Insert "from 1979 through 1984" at end of third from last paragraph, beginning "D035 applies" | Per SME, D022 does not apply to P/S code FF because high temperature processing would vaporize all chloroform. Report updated to reflect information<br><br>Per SME, timeframe updated |
| Attach 3/ pp. 2–4<br><br>Page 1 | Delete "D022 from FF timeline. Insert "(only from 1979 through 1984)" after D035 and F005 and insert "F002 (from 1995 to the present)" on lower line in MA timeline. Move vertical bar to end of 1985 from middle of 1984 in PE timeline. Change the year "1982" to "1992" in the second note at end of table.<br><br>Add "D008" to DOP timeline | Timelines updated to reflect SME and timeframe usage information. |
| Attach. 4 / pp. 1, 2, 3, 4, 5, 6, 7, 8, and 9 | Insert "D007" in "EPA Codes" column of ARI row. Delete "D022" from "EPA Codes" column of FF row. Insert "F002" to "EPA Codes" column of MA row. Insert "D008 (gloves)" to "EPA Codes" column of WE row.<br><br>Added "*D008" to EPA Codes column as appropriate | Table updated to reflect information added in report per SME and/or timeframe usage. |
| Attach. 6, pp. 1, 2 | Add new Attachment 6 and update "Contents" page to reflect addition<br><br>Add following paragraph to end of Section 2.0:<br><br>"When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6)." | New TWCP-QP-1.1-021 requirement |

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# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Report for Metal Operation Processes at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-003,R.2 (LA-UR-01-2556)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AO, ARI, BA, BC, BT, CA, CN, CO, CT, DA, DOP, DT, EL, ELW, EM, EVAC, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT

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## HISTORY OF REVISIONS

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|---|---|---|---|
| 0 | 06/28/00 | — | New report (TWCP-03942) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAO CAR-00-036 |
| 2 | 05/17/01 | All | Respond to CBFO review comments and update to include new AK information |
| 2/IC1 | 03/21/02 | Title page, v–ix, 1, 8, 11, 28–30, Att. 3, Att. 4 | Respond to audit comments |

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1 Acceptable Knowledge Roadmap (13 pages)
2 LANL and TA-55 Sites Maps (2 pages)
3 Timeline for Metal Operations (5 pages)
4 Process Inputs and Outputs (9 pages)
5 Simplified Process Flow Diagram for Metal Operations (3 pages)
6 Decision/Discrepancies Resolution Documentation (2 pages)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| AK Information Summary | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001,R.5) |
| ARIES | Advanced Recovery and Integrated Extraction System |
| CFR | *Code of Federal Regulations* |
| C-N-O | carbon-nitrogen-oxygen |
| D | EPA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | Direct Oxide Reduction (process conducted under P/S code OR) |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EB | electron beam |
| EPA | U.S. Environmental Protection Agency |
| F | EPA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| GB | glovebox |
| GTAW | gas tungsten arc welder |
| HEPA | high-efficiency particulate air |
| HIP | Hot Isostatic Press |
| HWN | hazardous waste number |
| K | EPA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| MEK | methyl ethyl ketone |
| MET | Metal [designator for individual documents in metal operation processing reports in Attachment 1, Acceptable Knowledge Roadmap] |
| MOX | mixed oxide |
| MT | material type |
| Nd:YAG | Neodynium:Yttrium Alumina Garnet |
| NMT | Nuclear Material Technology |
| OSWER | Office of Solid Waste and Emergency Response (EPA) |
| P | EPA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| P/S [code] | process/status [code] |
| PCB | polychlorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| PIGMA | pressurized inert gas metal arc [welder] |
| QA | quality assurance |
| QP | quality procedure |

| | |
|---|---|
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| SME | subject matter expert |
| SNM | special nuclear material |
| SOP | safe/standard operating procedure |
| TA | technical area |
| TIG | tungsten inert gas |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization/Certification Program |
| UCNI | Unclassified Controlled Nuclear Information |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request form |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**Note:** This index indicates the main process AK report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| ACL | Analytical Chemistry Laboratory | Miscellaneous Operations |
| AO | Assembly Operation | Metal Operation Processes |
| ARI | ARIES | Metal Operation Processes |
| BA | Basement Isopress | Metal Operation Processes |
| BC | Physical Properties | Metal Operation Processes |
| BT | Burst Testing | Metal Operation Processes |
| CA | Casting | Metal Operation Processes |
| CF | Cement Fixation | Nitrate Operations |
| CN | C-N-O Analysis | Metal Operation Processes |
| CO | Comminution | Metal Operation Processes |
| CT | Compatibility Testing | Metal Operation Processes |
| DA | Alloy Development | Metal Operation Processes |
| DOP | Detector Oxide Preparation | Metal Operation Processes |
| DT | John Ward R&D | Metal Operation Processes |
| EL | Element Loading | Metal Operation Processes |
| ELW | Experimental Laser Welding | Metal Operation Processes |
| EM | Electron Microscopy | Metal Operation Processes |
| ER | Electrorefining | Pyrochemical Processes |
| EVAC | Evacuation and Bake Out | Metal Operation Processes |
| FF | Fuel Fabrication | Metal Operation Processes |
| FSPF | Special Furnace Operation | Metal Operation Processes |
| GI | Pellet Grinding & Inspection | Metal Operation Processes |
| HG | Pu Removal by Mercury | Metal Operation Processes |
| HP | Cement Fixation | Nitrate Operations |
| ID | Immersion Density | Metal Operation Processes |
| IN | Inspection | Metal Operation Processes |
| IS | Incinerator | Nitrate Operations |
| ITF | Impact Test Facility | Metal Operation Processes |
| ITF4 | Impact Test Facility | Metal Operation Processes |
| ITF7 | Impact Test Facility | Metal Operation Processes |
| JA | Gas Isostatic Press | Metal Operation Processes |
| KBTF | Kolsky Bar Test Facility | Metal Operation Processes |
| MA | Machining | Metal Operation Processes |

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| MBC | Crystal | Metal Operation Processes |
| ME | Metallography | Miscellaneous Operations |
| MOX | Mixed Oxide Fuel Production | Metal Operation Processes |
| MW | Metal Working | Metal Operation Processes |
| OB | Oxide Blending | Metal Operation Processes |
| OM | Oxygen To Metal Ratio Determination | Metal Operation Processes |
| OR | Direct Oxide Reduction | Pyrochemical Processes |
| PAF | Passivation Furnaces | Nitrate Operations |
| PCH | Plasma Chemistry | Metal Operation Processes |
| PD | Pit Disassembly | Metal Operation Processes |
| PE | Sputtering Process | Metal Operation Processes |
| PF | Plutonium Surfaces | Metal Operation Processes |
| PH | Thermal Hydride/Dehydride | Metal Operation Processes |
| PIG | Welding | Metal Operation Processes |
| RAP | Research Alloy Preparation | Metal Operation Processes |
| RAP2 | Research Alloy Preparation | Metal Operation Processes |
| RL | Radiochemical Coating | Metal Operation Processes |
| RM | Reduction to Metal | Special Processing |
| RS | Pellet Sintering | Metal Operation Processes |
| SP | Scrap Dissolution, G438 | Nitrate Operations |
| SRL | Special Recovery Line | Metal Operation Processes |
| SS | Salt Stripping | Pyrochemical Processes |
| TIGR | Thermally-Induced Gallium Removal | Metal Operation Processes |
| UA | Uranium Fabrication | Metal Operation Processes |
| VD | Vapor Degreaser and Sand Blasting | Metal Operation Processes |
| WE | Welding | Metal Operation Processes |
| WLT | Welding Leak Test | Metal Operation Processes |
| WM | Waste Management | Miscellaneous Operations |

* Process AK reports: Metal Operation Processes (this report), Miscellaneous Operations (TWCP-AK-2.1-004,R.2), Pyrochemical Processes (TWCP-AK-2.1-006,R.2), and Special Processing (TWCP-AK-2.1-007,R.2)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste Generating Process:** Metal Operations

**P/S codes:** AO, ARI, BA, BC, BT, CA, CN, $CO_x$, CT, DA, DOP, DT, EL, ELW, EM, EVAC, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed debris

**Site:** LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, as well as associated maintenance operations and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from metal operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

TA-55 Plutonium Facility, Building PF-4, rooms 115, 124, 125 and 126 (reactor fuel development activities) and rooms 38 East, 113, 114, 201E, 305, 306, 308, 309, 319 and 327 (other metal operation processes). Plutonium operations included preparing ultra-pure plutonium metal, alloys, and compounds; preparing specific alloys on a large scale; determining high temperature thermodynamic properties of plutonium; and disassembling compounds for inspection and analysis.

**Description of the process waste (physical form and typical content description):**

Solid TRU waste from metal operation processes consists primarily of graphite and debris waste, including cellulosic, ceramic, plastic, rubber, metal, and glass debris. Typical debris items are rags, gloves (leaded and non-leaded), small tools, steel storage containers, magnesium oxide crucibles, HEPA filters, paper, cardboard, strain gauges, plastic items, and scrap stainless steel.

Solid TRU waste from reactor fuel development processes: tungsten carbide and hardened steel press dies, diamond or aluminum oxide grinding wheels, HEPA filters, rubber, wood, paper, rags, cardboard, glass vials, balances, steel and brass storage containers, ceramic, graphite, magnesium oxide crucibles, vacuum pumps, graphite trays, tungsten trays, molybdenum trays, thermocouples, heating elements, non-leaded gloves, and stainless and hardened steel balls.

***Summary Category Groups:*** S3000, S5000

***Waste Matrix Codes:*** S3100, S3200, S5100, S5110, S5120, S5300, S5310, S5311, S5400

**Description of the waste-generating process:**

The overall defense-related goal of the metal operation processes is to cast and machine plutonium metal. Reactor fuel development is also part of metal operation processes.

**Process feed:**

Plutonium metal or metal alloys and oxides, disassembled weapons components (pits), other actinide metals or metal alloys and oxides, reactor fuel pellets.

**Radioisotopic content of the waste:**

Variety of uranium and plutonium material types with different well-defined isotopic compositions; various radionuclides used as sources, including Am-241, Am-243, Ce-144, Cm-244, Pa-231, Np-237, Th-232, Th-232 enriched in Th-230, U-233, and depleted uranium. Am-341, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Cs-137 and Pa-231 may be occasionally be present in trace amounts.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D004 (arsenic): P/S code PE (1984–1985 only)
- D007 (chromium): P/S codes ARI, PCH
- D008 (lead materials): P/S codes BT, DOP, and KBTF
- D008* (leaded gloves until May 1992): P/S codes BA, BC, CA, DA, DOP, IN, JA, MA, MW, PCH, PE, PF, PH, RL, UA, VD, WE
- D035 (methyl ethyl ketone): P/S code MA (between 1979 through 1984)
- D040 (trichloroethylene): P/S codes EL, FF, and MA (for MA, applies from 1979–1992 and from February 2000–present)
- F001: P/S code MA due to use of trichloroethylene (from 1979–1992 and from February 2000 to the present)
- F002: P/S codes DA and MA (form 1995 to the present) due to use of Freon TF
- F005: P/S code MA due to use of methyl ethyl ketone (between 1979 through 1984)
- No K or P codes apply

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR METAL OPERATION PROCESSES AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes that generated TRU waste in the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for several waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to TA-55 waste streams resulting from metal operation processes covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001) (AK Information Summary) that includes information regarding all TRU waste streams
- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to metal operations is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No. TWCP-3541. Individual documents in this record have been assigned a separate identifier, MET-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

present in the process wastes, based on subject matter expert (SME) interviews and any relevant records

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) is contained in these records, and will not be included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK report is part of a set of closely related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six operational areas. The multiple processes in each area are described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003) [this report]
- *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, metal operation processes include 49 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6).

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in metal operation processing, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Most processes in metal operations were solely defense-related (TWCP-614, TWCP-4162). Exceptions are the majority of activities in the reactor-fuel fabrication program that was active from 1979 to 1997, and ongoing non-defense research and development (R&D) activities. However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste (LLW). Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (DLs) (TWCP-816).

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the AK Information Summary. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

## 3.3 Waste Physical Form and Waste Content Description

Wastes generated during metal operation processes consist primarily of debris wastes, and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. General debris waste consists of cellulosic materials (for example, paper, cloth), plastics (for example, gloves, tape, labware), rubber, metal, and glass debris.

- Debris waste from the reactor fuel development operations includes tungsten carbide and hardened steel press dies; diamond or aluminum oxide grinding wheels; high-efficiency particulate air (HEPA) filters; rubber; wood; paper; rags; cardboard; glass vials; balances; steel and brass storage containers; ceramic, graphite, and magnesium oxide crucibles (crucible waste out of P/S code CN), vacuum pumps; graphite and molybdenum trays; thermocouples; non-leaded gloves; and stainless and hardened steel balls.

- Debris waste from on-going metal operations include rags, graphite, gloves (leaded and non-leaded), steel storage containers, graphite and tantalum crucibles, HEPA filters, paper, cardboard, plastic items, and scrap aluminum and stainless steel.

- Debris waste from developmental metal operations include rags, gloves (leaded and non-leaded), HEPA filters, paper, cardboard, strain gauges, plastic items, and scrap stainless steel.

These debris items are contaminated with small amounts of radioactive and chemical substances from metal operation processes.

## 3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1979, when metal operation processes first began, to the present. Wastes from the metal operation processes have different associated EPA hazardous waste numbers (HWNs) depending on

the time period during which they were generated. The P/S codes, their time period of generation, and corresponding EPA HWNs are shown graphically in Attachment 3, Time Lines.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

## 3.5 Waste Generation Processes

The following subsections describe the generation of waste by metal operation processes.

Manufacturing and research operations performed at TA-55 in the production of plutonium also generate plutonium-contaminated scrap and residues. The metal operation processes contribute to these scrap and residue wastes. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery and manufacturing operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352). A full-block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

Metal operation processes can be divided into three categories:

- Reactor fuel development processes (Section 3.5.1)
- On-going metal operation processes conducted since TA-55 began operations (Section 3.5.2)
- Developmental metal operations that were developed recently (Section 3.5.3)

Processes included in each of these three categories are described below. Timelines for these processes are shown Attachment 3. A complete listing of P/S codes for metal operation processes, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. A simplified process flow diagram for metal operations is found in Attachment 5.

3.5.1 Reactor Fuel Development (P/S codes CN, CO, CT, EL, FF, GI, ID, MOX, OB, OM, RS)

Procedures for reactor fuel development activities reviewed during the AK search did not have P/S codes assigned to them. However, SME input provided assignment of P/S codes to these procedures (references MET-1 through MET-38 and MET-59 [all in TWCP-3541]). The descriptions below are based on SME input, as indicated in the text and in Attachment 4.

Enriched uranium oxide, depleted uranium oxide, and/or plutonium oxide feeds were blended and mixed with graphite and stearic acid. Stearic acid was used to keep the material from sticking during milling. The blended oxide was then pressed into briquettes. This operation was performed under P/S code OB. Small pieces of briquette and powder left after pressing were sent to the vault or to recovery.

The briquettes produced under P/S code OB were transferred to P/S code RS for carbothermic reduction. In this process the plutonium or uranium oxide were reduced to the carbide form, resulting in the removal of most carbon and nearly all oxygen from the material, and in the decomposition of the stearic acid. The carbide briquettes were then transferred to P/S code CO.

A jaw crusher was used to reduce the size of the carbide briquettes in preparation for pulverizing in P/S code CO. The crushed material was mixed with 0.2 wt.% stearic acid and polyethylene glycol. A vibratory mill pulverized the crushed material to 325 mesh. Nickel powder at a concentration of 2000 ppm was added to the pulverized carbide as a sintering aid. This material was sent back to P/S code RS.

The plutonium and uranium carbide powder was pressed into pellets under P/S code RS. These pellets were then loaded into molybdenum trays. The trays were placed in a furnace at 450 °C to burn off the stearic acid and polyethylene glycol. Small amounts of MolyKote were used for hand pressing of pellets. The pellets were sintered in an argon-hydrogen atmosphere at 1600 °C. Sintered pellets were transferred to P/S code GI.

Pellets were inspected to meet specification (P/S code GI). Out-of-specification material was ground to specification with either diamond or aluminum oxide grinding wheels. A final inspection was performed on these pellets with a hand micrometer, which was later replaced by a laser micrometer. Those pellets that met final inspection specifications were transferred to P/S code EL. Those that did not were sent to the vault for recovery. Sample pellets were collected for chemical analysis (P/S code ACL), carbon-nitrogen-oxygen (C-N-O) analysis (P/S code

CN), compatibility testing (P/S code CT), immersion density measurements (P/S code ID), metallographic inspection (P/S code ME), and/or determination of the oxygen to metal ratio (P/S code OM). (P/S codes ACL and ME are discussed in *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* [TWCP-AK-2.1-004].)

Fuel pellets were loaded into fuel elements under P/S code EL. Pellets were placed into "V" troughs made of 1-inch x 1-inch V-shaped stainless steel and aluminum for measurement of fuel pellet dimensions. After the dimensional analysis, the pellets were transferred into another glovebox through a one-inch port. Maintenance of a differential pressure between gloveboxes, with lower pressure in the glovebox where dimensional analysis was done, ensured the cleaniness of the glovebox in which the fuel cladding was added. The fuel pellets were transferred into the cladding glovebox through the port. The cladding tube was held in a lathe while the pellets were pushed into the cladding with a pushrod. A stainless steel shroud tube was placed in the cladding tube prior to insertion of the pellets. A spring and end cap were placed in the open end of the cladding tube, and a tungsten inert gas (TIG) weld was made at the joint between the end cap and the cladding. Cladding, spring, and end cap were stainless steel. Bonding of the fuel was done with either helium or sodium. Any excess sodium was reacted with Dowanol 80 to form a stable sodium salt, which prevented metallic sodium from entering the waste stream.

A cleaning machine was used outside the glovebox for cleaning the different tubing prior to loading. The cleaning solution was ethanol, water, and a mild caustic or acid. Any waste generated from this operation would not be TRU waste. These operations took place in Room 124 from 1979 until 1994.

In February 1988, P/S codes CN, CO, CT, EL, GI, ID, OB, OM, and RS for reactor fuel development became P/S code FF, marking the change from carbide fuels to nitride fuels. All processes under the old P/S codes should have remained the same under P/S code FF. Molybdenum equipment was replaced with tungsten equipment. No changes occurred in the chemicals used in the processes except for removal of the nickel sintering aid. Defense-related SP100 reactor fuel wastes were segregated from all other wastes.

Magnesium perchlorate was used in the glovebox line in P/S code FF, and was the only chemical used there (TWCP-5158). It was used as a water getter, and was changed once during the period 1987 to 1992. The spent chemical was sent to cement fixation, P/S code CF.

From 1988 to 1989, P/S code MOX was set up to fabricate mixed oxide (MOX) fuel. Researchers from Hanford were the principal personnel involved in the work. Only a small amount of LANL waste was generated under this P/S code; the remainder was segregated as Hanford-generated waste. Zinc stearate was used as an anti-sticking agent during blending.

Starting in 1996 and continuing to the present time, LANL began work on MOX fuel under P/S code FF. As a result of the current effort in MOX fuel development, the issue of gallium removal became important. Early thermal gallium removal was the precursor to Thermally Induced Gallium Removal under P/S code TIGR (see section 3.5.3.11).

Some R&D efforts took place under P/S code FF. Microspherical fuel R&D was conducted mostly in a fumehood, not in a glovebox, and the waste generated from this operation would be low level. The microspherical fuel work involved the use of graphite, depleted uranium, sugar, surfactants, and ethylene glycol, which were mixed with water to form slurry. This slurry was sprayed or injected into supercooled hexane or chloroform in order to form frozen microspheres. The microspheres were then freeze-dried before being introduced into a glovebox where they were sintered at 1200 °C. Some of the depleted uranium microspheres were discarded in cemented waste and carry D022 in P/S code CF in nitrate operations.

Uranium residues and scrap from the reactor fuel development program had several disposal paths (MET-75/TWCP-3541). Most of the highly-enriched uranium nitride fuel went to the Y-12 Plant in Oak Ridge, Tennessee, and some remaining material in the TA-55 vault will also be sent there in the near future. However, the Y-12 Plant will not accept this material in the form of scrap or excess because of its plutonium contamination, nor will the Y-12 Plant take depleted nitride pellets due to the low uranium enrichment. Consequently, those items have been oxidized and blended as necessary, canned, and stored in the vault. Depleted nitride material used for development was burned and discarded in a cement matrix. Earlier carbide fuels were sent to Savannah River Site for recovery. MOX material is being consolidated and packaged for shipment and recovery at the Savannah River Site.

Acetone was used outside the glovebox, and ethanol was used inside the glovebox. Trichloroethylene was used as a lubricant for an Isomet cut-off saw, thus carrying the D040 code.

Waste materials generated from the reactor fuel development program included: tungsten carbide and hardened steel press dies; diamond or aluminum oxide grinding wheels; HEPA filters; rubber; wood; paper;

rags; cardboard; glass vials; balances; steel and brass storage containers; ceramic, graphite, and magnesium oxide crucibles (crucible waste out of P/S code CN), vacuum pumps; graphite, tungsten and molybdenum trays; thermocouples; heating elements; non-leaded gloves; and stainless and hardened steel balls.

3.5.2 On-Going Metal Operation Processes

3.5.2.1 P/S Code BA: Basement Isopress

The Autoclave Hot Isostatic Press (HIP) uses high pressure and high temperature (up to 1500 °C) to increase the densities of parts (MET-48/TWCP-3541). R&D projects to bond materials and consolidate powders are also mentioned in the written procedure. In addition to plutonium, other isotopes that may be used in the HIP include Am-241, Cm-244, Np-237, U-233, and Pu-242 as long as the material is placed in coupons. The process takes place in Room 38 East. Wastes include rags and paper from cleaning; tools; spent hydraulic fluid, silicone lubricant and isopropyl alcohol; and miscellaneous materials consisting of stainless steel, aluminum, titanium and firebrick.

3.5.2.2 P/S Code BC: Physical Properties

Measuring Physical Properties (MET-41, MET-64 [both in TWCP-3541]) is a procedure that describes techniques for the study of physical properties of alloys, including the structural, magnetic, electronic and metallurgical properties of actinide metals, alloys and compounds. A muffle furnace with an argon atmosphere is used for testing sample homogeneity or compatibility, and for temporary storage. Measurements include dilatometry (thermal expansion) and electrical resistivity. A Carver press is used to produce sample wires and pellets. The process takes place in Room 113, glovebox G187. Wastes include rags and paper from cleaning; glass, plastic, and metal labware; and discarded dies from the press.

3.5.2.3 P/S Code CA: Casting

The casting process receives plutonium metal from pyrochemical operations under P/S codes RM or SS (described in TWCP-AK-2.1-006 and TWCP-AK-2.1-007, respectively) depending on material type, or from other sources such as P/S code SRL. The metal is combined with

other metal from different sources to produce a product metal that meets purity specifications. Specification metal is then cast as a prealloyed feed aliquot at which time gallium metal is added, it is analyzed chemically in-line to determine the proper gallium content, and the metal is placed into in-line storage. Metal is pulled from in-line storage to cast into shapes. Casting is done by an induction furnace using tantalum crucibles and tantalum puller plugs. Molten plutonium is poured into the graphite mold through a tantalum funnel. Casting is done under vacuum so that the plutonium does not oxidize. The mold is allowed to cool at which time the cast shape is unmolded and sent to heat treatment to homogenize the plutonium. After heat treatment, the parts undergo density determination using bromobenzene. Bromobenzene is volatile, and hence evaporates and is removed by the ventilation system. The cast shape undergoes a final heat treatment and density measurement. The finished cast parts are sent to machining (P/S code MA), or are placed in temporary in-line storage. Other parts produced by casting are transferred to P/S codes such as ITF and KBTF.

Chemical analysis is performed on rejected parts. If the rejected parts meet the chemical requirements, the parts are added to other metal in the metal blending step described above. Those parts that do not meet the chemical specifications are cast into ingots. These ingots are sent to P/S code RM or SS, depending on the material type, to be electrorefined.

Casting skulls, which are small amounts of plutonium left on the furnace and crucible surfaces, are oxidized to plutonium oxide. The plutonium oxide easily brushes from the metal surfaces with a paintbrush, thus allowing the tantalum crucibles and funnels to be reused many times. In addition, scrap from the cast pre-alloyed feed aliquot and the casting step are roasted to oxide. This plutonium oxide is sent to aqueous recovery.

Graphite molds have always constituted the largest volume of waste from casting operations because these molds are used only once. R&D efforts are exploring the use of metal molds because they would be reusable, thereby reducing the amount of waste generated by casting operations. The used graphite molds sometimes undergo a scabbling process in which the graphite mold surfaces are removed so that

residual plutonium can be dissolved from these fines. The graphite molds are discarded as waste under P/S code CA.

Other wastes generated by casting include the occasional discard of tantalum crucibles and funnels, tools, rags, gloves (leaded), gaskets, and small amounts of plastics and glass. All these items would be discarded under P/S code CA.

Bromobenzene and Freon TF are the only chemicals used in casting. Freon TF is used infrequently to clean the furnace and tantalum parts, but no TRU waste is generated. The Freon-cleaned parts are air-dried.

Roadmap references for casting are MET-45, MET-62, and MET-66 (all in TWCP-3541).

3.5.2.4 P/S Code MA: Machining

Machining involves a variety of operations on cast parts obtained from P/S code CA. Machining operations include turning, milling, grinding, and boring. The objective of the machining operations is to bring the parts to their final dimensional specifications.

Chemicals used in the past as coolants during machining include Tap Magic (which contains 1,1,1 trichloroethane) and Freon TF. Tap Magic use was discontinued in 1992, and Freon TF use was discontinued in 1995 because it was an inferior coolant for plutonium due to the nature of machining this metal. Processes within machining have used dry machining techniques since 1992. When cooling is required, SF-2I is used. SF-2I is a perfluro compound made by 3M. Although the components are proprietary information and therefore not known, SF-2I is quite volatile and evaporates during use. Texaco Regal 32 is used as a cutting oil for the final cut on a part because of the superior finish it gives to the final cut. Although Tap Magic contains 1,1,1 trichloroethane, the EPA HWN F002 listing does not apply in this case because the chemical was used as a coolant, and not as a solvent.

Cleaning solvents were used in machining operations in the past, and still are occasionally used, although with less-hazardous substitutes. Methyl ethyl ketone (MEK) (EPA HWNs D035 and F005) was used. Metalprep 79 was a phosphoric acid-based metal cleaner used until about 1992

when it was replaced by a metal cleaner derived from citrus fruit. This cleaner met with only limited success and is no longer used. Freon TF is used to remove oil from turnings (degreasing) before they are sent to recovery. For final cleaning, trichloroethylene was used from 1979 until 1992, when it was replaced by the use of ethanol or isopropanol until February 2000. Since February 2000, trichloroethylene has been used to clean parts at the assembly stage. Cellulosic wastes generated as a result of assembly operations under P/S code MA would have EPA HWN F001 from 1979 to 1992 and again during March 2000, as well as EPA HWN D035 throughout its period of operation (in the absence of information about the extent of use of MEK).

*Ultrasonic Pit Inspection* is a physical inspection process performed during machining and uses no chemicals. The process takes place in Room 319. The written procedure did not include a process flow diagram.

Roadmap references for machining are MET-42, MET-62, MET-67, MET-68, and MET-76 (all in TWCP-3541).

Wastes generated from machining operations include rags, gloves, small amounts of plastics and other metals, routine glovebox maintenance items, tools, grinding wheels, and cutters. Cellulosic, plastic and rubber wastes generated under P/S code MA would be conservatively assigned the EPA HWNs F001 and F005 because of the historical and continuing use of F-listed solvents. This code would not apply to glass or metal debris because the non-porous surfaces of these materials would not absorb any fluid.

3.5.2.5 P/S Codes MW: Metal Working, PD: Pit Disassembly, and SRL: Special Recovery Line

Pit disassembly is conducted under P/S codes MA, MW, PD, and SRL, depending on whether the pit is contaminated with tritium (MET-42, MET-51, MET-52, MET-53, MET-62 [all in TWCP-3541]). The procedures describe separation and sampling of pit assemblies using milling, turning and grinding techniques. The process takes place in Rooms 305, 308, 309 and 319.

Pits are received and monitored for tritium. If no tritium is detected or is below a specified activity, the pit is placed in GB 386 where it is cut in half, and its components are

separated and decontaminated of slight tritium contamination. Care is taken not to mix non-special nuclear material metals with the special nuclear material (SNM) metals. The non-SNM metals are discarded as waste. Uranium and plutonium shells are decontaminated of minor surface contamination. Uranium shells are sent to the vault. Plutonium shells are sent to the vault or to P/S codes CA, MA, or SS. P/S code SS is discussed in *Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006).

Tritium is recovered in the Special Recovery Line (P/S code SRL) if tritium is above a specified activity. Separation of pit components is done using a special abrasive cut-off wheel. The pit is cut in half, and the shells are cleaned with copper wool and Freon TF. Scrap is sent to recovery or to waste management depending on whether the material is SNM or not. After the shells are cleaned with the copper wool and Freon TF, they are placed in an ultrasonic bath for cleaning using product SF-2I. Tritium-contaminated water is collected and poured over zeolites for disposal.

Small-scale decontamination of tritium-contaminated plutonium and other SNM is done in the SRL furnace. The SRL furnace area consists of different sections, including metal handling, tritium removal furnace, equipment for collecting tritium liberated in furnace, and effluent treatment system. The procedure that describes the operation of the furnace and furnace gas treatment system contains no details on disposition of output materials, or post-run cleaning operations.

Wastes generated from pit disassembly operations include rags and paper from cleaning, glass and rubber labware, hand tools and aluminum foil, cutting wheels, milling machine cutters, and lathe cutting tools. Tritium-contaminated trash is generated in the form of copper wool and rags.

3.5.2.6 P/S Code PCH: Plasma Chemical Reactor

Plasma etching of samples is conducted in a 20-liter vacuum chamber into which up to four process gases are dynamically pumped (MET-40/TWCP-3541). The gases are tetrafluoromethane, hexafluoroethane, perfluoropropane, oxygen, argon and carbon dioxide. Two electrodes are in the chamber: (1) an upper power electrode through which

reactant gas enters, and (2) a lower substrate electrode where the sample is placed. A plasma of the gases is formed through ionization and disassociation of the gases. The process takes place in Room 114, glovebox GB111, and in Room 319, in hood XB305. Wastes include rags and paper from cleaning; glass, plastic and metal labware; used pump oil (Fomblin brand, contains perfluoropolyether); discarded test samples such as tantalum foil, tungsten foil, tungsten-coated silicon, silicon dioxide; and various actinide surfaces. No RCRA-regulated materials are used. Gases are consumed in the plasma. EPA HWN D007 (chromium) is assigned to solid wastes generated under P/S code PCH.

3.5.2.7 P/S Code PH: Thermal Hydride/Dehydride

a. Plutonium Hydriding System

The plutonium hydriding process studies the reactions of Plutonium alloys and other actinides with hydrogen and other gases (MET-43/TWCP-3541). The process takes place in Room 114, glovebox 110, and uses no chemicals other than the gases. Wastes include debris wastes, but the types of wastes are not mentioned in the procedure.

b. Operating the Hydride-Dehydride Systems

The hydride-dehydride operating procedure describes how to safely form plutonium hydride, and then to decompose it to plutonium metal (MET-44/TWCP-3541). Three phases are involved: (1) phase one uses hydrogen gas in large amounts and dehydriding is done in a separate reactor, and (2) phases two and three use a closed loop, minimal hydrogen gas, and a single reactor. The process takes place in Room 114, GB 116, GB 119 and GB 154. No chemicals are used besides the gases. Wastes produced are debris wastes, not RCRA-regulated, including rags and paper from cleaning, used Fromblin pump oil and tools.

3.5.2.8 P/S Code WE: Welding

Welding operations under P/S code WE fall into two categories: encapsulation of radioactive isotopes (MET-39/TWCP-3541) and other welding operations (MET-69/TWCP-3541). Two methods of welding are employed: a gas tungsten arc welder (GTAW) and an

electron beam (EB) welder. Encapsulation of radioactive isotopes involves placing the isotope to be sealed into a stainless steel capsule and subsequently welding the capsule closed. The exterior of the capsule is cleaned with Freon TF. The Freon TF is allowed to evaporate, hence no wiping of the capsule surface with rags is required. Other welding operations include welding of plutonium samples on vanadium in an argon atmosphere, brazing gold to repair platinum frits, welding titanium to repair titanium boats, and welding of aluminum. No welding of lead occurs. Welding outside of the glovebox line is also done under this P/S code. Waste generated under P/S code WE includes hand tools, spent welding rods, stainless steel capsules, rags, and glovebox maintenance items.

Other P/S codes included in the Ongoing Metal Operations are covered below; however, no written procedures were found for them, and descriptions are based solely on SME information.

3.5.2.9 P/S Code DA: Alloy Development

This process was for the development of plutonium alloys (MET-55/TWCP-3541). Pu metal was placed in metal cups onto which the alloying metal was coated on the cup walls. The alloys were melted in the metal cups. The melt was allowed to cool. Observations were made on the success of the alloying process. If the alloy reacted with the cup, it was sent to aqueous recovery. If not, it could either be sent back to casting (P/S code CA) or possibly to electrorefining (P/S code ER or SS), depending on the circumstances. Bromobenzene was used for density measurements. Freon TF was used to clean parts prior to 1992; accordingly, EPA HWN F002 was assigned to cellulosic, rubber, and plastic debris from this process during that time period. No RCRA-listed metals were used to produce the alloys. Outputs of P/S code DA would go to P/S codes CA, SS (ER, prior to SS), or aqueous recovery. Waste would include rags, gloves, metal cups, and other general glovebox maintenance items.

3.5.2.10 P/S Code DOP: Detector Oxide Preparation

This operation involved preparation of radionuclide detector packages. The process ended operations in 1993, and the two gloveboxes involved have been inactive since that time. However, TA-55 personnel are planning to clean out those

gloveboxes so that new operations can be carried out in them. AK information in this report will still be applicable to the decommissioning waste, but will be generated in 2001. A small amount of lead sheet was used for shielding (TWCP-5167); therefore, EPA HWN D008 applies to waste generated under this P/S code. No RCRA-listed chemicals were used in this operation, although leaded gloves were probably discarded under this P/S code (MET-71, MET-72/TWCP-3541).

3.5.2.11 P/S Code DT: John Ward R&D

This P/S code was used in a nonprocessing area, and only generated routine TRU glovebox waste.

3.5.2.12 P/S Code EM: Electron Microscopy.

No written procedures were found for this process, and the SMEs associated with the process have either retired or left the laboratory.

3.5.2.13 P/S Code HG: Plutonium Removal by Mercury

Only "cold" work was done under this P/S code so no TRU waste would be generated from it (MET-62/TWCP-3541).

3.5.2.14 P/S Code IN: Inspection

This code applies to the physical inspection of parts for dimensionality (MET-69/TWCP-3541), which only generates routine glove box maintenance waste items.

3.5.2.15 P/S Code ITF, ITF4, and ITF7: Impact Test Facility

ITF4 is an old designation for P/S code ITF. There is a 7-inch gas gun (ITF7) and a 40-mm powder gun (ITF4) used in this test facility (MET-58/TWCP-3541). The 7-inch gun is used for Pu-238 experiments, such as heat source impact testing and impact testing of Pu-238 capsules in graphite blocks. No explosives are used in this process. The entire test is conducted in a tube so that the material is contained. The entire tube with contents is transferred back to Nuclear Material Technology (NMT)-9 for recovery elsewhere in Building PF-4. No TRU waste is generated from the 7-inch gun experiments.

The 40-mm gun enables the experimenter to generate data on materials in high stress environments. During the test, a projectile propelled to hyper-velocity by a charge of smokeless powder, strikes an instrumented target contained within a glovebox. The target is shattered into macro and microscopic pieces during the impact and the projectile is arrested by a series of stopping plates. Target materials can range from surrogate materials to actinides. Post test, the remains of the target material, projectile, instrumentation, and stopping plates are removed as waste or reused. Materials are segregated to minimize generation of mixed wastes and to recover actinides for reuse. The barrel, breech and other operating parts are cleaned using rags and GoJo cleaner. Since the launcher is contained within a glovebox, materials removed are possibly contaminated with actinides. MET-70/TWCP-3541 has a more complete description of the process and of the wastes generated.

Wastes generated from this operation include rags, metals, wire, HEPA filters, and gloves. GoJo cleaner is a high-purity kerosene derivative.

3.5.2.16 P/S Code JA: Gas Isostatic Press

This process is similar to P/S code BA except that it takes place in a glovebox, samples are not heated, and air is the medium used to pressurize the press instead of hydraulic oil (MET-64, MET-69 [both in TWCP-3541]). No RCRA-listed chemicals were used in this process. Only rags and glovebox maintenance items were generated. This process was active from 1979 to 1997 or 1998.

3.5.2.17 P/S Code PE: Sputtering Process

From 1982 to 1990, this process sputtered various metals onto plutonium and vice versa (MET-54/TWCP-3541). The only RCRA-listed metal used was arsenic (EPA HWN D004) for a short duration in 1984 to 1985. Other metals recalled by the SME were gold and lutetium. No solvents were used in this process.

3.5.2.18 P/S Code PF: Plutonium Surfaces

Starting in 1983 and continuing to the present, various physical and spectroscopic methods are used to characterize plutonium surfaces (MET-64/TWCP-3541). Freon TF and

SF2I are used outside the glovebox line as cutting fluids. An alcohol is used, but the SME could not recall which type.

3.5.2.19 P/S Code RL: Radiochemical Coating

Based on SME input, this process is similar to P/S code PE (MET-65/TWCP-3541). Metals were coated onto plutonium. Metals used by this SME were gold and lutetium. No solvents were used.

3.5.2.20 P/S Code UA: Uranium Fabrication

Two activities are covered by this P/S code—pit disassembly and detector fabrication (MET-69/ TWCP-3541). Uranium shells removed during pit disassembly are accounted for under P/S code UA. Plutonium operations that are identical during pit disassembly to the uranium operation are covered under P/S codes IN, MW and SRL. Detector packages using uranium-233 were fabricated under P/S code UA, generating the same types of wastes as were generated by detector package fabrication under P/S code WE. This P/S code may contain leaded gloves; however, no lead chemicals were used. P/S code UA generates the same wastes as do P/S codes IN, MW and SRL.

3.5.2.21 P/S Code VD: Vapor Degreaser & Sand Blasting

Sand blasting is a "cold" operation. The vapor degreaser operation cleans parts in an ultrasonic bath using Freon TF (MET-69/TWCP-3541). The operation accepts parts from P/S codes CA, PE, and PF. The parts are placed in the ultrasonic bath, cleaned, and allowed to air dry. Over time, the Freon TF evaporates from the bath. Wastes include rags and general glovebox maintenance items.

3.5.3 Developmental Metal Operations

3.5.3.1 P/S Code ARI: ARIES

The Advanced Recovery and Integrated Extraction System (ARIES) is a demonstration process which receives and disassembles pits, plutonium hydrides and metallic plutonium, from which it produces Pu metal or oxide powder (MET-49/TWCP-3541). The product is canned for long-term storage. Wastes include plutonium-contaminated debris waste. Wastes also come from the electrolytic decontamination module. No RCRA-regulated waste is produced.

Operation of the ARIES Electrolytic Can Decontamination System (MET-50/TWCP-3541) decontaminates the external surfaces of canned plutonium using an electrolytic decontamination system. An electrolyte (initially sodium nitrate, now sodium sulfate) and water are used in the system in a recycle mode. Sodium hydroxide is used for pH control. Wastes include electrolyte and water solutions contaminated with plutonium. There is the potential for chromium (D007) to be present in the electrolyte solution waste when this solution has been used to decontaminate stainless steel. Although no disposal path is mentioned in the reference, it is assumed that this liquid waste is sent either to cement fixation (P/S code CF) or to the RLWTF at TA-50.

Other P/S codes included in the Developmental Metal Operations group but for which no procedures were found during this AK search are listed below. SME input provided information on these P/S codes.

3.5.3.2 P/S Code AO: Assembly Operations

Operations in P/S code AO involve bringing nuclear material out of the glovebox and encapsulating it in a cold container (MET-69, MET-74/TWCP-3541). This outer container can be a bolted assembly or a welded assembly using electron beam, pressurized inert-gas metal arc (PIGMA), tungsten inert gas (TIG), or laser welding techniques. No solvents are used. Wastes include aluminum foil, plastic bags, and gloves. This waste is nearly always LLW.

3.5.3.3 P/S Code BT: Burst Testing

Hemi-shells are placed on a test stand and a buffered test solution is pumped into the shell and pressurized until it bursts (MET-58/TWCP-3541). Strain gauges monitor the deformation of the shell. The test solution is sodium tetraborate and sodium hydroxide and is filtered and reused. The solution is eventually discarded in the caustic waste line to the RLWTF at TA-50.

Wastes include rags. HEPA filters, gloves, electric lead wires, and strain gauges. Strain gauges have electrical contact points that are tin-lead solder. Metal waste from this P/S code would, therefore, carry EPA HWN D008. No solvents are used.

3.5.3.4 P/S Code ELW: Experimental Laser Welding

Laser welding and brazing is performed at TA-55 on a variety of materials, ranging from stainless steel to SNM materials (MET-60/TWCP-3541). It is performed in one of three high-purity argon gloveboxes located in PF-4. A 1-kW, pulsed Neodynium:Yttrium Alumina Garnet (Nd:YAG) laser energy beam is delivered into the glovebox environment through an optical fiber. Computerized numerical control motion systems and rotary motion systems manipulate the relative position of the laser with respect to a weld joint. Laser melting and subsequent solidification is used to join the components being fabricated. No RCRA constituents are used in this process.

3.5.3.5 P/S Code EVAC: Evacuation and Bake Out

Only LLW is generated under this P/S code (MET-69, MET-74/TWCP-3541).

3.5.3.6 P/S Code FSPF: Special Furnace Operations

This process involves heating samples in a controlled environment (MET-57, MET-64/TWCP-3541). The furnace is controlled by a computer, and is capable of being evacuated by a cryo-pump during the heating. There is a neutron detector that can be used during heating. The furnace is large enough to do full-size tests, and can also be used to heat-treat samples. Although no chemicals are used, waste is created by compatibility and weld testing, mostly in the form of contaminated scrap metals, ceramics, glass, and plastic.

3.5.3.7 P/S Code KBTF: Kolsky Bar Test Facility

The KBTF is a gas gun operation for physical property testing (MET-58/TWCP-3541). A stainless steel bar with plastic seals at each end is fired by gas pressure down a stainless steel barrel that strikes a target, usually plutonium. Behind the target is another stainless steel bar instrumented with sensors. This bar is butted against a plastic wrapped lead brick at the back of the chamber. The facility started operation in December 1997 and has had 40 shots fired thus far.

Wastes include rags, HEPA filters, and gloves. The rags may contain some lead/lead oxide from cleaning operations; hence, wastes from this operation are assigned EPA HWN

D008. The barrel is cleaned with a cotton swab. No solvents are used.

3.5.3.8 P/S Code MBC: Crystal

This process studied the work hardening of plutonium (MET-63/ TWCP-3541). Plutonium metal samples were placed in a Carver press and subjected to high pressure. The Carver press developed a leak and was discarded. No RCRA-listed constituents were used in this operation. Rags and routine glovebox maintenance items are typical wastes generated under this P/S code.

3.5.3.9 P/S Code PIG: Welding

This operation uses aluminum to weld beryllium (MET-61/ TWCP-3541). No other metals have been used. Ethanol is the only chemical used in this operation.

3.5.3.10 P/S Code RAP and RAP2: Research Alloy Preparation

No activity has occurred in these P/S codes (MET-64/ TWCP-3541).

3.5.3.11 P/S Code TIGR: Thermally Induced Gallium Removal

The process involves passing argon—6 percent hydrogen gas—over $PuO_2$-$Ga_2O_3$ powder at 600 °C to 1200 °C to produce $Ga_2O$ and $H_2O$. $Ga_2O$ is evolved from the powder and condenses on a cold spiral condenser downstream. The $Ga_2O$ is eventually converted to $Ga_2O_3$ upon exposure to the glovebox atmosphere (MET-56/TWCP-3541). No RCRA constituents are used in this process.

3.5.3.12 P/S Code WLT: Welding Leak Test

This operation performs the leak detection of containers back-filled with gas to allow storage of plutonium metal in gloveboxes without reaction with atmospheric contaminants (MET-74/TWCP-3541). No solvents are used. Because items under P/S code WLT are in the glovebox line, they become TRU waste when discarded. These items consist of plastic rags and bags, cotton gloves, and a minimal quantity of metal including Swagelok fittings.

### 3.6 Material Inputs to the Waste Generation Processes

Attachment 4 lists P/S codes for metal operation processes at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for metal operation processes consist of the general types of materials listed in Table 1 that are obtained from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites.

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

**Table 1. Process Feed Materials for Metal Operation Processes**

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes in Metal Operation Processes |
|---|---|---|
| Disassembled weapons components (pit disassembly) | High-purity Pu and U material types | ARI, CA, PH, SRL |
| Pu metal or metal alloys | High purity, no RCRA-regulated substances, unless noted otherwise | AO, ARI, BC, BT, CA, DA, ELW, EVAC, FSPF, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MW, PCH (variable purity), PD, PE, PF, PH, RL, SRL, VD, WE, WLT |
| Pu and other radionuclides, as oxides | High purity, no RCRA-regulated substances | DOP |
| Reactor fuel pellets | High purity Pu and U material types, no RCRA-regulated substances | FF, MOX, OB |

#### 3.6.1 Physical Waste Form Identification

Waste from metal operation processes primarily consists of debris waste, including cellulosic materials, plastics, rubber, metal debris, glass debris, and graphite. Some waste is immobilized in cement and discarded under P/S codes CF or HP (discussed in TWCP-AK-2.1-005). Process waste from reactor fuel development processes include tungsten carbide and hardened steel press dies, diamond or aluminum oxide grinding wheels, HEPA filters, rubber, wood, paper, rags, cardboard, glass vials, balances, steel and brass storage containers, ceramic, graphite, and magnesium oxide crucibles, vacuum pumps, graphite and molybdenum trays, thermocouples, non-leaded gloves, and stainless and hardened steel balls. Process waste from other metal operations include rags, graphite, gloves (leaded and non-leaded), steel storage containers,

graphite and tantalum crucibles, HEPA filters, paper, cardboard, strain gauges, plastic items, and scrap stainless steel.

Leaded gloves are also generated as process waste. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste were incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item ID number and record its matrix material. This form was signed by the waste packager, then reviewed and approved by quality assurance (QA) personnel.

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for metal operation processes at TA-55 are listed in Table 2. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The MT notation was developed because it is a convenient way to describe MTs that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the MTs at the time the waste was characterized.

The MT provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. These bounding calculations provide a basis for identifying enrichment or depletion of one radionuclide verus another based on radioassays of individual waste containers. The results of these calculations are also tabulated in Table 2. The calculations assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

The primary uranium MT inputs for reactor fuel development activities and for pit disassembly at TA-55 are listed in Table 3.

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Pu Isotope (Wt.%) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

SOURCE: TWCP-698

**Table 3. Average Isotopic Content of Uranium Material Types and Enrichments (Wt.%)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

SOURCE: TWCP-698

Metal operation processes primarily receive feed material from other P/S codes, particularly P/S code SS (*Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55* [TWCP-AK-2.1-006]) and RM (*Process Acceptable Knowledge Report for Special Processing at TA-55* [TWCP-AK-2.1-007]), and are not expected to alter the isotopic ratios of the feed material. The MT used in the process generating each waste item was documented on the WODF and DWLS. Many P/S codes processed feed material in which radionuclides other than plutonium were present in significant levels (Attachment 4):

- Depleted or enriched uranium metal or oxides were the process feed materials for P/S codes CN, FF, GI, MW, OB, PD, RS, SRL, and UA. Of these codes, FF, PD, and SRL are still active.

- P/S code WE worked with radionuclides used as sources from 1978 to the present (Am-241, Am-243, Ce-144, Cm-244, depleted uranium, Pa-231, Np-237, Th-232, Th-232 enriched in Th-230) (TWCP-882).

- P/S codes BC and JA worked with Am-243 (1992 to present), depleted uranium (1990 to present), Np-237 (1983 to present), Pa-231 (1989), and Th-232 enriched in Th-230 (1994 to present). (P/S code JA ended in 1997 or 1998; BC is still active.)

- P/S code DOP worked with Am, Ce-144, Cm-244, Np-237, Th-232, U-233. Cm-244 was introduced in P/S code DOP starting in 1988, but could also show up after that date in P/S codes IS, WE, CA and CF (TWCP-5165).

- P/S code BA worked with various radionuclides (unspecified).

- P/S code PI worked with U, Np, and Am isotopes (TWCP-5166).

In some cases, SME information has identified several P/S codes in which secondary radionuclides are expected to be present in process wastes, in addition to the cases listed above (TWCP-698):

- Some of the process wastes from P/S codes CA and MA contain Am-241, Am-243 and Np-237 during the period 1984 to 1990.

- Some of the process wastes from P/S code PH contains Am-243 (1993 to present).

Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present mostly in minor amounts in nearly all debris waste from metal operation processes at TA-55, with the exceptions as noted above.

Cs-137 and Pa-231 could be present in trace amounts due to their widespread presence as contaminants in TA-55 operations (TWCP-5164, TWCP-5165).

In general, uranium and its isotopes are expected to be present only at trace levels, if at all, if the feed material did not purposefully contain uranium. If the waste generator indicates that only plutonium is present in the feed material, then U-236 and U-238 are not expected to be present in measurable concentrations. U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. On the other hand, U-234 would be present in MT 83 (and to a lesser extent in other plutonium material types) as a decay product of Pu-238 (half-life, 87.74 years) (Table 2). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total plutonium would be about 0.14. After 36 years, this ratio would increase to 0.26.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). If warranted, this AK report will be updated to incorporate the results of these comparisons.

3.6.3 Chemical Content Identification

Chemical inputs to metal operation processes are listed in Table 4.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA HWNs to process wastes from metal operations is summarized below, as well as on the process timelines in Attachment 3, and the table of process inputs and outputs in Attachment 4. These assignments are based on the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

4.1 F, K, and P Listings

The following F listings only apply to cellulosic, ceramic, plastic, and rubber items. The F listings do not apply to glass or metal debris, even if these items were in contact with the F-listed chemicals, because their non-porous surfaces do not absorb liquids or gases.

**Table 4. Chemical Inputs to Processes Described in This Report**

| Chemical Input | P/S Codes in which RCRA-Listed Chemical Is Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| **Gases** | | |
| Argon<br>Carbon dioxide gas<br>Hexafluoroethane gas<br>Hydrogen<br>Oxygen<br>Perfluoropropane gas<br>Tetrafluoromethane gas | | |
| **Bases** | | |
| Potassium hydroxide<br>Sodium hydroxide | NA | D002 (strong base) does not apply because there are no free liquids in the solid wastes from these processes. |
| **Inorganic Chemicals** | | |
| Graphite<br>Magnesium perchlorate<br>Silicone lubricant<br>Sodium nitrate<br>Sodium sulfate<br>Sodium tetraborate | FF | D001 (oxidizer) does not apply to P/S code FF (TWCP-5158). |
| Uranium nitride, depleted | FF | D003 does not apply in this case. Although uranium nitride is pyrophoric, its disposal in an oxidizing environment eliminates this characteristic because it is converted to uranium oxide |
| Uranium oxide, depleted<br>Zinc stearate<br>Zirconium carbide | | |
| **Metals** | | |
| Arsenic metal<br>Copper wool<br>Gallium<br>Gold metal | PE | D004 applies to P/S code PE; used between 1984 to 1985 |
| Lead metal<br>Lutetium metal<br>Nickel powder, Nickel ribblets<br>Niobium + 1% zirconium metal (as sheet)<br>Platinum | DOP, KBTF | D008 applies to P/S codes DOP and KBTF |
| Sodium metal | EL | D003 does not apply because excess Na is dissolved in Dowanol 80 |
| Stainless steel | WE | D007 does not apply. No potential to leach chromium because stainless steel is not exposed to strong acids in P/S code WE |
| Tin-lead solder | BT | D008 applies to metal waste generated under P/S code BT |
| Titanium<br>Uranium metal powder, depleted<br>Vanadium metal | | |

| Chemical Input | P/S Codes in which RCRA-Listed Chemical Is Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| **Organic Chemicals** | | |
| 3-in-1 Household Oil | | |
| Acetone | FF, MOX | F003 does not apply because acetone was only used outside the glovebox and hence is not in the TRU process waste |
| Bromobenzene | | D001 does not apply because there are no free liquids in solid waste |
| Chloroform | FF | D022 does not apply to P/S code FF because sintering removed the residual chloroform. |
| Dow Corning 2000 Oil | | |
| Dowanol 80 (long-chain alcohol) | | |
| Ethanol | | D001 does not apply to ethanol; no free liquids in this waste |
| Ethylene glycol | | |
| Fantastic | | |
| Freon TF | CA, DA, MA, MW, PD, PF, SRL, UA, VD, WE | F002 applies to P/S code DA.. In P/S codes MA and PF, F002 does not apply because Freon TF is used as a coolant for cutting saws. In other P/S codes, Freon TF is used as a solvent to clean metal parts, but the parts are routinely air-dried to avoid the need for cellulosic wipes, and F002 does not apply. |
| Fomblin pump oil (contains perfluoropolyether) | | |
| GoJo cleaner (kerosene derivative) | | |
| Hexane | | D001 does not apply; no free liquids in this waste |
| Isopropanol | | D001 does not apply; no free liquids in this waste |
| Metalprep 79 (phosphoric acid-based metal cleaner) | | |
| Methanol | | F003 does not apply because methanol is only used outside glovebox. |
| Methyl ethyl ketone | MA | F005 and D035 apply to P/S code MA |
| MolyKote | | |
| Nuetracleaner #1 | | |
| Nuetracleaner #2 | | |
| Polyethylene glycol | | |
| SF-2I (as coolant) | | |
| Stearic acid | | |
| Sugar | | |
| Surfactants | | |
| Tap Magic (contains 1,1,1 trichloroethane) | MA | F002 does not apply because Tap Magic is used as a metal cutting fluid or coolant, not as a solvent. Its use was discontinued in 1992. |
| Tetrachloroethane | | No codes apply. Although tetrachloroethane is listed on the chemical inventory for metal operations, it was never used in glovebox operations |
| Texaco Regal 32 oil (cutting oil) | | |

| Chemical Input | P/S Codes in which RCRA-Listed Chemical Is Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| Trichloroethylene<br><br><br><br><br>Vactra Oil<br>Windex | EL, FF, MA | D040 applies to P/S codes EL, FF, and MA. F001 applies to P/S code MA, in which trichloroethylene was used as a degreaser during final cleaning of metal parts from 1979 to 1992, resuming again in February 2000. No F codes apply to EL or FF, in which trichloro-ethylene was used as a lubricant for a cutting saw, not as a solvent or degreaser. |

- F001 applies to wastes generated under P/S code MA due to the use to trichloroethylene as a degreaser until 1992, resuming again in February 2000.
- F002 applies to wastes generated under P/S code DA because Freon TF was occasionally used in this process, and to P/S code MA from 1995 to the present.
- F005 applies to waste generated under P/S code MA due to the use of methyl ethyl ketone from 1979 through 1984.

K or P listings do not apply to solid wastes generated from any of the metal operation processes because no K-listed or P-listed chemicals were present in the feed materials, chemicals or equipment used in these processes.

4.2 Toxicity Listings

D001 (ignitable), D002 (corrosive), or D003 (reactive) listings do not apply to the solid wastes from metal operation processes because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 5.0). Although the strong oxidizer magnesium perchlorate was used as a water getter in P/S code FF, the used salts were sent to cement fixation (TWCP-5158).

D004 applies to P/S code PE, in which arsenic was used in 1984 and perhaps into 1985 (MET-54/TWCP-3541).

D007 applies to P/S code PCH and ARI after 1996.

D008 applies to metal debris from P/S codes codes BA, BC, CA, DA, DOP, IN, JA, MA, MW, PCH, PE, PF, PH, RL, UA, VD, and WE until May 1992, when leaded gloves began to be routinely segregated from other metal debris waste (TWCP-4166). Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, leaded gloves were segregated and discarded in the metal debris waste stream. Since May 1992, leaded gloves

have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

D008 applies to metal waste generated under P/S code BT due to the use of tin-lead solder connections on the strain gauges used in this series of experiments (MET-58/TWCP-3541).

D008 applies to P/S code KBTF, in which a plastic-wrapped lead brick is used as a damper at the rear end of the test chamber (MET-58/TWCP-3541). Waste could potentially be contaminated with lead or lead oxide during clean-up operations in the test chamber.

D008 applies to P/S code DOP due to the use of lead sheet for shielding (TWCP-5167).

D035 applies to P/S code MA due to the use of methyl ethyl ketone from 1979 through 1984.

D040 applies to P/S codes EL and FF due to the use of trichloroethylene as a lubricant in an Isomet cut-off saw (MET-59/TWCP-3541).

D040 applies to P/S code MA due to the use of trichloroethylene in the final cleaning of metal parts from 1979 to 1992, resuming again in February 2000.

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes that the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix."

Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), in use at LANL since 1991, includes a statement that must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) re-emphasizing the prohibition on liquids in the waste, and the continuation of waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data are used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166) and were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of LANL Direct Oxide Reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed, or the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see sections 5.0 and 6.0.

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the metal operation processes, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 4, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is

drained, it is handled by a subcontractor who is wholly responsible for its disposal (*Process Acceptable Knowledge Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005, R.2, section 8.0]); this oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Records Management* (TWCP-QP-1.1-004)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- *Waste Analysis Plan, to the Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088, Attachment B)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## ACCEPTABLE KNOWLEDGE ROADMAP

Waste Stream: Waste from Process/Status codes ARI, BA, BC, BT, CA, CN, CO, CT, DA, DOP, DT, EL, ELW, EM, FF, FSPF, GI, HG, ID, IN, ITF, ITF4, ITF7, JA, KBTF, MA, MBC, MOX, MW, OB, OM, PCH, PD, PE, PF, PH, PIG, RAP, RAP2, RL, RS, SRL, TIGR, UA, VD, WE, WLT

Copies of these documents are in the TWCP RMDC Center. Refer to *Records Management* (TWCP-QP-1.1-004) for information on obtaining copies.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of Pu recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering Pu from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | None |
| TWCP-697 | C | Waste management requirements to meet WIPP WAC requirements were formalized in 1984. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste management requirements to meet WIPP WAC requirements. Generator Attachments were used to describe and reference specific generator procedures. | Overview document—Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

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|---|---|---|---|---|---|
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Waste was co-mingled with room trash, and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits. | None |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process/status code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | N/A | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Segregation of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997. | None. |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests were conducted on residues rather than on waste. |
| MET-1/TWCP-3541 (UCNI) | C | Reactor Fuels Development | MAS-NF-DE-11-13—Potential hazards associated with metallography in Room 115 | Describes metallography process involved in reactor fuel development. | None |
| MET-2/TWCP-3541 (UCNI) | C | Reactor Fuels Development | MAS-NF-DE-11-18—Metallographic procedure for making alpha autoradiographs | Describes procedure for making alpha autoradiographs. | None |

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|---|---|---|---|---|---|
| MET-3/TWCP-3541 (UCNI) | C | Reactor Fuels Development | MAS-NF-DE-11-8—Metallurgical examination of Pu-contaminated materials | Describes procedure for metallurgical examination of Pu-contaminated materials. | None |
| MET-4/TWCP-3541 (UCNI) | C | Reactor Fuels Development | MAS-NF-DE-11-14—Identification of potential hazards associated with metallography in Rooms G104 and G107 | Describes procedure for identifying hazards associated with metallography at TA-55. | None |
| MET-5/TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3401—Cleaning of SP-100 fuel pin components (P/S EL) | Describes procedure for cleaning of SP-100 fuel pin components. | None |
| MET-6/TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3402—Heat treatment of SP-100 components (P/S EL) | Describes process for heat treatment of SP-100 components. | None |
| MET-7/TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3530—Shroud tube fuel and insulator pellet loading (P/S EL) | Describes process for shroud tube fuel and insulator pellet loading. | None |
| MET-8/TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3540—Fuel element component assembly (P/S EL) | Describes process for fuel element component assembly. | None |
| MET-9/TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3570—Fuel element and component examination (P/S EL) | Describes process for fuel element and component examination,. | None |
| MET-10/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3590—Wire wrap (P/S EL) | Describes process for wire wrap. | None |
| MET-11/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3620—Fuel and insulator pellet archive (P/S EL) | Describes process for fuel and insulator pellet archives. | None |
| MET-12/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3630—Sampling of EBRI-II type fuel elements and wrap wires for residual chloride and fluoride (P/S EL) | Describes process for sampling of EBRI-II type fuel elements and wrap wires for residual chloride and fluoride. | None |

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|---|---|---|---|---|---|
| MET-13/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3820—Cleaning requirements for large components (P/S EL) | Describes process for cleaning and requirements for large components. | None |
| MET-14/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3830—Cleaning for small components (P/S EL) | Describes process for cleaning of small components. | None |
| MET-15/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3340—Sodium melting using cassette (P/S EL) | Describes process for sodium melting using cassette. | None |
| MET-16/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-FI-3002—Fabrication and inspection of He-bonded fuel elements (P/S EL) | Describes process for fabrication and inspection of He-bonded fuel elements. | None |
| MET-17/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-FI-3004—Fabrication and inspection of Na-bonded WSA-60 fuel pin capsules (P/S EL) | Describes process for fabrication and inspection of Na-bonded WSA-60 fuel pin capsules. | None |
| MET-18/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-MS-2006—Material specification for 235-U | Describes process for material specification for 235-U. | QA Requirement documents |
| MET-19/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-MS-2004—Carbothermic process material specification for U oxide powder | Describes process for carbothermic process material specification for U oxide powder. | QA Requirement documents |
| MET-20/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-MS-2001—Carbothermic process material specification for Pu oxide powder | Describes process for carbothermic process material specification for Pu oxide powder. | QA Requirement documents |
| MET-21/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-MS-2000—Material specification for U oxide powder, depleted | Describes process for material specification for depleted U oxide powder. | QA Requirement documents |
| MET-22/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2011—Master blend preparation for Pu oxide powder (P/S OB and FF) | Describes process for master blend preparation for Pu oxide powder. | None |

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|---|---|---|---|---|---|
| MET-23/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2040—Vacuum reduction procedure for U carbide or U-Pu carbide preparation (P/S RS and FF) | Describes process for vacuum reduction for U carbide or U-Pu carbide preparation. | None |
| MET-24/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2050—Comminution and Ni addition for U carbide or U-Pu carbide (P/S CO and FF) | Describes process for comminution and Ni addition for U carbide or U-Pu carbide. | None |
| MET-25/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2060—Automatic pellet pressing (P/S MOX and FF) | Describes process for automatic pellet pressing. | None |
| MET-26/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2070—Sintering for U or U-Pu carbide pellets (P/S MOX, RS, and FF) | Describes process for sintering for U or U-Pu carbide pellets. | None |
| MET-27/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2080—Manual pellet pressing (P/S MOX and FF) | Describes process for manual pellet pressing. | None |
| MET-28/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2090—Sampling sintered fuel and insulator pellets (P/S MOX, GI, and FF) | Describes process for sampling sintered fuel and insulator pellets. | None |
| MET-29/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2100—Measuring density of sintered fuel or insulator pellets (P/S MOX, ID, GI, and FF) | Describes process for measuring density of sintered fuel or insulator pellets. | None |
| MET-30/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2110—Physical inspection and size sorting (P/S MOX, GI, and FF) | Describes process for physical inspection and size sorting. | None |
| MET-31/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2130—Centerless grinding (P/S MOX, GI, and FF) | Describes process for centerless grinding. | None |
| MET-32/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-2160—Binder burnout (P/S RS, MOX, and FF) | Describes process for binder burnout. | None |
| MET-33/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3000—Cleaning requirements (P/S EL) | Describes process for cleaning requirements. | None |

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|---|---|---|---|---|---|
| MET-34/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3300—Sodium canister startup and casting (P/S EL) | Describes process for sodium canister startup and casting. | None |
| MET-35/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3310—Sodium extrusion (P/S EL) | Describes process for sodium extrusion. | None |
| MET-36/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3330—Sodium loading into fuel elements (P/S EL) | Describes process for sodium loading into fuel elements. | None |
| MET-37/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3350—Sodium bonding (P/S EL) | Describes process for sodium bonding. | None |
| MET-38/ TWCP-3541 (UCNI) | C | Reactor Fuels Development | FAB-PP-3360—WSA capsule loading and sodium melting (P/S EL) | Describes process for WSA capsule loading and sodium melting. | None |
| MET-39/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | 353-WEL—Encapsulation of Radioactive Isotopes (P/S WE) | Describes process for encapsulation of radioactive isotopes | Vague description of process; therefore vague on chemical use |
| MET-40/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | 118-MRD—Plasma Chemical Reactor (P/S PCH) | Describes process for plasma chemical reactor operation | None |
| MET-41/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | 116-MRD -Measuring Physical Properties (P/S BC) | Describes process for measuring physical properties | Poor description of chemical use |
| MET-42/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | 397-SEC—Safe Operating Procedure for Pit Disassembly (P/S MW, MA, PD, SRL) | Describes process for safe operating procedure for pit disassembly | None |
| MET-43/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | NMT5-SOP-3026-MRD—Plutonium Hydriding System (formerly 3026-MRD-R01) (P/S PH) | Describes process for Pu hydriding system | None |
| MET-44/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | 119-MRD—Operating the Hydride-Dehydride Systems (P/S PH) | Describes process for operating the hydride-dehydride systems | None |
| MET-45/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | 317-CAS—Button Breaking Press (P/S CA) | Describes process for button breaking press | None |

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|---|---|---|---|---|---|
| MET-46/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | 321-MET—Ultrasonic Degreaser (P/S MA) | Describes process for operation of the ultrasonic degreaser | None |
| MET-47/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | ESA-2 SOP-20.6.4—Ultrasonic Pit Inspection at TA-55 (P/S MA) | Describes process for ultrasonic pit inspection at TA-55 | None, physical inspection—no chemical use |
| MET-48/ TWCP-3541 (UCNI) | C | On-Going Metal Operations | 399-MET—Operating the Autoclave Hot Isostatic Press (P/S BA) | Describes process for operating the autoclave hot isostatic press | None |
| MET-49/ TWCP-3541 (UCNI) | C | Developmental Metal Operations | NMT6-AP-AR-142—ARIES Integration System (P/S ARI) | Describes process for ARIES integration system | Weak on describing chemical use |
| MET-50/ TWCP-3541 (UCNI) | C | Developmental Metal Operations | NMT6-SOP-AR-127—Operation of the ARIES Electrolytic Can Decontamination System (P/S ARI) | Describes process for operation of the ARIES electrolytic can decontamination system | None |
| MET-51/ TWCP-3541 (UCNI) | C | Developmental Metal Operations | ATP/SRL-104—Pit Disassembly (formerly 397-SRL-R04) (P/S SRL) | Describes process for pit disassembly | None |
| MET-52/ TWCP-3541 (UCNI) | C | Developmental Metal Operations | ATP/SRL-105—Processing Material in the Special Recovery Line Furnace (P/S SRL) | Describes process for processing material in the special recovery line furnace | None |
| MET-53/ TWCP-3541 (UCNI) | C | Developmental Metal Operations | 397-SRL—Pit Disassembly (Special Recovery Line) (P/S SRL) | Describes process for pit disassembly (Special Recovery Line) | None |
| MET-54/ TWCP-3541 (UCNI) | D | Information regarding P/S code PE | Rueben Gutierrez, SME, 2/17/2000 | Sputtering operations deposited Pu onto other surfaces. Other sputtering operations deposited other metals as thin films onto Pu. | No procedure existed for this process. SME recall of information about a process that occurred over a decade ago. |
| MET-55/ TWCP-3541 (UCNI) | D | Information regarding P/S code DA | Dale Soderquist, SME. 2/28/2000 | P/S code DA was a process to study Pu alloys. | No procedure existed for this process. |

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|---|---|---|---|---|---|
| MET-56/ TWCP-3541 (UCNI) | D | Information regarding P/S code TIGR | David Kolman, SME, 3/2/2000 | Process is a dry process to remove gallium from Pu. Very little waste generated from this process. | No procedure existed for this process. |
| MET-57/ TWCP-3541 (UCNI) | D | Information regarding P/S code FSPF | Janice Aasen, SME, 3/7/2000 | FSPF replaced P/S code DA and was set up to be like DA. Process involves heating samples in a furnace under a controlled environment. | As with P/S code DA, no procedure existed for FSPF. |
| MET-58/ TWCP-3541 (UCNI) | D | Information regarding P/S codes KBTF, ITF, ITF4, ITF7, and BT | Jim Foxx, SME, 3/15/2000 | Jim Foxx interviewed Ben Lopez, SME for KBTF and ITF, ITF4, and ITF7. Both processes are impact tests for determining physical properties of materials. | No procedures existed for these processes. |
| MET-59/ TWCP-3541 (UCNI) | D | Information regarding the reactor fuels program. | Ken Chidster, Roberta Simpson, and Rudy Fernandez, SMEs, 3/7/2000, 3./13/200 | Provided detailed information on reactor fuels development work. Provided information on P/S codes CN, CO, CT, EL, FF, ID, OB, OM, MOX, and RS. | Very thorough source of information |
| MET-60/ TWCP-3541 (UCNI) | D | Information regarding P/S code ELW | John Milewski, SME, 2/29/2000 | Laser welding operation for Pu and other metals. Minimal amounts of waste generated, no RCRA-listed constituents | No procedure existed for this process |
| MET-61/ TWCP-3541 (UCNI) | D | Information regarding P/S code PIG | Richard Oleary, SME, 2/29/2000 | Welding operation in which ethanol is the only chemical use. | No procedure existed for this process |
| MET-62/ TWCP-3541 (UCNI) | D | Information regarding P/S code CA, MA, PD, SRL, and HG | David Olivas, Charles Rense, SMEs, 3/2/2000 | Information provided clarified issues for these P/S codes that were unclear from the limited procedures available. | Limited number of procedures available for these P/S codes, hence it was difficult to generate a clear understanding of these processes. |

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| MET-63/ TWCP-3541 (UCNI) | D | Information on P/S code MBC | Mike Blau, Dane Spearing, SMEs, 3/6/2000, 3/8/2000 | Information on potential RCRA-listed constituents. This operation uses none. | No process description available |
| MET-64/ TWCP-3541 (UCNI) | D | Information on P/S codes RAP, RAP2, FSPF, PF, and JA | Barbara Cort Martinez, SME, 2/29/2000 | Reasonable information on P/S code PF obtained, but limited information on other codes. Time information good. RCRA information good. | No procedures existed for these processes. Sketchy information on P/S code JA process. Limited information on P/S code FSPF. |
| MET-65/ TWCP-3541 (UCNI) | D | Information on P/S code RL | Jack Simpson, SME, 2/28/2000 | Process is similar to P/S code PE in that Pu metal was coated with thin film of other metals. | No procedures existed for this process. SME couldn't recall a lot of detail. |
| MET-66/ TWCP-3541 (UCNI) | D | Information on P/S code CA | Dale Soderquist, SME, 3/29/2000 | Detailed information on casting operations. | Procedures available for casting operations provided little useful information. SME input provided the detail. |
| MET-67/ TWCP-3541 (UCNI) | D | Information on chemicals used in machining operations, P/S code MA. | George Zakar, SME, 3/15/2000 | SME provided a list of chemicals used in machining operations. | Procedures available for machining operations were sketchy and provided little information about chemical use in machining. SME input provided a detailed list. |
| MET-68/ TWCP-3541 (UCNI) | D | Information regarding P/S code MA | George Zakar, SME, 3/29/2000 | SME provided detailed information on machining operations that was not available from the procedures. | Procedures provided little information on process descriptions or chemicals used in machining. SME input provided required information. |
| MET-69/ TWCP-3541 (UCNI) | D | Information regarding P/S codes AO, EVAC, IN, JA, UA, VD, and WE | Jim Foxx, SME, 4/12/2000 | SME provided information on process and wastes generated from these various P/S codes. | No procedures existed for these P/S codes. |

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|---|---|---|---|---|---|
| MET-70/ TWCP-3541 (UCNI) | | Waste Management Plan, October 14, 1999 Rev. 1, 40-MM Powder Breech Project, TA-55 Bldg. PF-4, Los Alamos National Laboratory | Jim Foxx, 3/9/2000 | Information regarding P/S code ITF. Includes process description, some of the materials used. | Details on materials used is sketchy, hence input from SME was required. |
| MET-71/ TWCP-3541 (UCNI) | C | Procedure for Curium-244 Detector Fabrication, P/S code DOP | TA-55 Document, 308-FAB-R03 | Contains materials used in the process | No RCRA analyses documents |
| MET-72/ TWCP-3541 (UCNI) | C | Procedure for Robotic Isotope Detector Fabrication | TA-55 Document, 3029-DET-R00 | Contains materials used in the process | No RCRA analyses documents |
| MET-73/ TWCP-3541 (UCNI) | D | Information regarding P/S codes PPD, UA, VD, IN, WE and type of Dowanol used in P/S codes EL and FF | Jim Foxx, SME, 5/2/2000 | SME provided additional information about processes, time periods, and chemical use and type | Answers to specific questions |
| MET-74/ TWCP-3541 (UCNI) | D | Information regarding P/S codes AO, EVAC, MA, and WLT | Jim Foxx, SME, 6/26/2000 | SME provided additional information on P/S codes AO, EVAC, and WLT than was contained in MET69 | Answers to specific questions |
| MET-75/ TWCP-3541 (UCNI) | D | Information regarding deposition of uranium used in reactor fuel development | Jim Foxx, SME, 6/27/2000 | SME provided information on uranium deposition | Answers to specific questions |
| MET-76/ TWCP-3541 (UCNI) | D | Information on TCE use in P/S code MA | Jim Foxx, SME, 6/29/2000 | SME provided information on trichloroethylene use in P/S code MA | Answers to specific questions |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |

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|---|---|---|---|---|---|
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4162 | D | Answers to questions about P/S codes PB, PuBe, CC, MB, MS, FF, BF, and other issues | Interview with Jim Foxx, 10/12/00 | Answers to questions on use of asbestos at TA-55, non-defense activities, and specific P/S codes in chloride operations. | None |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of Ag, disposal of ash and resins, and use of gases. | None |
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of Ag from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that Ag in ash is below limits of regulatory concern | None |
| TWCP-4720 | A | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |

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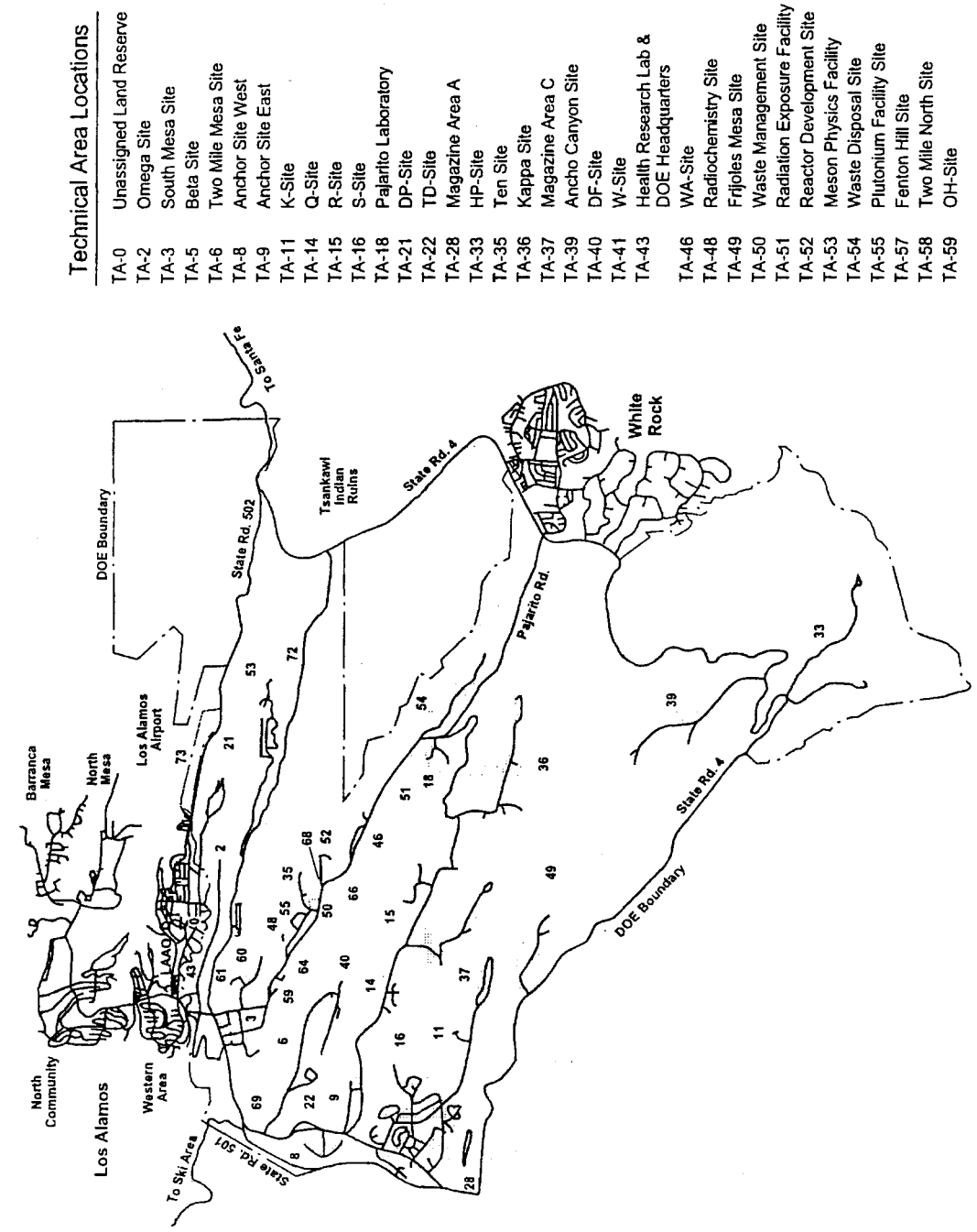
| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5158 | D | Chemical use in P/S code FF | Interview with Fred Hampel (TA-55 SME) on 4/19/01 | Magnesium perchlorate was used in the glovebox line in P/S code FF, and was the only chemical used there. It was used as a water getter, and was changed once during the period 1987 to 1992. The spent chemical was sent to cement fixation, P/S code CF. | No information about after 1992 |
| TWCP-5164 | D | Sources of Cs-137 and Pa-231 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 2, 2001 | Plutonium operations never handled Cs-137 or Pa-231 in any of the Pu processing areas at TA-55. However, Cs-137 is expected to be present in the wastes because it is a fission product of several Pu isotopes. Pa-231 is expected to be present (as a function of the age of the waste) because it is a decay chain daughter of Pu-239 and U-235. | None |
| TWCP-5165 | D | Sources of Cs-137, Pa-231, and Cm-244 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Dominant source of Cs-137 expected to be due to residual contamination from original separation of Pu from production fuel. Cm-244 introduced in P/S code DOP starting in 1988, but could also show up after that date in IS, WE, CA and CF. | None |
| TWCP-5166 | D | Secondary radionuclides used in P/S code PI | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Amendment of Foxx's 1997 memo (TWCP-882): P/S code PI was a user of U, Np and Am isotopes | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5167 | D | Use of lead in P/S code DOP | Interview with Jim Foxx (TA-55 SME) on February 7, 2001 | In addition to an encapsulated lead pig, P/S code DOP also used lead shielding (which therefore requires application of HWN D008 to its waste). | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2 | A | *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | A | *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for nitrate operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | A | *Process Acceptable Knowledge Report for Pyrochemical Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for pyrochemical operations at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | *Process Acceptable Knowledge Report for Special Processing Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-PLAN-0.2.7-001,R.5 | C | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK reference base on generator's original data | Detailed information on each waste drum and waste stream | None |

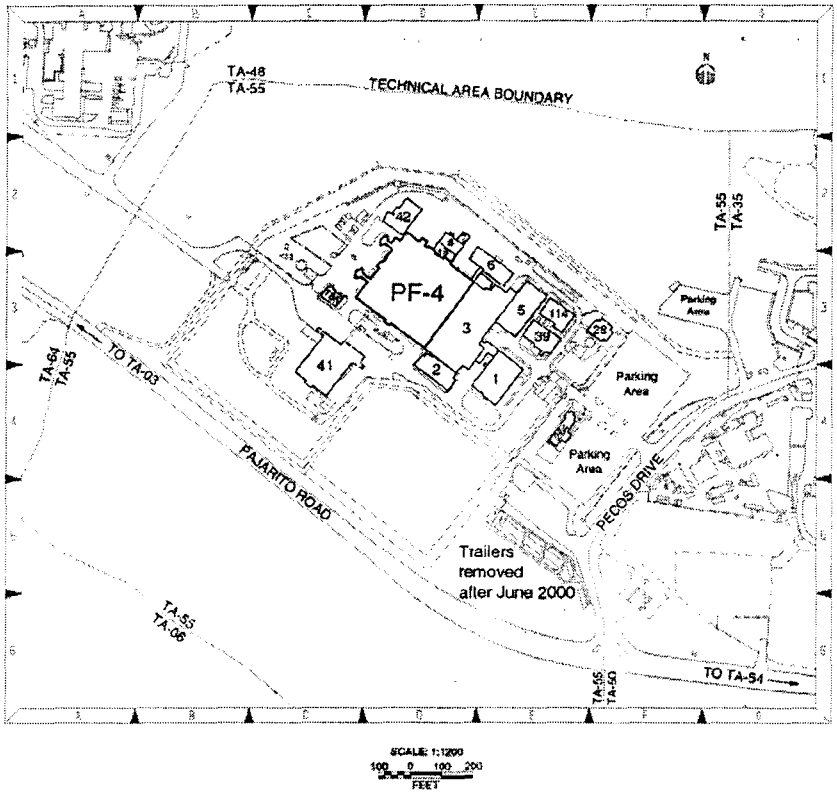
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# MAP OF LANL


Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Barranca Mesa
North Mesa
Los Alamos Airport
LAAO
North Community
Los Alamos
Western Area
To Ski Area
State Rd. 501
DOE Boundary
State Rd. 4

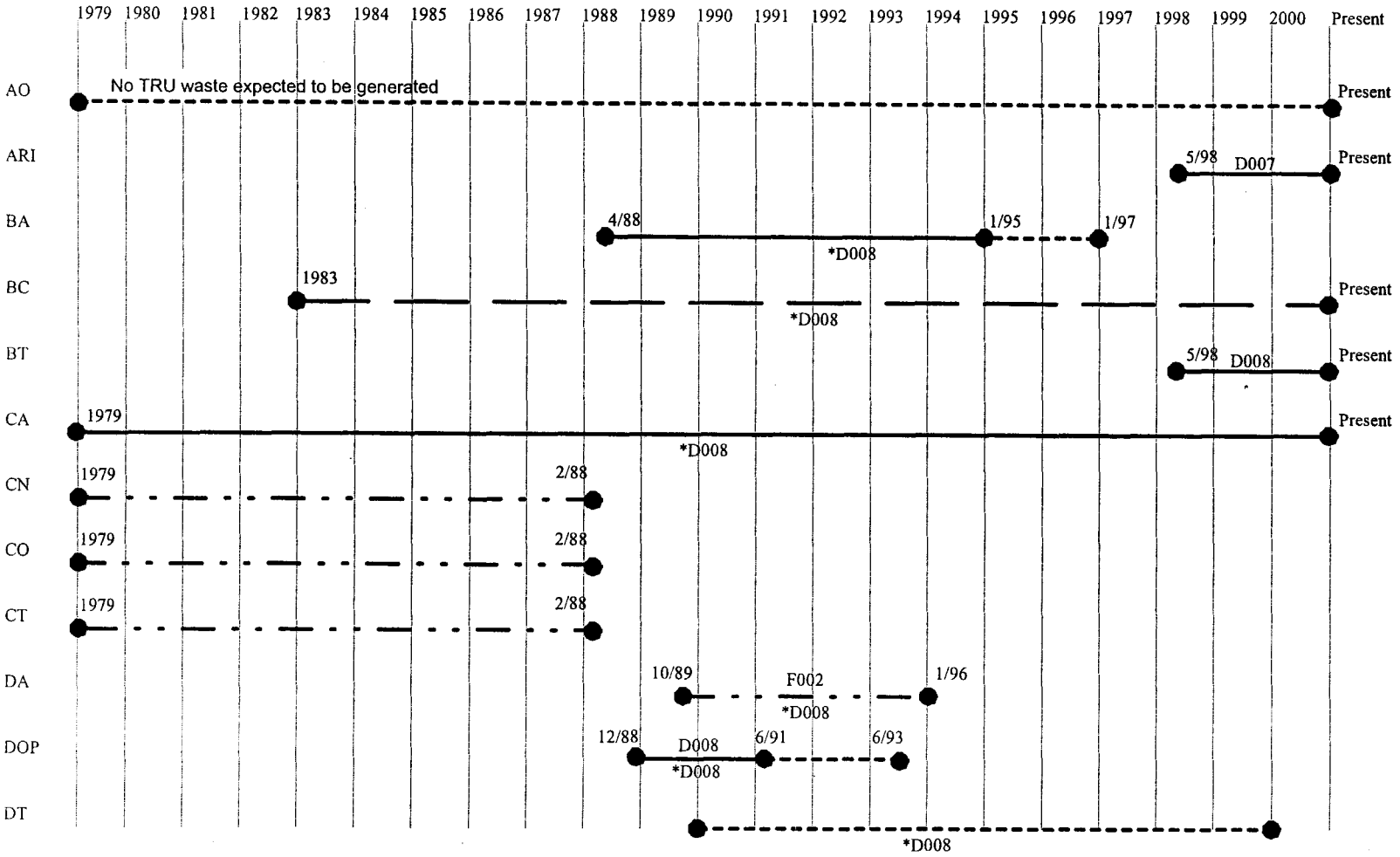
**MAP OF TA-55**

**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.

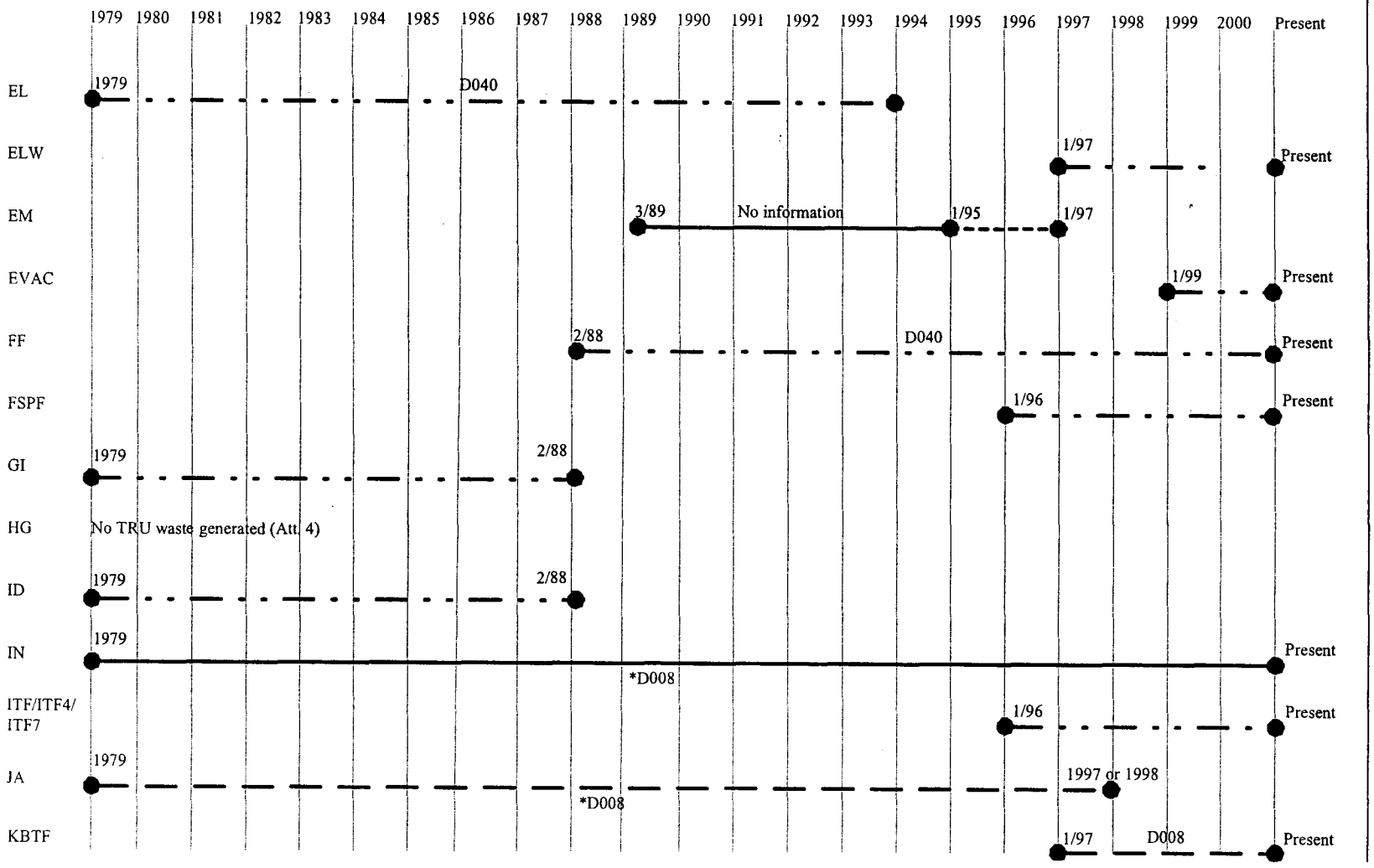


## TIMELINE FOR METAL OPERATIONS

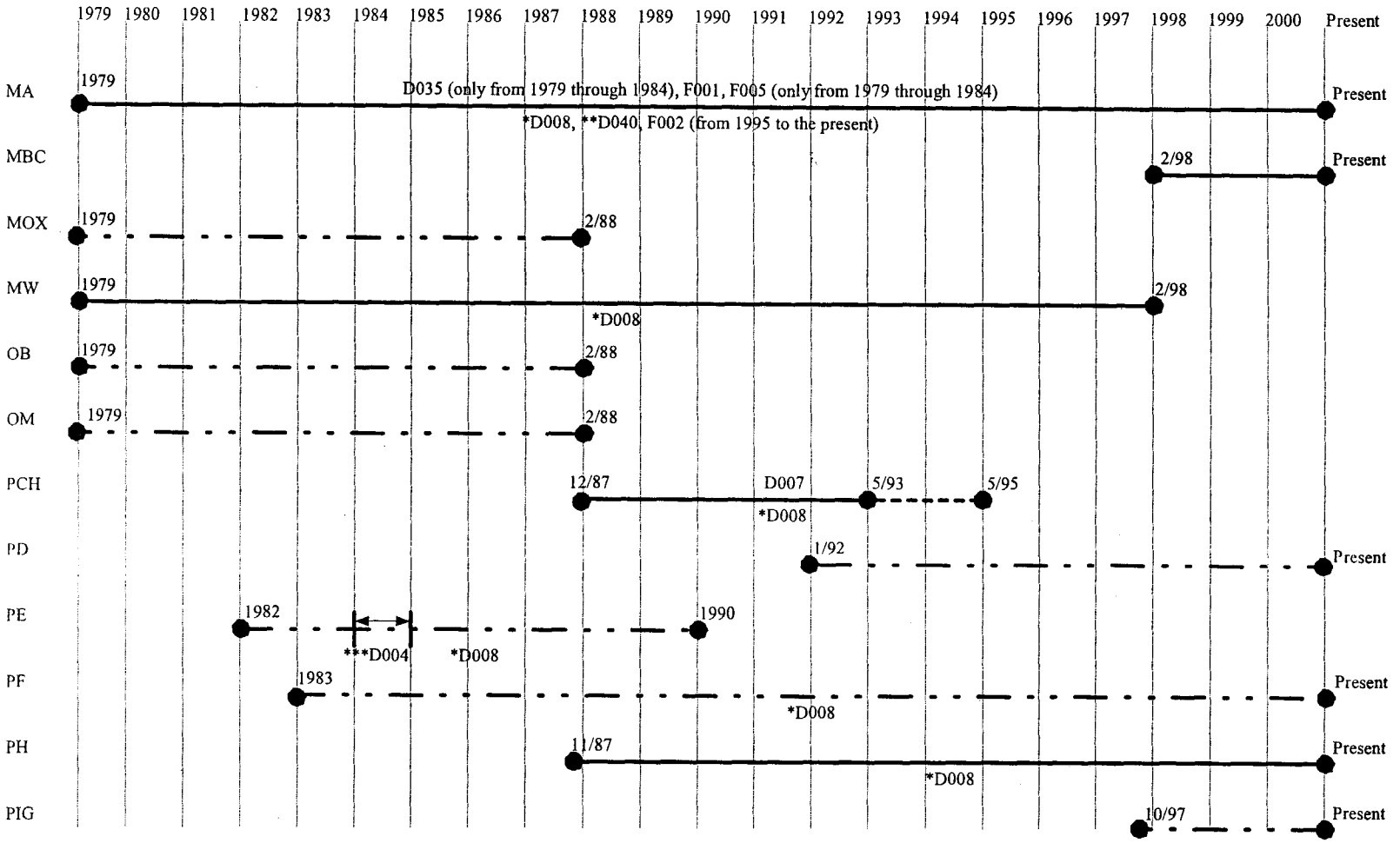
See Section 4.0 for details of RCRA code applicability to waste types generated under each P/S Code.



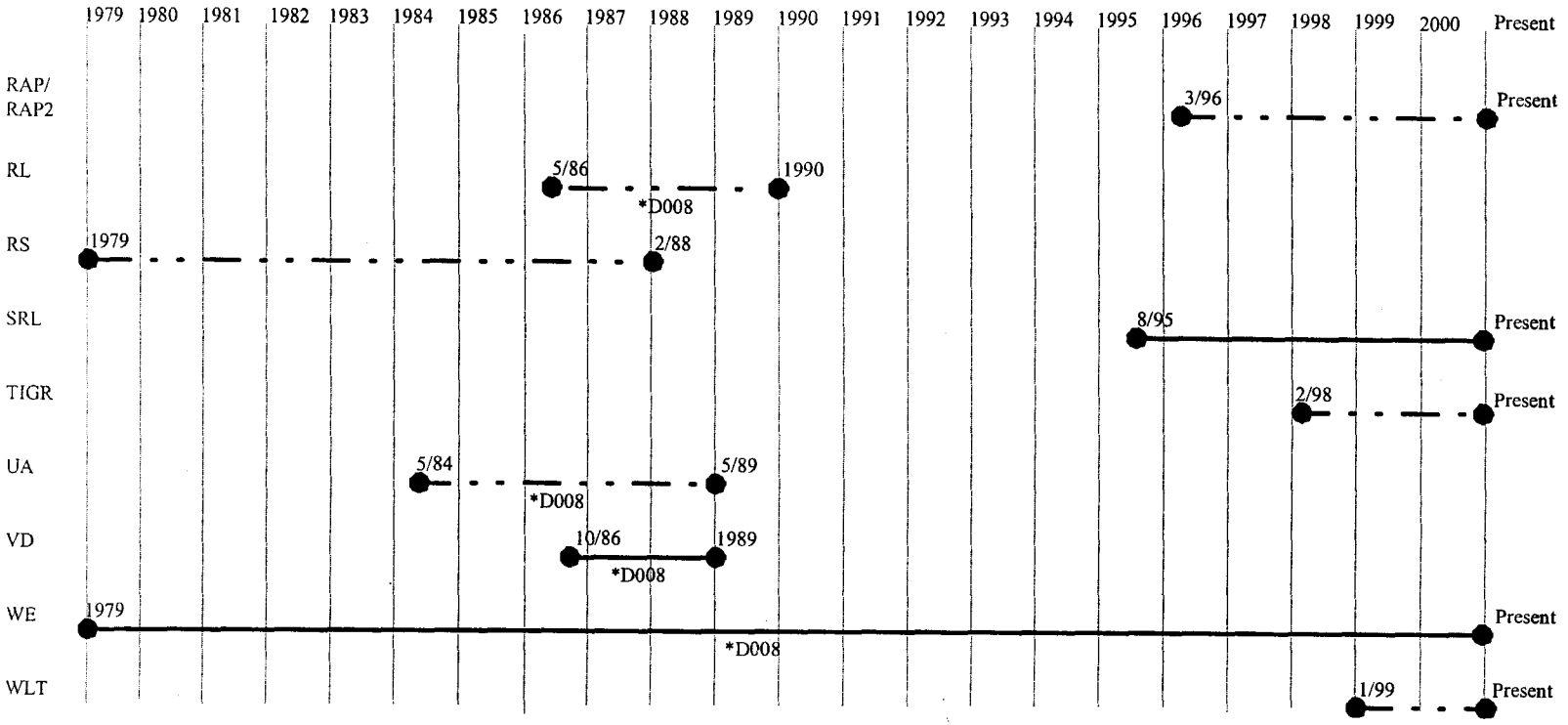
## TIMELINE FOR METAL OPERATIONS (continued)



## TIMELINE FOR METAL OPERATIONS (continued)



**TIMELINE FOR METAL OPERATIONS (continued)**




* Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

** Trichloroethylene was used in the final cleaning of metal parts from 1979–1992, resuming in February 2000.

*** Arsenic was only used in 1984 and perhaps into 1985.

## TIMELINE EXPLANATION



The P/S code is established in either the P/S diagrams or in both (or all) revisions of the procedures designating the start and end dates (e.g., Rev. 0 to Rev. 1; or Rev. 0 to Rev. 5)



The P/S code is not identified in the procedure, but the process description matches the P/S code and the description in previous or later revisions of the same procedure.



Extrapolate out two(2) years beyond the last procedure to next possible review date.



Time period based on subject matter expert comments.

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AO | Assembly Operation | Pu metal (high purity) | No chemicals used | Pu metal parts | Waste is LLW | | MET-69, MET-74/ TWCP-3541 |
| ARI | ARIES | Pu metal (high purity) | Sodium hydroxide, sodium nitrate, sodium sulfate | Pu metal and plutonium oxide to vault | rags, tools, labware, gloves, spent electrolyte solution | D007 | MET-49, MET-50/ TWCP-3541 |
| BA | Basement Isopress | Pu and isotopes of other radionuclides sealed in coupons | No chemicals used | Pu and isotopes of other radionuclides sealed in coupons | Rags, paper, tools, gloves, spent hydraulic fluid, spent hydraulic fluid, silicone lubricant, isopropyl alcohol, miscellaneous materials consisting of stainless steel, aluminum, titanium and firebrick | *D008 | MET-48/ TWCP-3541 |
| BC | Physical Properties | Actinide metals, alloys, and compounds | No chemicals used | Actinide metals, alloys, and compounds | rags, paper, tools, gloves, glass, plastic and metal labware, press dies | *D008 | MET-41, MET-64/ TWCP-3541 |
| BT | Burst Testing | Pu metal (high purity) | sodium hydroxide, sodium tetraborate, tin-lead solder | Material to vault. | rags, tools, gloves, HEPA filters, wire, strain gauges | D008 | MET-58/ TWCP-3541 |
| CA | Casting | High purity metal from P/S code RM and SS or other P/S codes, e.g. SRL | Freon TF, bromobenzene | Cast metal parts | Rags, tools, gaskets, graphite crucibles, rags, tools, tantalum parts, plastic and glass, leaded gloves | *D008 | MET-45, MET-62, MET-66/ TWCP-3541 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| CN | Carbon-Nitrogen-Oxygen (C-N-O) Analysis | Sample reactor fuel pellet for analysis | No chemicals used | No Product. Samples not analyzed returned to P/S code GI. Analyzed samples to vault | Labware, rags, non-leaded gloves, HEPA filters, rubber, wood, paper, cardboard, glass vials, balances, steel and brass storage containers, graphite, molybdenum trays, magnesium oxide crucibles | | MET-59/ TWCP-3541 |
| CO | Comminution | Crushed briquettes from P/S code RS | Stearic acid, nickel powder, polyethylene glycol | Product to P/S code RS, scrap to vault. | Tools, labware, rags, non-leaded gloves, HEPA filters, rubber, wood, paper, cardboard, glass vials, balances, steel and brass storage containers, graphite, molybdenum trays, stainless and hardened steel balls | | MET-59/ TWCP-3541 |
| CT | Compatibility Testing | Encapsulated material, P/S code is a status only, hence no TRU waste was probably generated. | No chemicals used | N/A | N/A | | MET-59/ TWCP-3541 |
| DA | Alloy Development | Pu metal, alloying metals. | Bromobenzene, Freon TF | Pu alloys to P/S CA, SS or aqueous recovery | Labware, gloves, rags, metal cups | *D008 F002 | MET-55/ TWCP-3541 |
| DOP | Detector Oxide Preparation | Oxides of various radionuclides | No chemicals used | Encapsulated oxide | Labware, gloves, rags | D008 *D008 | MET-71, MET-72/ TWCP-3541 |
| DT | John Ward R&D | Nonprocessing | Nonprocessing | N/A | N/A | | |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| EL | Element Loading | Reactor fuel pellets from P/S code GI | Ethanol, mild acids and caustics, helium, sodium metal, Dowanol 80, trichloroethylene | Fuel pin | Tools, labware, rags, non-leaded gloves, spent welding rods, Dowanol 80 containing sodium metal | D040 | MET-59/ TWCP-3541 |
| ELW | Experimental Laser Welding | Pu metal | Ethanol | Welded part | Gloves, rags | | MET-60/ TWCP-3541 |
| EM | Electron Microscopy | No AK information available | | | | | |
| EVAC | Evacuation and Bake-out | Pu metal parts | No chemicals used | Pu metal parts | Waste is LLW | | MET-69, MET-74/ TWCP-3541 |
| FF | Fuel Fabrication | Uranium oxide, uranium carbide, uranium nitride | Graphite, sugar, stearic acid, ethylene glycol, helium, argon, hydrogen gas, sodium metal, Dowanol 80, bromobenzene, MolyKote, magnesium perchlorate, microspheres, ethylene glycol, surfactants, hexane, chloroform, ethanol, trichloroethylene, chloroform | Fuel pin | Tools, labware, rags, non-leaded gloves, tungsten carbide and hardened steel press dies; diamond or aluminum oxide grinding wheels; HEPA filters; rubber; wood; paper; cardboard; glass vials; balances; steel and brass storage containers; ceramic, graphite, and magnesium oxide crucibles, vacuum pumps; graphite and molybdenum trays; thermocouples; stainless and hardened steel balls | D040 | MET-59/ TWCP-3541 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| FSPF | Special Furnace Operation | Pu metal (high puity) | No chemicals used | Pu metal to vault, Pu contaminated metals to recovery if > DL. | Pu contaminated metals to discard if < DL. Rags, gloves, ceramics, glass, plastics | | MET-57, MET-64/ TWCP-3541 |
| GI | Pellet Grinding and Inspection | Uranium or Pu pellets from P/S code RS | No chemicals used | Pellets to P/S EL or to vault | Rags, tools, non-leaded gloves, HEPA filters, rubber, wood, paper, cardboard, glass vials, balances, steel and brass storage containers, graphite, molybdenum trays, diamond and aluminum oxide grinding wheels | | MET-59/ TWCP-3541 |
| HG | Pu Removal by Mercury | "Cold" Experiments only | N/A | N/A | No TRU waste generated | | MET-62/ TWCP-3541 |
| ID | Immersion Density | Uranium or Pu pellets from P/S code GI | Bromobenzene | Pellets to P/S code EL, FF or ME | Status code, so no TRU waste generated; non-leaded gloves; LLW | | MET-59/ TWCP-3541 |
| IN | Inspection | Status only, Physical inspection of parts | No chemicals used | Inspected Parts | Gloves, rags, tools | *D008 | MET-69/ TWCP-3541 |
| ITF | Impact Test Facility | Pu metal | GoJo cleaner | 7" gas gun tube to NMT-9 for recovery; data from 40-mm gun; materials reused if possible | Rags, metals, wire, HEPA filters, gloves from 40-mm gun; no TRU waste generated from 7" gas gun | | MET-58/ TWCP-3541 |
| ITF4 | Impact Test Facility | Pu metal | GoJo cleaner | 7" gas gun tube to NMT-9 for recovery; data from 40-mm gun; materials reused if possible | Rags, metals, wire, HEPA filters, gloves from 40-mm gun; no TRU waste generated from 7" gas gun | | MET-58/ TWCP-3541 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| ITF7 | Impact Test Facility | Pu metal | GoJo cleaner | 7-in. gas gun tube to NMT-9 for recovery; data from 40-mm gun; materials reused if possible | Rags, metals, wire, HEPA filters, gloves from 40-mm gun; no TRU waste generated from 7-in. gas gun | | MET-58/ TWCP-3541 |
| JA | Gas Isostatic Press | Pu and isotopes of other radionuclides | No chemicals used | Material returned to P/S code BC | Gloves, rags, tools | *D008 | MET-64, MET-69/ TWCP-3541 |
| KBTF | Kolsky Bar Test Facility | Pu metal | No chemicals used; plastic-wrapped lead bricks used as damper | Pu metal returned to sending P/S code | Gloves, rags, tools | D008 | MET-58/ TWCP-3541 |
| MA | Machining | High purity Pu metal | Tap Magic, Freon TF, Metalprep 79, Texaco Regal 32 oil, methyl ethyl ketone, trichloroethylene, ethanol, isopropanol | Machined part, scrap and trunings to recovery | Gloves, rags, tools, plastics, grinding wheels, lathe cutting tools, milling machining cutters | F001 F002 F005 *D008 D035 D040 | MET-42, MET-46, MET-47, MET-62, MET-67, MET-68, MET-76/ TWCP-3541 |
| MBC | Crystal | Pu metal | No chemicals used | Pu metal to recovery | Gloves and rags | | MET-63/ TWCP-3541 |
| MOX | Mixed Oxide Fuel Production | Uranium/Pu oxide | Zinc stearate | Fuel pellets | Tools, labware, rags, non-leaded gloves, HEPA filters, rubber, wood, paper, cardboard, glass vials, balances, steel and brass storage containers, graphite, molybdenum trays | | MET-63/ TWCP-3541 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| MW | Metal Working | Pu metal, uranium metal | Freon TF | Pu metal to recovery, uranium metal to vault | Gloves, rags, paper, copper wool, tools, plastic bottles, glass and rubber labware, aluminum foil, cutting wheels, milling machine cutters, and lathe cutting tools. Tritium-contaminated copper wool and rags | *D008 | MET-42/ TWCP-3541 |
| OB | Oxide Blending | Enriched uranium oxide, depleted uranium oxide, Pu oxide | Graphite, stearic acid | Blended oxides to P/S code RS | Rags, tools, non-leaded gloves, HEPA filters, rubber, wood, paper, cardboard, glass vials, balances, steel and brass storage containers, graphite, molybdenum trays, ceramic and graphite crucibles | | MET-59/ TWCP-3541 |
| OM | Oxygen to Metal Ratio Determination | Reactor fuel pellets | No chemicals used | Reactor fuel pellets | Status code, no TRU waste generated; LLW | | MET-59/ TWCP-3541 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| PCH | Plasma Chemistry | Pu metal (varying purity) | Various gases used for plasma: tetrafluoroethane, hexafluoroethane, perfluoropropane, oxygen, argon, carbon dioxide, Fomblin pump oil (contains perfluoropolyether) | Pu metal to recovery | Gloves, rags, tools, glass, plastic and metal labware; used pump oil (Fomblin brand); discarded test samples such as tantalum foil, tungsten foil, tungsten-coated silicon, silicon dioxide; and various actinide surfaces | D007 *D008 | MET-40/ TWCP-3541 |
| PD | Pit Disassembly | Pu metal, uranium metal | Freon TF SF-2I | Pu metal to recovery, uranium metal to vault | Gloves, rags, copper wool, tools, plastic bottles, glass and rubber labware, aluminum foil, cutting wheels, milling machine cutters, and lathe cutting tools. Tritium-contaminated copper wool and rags | | MET-42, MET-50/ TWCP-3541 |
| PE | Sputtering Process | Pu metal (high purity), arsenic, gold, lutetium | No other chemicals used | Part with sputtered metal coating | Gloves, rags, tools, metals used in coating process | D004 *D008 | MET-54/ TWCP-3541 |
| PF | Plutonium Surfaces | Pu metal | Ethanol and possibly methanol | Pu metal to recovery | Tools, labware, rags, gloves, plastics | *D008 | MET-64/ TWCP-3541 |
| PH | Thermal Hydride/Dehydride | Pu metal, Pu alloys and other actinides | hydrogen gas | Pu metal and alloys to recovery, other actinides to vault | Tools, labware, rags, paper, gloves, used Fromblin pump oil | *D008 | MET-43, MET-44/ TWCP-3541 |
| PIG | Welding | Beryllium, aluminum | Ethanol | Beryllium welded part | Gloves and rags | | MET-61/ TWCP-3541 |
| RAP/ RAP2 | Research Alloy Preparation | No activity in these P/S codes | None | | | | MET-64/ TWCP-3541 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| RL | Radiochemical Coating | Pu metal (high purity), other metals | Gold metal and lutecium metal | Pu metal part with metal coating | Gloves and rags, metals used in coating process | *D008 | MET-65/ TWCP-3541 |
| RS | Pellet Sintering | Enriched uranium oxide, depleted uranium oxide, Pu oxide from P/S code OB; also returned from P/S code CO | Argon, hydrogen gas, MolyKote | Sintered fuel pellets to P/S code GI | Tools, labware, rags, non-leaded gloves, HEPA filters, rubber, wood, paper, cardboard, glass vials, balances, steel and brass storage containers, graphite, molybdenum trays, ceramic and graphite crucibles, thermocouples, heating elements, vacuum pumps | | MET-59/ TWCP-3541 |
| SRL | Special Recovery Line | Pu metal, uranium metal | Freon TF<br>SF-2I<br>copper wool | Pu metal to recovery, uranium metal to vault | Gloves, rags, copper wool, tools, plastic bottles, glass and rubber labware, aluminum foil, cutting wheels, milling machine cutters, and lathe cutting tools, tritium-contaminated copper wool and rags | | MET-42, MET-51, MET-52 MET-53, MET-62/ TWCP-3541 |
| TIGR | Thermally Induced Gallium Removal | Pu-gallium oxide | argon and hydrogen gas | Separated Pu oxide and gallium oxide | Tools, labware, rags, gloves | | MET-56/ TWCP-3541 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| UA | Uranium Fabrication | Uranium metal and oxide | Freon TF | Uranium to vault | Gloves, rags, copper wool, tools, glass and rubber labware, aluminum foil, cutting wheels, milling machine cutters, and lathe cutting tools. | *D008 | MET-69, MET-73/ TWCP-3541 |
| VD | Vapor Degreaser and Sand Blasting | Pu metal parts | Freon TF | Cleaned parts | Gloves, rags, tools | *D008 | MET-69/ TWCP-3541 |
| WE | Welding | Pu metal, other metals including aluminum, titanium, gold | Freon TF | Welded parts | Gloves, rags, tools, spent welding rods, stainless steel capsules | *D008 | MET-39, MET-69/ TWCP-3541 |
| WLT | Welding Leak Test | Pu metal parts | No chemicals used | Pu metal parts | Plastic gloves, bags and rags, cotton gloves, minimal amount of metal items | | MET-74/ TWCP-3541 |

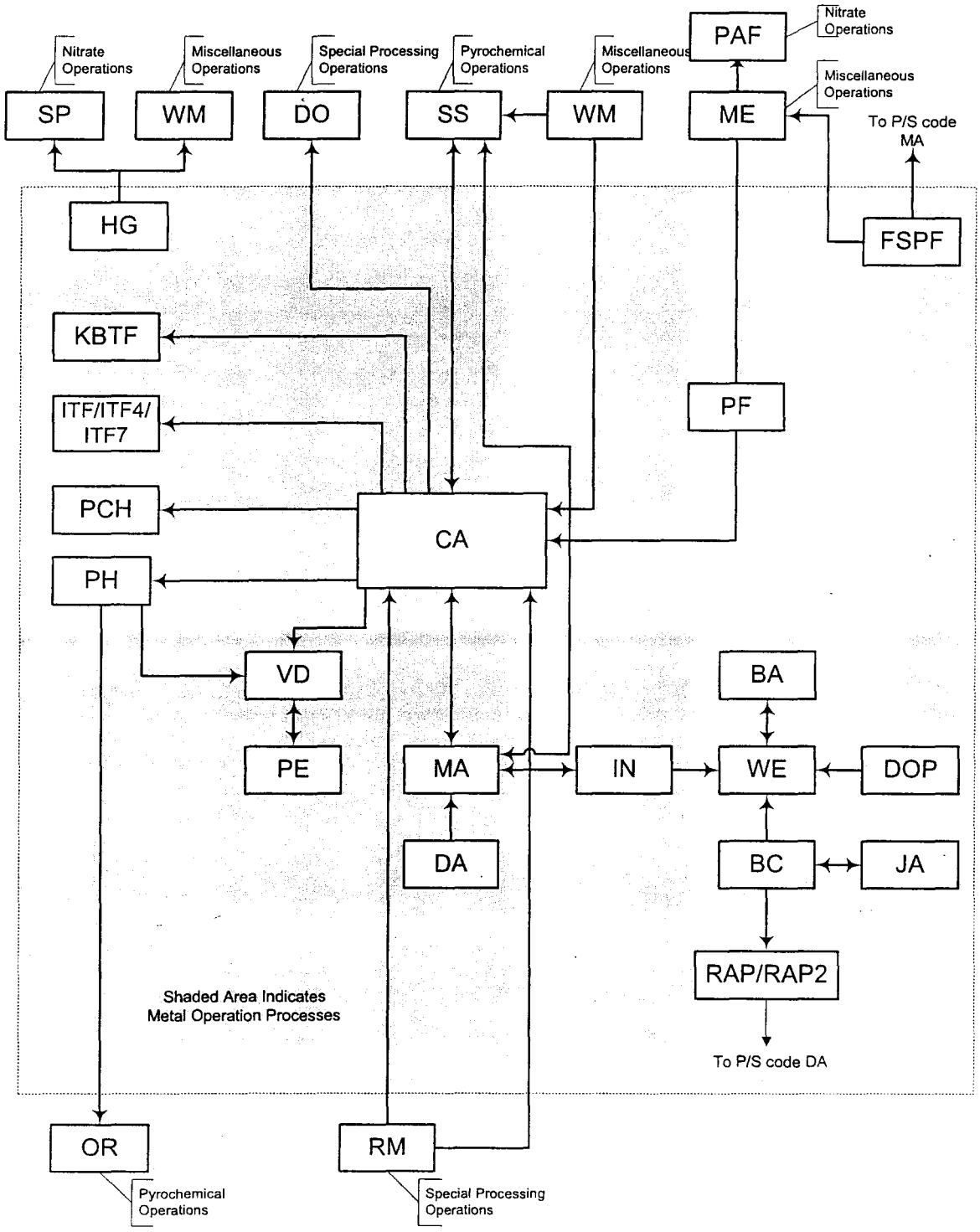
[1] All P/S codes generate routine laboratory debris waste. The debris waste may consist of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated.

[2] See discussion in Section 4.0 for details on the applicability of the EPA HWNs listed in this column. The EPA HWNs listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation). The resulting treated waste stream is evaluated for hazardous waste constituents and assigned the applicable EPA HWNs. All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other metal debris waste and are assigned EPA HWN D008 under the originating P/S code.

[3] Refer to the Acceptable Knowledge Roadmap in Attachment 1.

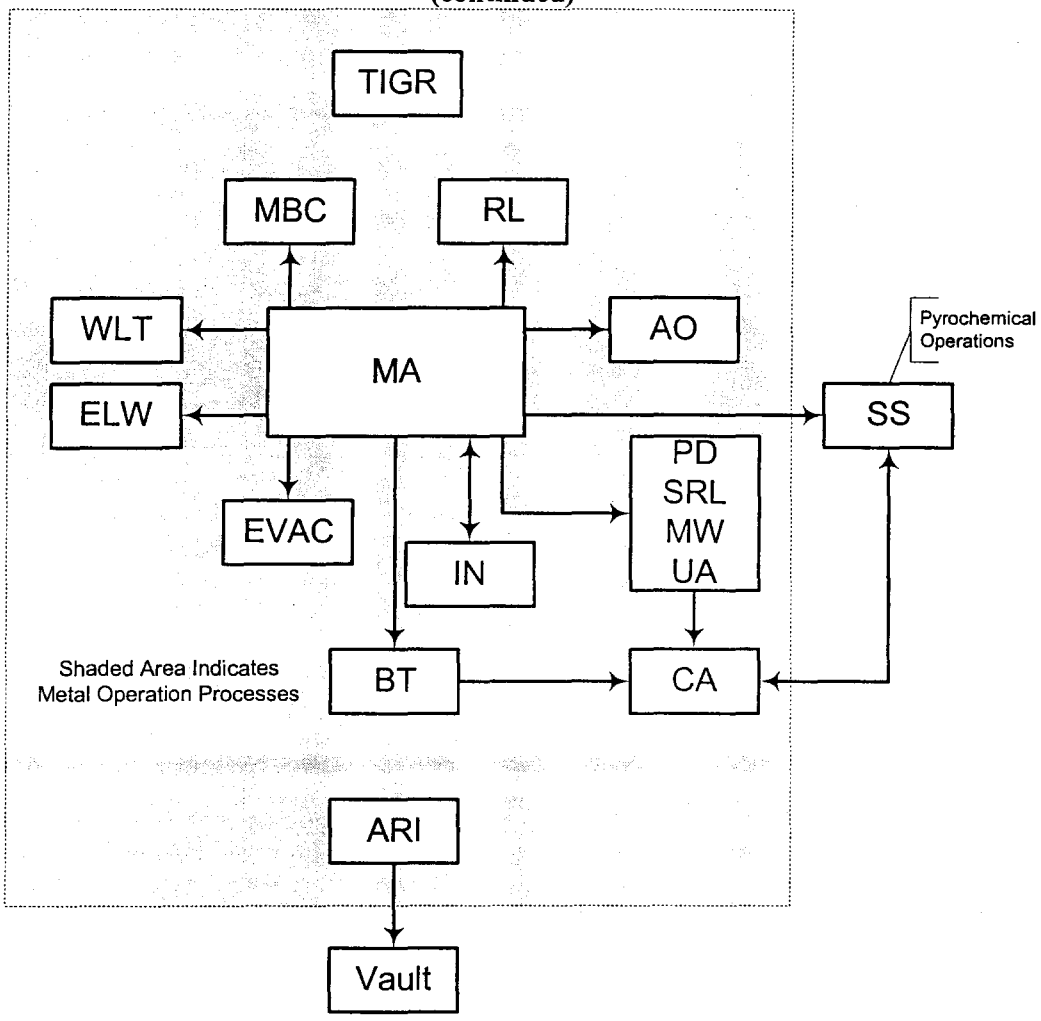
*D008 due to leaded gloves

# SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS




**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

## SIMPLIFIED PROCESS FLOW DIAGRAM FOR METAL OPERATIONS (continued)



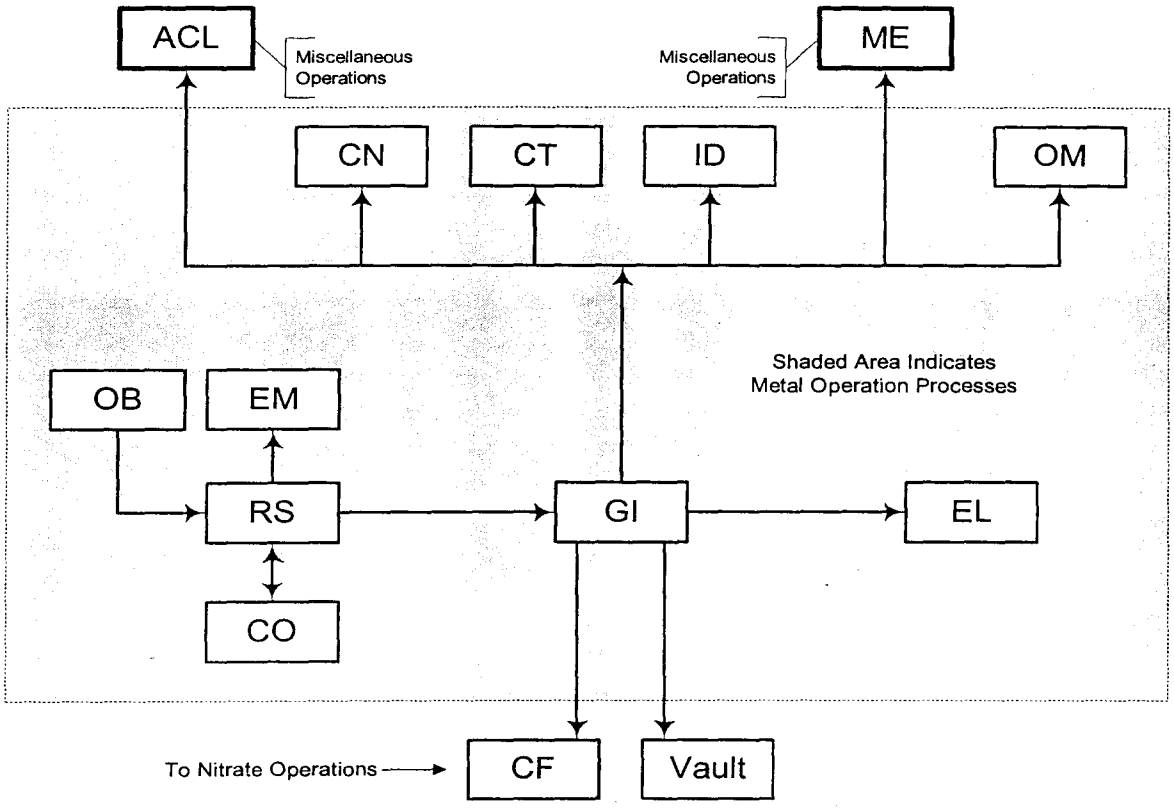

**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

**NOTE:** P/S code UA tracks uranium compounds from Pit Disassembly. Activities under this P/S code would be similar to those under P/S codes IN, MW, and WE.

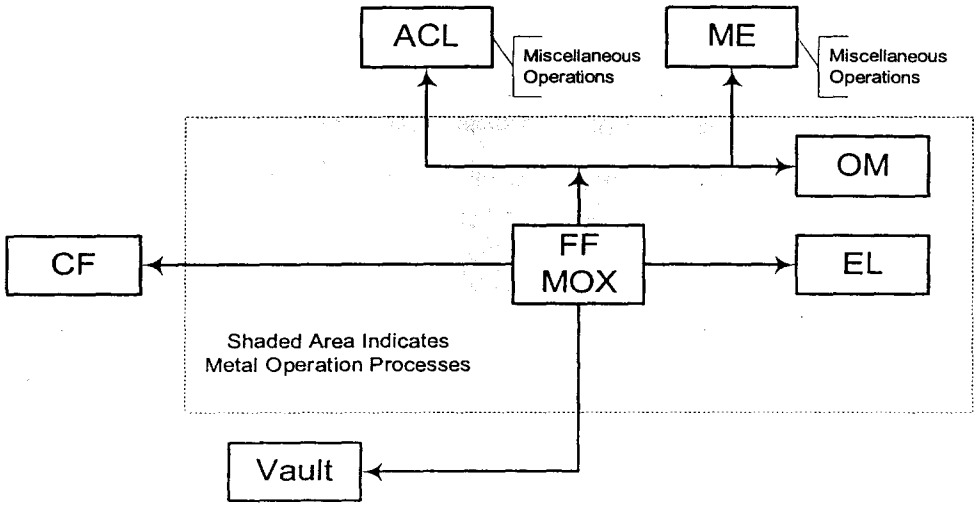
**LEGEND**

| | | | |
|---|---|---|---|
| AO | Assembly Operations | MW | Metal Working |
| ARI | ARIES | PD | Pit Disassembly |
| BM | Burning Metal | RB | Roasting and Blending |
| BT | Burst Testing | RL | Radiochemical Coating |
| CA | Casting | SRL | Special Recovery Line |
| ELW | Experimental Laser Welding | SS | Salt Stripping |
| EVAC | Evacuation and Bake Out | TIGR | Thermally Induced Gallium Removal |
| IN | Inspection | UA | Uranium Fabrication |
| MA | Machining | WLT | Welding Leak Test |
| MBC | Crystal | | |

## SIMPLIFIED PROCESS FLOW DIAGRAM: REACTOR FUEL DEVELOPMENT




In 1988, P/S codes CO, GI, ID, OB, and RS were combined into P/S code FF. P/S codes CT, ID, and OM are status codes only, and probably do not generate TRU waste.




**NOTE:** All of these P/S codes may obtain feed material from or send product output to the vault.

## Decision/Discrepancy Resolution Documentation
### TA-55 Metals Operations

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| CA | Freon used until 1992 and then replaced by SF2I | MET-62/TWCP-3541 | Freon and bromobenzene were the only chemicals used | MET-66/TWCP-3541 | Process report states freon and bromobenzene | C—meeting with SMEs said to keep freon and bromobenzene. Bromobenzene has no hazardous waste number. SF2I is non-hazardous. See attached meeting notes. |
| FSPF | States FSPF is a new code and does not generate waste | MET-64/TWCP-3541 | States DA became FSPF in 1996 and generates debris waste | MET-57/TWCP-3541 | Process report uses MET-57 information in section 3.5.3.6 | C—meeting with SME's stated FSPF was not begun until 1996, and does not generate any hazardous waste. DA only had leaded gloves and they were segregated after 1992. Therefore FSPF does not contain any hazardous constituents. See attached meeting notes. |
| RL | Per Jack Simpson, arsenic may have been used as a coating material | TWCP-3541/MET-65 | Process report does not mention arsenic | Process report, section 3.5.2.19 | | C—RL did not begin until May 1986. This process was similar to P/S code PE, which possibly used arsenic between 1982 and 1986, probably 1984 or 1985. RL did not use arsenic, per SME. See attached meeting notes. |
| HG and AO | States P/S code HG is a cold process | TWCP-3541/MET-62 | Lists P/S code HG and the mercury associated with HG as being in TRU waste | TWCP-882 | Process report section 3.5.2.13 and the timeline in the report state it is a cold process<br>Report also says waste in AO is LLW, but TWCP-882 indicates TRU | A—SME indicated HG P/S code never used radioactive material, so it did not generate any TRU mixed waste. Also, P/S code AO was both a LL and a TRU P/S code. |

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| All | Timeframes for P/S codes | TWCP-882 | Timeframes in report are not the same | Process report | Inconsistent | C—The purpose of TWCP-882 was to identify possible secondary radionuclides and not to assign time frames. Therefore ignore time frames from TWCP-882 as they are only estimates. Process report information is correct and is based on other, more accurate information. See attached meeting notes. |

Sandy Wander — Evaluator (Print Name)
AK Investigator — Title
Sandy Wander 2/25/02 — Signature / Date

P Rogers — SPM Review (Print Name)
Pamela Rogers — Signature
2/26/02 — Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other (specify)]

Operation of the ARIES Electrolytic Can Decontamination System (MET-50/TWCP-3541) decontaminates the external surfaces of canned plutonium using an electrolytic decontamination system. An electrolyte (initially sodium nitrate, now sodium sulfate) and water are used in the system in a recycle mode. Sodium hydroxide is used for pH control. Wastes include electrolyte and water solutions contaminated with plutonium. There is the potential for chromium (D007) to be present in the electrolyte solution waste when this solution has been used to decontaminate stainless steel. Although no disposal path is mentioned in the reference, it is assumed that this liquid waste is sent either to cement fixation (P/S code CF) or to the RLWTF at TA-50.

Other P/S codes included in the Developmental Metal Operations group but for which no procedures were found during this AK search are listed below. SME input provided information on these P/S codes.

3.5.3.2 P/S Code AO: Assembly Operations

Operations in P/S code AO involve bringing nuclear material out of the glovebox and encapsulating it in a cold container (MET-69, MET-74/TWCP-3541). This outer container can be a bolted assembly or a welded assembly using electron beam, pressurized inert-gas metal arc (PIGMA), tungsten inert gas (TIG), or laser welding techniques. No solvents are used. Wastes include aluminum foil, plastic bags, and gloves. This waste is nearly always LLW.

3.5.3.3 P/S Code BT: Burst Testing

Hemi-shells are placed on a test stand and a buffered test solution is pumped into the shell and pressurized until it bursts (MET-58/TWCP-3541). Strain gauges monitor the deformation of the shell. The test solution is sodium tetraborate and sodium hydroxide and is filtered and reused. The solution is eventually discarded in the caustic waste line to the RLWTF at TA-50.

Wastes include rags. HEPA filters, gloves, electric lead wires, and strain gauges. Strain gauges have electrical contact points that are tin-lead solder. Metal waste from this P/S code would, therefore, carry EPA HWN D008. No solvents are used.

# CCP Records Transmittal/Receiving Form

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| Attn: | Records Custodian | From: | Trey Greenwood |
| Ship to: | CCP Central Records/ CCP Records Custodian | Site: | Los Alamos National Laboratory |
| | 4021 National Parks Highway - MS GSA 203 | Company: | Technical Specialists |
| | Carlsbad, NM 88220 | Telephone Number: | 505-302-6000 |
| | | Date Sent: | 11/23/04 |

Telephone Number: 505-234-7523

11/10/04

| Document Number | Title/Description | Record Date | Total Pages |
|---|---|---|---|
| D029 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-6 | ~~9/17/2004~~ 9/23/04 | 1 |
| | Process Acceptable Knowledge Report for Metal Operation Processes at TA-55 | 5/17/2001 | 81 |
| | | | |
| | | | |
| | N/A | | |
| | | | |

| Comments |
|---|
| None |

## CCP Records Center
## Acceptance/Rejection Signature and Date

Records Accepted ☒ Christal Ingram (Signature) | Christal Ingram (Printed Name) | 02-24-05 (Date)

Records Rejected ☐ _____ (Signature) | _____ (Printed Name) | _____ (Date)

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## Attachment 2 - CCP Records Transmittal/Receiving Form

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| | | | |
|---|---|---|---|
| Attn: | Sheila Pearcy | From: | Amy Johns |
| Ship to: | CCP Central Records/ CCP Records Custodian | Site: | Los Alamos National Laboratory, CCP-AK-LANL-006 |
| | 4021 National Parks Highway - MS GSA 203, Carlsbad, NM 88220 | Company: | Technical Specialists, LLC |
| | | Telephone Number: | 505-302-8669 |
| Telephone Number: | 505-234-7523 | Date Sent: | 1/26/2009 |

| | | | |
|---|---|---|---|
| D029 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-6 | 1/14/2009 | 2 |
| | N/A | | |

Please supercede existing Attachment 3.

Acceptance/Rejection Signature and Date

| | | | |
|---|---|---|---|
| Records Accepted ☑ | Sonia Gonzalez (Signature) | SONIA GONZALEZ (Printed Name) | 02.17.09 (Date) |
| Records Rejected ☐ | Signature | Printed Name | Date |

Reason for Rejection: N/A

| | | | |
|---|---|---|---|
| Re-submittal: | Signature | Printed Name | Date |

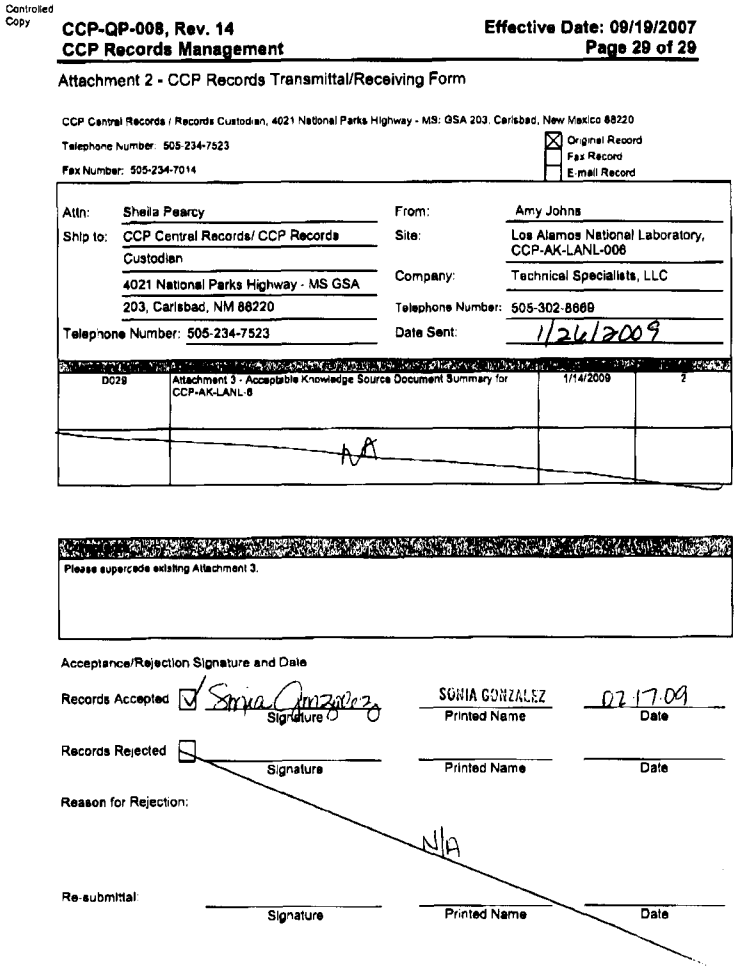
**HP LaserJet** *M2727nf MFP*

# Fax Confirmation Report

HP LASERJET FAX

Feb-18-2009 8:49AM

| Job | Date | Time | Type | Identification | Duration | Pages | Result |
|---|---|---|---|---|---|---|---|
| 5133 | 2/18/2009 | 8:48:33AM | Send | 96283238 | 0:33 | 1 | OK |



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**CCP-QP-008, Rev. 14** **Effective Date: 09/19/2007**
**CCP Records Management** **Page 29 of 29**

Attachment 2 - CCP Records Transmittal/Receiving Form

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☐ Fax Record
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| | | | |
|---|---|---|---|
| Attn: | Sheila Pearcy | From: | Amy Johns |
| Ship to: | CCP Central Records/ CCP Records Custodian<br>4021 National Parks Highway - MS GSA 203, Carlsbad, NM 88220 | Site: | Los Alamos National Laboratory, CCP-AK-LANL-008 |
| | | Company: | Technical Specialists, LLC |
| | | Telephone Number: | 505-302-8669 |
| Telephone Number: | 505-234-7523 | Date Sent: | 1/26/2009 |

| | | | |
|---|---|---|---|
| D029 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-8 | 1/14/2009 | 2 |
| | N/A | | |

Please supercede existing Attachment 3.

Acceptance/Rejection Signature and Date

Records Accepted ☑ Signature | SONIA GONZALEZ Printed Name | 02.17.09 Date

Records Rejected ☐ Signature | Printed Name | Date

Reason for Rejection: N/A

Re-submittal: Signature | Printed Name | Date

QP-00-004,R.0
Effective Date: 06/18/03

TWCP-15416

# RECORDS SUBMITTAL

**INSTRUCTIONS:** This form is prepared by the record source when submitting individual records, batch data reports, or a records package to the RMDC Center. For records packages, a Table of Contents (TOC) must also be submitted. Each record submitted requires a complete form.

**MANDATORY:** X To the best of my knowledge, the record(s) have no radioactive contamination.

Signature: _____

**RECORD TYPE:**

X Project 2010 ☐ Facility (RRES)

☐ Other: _____ ☐ UCNI ☐ Proprietary

**RECORD SOURCE:**

Submittal Date: 7/25/03 Z No.: 109592 Name/Org: PATRICIA PATTON – RRES-CE

Originator: JOHN MUSGRAVE Organization: NMT

**TYPE OF RECORD/ACTION TO BE TAKEN**

X Individual Record ☐ Batch Data Report ☐ Records Package (+ TOC)

X New ☐ Revision* ☐ Addition* ☐ Supersedes*

*Record Barcode Number: _____ *Review Cycle (if applicable): ☐ Yes ☐ No ☐ NA

**RECORD ID NUMBER**: (e.g., memo symbol number, procedure (include revision), deficiency number, batch data report number, unique record identifier if applicable):

TWCP-AK-2.1-007, R.2

Record Date: 5/18/01 Physical Page Count: 113 X Single Sided ☐ Double Sided

Category Number: (from page two): 07

**RECORD TITLE, SUBJECT, AND/OR KEYWORDS:**

TWCP-AK-2.1-007, R.2/IC1 Process AK Report for Special Processing at TA-55 (INCLUDES INTERIM CHANGE 1) - LA-UR-01-2560 – LA-UR-02-1712

**RECORD CENTER USE ONLY**

☑ Accepted Date: 7-25-03 ☐ Return Date: _____

Signature: _____ Resubmitted: _____

RIDs Type: LT

Scan Date: By: QC Date: By:

X-Sender: chsmith@norris-mail.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.1
Date: Thu, 24 Jul 2003 10:37:16 -0600
To: pgp@lanl.gov
From: Cathy Smith <chsmith@lanl.gov>
Subject: Please retire Process AK Reports
Cc: sgw@lanl.gov
X-Scanned-By: MIMEDefang 2.35

Hi Patsy,

As we discussed yesterday, here is the list of Process AK Reports that we would like to retire as controlled documents and submit as records to RMDC. Could you let Betty Humphrey and myself know when you have the record IDs - we need to update the references in the main AKIS document.

Thanks a million!

Cheers, Cathy

The following can be turned into Records, to be referenced in our AKIS or AK Summaries...

1. TWCP-AK-2.1-002, R.2/IC1 Process AK Report for Chloride Operations at TA-55

2. TWCP-AK-2.1-003, R.2/IC1 Process AK Report for Metal Operations Processes at TA-55

3. TWCP-AK-2.1-004, R.2/IC2 Process AK Report for Miscellaneous Operations at TA-55

4. TWCP-AK-2.1-005, R.2/IC1 Process AK Report for Nitrate Operations at TA-55

5. TWCP-AK-2.1-006, R.2/IC1 Process AK Report for Pyrochemical Processes at TA-55

6. TWCP-AK-2.1-007, R.2/IC1 Process AK Report for Special Processing at TA-55

7. TWCP-AK-2.1-009, R.0/IC1 Process AK Report for Pu-238 Operations at TA-55

8. TWCP-AK-2.1-013, R.0 AK Report for NG Waste from Nitrate Operations at TA-55

9. TWCP-AK-2.1-014,R.0 AK Report for NG Waste from Miscellaneous Operations at TA-55

10. TWCP-AK-2.1-016,R.0 AK Report for NG Waste from Special Processing Operations at TA-55

11. TWCP-AK-2.1-017,R.0 AK Report for NG Waste from Metal/Pyrochemical Operations at TA-55

---

*"The simplest questions are the hardest to answer."*
*Northrop Frye*

Catherine H. Smith
***Project 2010***
RRES-CE Certification Group
Risk Reduction & Environmental Stewardship Division
Phone: 667-0113 Page: 664-7104

LA-UR-02-1712



# INTERIM CHANGE REQUEST

| ☑ TWCP ☐ WRR ☐ Other<br>If Other, please identify: _____ | IC Number: 1 |
|---|---|
| **Person Requesting this Interim Change:** Sandy Wander | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Process Acceptable Knowledge Report for Special Processing at TA-55 | **Document No./Revision:** TWCP-AK-2.1-007,R.2 (LA-UR-02-1712) |
| **Effective Date of Current Document:** 05/18/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| Title Page and p.1 | Delete "Summary" from title to read:<br>"Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55" | Clarification |
| Global | Change all occurrences of "Sampling Plan" to "AK Information Summary" | document title change |
| Note and 3rd column heading / p. vi | Delete "summary" from "NOTE" at top if page vi and from "*" note at bottom of page viii<br>Change 3rd column heading on page vi to read:"Process AK Report*"<br>Delete entire 4th column | Clarification |
| RCRA Constituents/ EPA Hazardous Waste Numbers / p. viii | In bullet beginning "D005 (barium)" add "D009 (mercury)" after "D008 (lead)" and add P/S codes DO, IX, and POSM<br>Delete fourth and sixth bullets<br>Add "*" after "D008" in bullet 5. | Per SME, P/S codes ACD, SL, POSM, DO and IX should all be assigned the same codes due to feed material may be in each P/S code.<br>Bullets deleted as P/S codes moved to other bullets.<br>Asterisk denotes "leaded gloves" was omitted. |
| Global search and delete / pp. 2 and 7 | From all references to "process AK summary report," delete "summary" to read "process AK report.<br>From all titles that previously read "Process Acceptable Knowledge Summary Report, " delete "Summary" to read "Process Acceptable Knowledge Report." | Clarification |
| 4.2 / p. 21 | In fourth paragraph, insert ", D009 (mercury)," after "D008 (lead)<br>In fifth paragraph, insert "D005 (barium)," at the beginning | Report updated to reflect SME comments above |
| 4.2 / p. 23 | To the end of the second sentence in the next to last paragraph of section 4.2 add:<br>and, therefore, carry the same P/S codes as ACD, IX, and SL (D005 [chromium], D006 [cadmium], D009 [mercury]) | Report updated to reflect SME comments above |

| | | |
|---|---|---|
| Attach. 3 / pp. 1 and 2 of 3 | Insert "D009" in timeline for ACD; insert "D005, D006, D009" and add additional asterisk to "*D007" and "*D011" in timeline for DO; insert "D005" in timeline for IX; insert "D005, D006" in timeline for POSM; insert "D009" in timeline for SL; insert additional asterisk in first note; insert asterisk in note beginning "D008="<br><br>Add "D008" to DO and POSM timelines; Add "D009" ti IAM and POSM timelines; Add "*D008" to PX; Add "*" ti "*D006" in PX timeline | Updated to reflect SME comments above. Asterisks added due to typo errors found during review.<br><br>Updated report due to typo errors found during review. |
| Attachment 4 / pp. 1, 2 and 3. | Add "*" to D008 in ACC, DO, IAM, IX, PI, POSM, RM, SL.<br><br>Add "D009" to ACD, DO, IAM, SL<br><br>Add "D005" to DO, IX, POSM<br><br>Add "D006" to DO and POSM<br><br>Add "D008" to DO, IAM, IX, POSM, SL<br><br>Add "*D008" to PX, SB, VU<br><br>Add "*D008" due to leaded gloves" in footnotes | Updated report due to typo errors found during review. |
| Attach. 6, pp. 1, 2 | Add new Attachment 6 and update "Contents" page to reflect addition<br><br>Add following paragraph to end of Section 2.0:<br><br>"When discrepancies in AK information are discovered, they are documented and resolved in accordance with Acceptable Knowledge Documentation (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6)." | New TWCP-QP-1.1-021 requirement |

**Date changes submitted**: 02/12/02 | **Desired effective date for changes**:

**INTERIM CHANGE APPROVAL**

| | |
|---|---|
| Document Preparer: S Wander | Reviewer (if applicable): Facility Rep |
| Signature: Sandy Wander Date: 3/19/02 | Signature: Wayne A. Pringle Date: 3/20/02 |
| Site Project QA Officer: ~~not required for AK~~ MH Gaut | LAAO (if implementing WAP requirements): NA |
| Signature: MH Gaut Date: 3/20/02 | Signature: Date: |
| ☑ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | Do changes affect WAP data collection, data quality, or performance criteria? |
| Site Project Mgr/Line Mgr: P Rogers | ☐ Yes ☒ No |
| Signature: Pamela Rogers Date: 3/19/02 | If yes, date of CBFO approval: _____ (documentation attached) |
| USQ Screener (if applicable): NA | |
| Signature: Date: 3-25-02 | |

**NOTE:** Changes can be designated on the document and attached to this form.

**Effective date for this interim change:** 3/21/02

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge ~~Summary~~ Report for Special Processing at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-007,R.2 (LA-UR-01-2560)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

**EFFECTIVE DATE:** 05/18/01

**NEXT REVIEW DATE:** 05/18/03

**DOCUMENT PREPARER:**

John Musgrave — 5/7/01
NAME — DATE

**APPROVALS:**

Jim Fabryka-Martin — 5/7/01
INDEPENDENT TECHNICAL REVIEWER/EDITOR — DATE

Mavis R Lo — 5/10/01
SITE PROJECT MANAGER — DATE

Sandy Wander — 5/14/01
WASTE CERTIFICATION OFFICIAL — DATE

[signature] — 5/14/01
SITE PROJECT QA OFFICER — DATE

Charles L. Fox — 5/7/01
FACILITY REPRESENTATIVE — DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 05/04/00 | — | New report (TWCP-03938) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | 05/18/01 | All | To respond to CBFO reviewer comments and update with new AK information |
| 2/IC1 | 03/21/02 | Title page, vi, viii, 1, 2, 4, 5, 7, 21, 23, Att. 3 and 4 | Clarification and update to include new information. |

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1 Acceptable Knowledge Roadmap (10 pages)
2 LANL and TA-55 Sites Maps (2 pages)
3 Timeline for Special Processing (3 pages)
4 Process Inputs and Outputs (3 pages)
5 Simplified Process Flow Diagram for Special Processing (1 page)
6 Decision/Discrepancies Resolution Documentation (1 page)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| AK Information Summary | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001,R.5) |
| CFR | *Code of Federal Regulations* |
| D | EPA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| ER | electrorefining |
| F | EPA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| K | EPA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| MCDOR | multicycle direct oxide reduction |
| MSE | molten salt extraction |
| MT | material type |
| OSWER | Office of Solid Waste and Emergency Response (EPA) |
| P | EPA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| P/S [code] | process/status [code] |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| SME | subject matter expert |
| SOP | safe/standard operating procedure |
| SP | special processing [designator for individual documents in special processing reports in Attachment 1, Acceptable Knowledge Roadmap] |
| TA | technical area |
| TCLP | toxicity characteristic leaching procedure |
| TRU | transuranic |

| | |
|---|---|
| TWCP | Transuranic Waste Characterization/Certification Project |
| UCNI | Unclassified Controlled Nuclear Information |
| WAC | waste acceptance criteria |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WIPP | Waste Isolation Pilot Plant |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request Form |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**Note:** This index indicates the main process AK report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| ACC | Ammonium Chloride Conversion | Special Processing |
| ACD | Cascade Dissolver | Special Processing |
| CA | Casting | Metal Operation Processes |
| CF | Cement Fixation | Nitrate Operations |
| DO | Dissolution of Oxide | Special Processing |
| EV | Evaporator | Nitrate Operations |
| HP | Cement Fixation | Nitrate Operations |
| IAM | Inspection and Measurement | Special Processing |
| IX | Ion Exchange | Special Processing |
| MA | Machining | Metal Operation Processes |
| PI | Preparation of Isotopes | Special Processing |
| POSM | Processing Out-of-Specification Material | Special Processing |
| PPD | Pu Pellet Dissolution | Special Processing |
| PX | Pyrochemical R&D | Special Processing |
| RM | Reduction to Metal | Special Processing |
| SB | Scrap Burning | Special Processing |
| SBB | Ca/Al Scrubbing RD&D | Special Processing |
| SE | Solvent Extraction | Chloride Operations |
| SL | Scrap Leaching | Special Processing |
| VU | Vessel Unloading | Special Processing |
| VUL | Vessel Unloading | Nitrate Operations |

* Process AK reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Metal Operation Processes (TWCP-AK-2.1-003,R.2), Nitrate Operations (TWCP-AK-2.1-005,R.2), Special Processing (this report)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Special Processing Operations

**P/S codes**: ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed debris.

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from special processing operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

TA-55 Plutonium Facility, Building PF-4, rooms 209 and 401. Plutonium operations included preparing ultra-pure plutonium metals, alloys, and compounds; and reclaiming plutonium from scrap and residues produced by numerous feed sources.

**Description of the process waste (physical form and typical content description):**

Waste from special processing operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, glass debris. Some waste was also sent to nitrate operations for cement fixation.

***Summary Category Group:*** S3000, S5000

***Waste Matrix Codes:*** S3100, S3200, S5100, S5300, S5400

**Description of the waste-generating process:**

The overall goal of the special processing operations is to recover plutonium from impure metal, metal alloys, scrap, and residues and produce a purified plutonium oxide product or purified plutonium metal. Processes include head-end ion exchange, metal preparation, separation and purification by precipitation, and pyrochemical operations.

**Process feed:**

Plutonium metal or metal alloys and oxides; pyrochemical salts; crucible pieces; anode heels; and ash.

**Radioisotopic content of the waste:**

Variety of plutonium material types with different well-defined isotopic compositions. Am-241, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium, or plutonium and uranium, so that the waste will usually be enriched in Am-241 or U-234, but may also be depleted in some cases. Pa-231 and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D005 (barium) and D008 (lead): P/S code VU
- D005 (barium), D006 (cadmium), D007 (chromium), D008 (lead), D009 (mercury), and D011 (silver): P/S codes ACD, DO, JAM, IX, POSM, SB (not D009), and SL.
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): P/S code PX (zinc metal button)
- D006 (cadmium), D008 (lead), and D019 (carbon tetrachloride): P/S code PX because the salts, crucibles, and debris waste items discarded under this code may include some RCRA-regulated constituents above the toxicity characteristic limits
- D008* (lead): metal waste debris from all P/S codes in special processing, except ACD and PPD, due to disposal of leaded gloves; after May 1992, leaded gloves were separated from other metal debris
- No F, K or P codes

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1980–present

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR SPECIAL PROCESSING AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes that generate TRU waste in the Plutonium Facility at Technical Area (TA)-55, one of the TRU waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for several waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to TA-55 waste streams resulting from special processing covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001,R.5) (AK Information Summary) that includes information regarding all TRU waste streams

- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to special processing is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No. TWCP-3543. Individual documents in this record have been assigned a separate identifier, SP-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

present in the process wastes, based on subject matter expert (SME) interviews and any relevant data

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) is contained in these records, and will not be included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK report is part of a set of closely related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six operational areas. The multiple processes in each area are described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Report for Special Processing at TA-55* (TWCP-AK-2.1-007 [this report])

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, special processing includes 14 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6).

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in special processing, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Most processes in special processing were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not always segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167) as well as material type. For example, plutonium material type MT-42 (enriched in Pu-242) has always been segregated from other wastes; this material type is exclusively defense-related. Similarly, plutonium material type MT-83 (enriched in Pu-238) is also segregated from other wastes; but this material type is not used solely for defense activities. Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (DLs) (TWCP-816).

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard

to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the AK Information Summary. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

3.3 Waste Physical Form and Content Description

Wastes generated during special processing, primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50, are covered by this process AK report. General debris waste categories from special processing include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles
- Metal debris (for example, tantalum crucibles, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from special processing.

3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1980, when special processing first began in Building PF-4, to the present. Process wastes from special processing have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding EPA HWNs are shown graphically in Attachment 3, Timeline for Special Processing.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

## 3.5 Waste Generation Processes

The following subsections describe the generation of waste by special processing, as well as product and waste outputs to other processes or operations.

Manufacturing and research operations performed at TA-55 in the production of plutonium also generate plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery and manufacturing operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352 and TWCP-886).

This report focuses on special processing activities, which include the following:

- Head-end operations (P/S codes ACD, IAM, SB, and SL)
- Nitrate anion exchange (P/S code IX)
- Chloride anion exchange (P/S codes DO and POSM)
- Metal preparation (P/S codes PI and RM)
- Separation and purification by precipitation (P/S code DO)
- Pyrochemical operations (P/S codes PX and RM)
- Direct oxide reduction processes (P/S codes PX and RM)
- Molten salt extraction (P/S codes ACC, PX, and RM)
- Electrorefining (P/S codes PX, RM, and SBB)
- Pyroredox (P/S code PX)
- Plutonium pellet dissolution (P/S code PPD)

Each of these process categories is described below. Timelines for individual processes are presented in Attachment 3. A complete listing of P/S codes for special processing, their descriptions, feed materials, and inputs and outputs are found in Attachment 4. A simplified process flow diagram for special processing is found in Attachment 5.

3.5.1 Head-End Operations (P/S Codes ACD, IAM, SB, and SL)

Head-end operations involve incineration, calcination, leaching of noncombustible materials (including ash), conversion of pyrophoric metal and compounds to stable oxides, and dissolution. P/S code IAM is also classified as a head-end operation in this report because it involves inspection of scrap items from the vault to determine an appropriate disposition for them.

Combustible wastes are burned in a combustion chamber, and the ash is screened and the fines (<#12 sieve) are sent to the rotary calciner (P/S code RC, described in TWCP-AK-2.1-005) (TWCP-3543/SP-42). Rotary calciners remove incompletely oxidized organic material from some types of feed prior to leaching or dissolution in nitric acid (SP-5, SP-43 [both in TWCP-3543]). This treatment step is quite advantageous for the following reasons:

- Organic materials sometimes react vigorously when treated with strong nitric acid,
- Emulsions that form when nitric acid reacts with organic material impede plutonium recovery, and
- Some of the organic materials react in nitric acid to yield a dark mixture that in turn poisons the ion-exchange resin.

Glovebox operations and research and development (R&D) projects routinely generate non-plutonium scrap metal, glass, high-efficiency particulate air (HEPA) filters, tools, plastics, glovebox sweepings, sand, slag, crucibles, etc. Leaching in nitric acid and hydrofluoric acid, or pickling these materials in hydrochloric acid, is a relatively easy but incomplete decontamination method (SP-1, SP-2, SP-3, and SP-4 [all in TWCP-3543]).

Conversion of pyrophoric metals and compounds to stable oxides is usually done by calcination in a controlled oxygen atmosphere and at temperatures less than 600°C. Low-fired oxides are easier to dissolve in nitric acid (TWCP-3543/SP-42).

Dissolution of oxide prepares plutonium for purification by nitrate ion exchange processing and oxalate precipitation.

Under P/S code IAM, MT42 scrap items (gloves, ash, rags and other items that may contain RCRA-listed metals) were taken from the vault, visually inspected for material type, and remeasured by non-destructive assay. (MT42 is the designation for plutonium that is enriched in Pu-

242. See section 3.6.2 and Table 2.) If the Plutonium content was less than the DL, the items were discarded. Material that was not discardable, but was within specification, would be sent to P/S codes DO or SL for treatment or was returned to the vault. Out-of-specification material was sent to P/S code POSM for processing. Activities conducted under POSM are similar to those for P/S code DO (section 3.5.5).

3.5.2 Nitrate Anion Exchange (P/S code IX)

Nitrate anion exchange is the primary method used at LANL for the aqueous concentration of plutonium. The most commonly used ion exchange resin is a polyvinyl pyridine base macroporous-type resin. Information on the use of this method for processing plutonium material type MT 42 (see section 3.6.2 and Table 2), is provided in references SP-6, SP-7, SP-8, SP-9, SP-34 (all in TWCP-3543). Nitrate anion exchange for MT 52 is discussed in the nitrate operations process AK report (*Process Acceptable Knowledge Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005], section 3.5.3).

Nitrate anion exchange is a very powerful technique for recovery and separation of plutonium from most elements in the periodic table. At constant acidity, the amount of plutonium absorption onto the resin increases with nitrate concentration. Aluminum nitrate is added to the column to complex with fluoride and oxalate anions, which would otherwise complex with plutonium and prevent its full absorption onto the resin. The plutonium must be in the +IV oxidation state for absorption onto the column and, because plutonium can exist in five different oxidation states in aqueous solution, the oxidation state must be adjusted by careful selection of the sequence and type of reducing and oxidizing agents.

Major reducing and oxidizing agents used in plutonium production operations include hydroxylamine nitrate ($NH_2OH \cdot HNO_3$), ferrous ammonium sulfate [$Fe(SO_4)$ $(NH_4)_2SO_4 \cdot 6H_2O$], sodium nitrite ($NaNO_2$), urea [$CO(NH_2)_2$] and hydrogen peroxide ($H_2O_2$).

Ion exchange operations are typically divided into the following steps: (1) column conditioning, (2) feed oxidation state adjustment, (3) loading plutonium in nitric acid, (4) washing with 7 molar nitric acid, (5) elution with hydroxylamine nitrate, and (6) readjustment of the column from the low-acid elution step to 7–8 molar nitric acid for the next column run.

Effluents from nitrate ion exchange, when discardable, are sent to P/S code EV (part of nitrate operations), where they are reduced in volume by evaporation. Similar to waste from ion exchange processes in nitrate

operations (e.g., P/S codes DS and LR), these wastes may be contaminated with the heavy metals cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011). The evaporator salts are sent to cement fixation (P/S code CF, also part of nitrate operations). The distillate is sent to the RLWTF at TA-50.

3.5.3 Chloride Anion Exchange (P/S codes DO and POSM)

Chloride salts are an important class of residues and are by-products of pyrochemical operations that are also important to Special Processing operations. In addition, plutonium must be recovered from the hydrochloric acid leach solutions employed during pickling (also conducted under P/S code DO). Chloride anion exchange is the method of choice for recovery of plutonium from these chloride-based processes (SP-14, SP-16, SP-30, SP-33, SP-34 [all in TWCP-3543]). Chloride anion exchange is a more recent innovation in Special Processing operations. It was probably implemented sometime in the early 1990s (TWCP-3543/SP-37). Prior to that, hydroxide precipitation was used and is discussed in the chloride operations process AK report (TWCP-AK-2.1-002,R.2, section 3.5.4).

Special Processing operations use chloride anion exchange to recover plutonium from salts produced by multicycle direct oxide reduction (MCDOR), molten salt extraction (MSE), electrorefining (ER), and pyroredox operations. The general chloride anion exchange process consists of the following steps: (1) dissolution of salt in 2-4 molar hydrochloric acid, (2) adjustment of plutonium oxidation state, chloride concentrations, and pH using 12 molar hydrochloric acid and sodium nitrite, (3) loading of feed solution onto the ion exchange column, (4) washing with 8 molar hydrochloric acid, (5) elution of plutonium from the column with 0.5 molar hydrochloric acid and 0.5 molar hydroxylamine hydrochloride, and (6) precipitation of plutonium oxalate by addition of solid oxalic acid. Chloride concentrations in the column eluant were measured by titration using silver nitrate and potassium dichromate until the end of 1992 when this method was replaced with a silver electrode.

Activities conducted under P/S code POSM are similar to those described above for P/S code DO. Feed materials to P/S code POSM are provided by P/S code IAM (section 3.5.1).

3.5.4 Metal Preparation (P/S codes PJ and RM)

Conversion of plutonium to an oxide from scrap can be used as feed material for metal preparation (TWCP-3543/SP-17). The oxide compound is reduced to metal, often an impure form; however, the

oxide would not contribute RCRA-listed heavy metals to wastes produced during metal preparation (TWCP-3543/SP-44). In pyrochemical operations, several processes are used to convert this impure metal into high-purity metal.

3.5.4.1 Fluorides

Reactive plutonium oxides formed by calcination of oxalate or peroxide precipitates can be treated in a hydrofluorinator to form plutonium fluoride ($PuF_4$). In the hydrofluorination step, the oxide is treated with hydrogen fluoride (HF) or fluorine gas ($F_2$) to produce $PuF_4$. The $PuF_4$ is mixed with calcium metal, which in turn is heated to form calcium fluoride ($CaF_2$) and plutonium metal. Quite often, a catalyst (in this case iodine [$I_2$]) is added to initiate the reaction and to provide sufficient energy to ensure the reaction goes to completion. This method of metal preparation neither purifies the product metal, nor does it introduce many impurities. However, a high-purity oxide feed can produce metal that meets purity specifications for many applications. Wastes generated from this operation include magnesium oxide (MgO) sand, $CaF_2$, and MgO crucibles. These waste items are sent to leaching operations to recovery any plutonium. Subsequent wastes are discarded. Hydrofluorination at LANL was discontinued in the early 1990s. In the Special Processing operations, this activity was conducted under P/S code PI (SP-22, SP-23, SP-41 [all in TWCP-3543]).

3.5.4.2 Oxides

Metal scrap containing plutonium can be converted to plutonium oxide by burning it at elevated temperature in air. Reactive plutonium oxides can then be converted to plutonium fluoride for reduction to plutonium metal. Unreactive or high-fired plutonium oxide does not react to form plutonium fluoride; instead, the addition of a strong reducing agent in a solvent salt is required to produce plutonium metal from such oxide. The resulting impure metal forms a button in the bottom of the crucible that is covered by a fused oxide/salt layer. The button is removed mechanically from the salt. All residues containing plutonium in excess of the DL are sent to aqueous recovery.

3.5.5 Separation and Purification by Precipitation (P/S code DO)

The separation of plutonium from aqueous solutions makes use of many different precipitation reactions, the most common being reactions involving oxalate, peroxide, hydroxide, and fluoride anions (TWCP-352; SP-10, SP-11, SP-12, SP-13, SP-15, SP-16, SP-25, SP-43 [all in TWCP-3543]). Common reasons for conducting these precipitation reactions include the following:

- Relatively concentrated plutonium nitrate solutions can be largely or partially purified from many cationic impurities.
- Precipitation of plutonium (III) oxalate from very large volumes of nitrate anion-exchange eluates is a very quick and convenient concentration step.
- Calcination at 550°C can easily convert precipitated oxalates of plutonium (III) and plutonium (IV) to reactive plutonium oxide ($PuO_2$) suitable for hydrofluorination prior to metal preparation by calcium reduction.
- Some precipitated plutonium fluoride salts are suitable precursors for reduction to metal.
- Precipitation of plutonium and americium hydroxides from waste solutions such as oxalate or peroxide filtrates is an effective method to allow discard of the alkaline filtrate and recycle of the plutonium and americium in the separated solids. The hydroxide filtrate is discarded to the caustic waste line for treatment at the RLWTF at TA-50.

The following discussion summarizes the more important precipitation reactions and disposition paths for their filtrates (TWCP-352).

3.5.5.1 Plutonium (III) oxalate

Since the early days of the Manhattan Project, researchers have found it advantageous to produce large-particle-size precipitate because large grain sizes filter most readily. Plutonium (III) oxalate precipitation provides good separation from such impurities as aluminum ($Al^{3+}$), ferric iron ($Fe^{3+}$), and uranium oxide ($UO_2^{2+}$). Less separation is provided from calcium, potassium or sodium, and none from americium (III).

3.5.5.2 Plutonium (IV) oxalate

Plutonium (IV) oxalate is often quite fine-grained and gummy, but controlled addition of oxalic acid solution produces a coarse-grained precipitate that compares favorably with the best plutonium (III) oxalate precipitates. The higher acidity of plutonium (IV) oxalate gives better separation of $Al^{3+}$, $Fe^{3+}$, and $UO_2^{2+}$ than does plutonium (III) oxalate.

3.5.5.3 Plutonium peroxide

Plutonium peroxide precipitate gives the best overall separation from cations; and, unlike the two oxalate precipitates, peroxide precipitation also gives excellent separation from Am-241. Plutonium peroxide is dissolved, reprecipitated as plutonium (III) oxalate, and calcined to provide plutonium oxide for plutonium metal production. Calcination of plutonium oxalate is more easily controlled than calcination of plutonium peroxide.

3.5.5.4 Plutonium hydroxide

Plutonium hydroxide precipitation is quite useful for producing a filtrate that can be discarded to final waste disposal. Oxalate and peroxide filtrates are frequently treated with sodium or potassium hydroxide to precipitate plutonium and Am-241 hydroxides and to destroy residual hydrogen peroxide. In addition, hydroxide precipitation is a good method for discarding spent chloride process solutions because alkaline solutions cause less corrosion of stainless steel. One potential problem with hydroxide precipitation is the generation of voluminous amounts of magnesium and calcium precipitates if pH is not carefully controlled.

3.5.5.5 Plutonium fluoride

Plutonium fluoride precipitation is not as common as precipitation of plutonium oxalate, peroxide, or hydroxide. The feedstock must be relatively pure because separation of plutonium from impurities is not as good for plutonium fluoride as for the other precipitation methods.

3.5.5.6 Disposition of oxalate and peroxide filtrates

Oxalate and peroxide filtrates cannot be sent directly to final waste management without further processing. Oxalate

filtrates cannot be directly processed by ion exchange because oxalic acid interferes with adsorption of plutonium onto the resin. Oxalate filtrates are evaporated to destroy the oxalate ion while reducing the volume of solution to be recycled through the ion exchange column (either nitrate or chloride ion exchange).

Both oxalate and peroxide filtrates are amenable to recovery of residual plutonium by hydroxide precipitation and subsequent disposal of the filtrate. The hydroxide cake can then be recycled to recover and purify the plutonium and americium if above the discard level, or can be discarded if these radionuclide concentrations are below the discard level.

3.5.6 Pyrochemical Operations (P/S codes PX and RM)

Pyrochemical operations for MT 42 (defined in section 3.6.2) include MCDOR with in-situ regeneration and electrorefining (P/S code RM) and MSE (P/S code RM), and oxide reduction (P/S code RM) (SP-17, SP-18, SP-19, SP-20, SP-21 [all in TWCP-3543]). Pyrochemical R&D efforts for MT 52 in the Special Processing area were done under P/S code PX. This included MCDOR with in-situ regeneration, electrorefining, pyroredox, preparation of $PuCl_3$ using chlorine gas and carbon tetrachloride, and MSE (SP-26, SP-27 SP-28, SP-29 [all in TWCP-3543]). Cadmium and lead were used occasionally as secondary solvent metals in P/S code PX.

3.5.7 Direct Oxide Reduction (DOR) Processes (P/S codes PX and RM)

3.5.7.1 Single-Pass DOR Process

Prior to the MCDOR process, a single pass DOR process was used for plutonium oxide (TWCP-2507, PYRO-14/TWCP-3542). Plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible at 820°C to 875°C. Any arsenic, mercury or selenium present in the impure plutonium oxide would be driven off due to their volatility at this high temperature (TWCP-1258). The reaction proceeds to completion when excess calcium is present and when sufficient $CaCl_2$ is available to dissolve the calcium oxide (CaO) product.

After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button

contains unreacted oxide and calcium metal shot, which was sometimes recovered by addition of fresh salt plus additional calcium metal. The process was then rerun. If the unreacted oxide and metal shot did not process after the second run, the material was sent to aqueous recovery. The product plutonium metal contains significant impurities, including additional metal impurities derived from the calcium metal and calcium chloride reagents. It must be further purified by ER. The salt, remaining calcium metal, and MgO crucible pieces are sufficiently low in plutonium to be discarded directly as waste under P/S codes RM or PX. Salt that cannot be discarded as waste is routed through aqueous chloride operations (P/S code DO) to recover the plutonium. After May 1987, spent salts above the DL were sent to controlled oxidation to oxidize the pyrophoric metals. In any case, all DOR salts were oxygen sparged before disposal.

The feed oxide, reagent salts and reductant are of the highest purity available because the process is non-purifying. In fact, the plutonium metal produced from this operation is always less pure than the feed material due to impurities derived from the reductants. Plutonium metal from this process typically requires further processing to meet purity requirements.

3.5.7.2 MCDOR Process

To minimize the salt waste, the MCDOR process was started in 1988 (TWCP-2502, SP-25, SP-27, SP-39 [all in TWCP-3543]). In this process, the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated. The salt is chlorinated and reused for MCDOR. The salt is discarded under P/S codes RM or PX if the plutonium concentration is below the DL. The salts above the DL are returned to P/S code DO for dissolution and recovery. Before 1987, the salts may have been discarded under P/S codes RM or PX or routed to chloride operations. The chlorine off-gas is passed through a caustic scrubber, with the caustic solution going to the RLWTF at TA-50 for disposal if the solution meets this facility's Waste Acceptance Criteria (WAC). If the solution does not meet the WAC, it is returned to P/S code DO for additional treatment.

MCDOR process inputs are low in contaminants. Only high-purity reagent chemical salts are used in the process, and the plutonium oxide feed materials are also of high purity, with absorbed water being the main impurity. MCDOR metal feed material analytical samples were analyzed for cadmium, chromium, lead, and silver. A review of 100 analyses showed that, even in the most impure sample, these D-listed toxicity characteristic metals were well below RCRA regulatory limits (TWCP-2540), as follows:

| Metal | Totals Analysis | Calculated TCLP Result | Regulatory Level |
|---|---|---|---|
| Cadmium | <10 ppm | <0.5 mg/L | 1 mg/L |
| Chromium | 30 ppm | 1.5 mg/L | 5 mg/L |
| Lead | 20 ppm | 1 mg/L | 5 mg/L |
| Silver | 2 ppm | 0.1 mg/L | 5 mg/L |

All metal impurities except barium would be reduced to the metal state and remain with the plutonium metal phase rather than be transferred into the molten salt phase. Hence, the molten salt phase is purified of regulated metals except for barium. These regulated metals will be present in the waste salt at levels below the toxicity characteristic levels. Because the salts are reused, only the initial reduction in fresh salt would contain any of the salt feed impurities.

The waste salt, crucibles, and debris waste items associated with this process are discarded under P/S codes DO, PX, or RM. Asbestos gloves were also used in glovebox operations under P/S codes RM or PX, and were disposed with ceramic and glass debris.

3.5.8 Molten Salt Extraction (P/S codes ACC, PX, and RM)

MSE is used to separate the more reactive elements such as rare earth elements, alkali metals, and alkaline earth metals, and americium from plutonium metal (TWCP-352, TWCP-3543/SP-19). This process is employed only if the americium content is greater than 1000 ppm. In the original process, which operated from 1980 to 1988, magnesium chloride ($MgCl_2$) was added to the impure plutonium metal in a tantalum crucible, covered with a mixture of sodium chloride and potassium chloride (NaCl/KCl), and then heated to 750 °C. Magnesium oxidized americium to americium chloride ($AmCl_3$), although some plutonium

was also converted to the chloride salt. In 1988, the MSE process was converted to use plutonium trichloride ($PuCl_3$) produced by in-situ chlorination. In the LANL process, 90 percent of the americium and 10 percent of the plutonium are transferred from the impure feed metal to the salt. After cooling, the salt and residual metal are mechanically separated. The salts are transferred to the aqueous chloride process under P/S code DO.

P/S code ACC was an experimental effort using ammonium chloride as a chlorinating agent to produce plutonium trichloride (SP-24/TWCP-3543).

3.5.9 Electrorefining (P/S codes PX, RM, and SBB)

The ER process was introduced in 1962 at TA-21 and was moved to TA-55 in 1979 under pyrochemical operations. This process was implemented as part of special processing in 1980. It takes impure metal from the MSE and MCDOR (DOR) processes and produces high purity plutonium metal (SP-18/TWCP-3543], TWCP-2505). Impure plutonium is cast as an anode, which is then placed in a magnesium oxide crucible with a salt mixture, a metal cathode (typically tungsten), and a seeding reagent that is $MgCl_2$ or $PuCl_3$ (TWCP-3543/SP-24, TWCP-2505). After the anode and salt melt, current is applied to the system, and plutonium at the anode is oxidized to plutonium ions, which travel to the cathode and are reduced back to the metal state. Impurities in the original plutonium anode that are less electroactive than plutonium (including cadmium, chromium, lead, and silver) remain in the anode, while impurities more electroactive than plutonium (including barium) are left in the molten salt. After cooling, the crucible is broken and the residues are physically separated from the high purity product metal. MT 42 anode heels are oxidized in P/S code RM, then are sent to aqueous recovery in P/S code DO. Salt and crucibles are sent for plutonium recovery under P/S code DO. MT 52 residues went to the vault. Salt may be stripped prior to going to P/S code DO.

In 1986 to 1989, secondary solvent metals such as cadmium, bismuth, lead, and gallium were added to experimental studies of the MT 52 electrorefining process (TWCP-3543/SP-29). The salts and crucibles from those ER runs may be contaminated with additional cadmium and lead, although those metals should have remained in the anode heels. However, these particular anode heels are retained in the vault at TA-55, with no plans to reprocess them in the near future. A pyroredox process was developed to recover plutonium from the anode heels, but it was mostly limited to demonstration runs.

The salt and crucible residues were discarded under P/S code PX when the plutonium content was sufficiently low. However, very little salt from this process met the DL. The salt typically contains up to eight percent of the feed plutonium and is treated by salt stripping to recover the plutonium under P/S code PX.

P/S code SBB was an R&D effort examining the feasibility of a DOR-like process for extracting plutonium from salt before discarding the salt. plutonium was chlorinated then reduced to the metal with calcium metal. The feed material for this process was salt containing plutonium MT 42.

3.5.10 Pyroredox (P/S code PX)

The pyroredox operation was developed to recover plutonium material type MT 52 from spent anode heels in the mid- to late-1980s (TWCP-2541). The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements easier to be oxidized than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. Any of the residual RCRA-regulated heavy metals that may have been present in the spent anode heel (barium, cadmium, chromium, lead, and silver), with the exception of barium, would be present in the zinc button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements easier to be reduced than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded under P/S code PX. The metal phase containing zinc was placed in the vault or further treated (TWCP-2540), and the plutonium eventually was routed back to electrorefining (also conducted under P/S code PX). In the electrorefining process, the RCRA-regulated metals are concentrated in the anode heel, which then may be treated in the pyroredox process to transfer these RCRA metals to the zinc button, or may be roasted in air to form metal oxides and then be dissolved in nitrate operations. Thus, only the zinc button output could contain RCRA-regulated metals above the toxicity characteristic limits.

3.5.11 Plutonium Pellet Dissolution (P/S Code PPD)

Pu-238 pellets were dissolved in a combination of nitric and hydrofluoric acid (TWCP-3543/SP-45). The plutonium was precipitated as the oxalate using either oxalic acid or sodium oxalate. After digestion, the mixture was filtered to separate the solid plutonium oxalate. The oxalate was converted to the oxide by heating to 600 °C to 700 °C, then the oxide was heated with water vapor to about 800 °C to volatilize the residual ion fluoride as HF. The oxalate filtrate was treated with a

caustic solution to remove the plutonium by hydroxide precipitation. After subsequent filtration, the hydroxide cake was dried and sent to the vault. The hydroxide filtrate was discarded to the RLWTF at TA-50 if it met this facility's WAC or was recycled to filtration until it did meet the WAC. No organic solvents or heavy metals were used in the process.

3.6 Material Inputs to the Waste Generation Processes

Attachment 4 lists P/S codes for special processing at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for special processing consist of the general types of materials listed in Table 1 that are obtained from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites.

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

3.6.1 Physical Waste Form Identification

Solid waste from special processing primarily consists of debris waste. Debris waste contains glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated as process waste. Prior to 1987, leaded gloves were discarded in combustible and non-combustible waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream. In addition, caustic solutions from hydroxide precipitation are discarded through the waste line to the RLWTF at TA-50.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance (QA) personnel. Example forms for one drum of waste generated can be viewed in record TWCP-2513.

**Table 1. Process Feed Materials for Special Processing**

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes in Special Processing |
|---|---|---|
| Ash from P/S code SB | Usually suspect contaminated with Ba, Cd, Cr, Pb, and Ag (D005, D006, D007, D008, D011). As, Hg, and Se may also be present although these metals are volatilized at high temperatures if present in the oxide and chloride forms. | ACD, DO, SL |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | ACD, SL |
| Hydroxide cakes | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | DO, POSM |
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings) | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | ACD, DO, SB, SL |
| Pu chlorides and fluorides (from P/S codes PI, PX, and RM) | Variable purity; may or may not contain RCRA-regulated substances | RM |
| Pu metal or metal alloy | High purity, no RCRA-regulated substances, unless noted otherwise | ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |
| Pu oxalates | Typically fairly pure, no RCRA substances present | SL |
| Pu oxides | Variable purity, suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008) | DO, PI, PX, POSM, RM |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than Ba (D005) are present | DO |

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for plutonium feed materials at Building PF-4 are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers. The results of these calculations are also tabulated in Table 2. The calculations assume that (a) none of these isotopes were initially present in the material, (b) the oldest plutonium material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in Am-241 or U-234 depending on whether the source of contamination is the process product or the process residues (TWCP-882).

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from special processing at TA-55.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all. U-238 would only be present if purposefully added to the feed material. U-235 in growth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. Uranium-234 would be present in MT 83 as a decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total plutonium would be about 0.14. Pa-231 and Cs-137 may be present in trace

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope (Wt.%) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

amounts because of their widespread presence as contaminants in TA-55 operations (TWCP-5164, TWCP-5165).

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). If warranted, this AK report will be updated to incorporate the results of these comparisons.

3.6.3 Chemical Content Identification

Chemical inputs to special processing are listed in Table 3. The use of strong acids, bases, or oxidizers does not result in RCRA listings for solid debris waste from these processes because of the absence of free liquids in this waste. However, D006, D007, D008, D011, and D019 apply to some of the process wastes generated by special processing, as noted in Table 3.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA HWNs to process wastes from special processing operations is summarized below, as well as on the process timelines in Attachment 3, and the table of process inputs and outputs in Attachment 4. These assignments take into account the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

4.1 F, K, and P Listings

No F, K, or P listings apply to solid wastes generated from any of the special processing because no F-listed, K-listed, or P-listed chemicals were present in the feed materials, chemicals or equipment used in these processes.

4.2 Toxicity Listings

No D001 (ignitable), D002 (corrosive), or D003 (reactive) listings apply to solid wastes from special processing because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 6.0).

D005 (barium) and D008 (lead) apply to P/S code VU.

D005 (barium), D006 (cadmium), D007 (chromium), D008 (lead), D009 (mercury), and D011 (silver) apply to P/S codes ACD, IAM, SB (not D009), and SL.

D005 (barium), D006 (cadmium), D007 (chromium), D008 (lead), D009 (mercury), and D011 (silver) apply to waste generated under P/S code IX.

## Table 3. Chemical Inputs to Processes Described in This Report

| Chemical Input | P/S Codes in Which RCRA-Listed Chemical Is Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| **Gas** | | |
| Chlorine gas<br>Fluorine gas<br>Hydrogen fluoride gas | | D001 and D002 do not apply to these gases, because there are no free liquids in this waste. Also the gas cylinders are outside the building, and the gases are plumbed into the glovebox. |
| **Acids** | | |
| Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Oxalic acid | | D002 does not apply to the solid process waste because there are no free liquids in this waste |
| **Bases** | | |
| Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the TRU process waste because there are no free liquids in this waste |
| **Metals** | | |
| Bismuth metal<br>Cadmium metal<br>Calcium metal<br>Gallium metal | PX | D006 |
| Lead metal | PX | D008 |
| **Inorganic Chemicals** | | |
| Aluminum nitrate<br>Ammonium chloride<br>Calcium chloride<br>Calcium fluoride<br>Ferrous ammonium sulfate<br>Hydrogen peroxide<br>Hydroxylamine hydrochloride<br>Hydroxylamine nitrate<br>Iodine<br>Magnesium chloride<br>Magnesium oxide (sand and crucibles)<br>Potassium chloride | | |
| Potassium dichromate | DO | D007 until end of 1993. Used in P/S code DO as titration endpoint until end of 1993. Solution and precipitates then processed by hydroxide precipitation under same code. Hydroxide cakes (in which chromium would be present) sent to P/S code POSM. Ultimately, chromium ends up in the solution sent to P/S code EV, from which residue gets sent to cement fixation. |
| Silver nitrate | DO, POSM | D011 until end of 1993. Used in P/S code DO for chloride titration until end of 1993. Solution and precipitates then processed by hydroxide precipitation under same code. Hydroxide cakes (in which silver would be present) sent to P/S code POSM. Ultimately, silver ends up in the solution sent to P/S code EV, from which residue gets sent to cement fixation. |

| Chemical Input | P/S Codes in Which RCRA-Listed Chemical Is Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| Sodium chloride<br>Sodium nitrite<br>Sodium oxalate<br>Zinc chloride | | |
| **Organic Chemicals** | | |
| Carbon tetrachloride<br><br>Urea | PX | D019. F002 does not apply because carbon tetrachloride was used as a chlorination reagent. |

D006 (cadmium), D008 (lead), and D019 (carbon tetrachloride) apply to salt, crucible and debris waste generated P/S code PX.

D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to the zinc metal waste produced from P/S code PX. In the ER process, these RCRA-regulated heavy metals concentrate in the anode heel, which then may be treated in the pyroredox process (P/S code PX) to transfer them to the zinc button, or may be roasted in air to form metal oxides and then be dissolved in nitrate operations. Thus, only the zinc button output could contain RCRA-regulated metals above the toxicity characteristic limits.

D006 (cadmium), D008 (lead), and D019 (carbon tetrachloride) apply to P/S code PX, as the salts, crucibles, and debris waste items discarded under this code may include some RCRA-regulated metal residues above the toxicity characteristic limits. Carbon tetrachloride was used as a chlorination reagent in this P/S code from April 1988 until July 1989.

D007 (chromium) and D011 (silver) apply to P/S codes DO and POSM. Potassium dichromate and silver nitrate were used in P/S codes DO and POSM for chloride titrations from 1990 until the middle of 1993. Solution and precipitates were then processed by hydroxide precipitation under the same code and, therefore, carry the same P/S codes as ACD, IX, and SL (D005 [barium], D006 [cadmium], and D009 [mercury]). Hydroxide cakes (in which chromium and silver would be present) were sent to P/S code POSM for additional processing. Ultimately, chromium and silver end up in the solution sent to P/S code EV, from which the residue gets sent to cement fixation.

D008 (lead) applies to metal waste from all P/S codes in special processing, except for P/S codes ACD and PPD. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes that the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200 °F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the solid waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, (3) and no sparking. Experimental results on the reactivity of LANL DOR salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 5.0 and 6.0.

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into special processing, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 3, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005,R.2, Section 8.0). This oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Records Management* (TWCP-QP-1.1-004)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)

- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## ACCEPTABLE KNOWLEDGE ROADMAP

Waste Stream: P/S Codes ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU.

Copies of these documents are in the TWCP RMDC Center. Refer to Records Management (TWCP-QP-1.1-004) for information on obtaining copies.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the plutonium residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is defense related | Memo from Doug Sankey. | All TA-55 waste is defense related | None |
| TWCP-697 | C | Waste management requirements to meet WIPP WAC requirements were formalized in 1984. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste management requirements to meet WIPP WAC requirements. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Waste was co-mingled with room trash, and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level DLs. | None |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process status code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Fixx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-1258 | B | "Waste Determination Report for Waste Stream TA-55-43, Lot No.1" | LANL internal report | Table B-1 lists the decomposition and vaporization temperatures of Hg, Se, and As and their oxides and chlorides. | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests were conducted on residues rather than on waste. |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-2502 | D | "Acceptable Knowledge Personnel Interview Form" for Waste Stream TA-55-39 (pyrochemical salts) and P/S codes MP, OR, SS, PX, ER, and RM | Jim Foxx, NMT-7 | Answers to miscellaneous questions on pyrochemical processes. | Not a good overview |
| TWCP-2505 (UCNI) | C | Procedure for Plutonium Electrorefining (P/S SS) | TA-55 Document, 432-MPP-R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-2507 (UCNI) | C | Procedure for Direct Oxide Reduction (P/S code OR) | TA-55 Document, 426-MPP-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-2513 | A | Example of Generator Reports for Drum 54856 | TA-55 Records Management Center | Example of generator records including WPRF #07045 and WODF form showing the waste generator certification statement. | Older forms are often hard to read. |
| TWCP-2540 (UCNI) | A | Answers to Questions about pyrochemical Processes | Jim Foxx, NMT-7-WM/EC-99-118 | Also contains old records of analysis of DOR salts | |
| TWCP-2541 (UCNI) | C | Procedure for Pyroredox Processing of Spent Electrorefining Anodes (P/S RA) | TA-55 Document, 460-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3542 (UCNI) (PYRO-14) | C | Procedure for Reduction of PuO2 to Metal, 700g Scale (P/S code OR) | TA-55 Document, 420-MPP-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-1) (UCNI) | C | Procedure for Pickling, Leaching, and Dissolution (P/S SL) | TA-55 Document, 209-MPP-R00-R01 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-2) (UCNI) | C | Procedure for Pickling or Surface Leaching (P/S SL) | TA-55 Document, 211-MPP-R00-R04 | Contains materials used in the process | No RCRA analyses documents |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3543 (SP-3) (UCNI) | C | Procedure for Stirred Tank Leaching of Bulk Solids (P/S SL) | TA-55 Document, 240-MPP-R00-R07 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-4) (UCNI) | C | Procedure for Distillation of Lean Plutonium Solutions (P/S SL) | TA-55 Document, 241-MPP-R01-R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-5) (UCNI) | C | Procedure for Rotary Calcination of Scrap (P/S SB) | TA-55 Document, 220-MPP-R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-6) (UCNI) | C | Procedure for Oxalate Precipitation of Plutonium From Nitrate Solutions (P/S IX) | TA-55 Document, 215-MPP-R01 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-7) (UCNI) | C | Procedure for Oxalate Precipitation of Ion Exchange Eluates (P/S IX) | TA-55 Document, 216-MPP-R01-R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-8) (UCNI) | C | Procedure for Nitrate Ion Exchange (P/S IX) | TA-55 Document, 219-MPP-R01-R07 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-9) (UCNI) | C | Procedure for Transfer of Waste-Acid Solution (P/S IX) | TA-55 Document, 236-MPP-R00-R06 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-10) (UCNI) | C | Procedure for Dissolution of Various Residue Materials in Hot Nitric Acid or Hydrochloric Acid (P/S DO) | TA-55 Document, 212-MPP-R01-R06 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-11) (UCNI) | C | Procedure for Conversion of Plutonium Oxalate to Oxide (P/S DO) | TA-55 Document, 213-MPP-R01-R09 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-12) (UCNI) | C | Procedure for Oxalate (IV) Precipitation (P/S DO) | TA-55 Document, 214-MPP-R01-R07 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-13) (UCNI) | C | Procedure for Peroxide Precipitation (P/S DO) | TA-55 Document, 217-MPP-R01 | Contains materials used in the process | No RCRA analyses documents |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3543 (SP-14) (UCNI) | C | Procedure for Dissolving Chloride Portion of Electrorefining Residues (P/S DO) | TA-55 Document, 226-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-15) (UCNI) | C | Procedure for Hydroxide Precipitation (P/S DO) | TA-55 Document, 230-MPP-R01-R08 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-16) (UCNI) | C | Procedure for Oxalate Precipitation of Plutonium from Hydrochloric Acid Solutions (P/S DO) | TA-55 Document, 232-MPP-R01-R03 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-17) (UCNI) | C | Procedure for Oxidation of Plutonium Metal and Alloys (P/S RM) | TA-55 Document, 222-MPP-R00-R02 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-18) (UCNI) | C | Procedure for Electrorefining of Plutonium Metal (P/S RM) | TA-55 Document, 258-MPP-R00-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-19) (UCNI) | C | Procedure for Molten Salt Extraction and Liquidation (P/S RM) | TA-55 Document, 262-MPP-R00-R04 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-20) (UCNI) | C | Procedure for Salt Stripping of Electrorefining Salts (P/S RM) | TA-55 Document, 264-MPP-R00-R02 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-21) (UCNI) | C | Procedure for Spent DOR Salt Regeneration (P/S RM) | TA-55 Document, 425-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-22) (UCNI) | C | Procedure for Hydrofluorination in the Special Isotope Preparation Line (P/S PI) | TA-55 Document, 290-MPP-R02-R03 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-23) (UCNI) | C | Procedure for Small Scale Bomb Reduction (P/S PI) | TA-55 Document, 291-MPP-R00-R01 | Contains materials used in the process | No RCRA analyses documents |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3543 (SP-24) (UCNI) | C | Procedure for Chlorination of Plutonium Compounds with Ammonium Chloride (P/S ACC) | TA-55 Document, 292-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-25) (UCNI) | C | Feed Preparation for +4 Oxalate Precipitation (P/S DO) | TA-55 Document, 210-MPP-R02 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-26) (UCNI) | C | Procedure for Chlorination of Plutonium Compounds (P/S PX) | TA-55 Document, 224-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-27) (UCNI) | C | Procedure for Multiple-cycle Direct Oxide Reduction (P/S PX) | TA-55 Document, 251-MPP-R00-R05 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-28) (UCNI) | C | Procedure for Breaking Press Operation (P/S PX) | TA-55 Document, 253-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-29) (UCNI) | C | Procedure for Solvent Anode Electrorefining (P/S PX). Also referenced in Pyrochemical Processes as PYRO-15/TWCP-3542) | TA-55 Document, 434-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-30) (UCNI) | C | Purifying and Recovery of Plutonium by Chloride Anion Exchange (P/S DO) | TA-55 Document, 273-CLO-R02, R03, R04 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-31) (UCNI) add to Att. 4 | C | Procedure for Vessel Handling (P/S VU) | TA-55 Document, 201-MPP-R01, R02, R05-R07 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-33) (UCNI) | C | Procedure for Precipitation of Plutonium (III) Oxalate in Hydrochloric Acid (P/S code DO) | TA-55 Document, 242-MPP-R00-R01 | Contains materials used in the process | No RCRA analyses documents |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3543 (SP-34) (UCNI) | C | Procedure for Leaching of Non-combustible Materials in Nitric Acid (P/S IX or NC) | TA-55 Document, 235-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-37) (UCNI) | D | Acceptable Knowledge Interview Form for Special Processing | Jim Foxx, NMT-7 1/19/00 | SME review of Special Processing AK Report | Addresses specific questions |
| TWCP-3543 (SP-38) (UCNI) | D | Acceptable Knowledge Interview Form for Special Processing | Jim Foxx, NMT-7 2/3/00 | Answers to questions about P/S code PPD and to MT42 waste volume | Addresses specific questions |
| TWCP-3543 (SP-39) (UCNI) | D | Procedure for Direct Oxide Reduction R&D | TA-55 Document 422-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-41) (UCNI) | C | Procedure for Generation of 242PuF6 | TA-55 Document 122-LPN-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-42) (UCNI) | C | Procedure for Burning of Combustibles in Head-End Operations | TA-55 Document, 221-MPP-R00 | Contains materials used in the process | Contains no chemical list: no chemicals used. No P/S code |
| TWCP-3543 (SP-43) (UCNI) | C | Alternate Procedure for Dissolution of Oxide Derived from Calcination of Oxalate | TA-55 Document, 448-REC-R00 | Contains materials used in the process, mineral acids used | No chemical list: no P/S code |
| TWCP-3543 (SP-44) (UCNI) | D | Acceptable Knowledge Interview Form for Special Processing | Jim Foxx, NMT-7 8/2/00 | Answer to question as to whether plutonium metal, pure or impure, is a contributor of RCRA-listed metals | Addresses specific questions |
| TWCP-3543 (SP-45) (UCNI) | D | Acceptable Knowledge Interview Form for Special Processing | Jim Foxx, NMT-7 | Answer to questions regarding P/S codes PPD, RAP2, SBB and SCB | Addresses specific questions |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4162 | D | Answers to questions about P/S codes PB, PuBe, CC, MB, MS, FF, BF, and other issues | Interview with Jim Foxx, 10/12/00 | Answers to questions on use of asbestos at TA-55, non-defense activities, and specific P/S codes in chloride operations. | None |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of Ag, disposal of ash and resins, and use of gases. | None |
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of Ag from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that Ag in ash is below limits of regulatory concern | None |
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |

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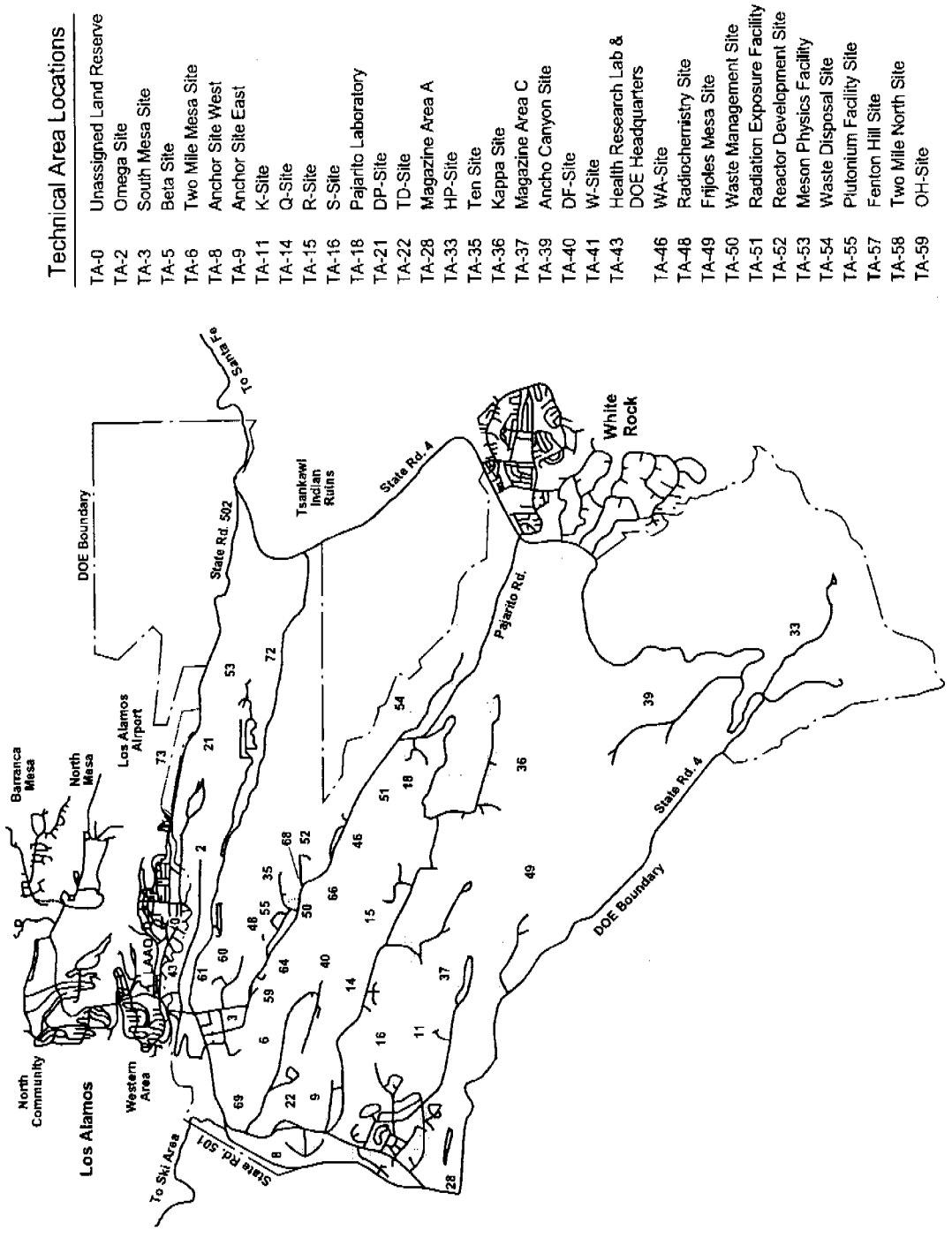
| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5164 | D | Sources of Cs-137 and Pa-231 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 2, 2001 | Plutonium operations never handled Cs-137 or Pa-231 in any of the Pu processing areas at TA-55. However, Cs-137 is expected to be present in the wastes because it is a fission product of several Pu isotopes. Pa-231 is expected to be present (as a function of the age of the waste) because it is a decay chain daughter of Pu-239 and U-235. | None |
| TWCP-5165 | D | Sources of Cs-137, Pa-231, and Cm-244 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Dominant source of Cs-137 expected to be due to residual contamination from original separation of Pu from production fuel. Cm-244 introduced in P/S code DOP starting in 1988, but could also show up after that date in IS, WE, CA and CF. | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2 | A | *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | A | *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for nitrate operations at TA-55 | None |

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| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-006,R.2 | A | *Process Acceptable Knowledge Report for Pyrochemical Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for pyrochemical operations at TA-55 | None |
| TWCP-PLAN-0.2.7-001,R.5 | C | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK reference base on generator's original data | Detailed information on each waste drum and waste stream | None |

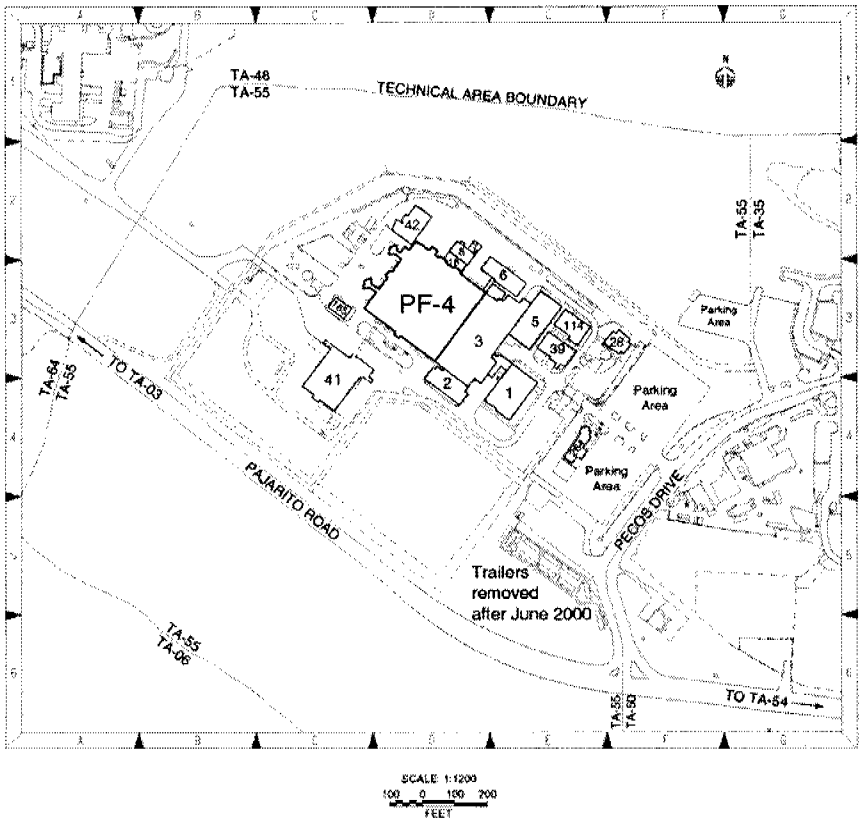
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# MAP OF LANL

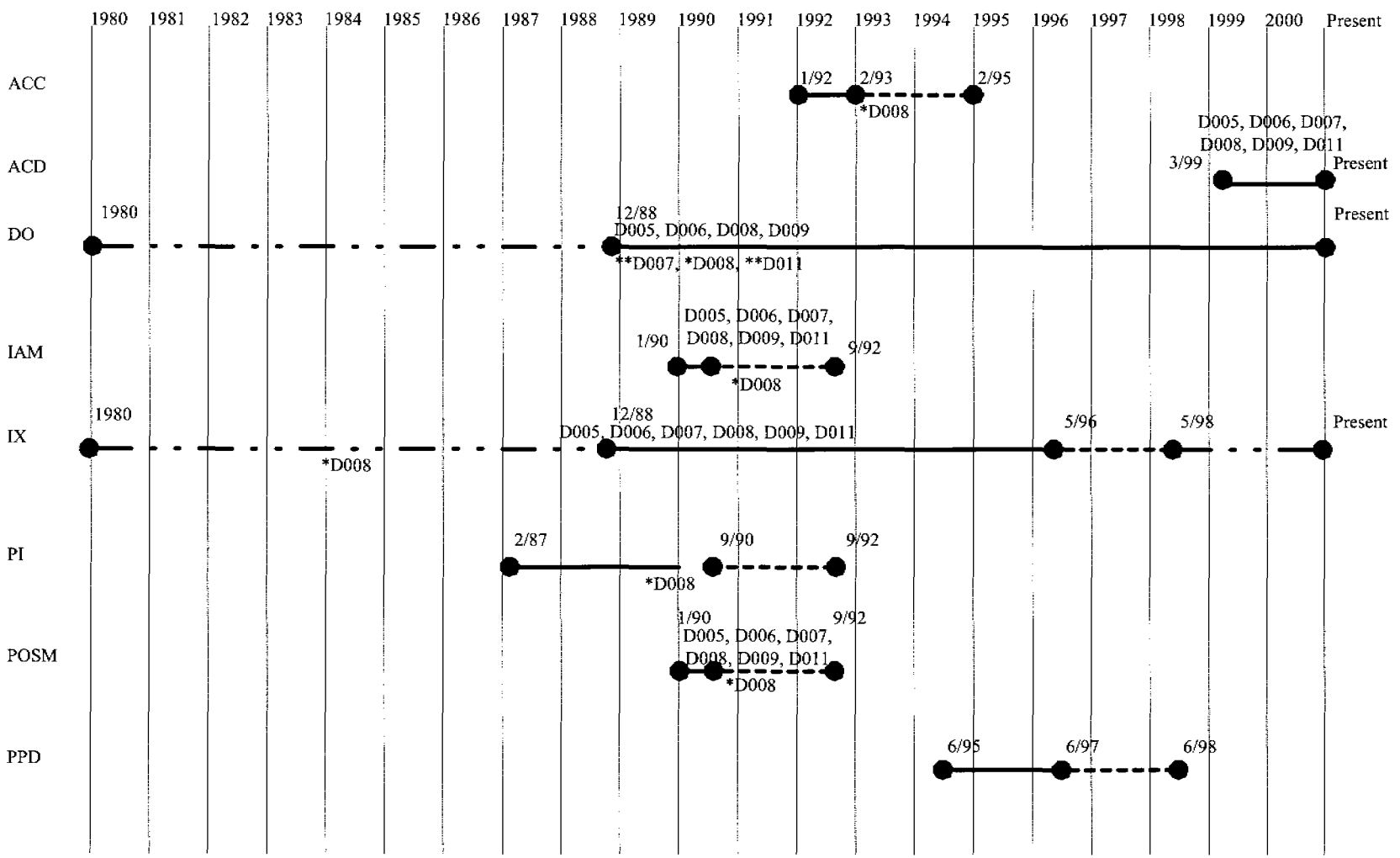

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Barranca Mesa
North Mesa
Los Alamos Airport
LAO
North Community
Los Alamos
Western Area
To Ski Area
State Rd. 501
DOE Boundary
State Rd. 4

## MAP OF TA-55

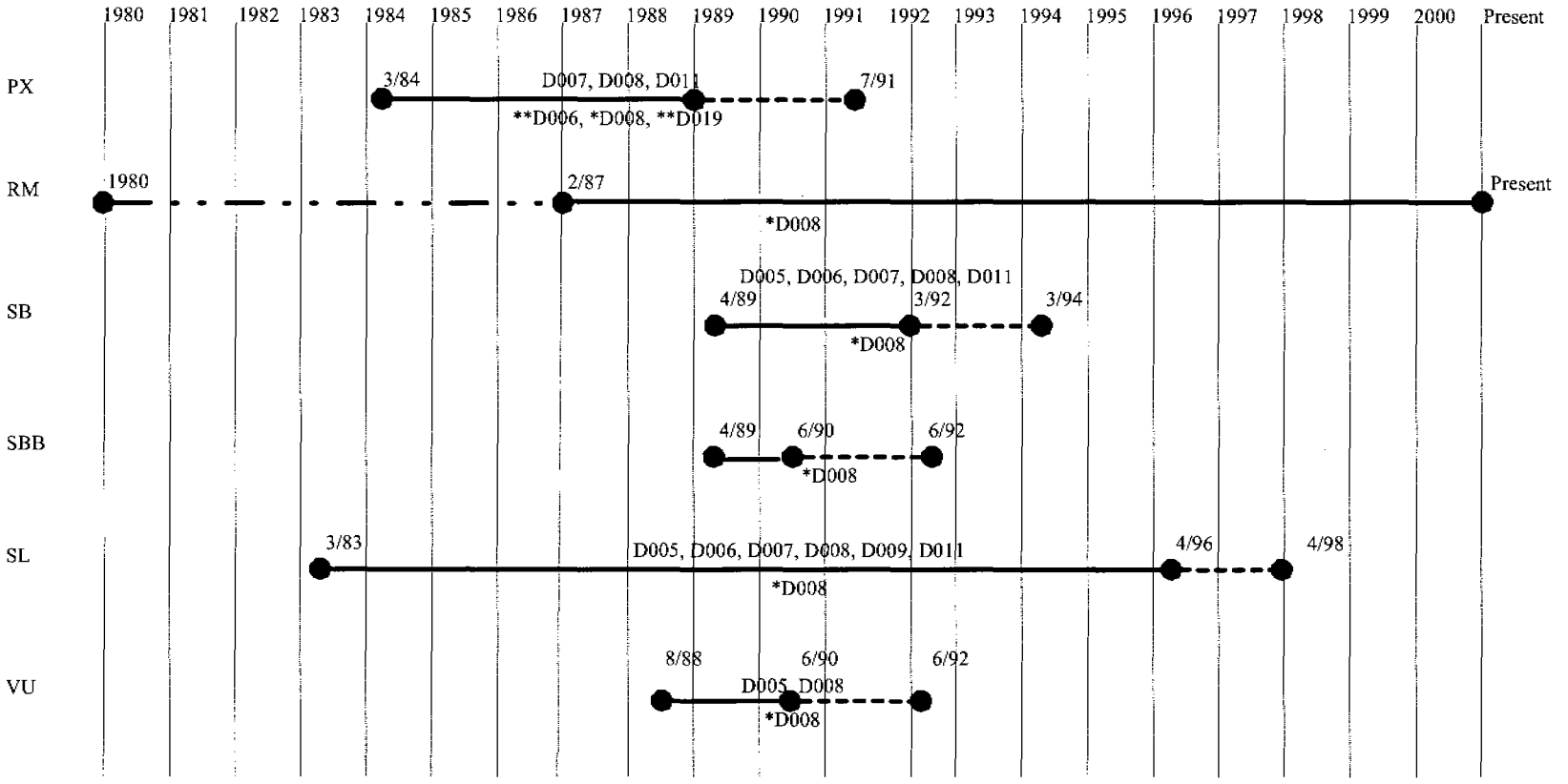
**Note**: The Plutonium Facility, Building PF-4, is labeled PF-4 on this map



## TIMELINE FOR SPECIAL PROCESSING



## TIMELINE FOR SPECIAL PROCESSING (continued)




*D008 = applies to leaded gloves. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

**Notes on time-dependence of EPA HWNs
D006 = applies to P/S code PX from 02/87 to 07/89
D007 = applies to P/S code DO from 1990 to mid-1993
D011 = applies to P/S code DO from 1990 to mid-1993
D019 = applies to P/S code PX from 04/88 to 07/89

**TIMELINE EXPLANATION**



The P/S code is established either in the P/S diagrams and/or in the procedures designating the start and end dates.



Extrapolate out two (2) years beyond the last revision date for the procedure to next possible review date.



Dates for which a process is known to have been in operation based on Subject Matter Expert input, but no procedures exist nor is there a P/S code for this time period.

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| ACC | Ammonium Chloride Conversion | plutonium metal (varying purity) | Ammonium chloride | plutonium trichloride to P/S RM | rags, tools, labware, gloves | *D008 | TWCP-3543 (SP-24) |
| ACD | Cascade Dissolver | plutonium scrap; plutonium contaminated tools, crucibles, metal items, and labware; labware; tools | Hydrofluoric acid, hydrochloric acid, nitric acid | plutonium lean leach solution to P/S IX, some material to vault | leached tools, crucibles, metal items, and labware to discard | D005, D006, D007, D008, D009, D011 | None |
| DO | Dissolution of Oxide | plutonium oxide (varying purity); plutonium scrap; plutonium contaminated tools, crucibles, salt, metal items, and labware, filtrates from oxalate precip in P/S IX, hydroxide cake from DO, solutions with solids | Nitric acid, hydrochloric acid, sodium hydroxide, potassium hydroxide, calcium fluoride, hydrofluoric acid, oxalic acid, hydroxylamine hydrochloride | Some material to vault. Hydroxide precip filtrate to caustic waste line. Hydroxide cake to DO or vault. Isotopically out-of-spec material to P/S code IAM or POSM. Plutonium lean leach solution to P/S IX. | Leached tools, crucibles, salt, metal, labware, spent ion exchange resins to discard. | D005, D006, D007, D008, *D008, D009, D011 | TWCP-3543 (SP-10, SP-11, SP-12, SP-13, SP-14, SP-15, SP-16, SP-25, SP-30, SP-33, SP-37, SP-43) |
| IAM | Inspection and Measurement | Material from P/S code DO, RM, other P/S codes. | No chemicals used. | Out-of-spec material to P/S code POSM. In-spec material to P/S DO, SL, or vault. | Discardable items to WM | D005, D006, D007, D008, *D008, D009, D011 | None |
| IX | Ion Exchange | Leach solutions from P/S codes DO and SL. | Nitric acid, hydroxylamine nitrate, sodium nitrite, aluminum nitrate, calcium fluoride, hydrofluoric acid, oxalic acid, ferrous ammonium sulfate, urea, hydrogen peroxide | Plutonium dioxide to P/S code RM. Filtrates to P/S DO. Washes and effluents off ion exhange columns DL to P/S code EVDL back through IX | Labware. Spent ion exchange resins to discard | D005, D006, D007, D008, *D008, D009, D011 | TWCP-3543 (SP-6, SP-7, SP-8, SP-9, SP-34) |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| PI | Preparation of Isotopes | Plutonium dioxide, impure plutonium metal | Fluorine gas, hydrogen fluoride gas, calcium metal, iodine | Plutonium metal to originating P/S code | Slag and crucible to vault or discard. Tools, labware, rags, gloves to discard | *D008 | TWCP-3543 (SP-22, SP-23, SP-41) |
| POSM | Processing Out-of-Specification Material | Out-of-spec plutonium scrap, hydroxide cakes | Nitric acid, sodium hydroxide, potassium hydroxide | Plutonium to vault | Ion exchange resins, hydroxide filtrate to caustic waste; labware, gloves, tools, rags to discard | D005, D006, D007, D008, *D008, D011 | None |
| PPD | Pu Pellet Dissolution | Pu pellet | Nitric acid, hydrofluoric acid, oxalic acid, sodium oxalate, sodium hydroxide, potassium hydroxide | Pu oxide to 238-Pu operations; Hydroxide cake to vault | Labware, gloves, rags to discard | None | TWCP-3543 (SP-38) |
| PX | Pyrochemical R&D | Pu oxide feed | Calcium metal, MgO crucibles, mineral acids, calcium chloride, sodium chloride, potassium chloride, carbon tetrachloride, cadmium metal, lead metal, gallium metal, bismuth metal | Pu metal to P/S CA, salts and crucible to vault or discard, anode residue to vault, spent hardware leach solution to P/S code SE. | Labware, gloves, rags to discard | D006, D007, D008, *D008, D011, D019 | TWCP-3543 (SP-26, SP-27, SP-28, SP-29) |
| RM | Reduction to Metal | Pu oxide or metal from various P/S's DO, CA, MA, vault. | Calcium metal, calcium chloride, sodium chloride, potassium chloride, chlorine gas | Pu metal (high purity) to P/S CA. Out-of-spec to P/S POSM or vault. Reprocess material to P/S DO. Salt and crucibles to P/S DO or discard. Labware, tools to P/S DO if >DL or to discard if <DL. | Covered in column to right | *D008 | TWCP-3543 (SP-17, SP-18, SP-19, SP-20, SP-21, SP-44) |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| SB | Scrap Burning | Pu scrap from various P/S codes. | No chemicals used | Calcinced scrap to P/S code SL | Gloves <DL to discard | D005, D006, D007, D008, *D008, D011 | TWCP-3543 (SP-5, SP-43) |
| SBB | Ca/Al Scrubbing RD&D | Pu samples from P/S codes OR or SS | Calcium metal, aluminum metal, calcium chloride, sodium chloride, potassium chloride, chlorine gas | Vault. Salt, crucibles > discard limit to vault. | Salt, crucibles <DL discard. Tools labware, rags, and gloves to discard. | *D008 | None |
| SL | Scrap Leaching | Pu scrap, other scrap metals, labware, gloves | Nitric acid, hydrofluoric acid, hydrochloric acid | Lean leach solution to P/S IX | Leached items to discard | D005, D006, D007, D008, *D008, D009, D011 | TWCP-3543 (SP-1, SP-2, SP-3, SP-4) |
| VU | Vessel Unloading | Vessels | WD-40<br>Vacuum grease<br>Silicon adhesive<br>Pneumatic tool oil | Vessel residues | Metal and wire debris | D005, D008, *D008 | TWCP-3543 (SP-31) |

[1]All P/S codes generate routine laboratory debris waste. For those P/S codes that generate only debris waste, this column is left blank. The debris waste may consist of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated.

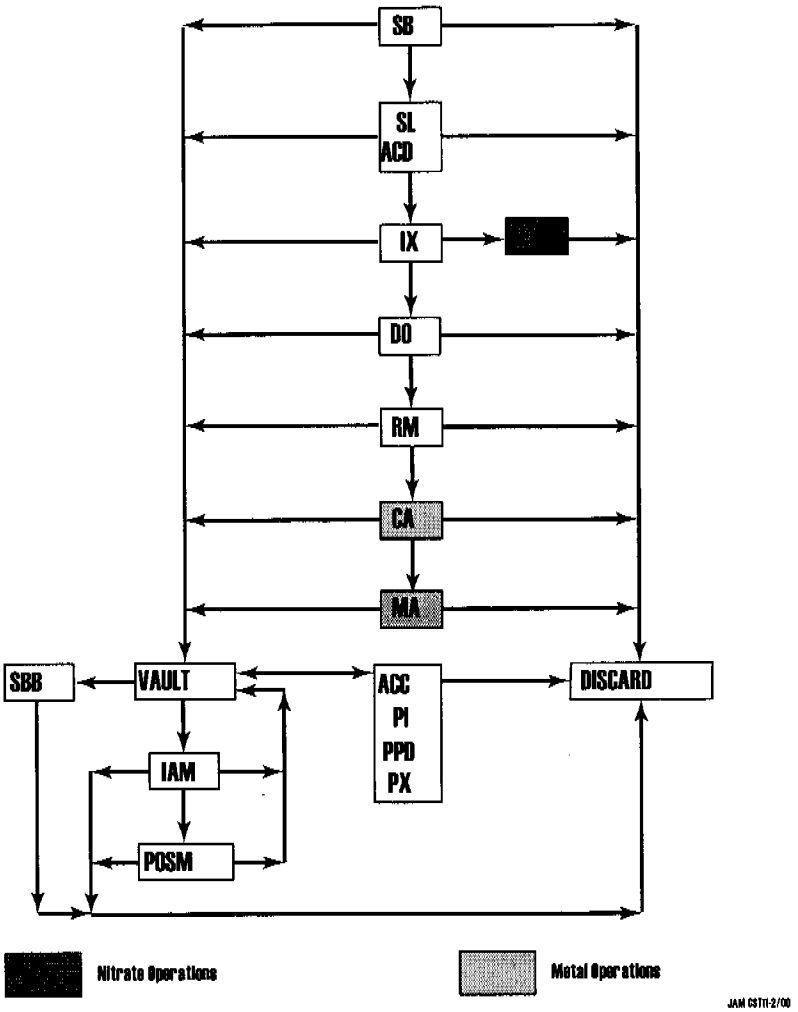
[2]The EPA hazardous waste codes listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation). The resulting treated waste stream is evaluated for hazardous waste constituents and assigned the applicable EPA hazardous waste codes. All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other debris waste and are assigned EPA hazardous waste code D008. The D008 code is assigned to the leaded gloves waste stream rather than to each P/S code waste stream.

[3]Refer to the Acceptable Knowledge Roadmap in Attachment 1.

*D008 due to leaded gloves

**SIMPLIFIED PROCESS FLOW DIAGRAM**

**FOR SPECIAL PROCESSING**



# Decision/Discrepancies Resolution Documentation
## TA-55 Special Processes Operations

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| SBB | States that SCB and SBB are pyro processes and should be grouped there | TWCP-3543/SP-45 | P/S code SBB is in special process AK report SCB is in pyrochemical report | Process Report | SCB in pyro process report and SBB in special process report. | C—SMEs stated in meeting that SBB was a developmental process performed in the pyrochemical process, and SCB was also a developmental process performed in the special processes operations. See attached meeting notes. |
| ACD, DO and SL | States As, Hg, and Se could not be in the waste | TWCP-4167 | Table 1 of Process report states that As, Hg, and Se may be present | Process Report | Codes not in process report. | C—SME said As, Hg, and Se would be volatilized in the process and therefore would not be in the waste. See attached meeting notes |
| All | All waste generated from TA-55 is defense related | TWCP-614 | Indicates that waste generated is from both defense and non-defense related operations. | TWCP-886, -4162, -4167 | | C—Memo dated 8/27/98 says segregation begun. See attached meeting notes. TWCP-4167 |

Sandy Wander — AK Investigator — Sandy Wander — 2/25/02
Evaluator (Print Name) — Title — Signature — Date

P Rogers — Paula Rogers — 2/26/02
SPM Review (Print Name) — Signature — Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other (Specify)]


Source: TWCP-07909

# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☐ Revision
☐ Interim Change

Document ID: TWCP-AK-2.1-007 New Rev/IC: R.2/IC1

Preparer: Sandy Wander

Document Title:
Process Acceptable Knowledge Report for Special Processing at TA-55

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revis
- ☒ Pagination verifie
- ☒ Document Heade
- ☒ Attachment Head
- ☐ Hazard Summary
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- orms have been marked as SAMPLE, if applicable
- orms extracted for Web publishing
- ectronic files archived
- Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

AK-007 effective date 3/21/02 -- posted to web on 3/28/02, delay in posting was due to pending response from CBFO per Jim Bailey.

RMDC 3/28/02

Document Tracking Closed ○ Open ◉ Closed Date to DC: 3/27/2002 Signed Initials: JSS

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 3/28/02

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 3/28/02
- ☑ Master Index Updated - Date: 3/28/02
- ☑ Archive old revision (Record)

- ☑ Capture Document: __ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date ✓ LAUR ✓ Title ✓ Link ✓ Test
- ☑ On-line test: ✓ Open Doc
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- ☑ N/A CBFO: __ Electronic Copy __ Printed
- ☑ Change Control Notification ✓ Sent ✓ Printed ✓ NA

Date Completed: 3/28/02 Signed Initials:

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☐ Revision ☐ Interim Change

Date Received: 3/21/2002

Current Rev/IC: R.2

Document ID: TWCP-AK-2.1-007

Rev/IC: R.2/IC1

Document Title:

Process Acceptable Knowledge Report for Special Processing at TA-55

Preparer: Sandy Wander Date to DP Team: 3/21/2002

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

03/27/02: Prepared document for transmittal to Document Control

## Step 3: Preliminary Review Cycle

☒ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle

☒ IC - Not Applicable (enter action in comments section)

Reviewer Comments Incorporated:
Redline/DRR Given to Preparer:
Reconciled Comments Returned:
Modifications Made to Document:
Preparer Review of Modifications:
Signed/Release for Final Signature:

Comments:

## Step 5: Final Signature Cycle

☒ IC - Not Applicable (enter action in comments section)

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
| Change Control | G M Polley | 3/21/2002 | 3/25/2002 | NA |
| | | | | |
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Comments

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: Procedure Notification
Cc: fabi,bailey, lpc
Bcc:
Attached:

The following are revised AK reports.

**Effective Date: 3/21/02**

**TWCP-AK-2.1-004,R.2/IC1 -** Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55 (LA-UR-02-1714)

**TWCP-AK-2.1-005,R.2/IC1 -** Process Acceptable Knowledge Report for Nitrate Operations at TA-55 (LA-UR-02-1715)

**TWCP-AK-2.1-006,R.2/IC1** - Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55 (LA-UR-02-1713)

[redacted] Process Acceptable Knowledge Report for Special Processing at TA-55 (LA-UR-02-1712)

**TWCP-AK-2.1-009,R.0/IC1** - Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55 (LA-UR-02-1709)

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

***Patricia G. Patton***

Los Alamos National Laboratory
E-ET / TWCP
Records Management / Document Control
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MS M319
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# LOS ALAMOS
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TWCP-AK-2.1-007,R.2/IC1

**Effective Date** 3-21-2002 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR SPECIAL PROCESSING AT TA-55 (LA-UR-021712)

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC ✓ | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
| ☐ RAMROD | | | | | |
| ☐ RANT | | | | | |
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# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☒ Revision ☐ Interim Change

Document ID: TWCP-AK-2.1-007 New Rev/IC: R.2

Preparer: John Musgrave

Document Title:

Process Acceptable Knowledge Summary Report for Special Processing at TA-55

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 5/17/2001 Signed Initials: JS

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 5/18/01

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- NA Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 1
- ☑ Control Stations Updated - Date: 5/18/01
- ☑ Master Index Updated - Date: 5/18/01
- ☑ Archive old revision (Record)

- ☑ Capture Document: ✓ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- NA Add: Controlled Document Original Signatures on File at the RMDC
- NA Security Set for: ____ Read Only
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- ☑ On-line test: ✓ Open Doc NA Password
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- ☑ CAO: ✓ Electronic Copy ✓ Printed

Date Completed: 5/18/01 Signed Initials: CJ

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle

☐ IC - Not Applicable (enter action in comments section)

| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

## Step 5: Final Signature Cycle

☐ IC - Not Applicable (enter action in comments section)

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
| J. Fabryka-Martin | Technical | 5/7/2001 | 5/7/2001 | Independent Technical Reviewer/Editor |
| M. Lin | SPM | 5/10/2001 | 5/10/2001 | Site Project Manager |
| S. Wander | QA | 5/14/2001 | 5/14/2001 | Waste Certification Official |
| M. Gavett | QA | 5/14/2001 | 5/14/2001 | Site Project QA Officer |
| C. Foxx | Fac Mgr | 5/7/2001 | 5/7/2001 | Faciity Representative |
| | | | | |
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Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
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| Classification | | | 5/16/2001 | LA-UR-01-2560 |
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Comments

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☒ Revision ☐ Interim Change

Date Received: 4/1/2001

Current Rev/IC: R.1

Document ID: TWCP-AK-2.1-007

Rev/IC: R.2

Document Title:

Process Acceptable Knowledge Summary Report for Special Processing at TA-55

Preparer: John Musgrave Date to DP Team: 4/1/2001

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

04/01/01 through 05/16/01: Incorporated changes as made by author, reviewers, and auditors.

## Step 3: Preliminary Review Cycle

☐ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
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Comments:

To: rubyannf@lanl.gov, mlgarcia@lanl.gov, prmtz@lanl.gov
From: Louise Garcia <louise@lanl.gov>
Subject: For Training Distribution
Cc: fl@lanl.gov, manmtz@lanl.gov
Bcc:
Attached:

The following are revised AK Reports.

**TWCP-AK-2.1-006,R.2 - Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55**

**TWCP-AK-2.1-007,R.2 - Process Acceptable Knowledge Summary Report for Special Processing at TA-55**

To: wipp.notify@wipp.carlsbad.nm.us
From: Louise Garcia <louise@lanl.gov>
Subject: [Procedure]
Cc: Tammy.Bowden@wipp.carlsbad.nm.us
Bcc: fl@lanl.gov
Attached: K:\twcp\RMDC\AK\TWCP-AK-2.1-006\TWCP-AK-2^1-006R2.pdf;
K:\twcp\RMDC\AK\TWCP-AK-2.1-007\TWCP-AK-2^1-007R2.pdf;

The following are revised AK Reports.

**TWCP-AK-2.1-006,R.2 - Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55**

**TWCP-AK-2.1-007,R.2 - Process Acceptable Knowledge Summary Report for Special Processing at TA-55**

# LOS ALAMOS
NATIONAL LABORATORY - TWCP RMDC

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## TWCP-AK-2.1-007,R.2

**Effective Date** 5-18-2001 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR SPECIAL PROCESSING AT TA-55

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC ✓ | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
| ☐ RAMROD | | | | | |
| ☐ RANT | | | | | |
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| ☐ QA | | | | | |

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Signature: Louise Garcia Date: 5/18/01

Draft #1

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Special Processing at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-007,R.1 (LA-UR-00-5863)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

**EFFECTIVE DATE:** 12/04/00

**NEXT REVIEW DATE:** 12/04/02

**DOCUMENT PREPARER:**

John Musgrave — NAME
12/04/00 — DATE

**APPROVALS:**

June Fabryka-Martin — INDEPENDENT TECHNICAL REVIEWER/EDITOR
12/04/00 — DATE

Pamela Rogers — SITE PROJECT MANAGER
12/04/00 — DATE

Matt J Riggs — WASTE CERTIFICATION OFFICIAL
12/04/00 — DATE

M A Gavett — SITE PROJECT QA OFFICER
12/04/00 — DATE

Charles L. Foxx — FACILITY REPRESENTATIVE
12/04/00 — DATE

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## PROCESS/STATUS (P/S) CODE INDEX

**Note:** This index indicates the main process AK summary report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| ACC | Ammonium Chloride Conversion | Special Processing | 3.4.8, Att. 4 |
| ACD | Cascade Dissolver | Special Processing | 3.4.1, Att. 4 |
| CA | Casting | Metal Operation Processes | 3.4.2, Att. 4 |
| CF | Cement Fixation | Nitrate Operations | 3.4.5, Att. 4 |
| DO | Dissolution of Oxide | Special Processing | 3.4.3, 3.4.5, 3.4.7, Att. 4 |
| EV | Evaporator | Nitrate Operations | 3.4.4, Att. 4 |
| HP | Cement Fixation | Nitrate Operations | 3.4.5, Att. 4 |
| IAM | Inspection and Measurement | Special Processing | 3.4.1, Att. 4 |
| IX | Ion Exchange | Special Processing | 3.4.2, Att. 4 |
| MA | Machining | Metal Operation Processes | 3.4.2, Att. 4 |
| PI | Preparation of Isotopes | Special Processing | 3.4.4, Att. 4 |
| POSM | Processing Out-of-Specification Material | Special Processing | 3.4.3, Att. 4 |
| PPD | Pu Pellet Dissolution | Special Processing | 3.4.11, Att. 4 |
| PX | Multiple DOR with In-Situ Regeneration and Electrorefining | Special Processing | 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, Att. 4 |
| RM | Reduction to Metal | Special Processing | 3.4.4, 3.4.6, 3.4.7, Att. 4 |
| SB | Scrap Burning | Special Processing | 3.4.1, Att. 4 |
| SBB | Ca/Al Scrubbing RD&D | Special Processing | 3.4.9, Att. 4 |
| SE | Solvent Extraction | Chloride Operations | 3.4.3, Att. 4 |
| SL | Scrap Leaching | Special Processing | 3.4.1, Att. 4 |
| VU | Vessel Unloading | Special Processing | Att. 4 |
| VUL | Vessel Unloading | Nitrate Operations | 3.4.1, Att. 4 |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002,R.1), Metal Operation Processes (TWCP-AK-2.1-003,R.1), Nitrate Operations (TWCP-AK-2.1-005,R.1), Special Processing (this report)

Rename
Pyrochemical R&D

**Process feed:**

Plutonium metal or metal alloys and oxides; pyrochemical salts; crucible pieces; anode heels; and ash.

**Radioisotopic content of the waste:**

Variety of plutonium material types with different isotopic compositions. Am-241, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium so that the waste will usually be enriched in americium, but may also be depleted in some cases.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D005 (barium) and D008 (lead): P/S code VU
- D005 (barium), D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): P/S codes ACD, IAM, SB and SL.
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): P/S code PX (zinc metal button)
- D006 (cadmium), D007 (chromium), D008 (lead), D009 (mercury), and D011 (silver): P/S code IX
- D006 (cadmium), D008 (lead), and D019 (carbon tetrachloride): P/S code PX because the salts, crucibles, and debris waste items discarded under this code may include some RCRA-regulated ~~metal residues~~ Constituents above the toxicity characteristic limits
- D007 (chromium) and D011 (silver): P/S codes DO and POSM
- D008 (lead): metal waste debris from all P/S codes in special processing, except ACD and PPD, due to disposal of leaded gloves; after May 1992, leaded gloves were separated from other metal debris
- No F, K or P codes

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1980–present

(MT42 is the designation for plutonium that is enriched in Pu-242. See section 3.5.2 and Table 2.)

Under P/S code IAM, MT42 scrap items (gloves, ash, rags and other items that may contain RCRA-listed metals) were taken from the vault, visually inspected for material type, and remeasured by non-destructive assay. If the Pu content was less than the DL, the items were discarded. Material that was not discardable, but was within specification, would be sent to P/S codes DO or SL for treatment or was returned to the vault. Out-of-specification material was sent to P/S code POSM for processing. Activities conducted under POSM are similar to those for P/S code DO (section 3.4.5).

3.4.2 Nitrate Anion Exchange (P/S code IX)

Nitrate anion exchange is the primary method used at LANL for the aqueous concentration of plutonium. The most commonly used ion exchange resin is a polyvinyl pyridine base macroporous-type resin. Information on the use of this method for processing plutonium material type MT 42 (see section 3.5.2 and Table 2), is provided in references SP-6, SP-7, SP-8, SP-9, SP-34 (all in TWCP-3543). Nitrate anion exchange for MT 52 is discussed in the nitrate operations process AK report (TWCP-AK-2.1-005,R.1, section 3.4.3).

Nitrate anion exchange is a very powerful technique for recovery and separation of plutonium from most elements in the periodic table. At constant acidity, the amount of plutonium absorption onto the resin increases with nitrate concentration. Aluminum nitrate is added to the column to complex with fluoride and oxalate anions, which would otherwise complex with plutonium and prevent its full absorption onto the resin. The plutonium must be in the +IV oxidation state for absorption onto the column and, because plutonium can exist in five different oxidation states in aqueous solution, the oxidation state must be adjusted by careful selection of the sequence and type of reducing and oxidizing agents.

Major reducing and oxidizing agents used in plutonium production operations include hydroxylamine nitrate ($NH_2OH \cdot HNO_3$), ferrous ammonium sulfate [$Fe(SO_4)\ (NH_4)_2SO_4 \cdot 6H_2O$], sodium nitrite ($NaNO_2$), urea [$CO(NH_2)_2$] and hydrogen peroxide ($H_2O_2$).

Ion exchange operations are typically divided into the following steps: (1) column conditioning, (2) feed oxidation state adjustment, (3) loading plutonium in nitric acid, (4) washing with 7 molar nitric acid, (5) elution with hydroxylamine nitrate, and (6) readjustment of the column from the low-acid elution step to 7–8 molar nitric acid for the next column run.

Effluents from nitrate ion exchange, when discardable, are sent to P/S code EV (part of nitrate operations), where they are reduced in volume

**Table 1. Process Feed Materials for Special Processing**

| Feed Material | Potential Presence of RCRA-Regulated Substances | P/S Codes in Special Processing |
|---|---|---|
| Ash from P/S code SB | Usually suspect contaminated with Ba, Cd, Cr, Pb, and Ag (D005, D006, D007, D008, D011). As, Hg, and Se may also be present although these metals are volatilized at high temperatures if present in the oxide and chloride forms. | ACD, DO, SL |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | ACD, SL |
| Hydroxide cakes | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | DO, POSM, |
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, ~~pump oils~~) | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | ACD, DO, SB, SL |
| Pu chlorides and fluorides (from P/S codes PI, PX, and RM) | Variable purity | RM |
| Pu metal or metal alloy | High purity, no RCRA-regulated substances, unless noted otherwise | ACC (variable purity), PI (variable purity), PPD, POSM, RM, SB |
| Pu oxalates | Typically fairly pure, no RCRA substances present | SL |
| Pu oxides | Variable purity, suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008) | DO, PI, PX, POSM, RM |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than Ba (D005) are present | DO |

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments (Weight %)**

bounds dimensionless

| Material Type (MT) | Plutonium isotope and half-life | | | | | | Upper limits for weight ratios | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 ($8.26 \times 10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

Source: TWCP-698

Footnote: (see AK-02)

*Acceptable Knowledge* (TWCP-DTP-1.2-064). If warranted, this AK report will be updated to incorporate the results of these comparisons.

3.5.3 Chemical Content Identification

Chemical inputs to special processing are listed in Table 3. The use of strong acids, bases, or oxidizers does not result in RCRA listings for solid debris waste from these processes because of the absence of free liquids in this waste. However, D006, D007, D008, D011, and D019 apply to some of the process wastes generated by special processing, as noted in Table 3.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA hazardous waste numbers to process wastes from special processing operations is summarized below, as well as on the process timelines in Attachment 3, and the table of process inputs and outputs in Attachment 4. These assignments take into account the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

## Table 3. Chemical Inputs to Processes Described in This Report

| Chemical Input | P/S Codes in which RCRA-Listed Chemical Is Used | Comments on Applicability of RCRA Listing |
|---|---|---|
| **Gas** | | |
| Chlorine gas<br>Fluorine gas<br>Hydrogen fluoride gas | ~~PX, PI, RM~~<br>~~PI~~<br>~~PI~~ | D001 and D002 do not apply to these gases, because there are no free liquids in this waste. Also the gas cylinders are outside the building, and the gases are plumbed into the glovebox. |
| **Acids** | | |
| Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Oxalic acid | | D002 does not apply to the solid process waste because there are no free liquids in this waste |
| **Bases** | | |
| Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the TRU process waste because there are no free liquids in this waste |
| **Metals** | | |
| Bismuth metal<br>Cadmium metal<br>Calcium metal<br>Gallium metal<br>Lead metal | <br>PX<br><br><br>PX | <br>D006<br><br><br>D008 |
| **Inorganic Chemicals** | | |
| Aluminum nitrate<br>Ammonium chloride<br>Calcium chloride<br>Calcium fluoride<br>Ferrous ammonium sulfate<br>Hydrogen peroxide<br>Hydroxylamine hydrochloride<br>Hydroxylamine nitrate<br>Iodine<br>Magnesium chloride<br>Magnesium oxide (sand and crucibles)<br>Potassium chloride | ~~PI~~ sulfate | |
| Potassium dichromate | DO | D007 until end of 1993. Used in P/S code DO as titration endpoint until end of 1993. Solution and precipitates then processed by hydroxide precipitation under same code. Hydroxide cakes (in which chromium would be present) sent to P/S code POSM. Ultimately, chromium ends up in the solution sent to P/S code EV, from which residue gets sent to cement fixation. |
| Silver nitrate | DO, POSM | D011 until end of 1993. Used in P/S code DO for chloride titration until end of 1993. Solution and precipitates then processed by hydroxide precipitation under same code. Hydroxide cakes (in which silver would be present) sent to P/S code POSM. Ultimately, silver ends up in the solution sent to P/S code EV, from which residue gets sent to cement fixation. |

limits. Carbon tetrachloride was used as a chlorination reagent in this P/S code from April 1988 until July 1989.

D007 (chromium) and D011 (silver) apply to P/S codes DO and POSM. Potassium dichromate ~~and silver~~ nitrate were used in P/S code DO for chloride titrations ~~until the end of~~ mid-1993. Solution and precipitates were then processed by hydroxide precipitation under the same code. Hydroxide cakes (in which chromium and silver would be present) were sent to P/S code POSM. Ultimately, chromium and silver end up in the solution sent to P/S code EV, from which the residue gets sent to cement fixation.

D008 (lead) applies to metal waste from all P/S codes in special processing, except for P/S codes ACD and PPD. Before 1992, leaded gloves were segregated and discarded as metal debris. Thus, metal debris containing these gloves from chloride operations before 1992 is assigned D008. Since May 1992, however, these gloves have been routinely segregated from other metal debris although they are still discarded under the originating P/S code (TWCP-4166).

4.3 Corrosivity, Reactivity, and Ignitability

See Section 6.0.

## 5.0 DETERMINATION OF THE RADIOISOTOPIC COMPOSITION

See Section 3.5.2.

## 6.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6). (see AK-02)

- ~~Explosives were prohibited~~ from TA-55 until installation of the Impact Test Facility ~~in the early~~ 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning.

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the solid waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 7.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 6.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005,R.1, Section 9.0). This oil does not enter the LANL disposal operations.

## 10.0 VERIFICATION THAT THERE IS NO ASBESTOS IN THE WASTE

Asbestos gloves were used in glovebox operations in P/S codes OR, RM and PX (TWCP-4162, TWCP-4166), which are discussed in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006,R.1), and in this report, section 3.4.7, respectively. These gloves were disposed with ceramic and glass debris. Asbestos heating mantles were never used at TA-55. Asbestos-bearing transite was widely used until recently for thermal insulation, including as a coverplate over the furnace in glovebox wells, and as part of end plates on Lindberg furnaces (TWCP-4162, TWCP-4166). Although many Lindberg furnaces have been replaced with newer asbestos-free furnaces, some are still in use at TA-55. The transite would have been disposed either as metal or as ceramic and glass waste streams.

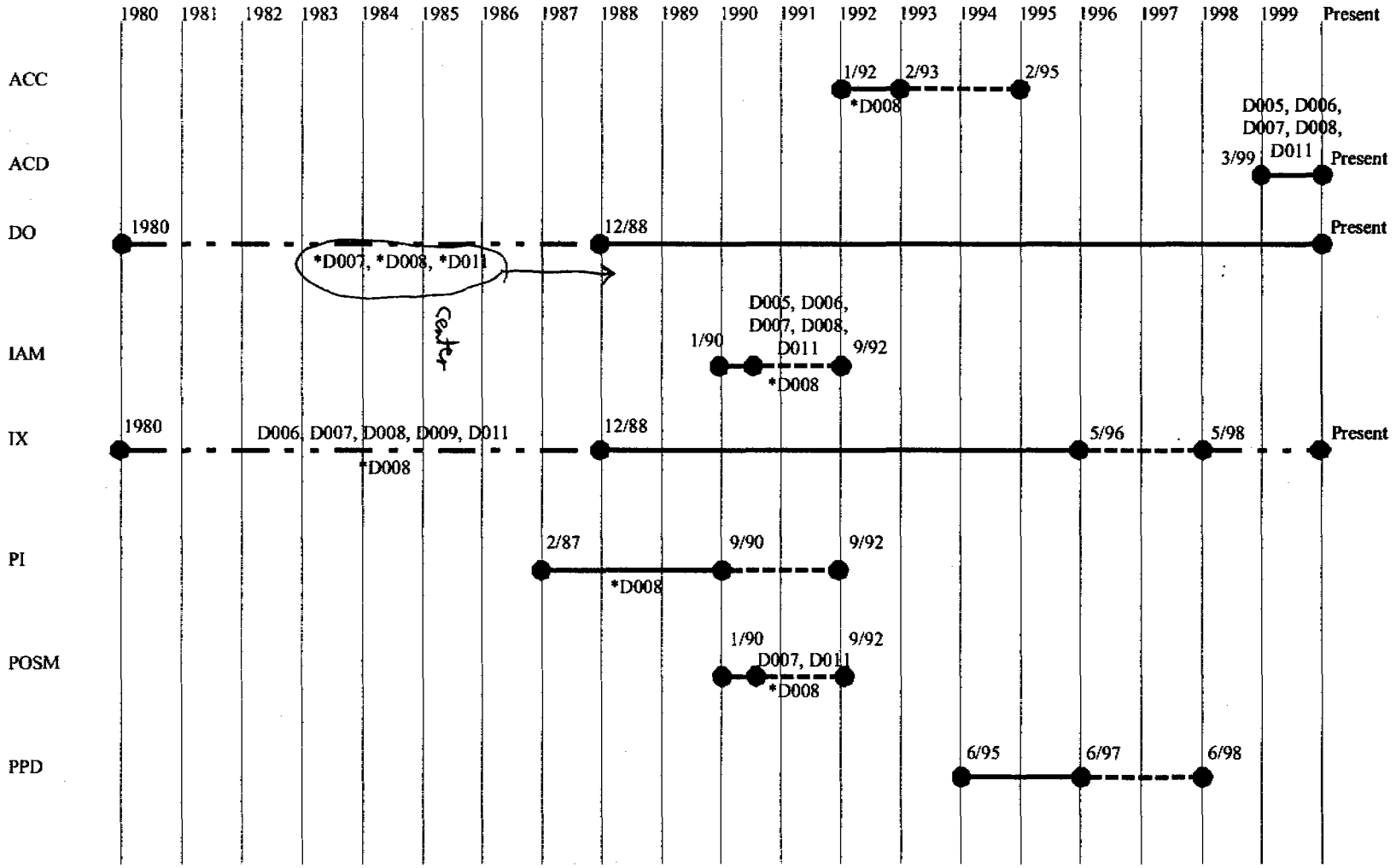
## 11.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.5)
- *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002,R.1)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003,R.1)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004,R.1)

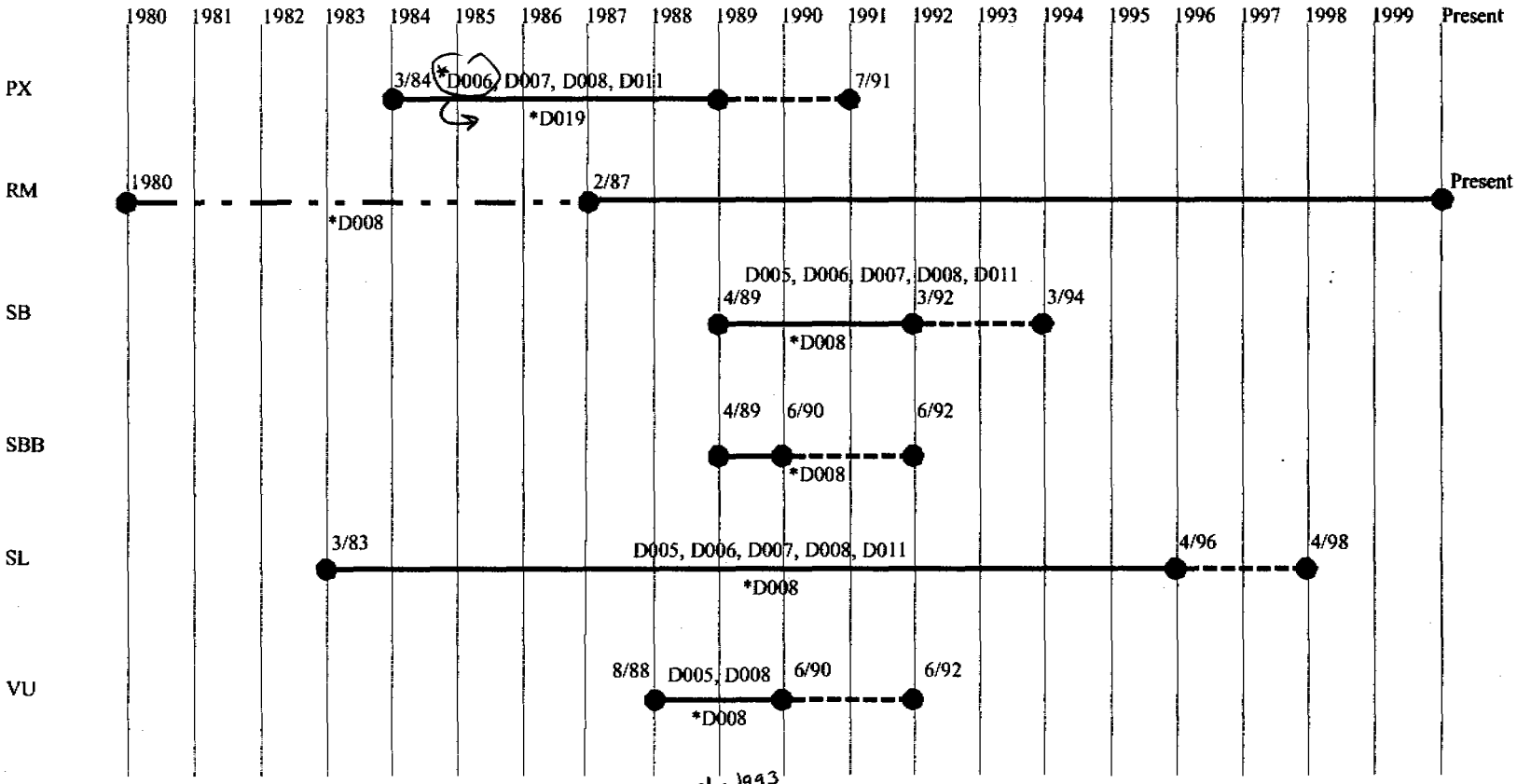
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005,R.1)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006,R.1)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## TIMELINE FOR SPECIAL PROCESSING

Center AWNs



## TIMELINE FOR SPECIAL PROCESSING (continued)




*Notes on time-dependence of RCRA codes
D006 = applies to P/S code PX from 2/87 - 7/89
D007 = applies to P/S codes DO ~~and POSM until the end of 1993~~ from 1990 to mid-1993
D008 = applies to leaded gloves which were discarded in a separate waste stream after 1992, still under the originating P/S code
D011 = applies to P/S codes DO ~~and POSM (until the end of)~~ 1993 ← POSM ends 9/92
D019 = applies to P/S code PX from 4/88 to 7/89

from 1990 to mid

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| PI | Preparation of Isotopes | Plutonium dioxide, impure Pu metal | Fluorine gas, hydrogen fluoride gas, calcium metal, iodine | Pu metal to originating P/S code | Slag and crucible to vault or discard. Tools, labware, rags, gloves to discard | D008 | TWCP-3543 (SP-22, SP-23, SP-41) |
| POSM | Processing Out-of-Specification Material | Out-of-spec plutonium scrap, hydroxide cakes | Nitric acid, sodium hydroxide, potassium hydroxide | Plutonium to vault | Ion exchange resins, hydroxide filtrate to caustic waste; labware, gloves, tools, rags to discard | D007, D008, D011 | None |
| PPD | Pu Pellet Dissolution | Pu pellet | Nitric acid, hydrofluoric acid, oxalic acid, sodium oxalate, sodium hydroxide, potassium hydroxide | Pu oxide to 238-Pu operations; Hydroxide cake to vault | Labware, gloves, rags to discard | None | TWCP-3543 (SP-38) |
| PX | Multiple DOR with in-situ Regeneration and Electrorefining. Rename to Pyrochemical R&D. | Pu oxide feed | Calcium metal, MgO crucibles, mineral acids, calcium chloride, sodium chloride, potassium chloride, carbon tetrachloride, cadmium metal, lead metal, gallium metal, bismuth metal | Pu metal to P/S CA, salts and crucible to vault or discard, anode residue to vault, spent hardware leach solution to P/S code SE. | Labware, gloves, rags to discard | D006, D007, D008, D011, D019 | TWCP-3543 (SP-26, SP-27, SP-28, SP-29) |
| RM | Reduction to Metal | Pu oxide or metal from various P/S's DO, CA, MA, vault. | Calcium metal, calcium chloride, sodium chloride, potassium chloride, chlorine gas | Pu metal (high purity) to P/S CA. Out-of-spec to P/S POSM or vault. Reprocess material to P/S DO. Salt and crucibles to P/S DO or discard. Labware, tools to P/S DO if >DL or to discard if <DL. | Covered in column to right | D008 | TWCP-3543 (SP-17, SP-18, SP-19, SP-20, SP-21, SP-44) |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| SB | Scrap Burning | Pu scrap from various P/S codes. | No chemicals used | Calcinced scrap to P/S code SL. | Gloves <DL to discard | D005, D006, D007, D008, D011 | TWCP-3543 (SP-5, SP-43) |
| SBB | Ca/Al Scrubbing RD&D | Pu samples from P/S codes OR or SS | Calcium metal, aluminum metal, calcium chloride, sodium chloride, potassium chloride, chlorine gas | Vault. Salt, crucibles > discard limit to vault. | Salt, crucibles <DL discard. Tools labware, rags, and gloves to discard. | D008 | None |
| SL | Scrap Leaching | Pu scrap, other scrap metals, labware, gloves | Nitric acid, hydrofluoric acid, hydrochloric acid | Lean leach solution to P/S IX. | Leached items to discard | D005, D006, D007, D008, D011 | TWCP-3543 (SP-1, SP-2, SP-3, SP-4) |
| VU | Vessel Unloading | Vessels | WD-40<br>Vacuum grease<br>Silicon adhesive<br>Pneumatic tool oil | Vessels<br>Residues | Metal and wire debris | D005, D008 | TWCP-3543 (SP-31) |

[1]All P/S codes generate routine laboratory debris waste. For those P/S codes that generate only debris waste, this column is left blank. The debris waste may consist of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated.

[2]The EPA hazardous waste codes listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation). The resulting treated waste stream is evaluated for hazardous waste constituents and assigned the applicable EPA hazardous waste codes. All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other debris waste and are assigned EPA hazardous waste code D008. The D008 code is assigned to the leaded gloves waste stream rather than to each P/S code waste stream.

[3]Refer to the Acceptable Knowledge Roadmap in Attachment 1.

MAVIS 5/4/01

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Special Processing at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-007,R.2 (LA-UR-01-)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

June Fabryka-Martin 5/4/01
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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present in the process wastes, based on subject matter expert (SME) interviews and any ~~available~~ relevant data

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) will be contained in these records, and will not be included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK summary report is part of a set of closely-related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007 [this report])

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, special processing includes 14 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the Sampling Plan. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, in order to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- ~~First~~ B. by radioisotope content (Pu-238 or Pu-239 material type)
- ~~Then~~ B by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- ~~Then~~ B. by hazardous waste status (mixed, non-mixed, or special case waste streams)

3.3 Waste Physical Form and Content Description

Wastes generated during special processing, primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50, are covered by this process AK report. General debris waste categories from special processing include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles
- Metal debris (for example, tantalum crucibles, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from special processing.

3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1980, when special processing first began in Building PF-4, to the present. Process wastes from special processing have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding EPA HWNs are shown graphically in Attachment 3, Timeline for Special Processing.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste

also classified as a head-end operation in this report because it involves inspection of scrap items from the vault to determine an appropriate disposition for them.

Combustible wastes are burned in a combustion chamber, and the ash is screened and the fines (<#12 sieve) are sent to the rotary calciner (P/S code RC, described in TWCP-AK-2.1-005) (TWCP-3543/SP-42). Rotary calciners remove incompletely oxidized organic material from some types of feed prior to leaching or dissolution in nitric acid (SP-5, SP-43 [both in TWCP-3543]). This treatment step is quite advantageous for the following reasons:

- Organic materials sometimes react vigorously when treated with strong nitric acid,
- Emulsions that form when nitric acid reacts with organic material impede plutonium recovery, and
- Some of the organic materials ~~dissolve~~ react in nitric acid to yield a dark ~~solution~~ mixture that in turn poisons the ion-exchange resin.

Glovebox operations and research and development (R&D) projects routinely generate non-plutonium scrap metal, glass, high-efficiency particulate air (HEPA) filters, tools, plastics, glovebox sweepings, sand, slag, crucibles, etc. Leaching in nitric acid and hydrofluoric acid, or pickling these materials in hydrochloric acid, is a relatively easy but incomplete decontamination method (SP-1, SP-2, SP-3, and SP-4 [all in TWCP-3543]).

Conversion of pyrophoric metals and compounds to stable oxides is usually done by calcination in a controlled oxygen atmosphere and at temperatures less than 600°C. Low-fired oxides are easier to dissolve in nitric acid (TWCP-3543/SP-42).

Dissolution of oxide prepares plutonium for purification by nitrate ion exchange processing and oxalate precipitation.

Under P/S code IAM, MT42 scrap items (gloves, ash, rags and other items that may contain RCRA-listed metals) were taken from the vault, visually inspected for material type, and remeasured by non-destructive assay. (MT42 is the designation for plutonium that is enriched in Pu-242. See section 3.6.2 and Table 2.) If the Pu content was less than the DL, the items were discarded. Material that was not discardable, but was within specification, would be sent to P/S codes DO or SL for treatment or was returned to the vault. Out-of-specification material was sent to

3.5.4.1 Fluorides

Reactive plutonium oxides formed by calcination of oxalate or peroxide precipitates can be treated in a hydrofluorinator to form plutonium fluoride ($PuF_4$). In the hydrofluorination step, the oxide is treated with hydrogen fluoride (HF) or fluorine gas ($F_2$) to produce $PuF_4$. The $PuF_4$ is mixed with calcium metal, which in turn is heated to form calcium fluoride ($CaF_2$) and plutonium metal. Quite often, a ~~booster~~ catalyst (in this case iodine [$I_2$]) is added to initiate the reaction and to provide sufficient energy to ensure the reaction goes to completion. This method of metal preparation neither purifies the product metal, nor does it introduce many impurities. However, a high-purity oxide feed can produce metal that meets purity specifications for many applications. Wastes generated from this operation include magnesium oxide (MgO) sand, $CaF_2$, and MgO crucibles. These waste items are sent to leaching operations to recovery any plutonium. Subsequent wastes are discarded. Hydrofluorination at LANL was discontinued in the early 1990s. In the Special Processing operations, this activity was conducted under P/S code PI (SP-22, SP-23, SP-41 [all in TWCP-3543]).

3.5.4.2 Oxides

Metal scrap containing plutonium can be converted to plutonium oxide by burning it at elevated temperature in air. Reactive plutonium oxides can then be converted to plutonium fluoride for reduction to plutonium metal. Unreactive or high-fired plutonium oxide does not react to form plutonium fluoride; instead, the addition of a strong reducing agent in a solvent salt is required to produce plutonium metal from such oxide. The resulting impure metal forms a button in the bottom of the crucible that is covered by a fused oxide/salt layer. The button is removed mechanically from the salt. All residues containing plutonium in excess of the DL are sent to aqueous recovery.

3.5.5 Separation and Purification by Precipitation (P/S code DO)

The separation of plutonium from aqueous solutions makes use of many different precipitation reactions, the most common being reactions involving oxalate, peroxide, hydroxide, and fluoride anions (TWCP-352; SP-10, SP-11, SP-12, SP-13, SP-15, SP-16, SP-25, SP-43 [all in TWCP-3543]). Common reasons for conducting these precipitation reactions include the following:

3.5.5.3 Plutonium peroxide

Plutonium peroxide precipitate gives the best overall separation from cations; and, unlike the two oxalate precipitates, peroxide precipitation also gives excellent separation from Am-241. Plutonium peroxide is dissolved, reprecipitated as plutonium (III) oxalate, and calcined to provide plutonium oxide for plutonium metal production. Calcination of plutoinium oxalate is more easily controlled than calcination of plutonium peroxide.

3.5.5.4 Plutonium hydroxide

Plutonium hydroxide precipitation is quite useful for producing a filtrate that can be discarded to final waste disposal. Oxalate and peroxide filtrates are frequently treated with sodium or potassium hydroxide to precipitate plutonium and Am-241 hydroxides and to destroy residual hydrogen peroxide. In addition, hydroxide precipitation is a good method for discarding spent chloride process solutions because alkaline solutions cause less corrosion of stainless steel. One potential problem with hydroxide precipitation is the generation of voluminous amounts of magnesium and calcium precipitates if pH is not carefully controlled.

3.5.5.5 Plutonium fluoride

Plutonium fluoride precipitation is not as common as precipitation of plutonium oxalate, peroxide, or hydroxide. The feedstock must be relatively pure because separation of plutonium from impurities is not as good for plutonium fluoride as for the other precipitation methods.

3.5.5.6 Disposition of oxalate and peroxide filtrates

Oxalate and peroxide filtrates cannot be sent directly to final waste management without further processing. Oxalate filtrates cannot be directly processed by ion exchange because oxalic acid interferes with adsorption of plutonium onto the resin. ~~LANL evaporates~~ are evaporated oxalate filtrates to destroy the oxalate ion while reducing the volume of solution to be recycled through the ion exchange column (either nitrate or chloride ion exchange).

Both oxalate and peroxide filtrates are amenable to recovery of residual plutonium by hydroxide precipitation and

pieces are sufficiently low in plutonium to be discarded directly as waste under P/S codes RM or PX. Salt that cannot be discarded as waste is routed through aqueous chloride operations (P/S code DO) to recover the plutonium. After May 1987, spent salts above the DL were sent to controlled oxidation to oxidize the pyrophoric metals. In any case, all DOR salts were oxygen sparged before disposal.

The feed oxide, reagent salts and reductant are of the highest purity available because the process is non-purifying. In fact, the plutonium metal produced from this operation is always less pure than the feed material due to impurities derived from the reductant~~/reagents~~. Plutonium metal from this process typically requires further processing to meet purity requirements.

3.5.7.2 MCDOR Process

To minimize the salt waste, the MCDOR process was started in 1988 (TWCP-2502, SP-25, SP-27, SP-39 [all in TWCP-3543]). In this process, the molten salt is regenerated by sparging the $CaCl_2$-CaO mixture with chlorine gas between multiple plutonium metal production runs. After approximately five cycles of metal production, the mixture is cooled and the salt and metal phases are separated. The salt is chlorinated and reused for MCDOR. The salt is discarded under P/S codes RM or PX if the plutonium concentration is below the DL. The salts above the DL are returned to P/S code DO for dissolution and recovery. Before 1987, the salts may have been discarded under P/S codes RM or PX or routed to chloride operations. The chlorine off-gas is passed through a caustic scrubber, with the caustic solution going to the RLWTF at TA-50 for disposal if the solution meets this facility's Waste Acceptance Criteria (WAC). If the solution does not meet the WAC, it is returned to P/S code DO for additional treatment.

MCDOR process inputs are low in contaminants. Only high-purity reagent chemical salts are used in the process, and the plutonium oxide feed materials are also of high purity, with absorbed water being the main impurity. MCDOR metal feed material analytical samples were analyzed for cadmium, chromium, lead, and silver. A review of 100 analyses showed that, even in the most impure sample, these D-listed toxicity

chlorinated then reduced to the metal with calcium metal. The feed material for this process was salt containing plutonium MT 42.

3.5.10 Pyroredox (P/S code PX)

The pyroredox operation was developed to recover plutonium material type MT 52 from spent anode heels in the mid- to late-1980s (TWCP-2541). The anode heel was polished with calcium metal to remove surface oxide, then oxidized to plutonium (III) with zinc chloride ($ZnCl_2$) in molten KCl, forming plutonium chloride ($PuCl_3$). Elements ~~more electroactive~~ than zinc (including barium) were oxidized into the salt phase, and the zinc formed a metal button. Any of the residual RCRA-regulated heavy metals that may have been present in the spent anode heel (barium, cadmium, chromium, lead, and silver), with the exception of barium, would be present in the zinc button. The salt was then mixed with calcium metal in $CaCl_2$ to reduce the plutonium to the metal phase, as well as reducing all elements ~~less electroactive~~ than calcium. The salt phase containing small amounts of the impurity barium was mechanically separated from the metal phase and discarded under P/S code PX. The metal phase containing zinc was placed in the vault or further treated (TWCP-2540), and the plutonium eventually was routed back to electrorefining (also conducted under P/S code PX). In the electrorefining process, the RCRA-regulated metals are concentrated in the anode heel, which then may be treated in the pyroredox process to transfer these RCRA metals to the zinc button, or may be roasted in air to form metal oxides and then be dissolved in nitrate operations. Thus, only the zinc button output could contain RCRA-regulated metals above the toxicity characteristic limits.

3.5.11 Plutonium Pellet Dissolution (P/S Code PPD)

Pu-238 pellets were dissolved in a combination of nitric and hydrofluoric acid (TWCP-3543/SP-45). The plutonium was precipitated as the oxalate using either oxalic acid or sodium oxalate ~~and~~ after digestion was filtered to separate the solid plutonium oxalate. The oxalate was converted to the oxide by heating to 600°C to 700°C, then heated with water vapor to about 800°C to volatilize the fluoride ~~content~~ as HF ~~to prepare the finished product.~~ The oxalate filtrate was treated with caustic to remove the plutonium by hydroxide precipitation ~~and~~ subsequent filtration. The hydroxide cake was dried and sent to the vault. The hydroxide filtrate was discarded to the RLWTF at TA-50 if it met this facility's WAC or was recycled to filtration until it did meet the WAC. No solvents or heavy metals were used in the process.

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# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Special Processing at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-007,R.2 (LA-UR-01-)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

?

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 05/04/00 | — | New report (TWCP-03938) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | | All | Respond to CBFO comments and update with new AK information |
| | | | |
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3 Timeline for Special Processing (3 pages)
4 Process Inputs and Outputs (3 pages)
5 Simplified Process Flow Diagram for Special Processing (1 page)

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## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**Note:** This index indicates the main process AK summary report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| ACC | Ammonium Chloride Conversion | Special Processing | 3.4.8, Att. 4 |
| ACD | Cascade Dissolver | Special Processing | 3.4.1, Att. 4 |
| CA | Casting | Metal Operation Processes | 3.4.2, Att. 4 |
| CF | Cement Fixation | Nitrate Operations | 3.4.5, Att. 4 |
| DO | Dissolution of Oxide | Special Processing | 3.4.3, 3.4.5, 3.4.7, Att. 4 |
| EV | Evaporator | Nitrate Operations | 3.4.4, Att. 4 |
| HP | Cement Fixation | Nitrate Operations | 3.4.5, Att. 4 |
| IAM | Inspection and Measurement | Special Processing | 3.4.1, Att. 4 |
| IX | Ion Exchange | Special Processing | 3.4.2, Att. 4 |
| MA | Machining | Metal Operation Processes | 3.4.2, Att. 4 |
| PI | Preparation of Isotopes | Special Processing | 3.4.4, Att. 4 |
| POSM | Processing Out-of-Specification Material | Special Processing | 3.4.3, Att. 4 |
| PPD | Pu Pellet Dissolution | Special Processing | 3.4.11, Att. 4 |
| PX | Pyrochemical R&D | Special Processing | 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, Att. 4 |
| RM | Reduction to Metal | Special Processing | 3.4.4, 3.4.6, 3.4.7, Att. 4 |
| SB | Scrap Burning | Special Processing | 3.4.1, Att. 4 |
| SBB | Ca/Al Scrubbing RD&D | Special Processing | 3.4.9, Att. 4 |
| SE | Solvent Extraction | Chloride Operations | 3.4.3, Att. 4 |
| SL | Scrap Leaching | Special Processing | 3.4.1, Att. 4 |
| VU | Vessel Unloading | Special Processing | Att. 4 |
| VUL | Vessel Unloading | Nitrate Operations | 3.4.1, Att. 4 |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Metal Operation Processes (TWCP-AK-2.1-003,R.2), Nitrate Operations (TWCP-AK-2.1-005,R.2), Special Processing (this report)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Special Processing Operations

**P/S codes**: ACC, ACD, DO, IAM, IX, PI, POSM, PPD, PX, RM, SB, SBB, SL, and VU

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed debris.

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from special processing operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

TA-55 Plutonium Facility, Building PF-4, rooms 209 and 401. Plutonium operations included preparing ultra-pure plutonium metals, alloys, and compounds; and reclaiming plutonium from scrap and residues produced by numerous feed sources.

**Description of the process waste (physical form and typical content description):**

Waste from special processing operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, glass debris. Some waste was also sent to nitrate operations for cement fixation.

***Summary Category Group(s):*** S5000

***Waste Matrix Code(s):*** S5100, S5300, S5400

**Description of the waste-generating process:**

The overall goal of the special processing operations is to recover plutonium from impure metal, metal alloys, scrap, and residues and produce a purified plutonium oxide product or purified Pu metal. Processes include head-end ion exchange, metal preparation, separation and purification by precipitation, and pyrochemical operations.

**Process feed:**

Plutonium metal or metal alloys and oxides; pyrochemical salts; crucible pieces; anode heels; and ash. Am-241 or U-234, ~~uranium (234)~~ or ~~plant~~ plutonium and uranium,

**Radioisotopic content of the waste:**

well-defined

Variety of plutonium material types with different isotopic compositions. Am-241, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium so that the waste will usually be enriched in ~~americium~~, but may also be depleted in some cases. Pa-231 and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D005 (barium) and D008 (lead): P/S code VU
- D005 (barium), D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): P/S codes ACD, IAM, SB and SL.
- D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver): P/S code PX (zinc metal button)
- D006 (cadmium), D007 (chromium), D008 (lead), D009 (mercury), and D011 (silver): P/S code IX
- D006 (cadmium), D008 (lead), and D019 (carbon tetrachloride): P/S code PX because the salts, crucibles, and debris waste items discarded under this code may include some RCRA-regulated constituents above the toxicity characteristic limits
- D007 (chromium) and D011 (silver): P/S codes DO and POSM
- D008 (lead): metal waste debris from all P/S codes in special processing, except ACD and PPD, due to disposal of leaded gloves; after May 1992, leaded gloves were separated from other metal debris
- No F, K or P codes

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1980–present

# PROCESS ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR SPECIAL PROCESSING AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021 R.5). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about ~~individual processes used by one of the TRU-waste generators~~ at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for ~~one or more~~ several waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to ~~Technical Area~~ (TA)-55 waste streams resulting from special processing covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001 R.3) (Sampling Plan) that includes information regarding all TRU waste streams

- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to special processing is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No. TWCP-3543. Individual documents in this record have been assigned a separate identifier, SP-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in special processing, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Most processes in special processing were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not always segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167) as well as material type. For example, plutonium material type MT-42 (enriched in Pu-242) has always been segregated from other wastes; this material type is exclusively defense-related. Similarly, plutonium material type MT-83 (enriched in Pu-238) is also segregated from other wastes; but this material type is not used solely for defense activities. Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (DLs) (TWCP-816).

Insert new text from file Process AK Section 3-2.doc →

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Stream(s)

### 3.3 Waste Physical Form and Content Description

Wastes generated during special processing, primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50, ~~are covered by this process AK report~~. General debris waste categories from special processing include

5 let, except add comma

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles

Dental rubber

- Metal debris (for example, tantalum crucibles, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from special processing.

3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1980, when special processing first began in Building PF-4, to the present. Process wastes from special processing have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding EPA HWNs are shown graphically in Attachment 3, Timeline for Special Processing.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

3.5 Waste Generation Processes

The following subsections describe the generation of waste by special processing, as well as product and waste outputs to other processes or operations.

Manufacturing and research operations performed at TA-55 in the production of plutonium also generate plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery and manufacturing operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352 and TWCP-886).

Each of these process categories is described below. Timelines for ~~(these)~~ individual processes are presented in Attachment 3. A complete listing of P/S codes for special processing, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. A simplified process flow diagram for special processing is found in Attachment 5.

This report focuses on special processing activities, which include the following:

- head-end operations (P/S codes ACD, IAM, SB and SL)
- nitrate anion exchange (P/S code IX)
- chloride anion exchange (P/S code DO and POSM)
- metal preparation (P/S codes RM and PI)
- separation and purification by precipitation (P/S code DO)

over

3.5.1 Head-End Operations (P/S Codes ACD, IAM, SB, and SL)

Head-end operations involve incineration, calcination, leaching of noncombustible materials (including ash), conversion of pyrophoric metal and compounds to stable oxides, and dissolution. P/S code IAM is also classified as a head-end operation in this report because it involves inspection of scrap items from the vault to determine an appropriate disposition for them.

Combustible wastes are burned in air in a ~~furnace prior to being calcined~~ combustion chamber, and the ash is screened and the fines (< #12 sieve) are sent to the rotary ~~calciner (see 3.5.2)~~ (TWCP-3543/SP-42). ~~Calcination uses~~ rotary calciners to remove incompletely oxidized organic material from some types of feed prior to leaching or dissolution in nitric acid (SP-5, SP-43 [both in TWCP-3543]). This treatment step is quite advantageous for the following reasons:

- Organic materials sometimes react vigorously when treated with strong nitric acid,
- Emulsions that form when nitric acid reacts with organic material impede plutonium recovery, and
- Some of the organic materials dissolve in nitric acid to yield a dark solution that in turn poisons the ion-exchange resin.

(P/S code RC, covered described in TWCP-AK-2.1-005)

Glovebox operations and research and development (R&D) projects routinely generate non-plutonium scrap metal, glass, high-efficiency particulate air (HEPA) filters, tools, plastics, glovebox sweepings, sand, slag, crucibles, etc. Leaching in nitric acid and hydrofluoric acid, or pickling these materials in hydrochloric acid, is a relatively easy but incomplete decontamination method (SP-1, SP-2, SP-3, and SP-4 [all in TWCP-3543]).

Conversion of pyrophoric metals and compounds to stable oxides is usually done by calcination in a controlled oxygen atmosphere and at temperatures less than 600°C. Low-fired oxides are easier to dissolve in nitric acid (TWCP-3543/SP-42).

Dissolution of oxide prepares plutonium for purification by nitrate ion exchange processing and oxalate precipitation.

Under P/S code IAM, MT42 scrap items (gloves, ash, rags and other items that may contain RCRA-listed metals) were taken from the vault, visually inspected for material type, and remeasured by non-destructive assay. (MT42 is the designation for plutonium that is enriched in Pu-242. See section 3.6.2 and Table 2.) If the Pu content was less than the DL, the items were discarded. Material that was not discardable, but was

within specification, would be sent to P/S codes DO or SL for treatment or was returned to the vault. Out-of-specification material was sent to P/S code POSM for processing. Activities conducted under POSM are similar to those for P/S code DO (section 3.4.5).

3.5.2 Nitrate Anion Exchange (P/S code IX)

Nitrate anion exchange is the primary method used at LANL for the aqueous concentration of plutonium. The most commonly used ion exchange resin is a polyvinyl pyridine base macroporous-type resin. Information on the use of this method for processing plutonium material type MT 42 (see section 3.6.2 and Table 2), is provided in references SP-6, SP-7, SP-8, SP-9, SP-34 (all in TWCP-3543). Nitrate anion exchange for MT 52 is discussed in the nitrate operations process AK report (*Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* [TWCP-AK-2.1-005], section 3.4.3).

Nitrate anion exchange is a very powerful technique for recovery and separation of plutonium from most elements in the periodic table. At constant acidity, the amount of plutonium absorption onto the resin increases with nitrate concentration. Aluminum nitrate is added to the column to complex with fluoride and oxalate anions, which would otherwise complex with plutonium and prevent its full absorption onto the resin. The plutonium must be in the +IV oxidation state for absorption onto the column and, because plutonium can exist in five different oxidation states in aqueous solution, the oxidation state must be adjusted by careful selection of the sequence and type of reducing and oxidizing agents.

Major reducing and oxidizing agents used in plutonium production operations include hydroxylamine nitrate ($NH_2OH \cdot HNO_3$), ferrous ammonium sulfate [$Fe(SO_4)\ (NH_4)_2SO_4 \cdot 6H_2O$], sodium nitrite ($NaNO_2$), urea [$CO(NH_2)_2$] and hydrogen peroxide ($H_2O_2$).

Ion exchange operations are typically divided into the following steps: (1) column conditioning, (2) feed oxidation state adjustment, (3) loading plutonium in nitric acid, (4) washing with 7 molar nitric acid, (5) elution with hydroxylamine nitrate, and (6) readjustment of the column from the low-acid elution step to 7–8 molar nitric acid for the next column run.

Effluents from nitrate ion exchange, when discardable, are sent to P/S code EV (part of nitrate operations), where they are reduced in volume by evaporation. Similar to waste from ion exchange processes in nitrate operations (e.g., P/S codes DS and LR), these wastes may be contaminated with the heavy metals cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011). The evaporator

salts are sent to cement fixation (P/S code CF, also part of nitrate operations). The distillate is sent to the RLWTF at TA-50.

3.5.3 Chloride Anion Exchange (P/S codes DO and POSM)

Chloride salts are an important class of residues and are by-products of pyrochemical operations that are also important to Special Processing operations. In addition, plutonium must be recovered from the hydrochloric acid leach solutions employed during pickling (also conducted under P/S code DO). Chloride anion exchange is the method of choice for recovery of plutonium from these chloride-based processes (SP-14, SP-16, SP-30, SP-33, SP-34 [all in TWCP-3543]). Chloride anion exchange is a more recent innovation in Special Processing operations. It was probably implemented sometime in the early 1990s (TWCP-3543/SP-37). Prior to that, hydroxide precipitation was used and is discussed in the chloride operations process AK report (TWCP-AK-2.1-002,R.1, section 3.4.4).

Special Processing operations use chloride anion exchange to recover plutonium from salts produced by multicycle direct oxide reduction (MCDOR), molten salt extraction (MSE), electrorefining (ER), and pyroredox operations. The general chloride anion exchange process consists of the following steps: (1) dissolution of salt in 2-4 molar hydrochloric acid, (2) adjustment of plutonium oxidation state, chloride concentrations, and pH using 12 molar hydrochloric acid and sodium nitrite, (3) loading of feed solution onto the ion exchange column, (4) washing with 8 molar hydrochloric acid, (5) elution of plutonium from the column with 0.5 molar hydrochloric acid and 0.5 molar hydroxylamine hydrochloride, and (6) precipitation of plutonium oxalate by addition of solid oxalic acid. Chloride concentrations in the column eluant were measured by titration using silver nitrate and potassium dichromate until the end of 1992 when this method was replaced with a silver electrode.

Activities conducted under P/S code POSM are similar to those described above for P/S code DO. Feed materials to P/S code POSM are provided by P/S code IAM (section 3.4.1).

3.5.4 Metal Preparation (P/S code RM and PI)

Conversion of plutonium to an oxide from scrap can be used as feed material for metal preparation (TWCP-3543/SP-17). The oxide compound is reduced to metal, often an impure form; however, the oxide would not contribute RCRA-listed heavy metals to wastes produced during metal preparation (TWCP-3543/SP-44). In pyrochemical

Both oxalate and peroxide filtrates are amenable to recovery of residual plutonium by hydroxide precipitation and subsequent disposal of the filtrate. The hydroxide cake can then be recycled to recover and purify the plutonium and americium if above the discard level, or can be discarded if these radionuclide concentrations are below the discard level.

3.5.6 Pyrochemical Operations (P/S codes PX and RM) 3.6.2

Pyrochemical operations for MT 42 (defined in section ~~5.2.1~~) include MCDOR with in-situ regeneration and electrorefining (P/S code RM) and MSE (P/S code RM), and oxide reduction (P/S code RM) (SP-17, SP-18, SP-19, SP-20, SP-21 [all in TWCP-3543]). Pyrochemical R&D efforts for MT 52 in the Special Processing area were done under P/S code PX. This included MCDOR with in-situ regeneration, electrorefining, pyroredox, preparation of $PuCl_3$ using chlorine gas and carbon tetrachloride, and MSE (SP-26, SP-27 SP-28, SP-29 [all in TWCP-3543]). Cadmium and lead were used occasionally as secondary solvent metals in P/S code PX.

3.5.7 Direct Oxide Reduction (DOR) Processes (P/S codes PX and RM)

3.5.7.1 Single-Pass DOR Process

Prior to the MCDOR process, a single pass DOR process was used for plutonium oxide (TWCP-2507, PYRO-14/TWCP-3542). Plutonium oxide and calcium metal are reacted in molten calcium chloride ($CaCl_2$) or $CaCl_2$ mixed with calcium fluoride ($CaF_2$), to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible at 820°C to 875°C. Any arsenic, mercury or selenium present in the impure plutonium oxide would be driven off due to their volatility at this high temperature (TWCP-1258). The reaction proceeds to completion when excess calcium is present and when sufficient $CaCl_2$ is available to dissolve the calcium oxide (CaO) product.

After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide and calcium metal shot, which was sometimes recovered by addition of fresh salt plus additional calcium metal. The process was then rerun. If the unreacted oxide and metal shot did not process after the second run, the material was sent to aqueous recovery. The product plutonium metal contains significant impurities, including additional metal impurities derived from the calcium metal

3.6 Material Inputs to the Waste Generation Processes

Attachment 4 lists P/S codes for special processing at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for special processing consist of the general types of materials listed in Table 1 that are obtained from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites.

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

3.6.1 Physical Waste Form Identification

Solid waste from special processing primarily consists of debris waste. Debris waste contains glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated as process waste. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream. In addition, caustic solutions from hydroxide precipitation are discarded through the waste line to the RLWTF at TA-50.

Prior to 1987, leaded gloves were discarded in the combustible and non-combustible waste streams.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance (QA) personnel. Example forms for one drum of waste generated can be viewed in record TWCP-2513.

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for plutonium feed materials at Building PF-4 are listed in Table 2. The designation *material type* (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized. The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively.* The results of these calculations are tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

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stet

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in ~~americium~~ depending on whether the source of contamination is the process product or the process residues (TWCP-882).

~~of uranium~~ Am-241 or U-234

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from special processing at TA-55.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all. U-238 would only be present if purposefully added to the feed material. U-235 in growth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. Uranium-234 would be present in MT 83 as a decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total Pu would be about 0.14. ~~No U-236 is present.~~ Pa-231 and Cs-137 may be present in trace amounts because of their widespread presence as contaminants in TA-55 operations (TWCP-5165, TWCP-5165).

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with*

Insert above:
* The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

Stet, except to add (TWCP-4720 at the end. place at TA-55 to ensure that explosives do not enter the waste stream

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. ~~Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning.~~ ~~In case of a misfire or unconsumed explosives, a procedure is in~~ (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200 °F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the solid waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, (3) and no sparking. Experimental results on the reactivity of LANL DOR salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 6.0 and 7.0.

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into special processing, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 3, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from

the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005,R.2, Section 9.0). This oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.3)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3543 (SP-34) (UCNI) | C | Procedure for Leaching of Non-combustible Materials in Nitric Acid (P/S IX or NC) | TA-55 Document, 235-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-37) (UCNI) | D | Acceptable Knowledge Interview Form for Special Processing | Jim Foxx, NMT-7 1/19/00 | SME review of Special Processing AK Report | Addresses specific questions |
| TWCP-3543 (SP-38) (UCNI) | D | Acceptable Knowledge Interview Form for Special Processing | Jim Foxx, NMT-7 2/3/00 | Answers to questions about P/S code PPD and to MT42 waste volume | Addresses specific questions |
| TWCP-3543 (SP-39) (UCNI) | D | Procedure for Direct Oxide Reduction R&D | TA-55 Document 422-MPP-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-41) (UCNI) | C | Procedure for Generation of 242PuF6 | TA-55 Document 122-LPN-R00 | Contains materials used in the process | No RCRA analyses documents |
| TWCP-3543 (SP-42) (UCNI) ~~[add to Section 3.4.2.]~~ | C | Procedure for Burning of Combustibles (in head-end operations) | TA-55 Document, 221-MPP-R00 | Contains materials used in the process | Contains no chemical list: no chemicals used. No P/S code |
| TWCP-3543 (SP-43) (UCNI) | C | Alternate Procedure for Dissolution of Oxide Derived from Calcination of Oxalate | TA-55 Document, 448-REC-R00 | Contains materials used in the process, mineral acids used | No chemical list: no P/S code |
| TWCP-3543 (SP-44) (UCNI) | D | Acceptable Knowledge Interview Form for Special Processing | Jim Foxx, NMT-7 8/2/00 | Answer to question as to whether Pu metal, pure or impure, is a contributor of RCRA-listed metals | Addresses specific questions |
| TWCP-3543 (SP-45) (UCNI) | D | Acceptable Knowledge Interview Form for Special Processing | Jim Foxx, NMT-7 | Answer to questions regarding P/S codes PPD, RAP2, SBB and SCB | Addresses specific questions |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |

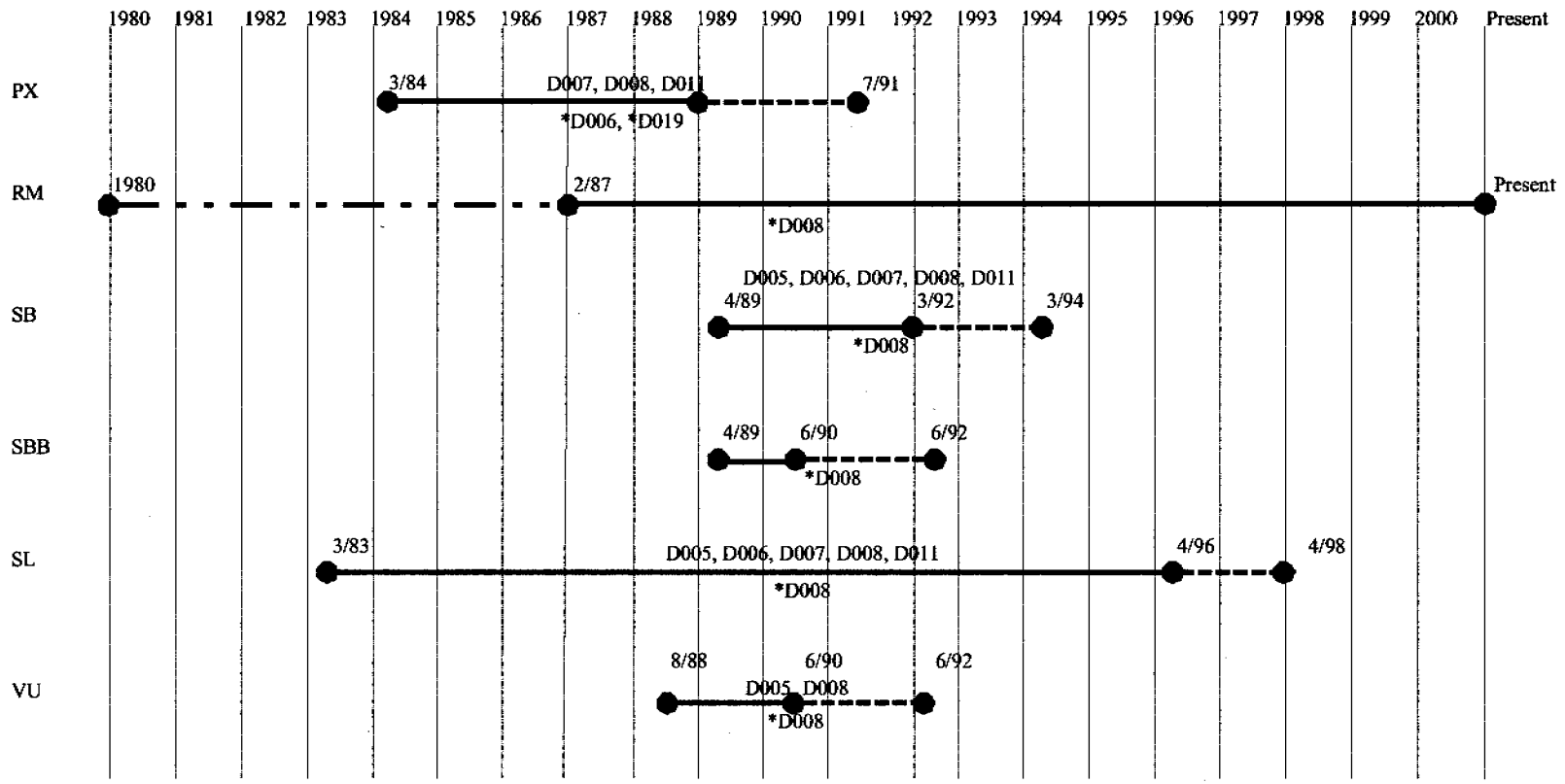
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4162 | D | Answers to questions about P/S codes PB, PuBe, CC, MB, MS, FF, BF, and other issues | Interview with Jim Foxx, 10/12/00 | Answers to questions on use of asbestos at TA-55, non-defense activities, and specific P/S codes in chloride operations. | None |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of Ag, disposal of ash and resins, and use of gases. | None |
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of Ag from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that Ag in ash is below limits of regulatory concern | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Summary Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |

Insert TWCP-4720, 5164, 5165 → (copy from TWCP-AK-2.1-608, R2 AK Roadmap)

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

**TIMELINE FOR SPECIAL PROCESSING (continued)**




*Notes on time-dependence of EPA HWNs
D006 = applies to P/S code PX from 02/87 to 07/89
D007 = applies to P/S code DO from 1990 to mid-1993 ~~POSM ends 09/92~~
D008 = applies to leaded gloves. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).
D011 = applies to P/S code DO from 1990 to mid-1993 ~~POSM ends 09/92~~
D019 = applies to P/S code PX from 04/88 to 07/89

QP-00-004,R.0
Effective Date: 06/18/03

Attachment 5–Form

TWCP-15413

# RECORDS SUBMITTAL

**INSTRUCTIONS:** This form is prepared by the record source when submitting individual records, batch data reports, or a records package to the RMDC Center. For records packages, a Table of Contents (TOC) must also be submitted. Each record submitted requires a complete form.

**MANDATORY:** X To the best of my knowledge, the record(s) have no radioactive contamination.

Signature: _____

**RECORD TYPE:**

X Project 2010 ☐ Facility (RRES)

☐ Other: _____ ☐ UCNI ☐ Proprietary

**RECORD SOURCE:**

Submittal Date: 7/25/03___ Z No.: 109592_____ Name/Org: PATRICIA PATTON – RRES-CE_____

Originator: JOHN MUSGRAVE_____ Organization: NMT_____

**TYPE OF RECORD/ACTION TO BE TAKEN**

X Individual Record ☐ Batch Data Report ☐ Records Package (+ TOC)

X New ☐ Revision* ☐ Addition* ☐ Supersedes*

*Record Barcode Number: _____ *Review Cycle (if applicable): ☐ Yes ☐ No ☐ NA

**RECORD ID NUMBER**: (e.g., memo symbol number, procedure (include revision), deficiency number, batch data report number, unique record identifier if applicable):

TWCP-AK-2.1-004, R.2

Record Date: 5/17/01____ Physical Page Count: 198 X Single Sided ☐ Double Sided

Category Number: (from page two): 07_____

**RECORD TITLE, SUBJECT, AND/OR KEYWORDS:**

TWCP-AK-2.1-004, R.2/IC2 Process AK Report for Miscellaneous Operations at TA-55 (INCLUDES INTERIM CHANGES 1 & 2) - LA-UR-01-2559 – LA-UR-02-1714

**RECORD CENTER USE ONLY**

☑ Accepted Date: 7-25-03 ☐ Return Date: _____

Signature: _____ Resubmitted: _____

RIDs Type: LT

Scan Date: _____ By: _____ QA Date: _____ By: _____

X-Sender: chsmith@norris-mail.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.1
Date: Thu, 24 Jul 2003 10:37:16 -0600
To: pgp@lanl.gov
From: Cathy Smith <chsmith@lanl.gov>
Subject: Please retire Process AK Reports
Cc: sgw@lanl.gov
X-Scanned-By: MIMEDefang 2.35

Hi Patsy,

As we discussed yesterday, here is the list of Process AK Reports that we would like to retire as controlled documents and submit as records to RMDC. Could you let Betty Humphrey and myself know when you have the record IDs - we need to update the references in the main AKIS document.

Thanks a million!

Cheers, Cathy

The following can be turned into Records, to be referenced in our AKIS or AK Summaries...

1. TWCP-AK-2.1-002, R.2/IC1 Process AK Report for Chloride Operations at TA-55

2. TWCP-AK-2.1-003, R.2/IC1 Process AK Report for Metal Operations Processes at TA-55

3. TWCP-AK-2.1-004, R.2/IC2 Process AK Report for Miscellaneous Operations at TA-55

4. TWCP-AK-2.1-005, R.2/IC1 Process AK Report for Nitrate Operations at TA-55

5. TWCP-AK-2.1-006, R.2/IC1 Process AK Report for Pyrochemical Processes at TA-55

6. TWCP-AK-2.1-007, R.2/IC1 Process AK Report for Special Processing at TA-55

7. TWCP-AK-2.1-009, R.0/IC1 Process AK Report for Pu-238 Operations at TA-55

8. TWCP-AK-2.1-013, R.0 AK Report for NG Waste from Nitrate Operations at TA-55

9. TWCP-AK-2.1-014,R.0 AK Report for NG Waste from Miscellaneous Operations at TA-55

10. TWCP-AK-2.1-016,R.0 AK Report for NG Waste from Special Processing Operations at TA-55

11. TWCP-AK-2.1-017,R.0 AK Report for NG Waste from Metal/Pyrochemical Operations at TA-55

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*"The simplest questions are the hardest to answer."*
*Northrop Frye*

Catherine H. Smith
***Project 2010***
RRES-CE Certification Group
Risk Reduction & Environmental Stewardship Division
Phone: 667-0113 Page: 664-7104

# INTERIM CHANGE REQUEST

LA-UR-02-1714

| ☑ TWCP ☐ WRR ☐ Other<br>If Other, please identify: _____ | IC Number: 2 |
|---|---|
| **Person Requesting this Interim Change:** Sandy Wander | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55 | **Document No./Revision:** TWCP-AK-2.1-004,R.2/IC1 (LA-UR-02-1714) |
| **Effective Date of Current Document:** 06/18/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| Title Page, p.1 | Delete "Summary" from title to read:<br>"Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55" | Clarification |
| Global | Change all occurrences of "Sampling Plan" to "AK Information Summary" | document title change |
| Note and 3rd column heading / pp. vi and viii | Delete "summary" from "NOTE" at top if page vi and from "*" note at bottom of page viii<br>Change 3rd column heading on page vi and vii to read:"Process AK Report*"<br>Delete entire 4th column | Clarification |
| RCRA Constituents/ EPA Hazardous Waste Numbers:/p. ix of x | Delete HRS, RD, and VS from bullet beginning D007 (chromium)<br>Delete APD and add AC, AC1, and AC2 from bullet beginning D011 (silver) | Updated report due to typo errors found upon review. Confirmed with SME. |
| RCRA Constituents/ EPA Hazardous Waste Numbers:/p. ix of x | Delete "(D007 only)" following "EDC" and before "EOC" from bullet beginning D007 (chromium) as follows:<br>EDC ~~(D007 only),~~ EOC<br>Delete "IE" from bullet 7, 8, 9, and 12<br>Add "*" after D008 in bullet 10. | Per SME, D007 and D009 should apply to be conservative.<br>Typos found during review.<br>Editorial repair |
| Global search and delete / p. 2 | From all references to "process AK summary report," delete "summary" to read "process AK report.<br>From all titles that previously read "Process Acceptable Knowledge Summary Report, " delete "Summary" to read "Process Acceptable Knowledge Report." | Clarification |
| 3.5.8/p. 20 | In the third line from the bottom, replace "sand and slag" with "stainless steel" | Updated report due to typo errors found upon review. Confirmed with SME. |

| | | |
|---|---|---|
| Table 1/p. 24 | In the "Pu oxides" row, middle column, modify as follows:<br>. . . EOC, **IE,** LIBS, ~~and~~ STF, **and VS** | Per SME, P/S code IE used high purity oxides.<br>VS added due to typo errors found upon review. |
| Table 5/pp. 31, 32, 33 | In AC2 row, add D038 to last column<br>In FDL and FLU rows, add D004 to third column and last column<br>In IE row, replace text in third and fifth columns with the word "none" and delete D005, D006, D007, D009, and D011 from the last column<br>Add D008 and other codes to table . Also added "*D008 due to leaded gloves. | P/S code AC2, updated report due to typo errors found upon review. Confirmed with SME<br>P/S codes FDL and FLU, updated report due to typo errors found upon review. Confirmed with SME<br>P/S code IE, updated report, per SME. P/S code IE used high purity oxides.<br>Updated table to reflect typo errors found during review. |
| Section 4.2, p. 35 | Delete all P/S codes listing | Unnecessary. Information listed elsewhere |
| Attach. 3/pp. 1–4 | Add D007, D008*, D009, D011, D018, D022, D038, F002, F005, F007 to timeline for AC1<br>Add D038 to timeline for AC/AC2<br>Add D009 to timeline for CV<br>Add "D009" to EDC timeline<br>Add D008* to timeline for ICP<br>Add D008* and delete all other codes from timeline for IE<br>Add D008* to timeline for SA<br>Delete WM from timeline for WM/XO/X0 and create new WM timeline with a solid line from 1/87 to 12/93 with the codes D007, D008, D009, D022, D035, D040, F001, F002, F005<br>Add "*D008" to all codes listed in bullet 10 on page ix | P/S code AC1, timeline updated due to typo errors found upon review.<br>P/S code AC/AC2, timeline updated due to typo errors found upon review.<br>P/S code CV, timeline updated due to typo errors found upon review.<br>P/S code EDC, timeline updated to reflect changes in report.<br>P/S code ICP, timeline updated due to typo errors found upon review.<br>P/S code IE, timeline updated to reflect changes to IE regarding use of high purity oxides per SME.<br>P/S code SA, timeline updated due to typo errors found upon review.<br>P/S code WM, timeline updated due to typo errors in dates found upon review.<br>Report updated to reflect omission of *D008. |
| Attach. 4 / all pages | Added *D008 and other codes to "EPA Codes", also added "*D008 due to leaded gloves" as footnote | Typo errors found during review. |
| Attach. 4 / p. 5 of 11 | In CV row, add D039 to "EPA Codes" column | P/S code CV, table updated due to typo errors found upon review. |

| | | |
|---|---|---|
| Attach. 4/ p. 5 of 11 | In EDC row, add "D009" to "EPA Codes" column | PS code EDC, table updated to reflect changes in report. |
| Attach. 4 / p. 7 of 11 | In IE row, replace "Unknown" in "Chemical/ Reagents" column with "High purity inputs" and delete D005, D006, D007, D009, D011 from "EPA Codes" column | Per SME, P/S code IE used high purity oxides. Report updated to reflect information. |
| Attach. 6, pp. 1, 2 | Add new Attachment 6 and update "Contents" page to reflect addition<br>Add following paragraph to end of Section 2.0:<br>"When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6)." | New TWCP-QP-1.1-021 requirement |

**Date changes submitted**: 02/12/02 | **Desired effective date for changes**:

**INTERIM CHANGE APPROVAL**

| | | | |
|---|---|---|---|
| Document Preparer: S Wander | | Reviewer (if applicable): Facility Rep. | |
| Signature: Sandy Wander | Date: 3/19/02 | Signature: Wayne A. Pennock | Date: 3/20/02 |
| Site Project QA Officer: ~~not required~~ M A Gavet | | LAAO (if implementing WAP requirements): N/A | |
| Signature: not required | Date: 3/21/02 | Signature: | Date: |
| ☒ ~~IC~~ Approved ☐ Major Rev. ☐ Hold for next Rev. | | Do changes affect WAP data collection, data quality, or performance criteria? | |
| Site Project Mgr/Line Mgr: P Rogers | | ☐ Yes ☒ No | |
| Signature: Pamela Rogers | Date: 3/19/02 | | |
| USQ Screener (if applicable): Not applicable | | If yes, date of CBFO approval: _____ (documentation attached) | |
| Signature: | Date: 3 25 02 | | |

**NOTE:** Changes can be designated on the document and attached to this form.

**Effective date for this interim change:** 3/21/02

# INTERIM CHANGE REQUEST

| ☒ TWCP ☐ WRR ☐ Other<br>**If Other, please identify:** _____ | **IC Number:** 1 |
|---|---|
| **Person Requesting this Interim Change:** June Fabryka-Martin | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55 | **Document No./Revision:** TWCP-AK-2.1-004,R.2 |
| **Effective Date of Current Document:** 05-17-01 | **Document Preparer:** John Musgrave |

| **CHANGE INFORMATION: Please ensure the following changes are made:** | | |
|---|---|---|
| Section/Page | Change: | Reason/Justification: |
| Attach. 3, pp. 1 and 64 JM | Delete U213 from timelines for P/S codes AC/AC2 and SA | To make hazardous waste code assignments shown on timeline consistent with discussion in text |
| **Date changes submitted:** | | **Desired effective date for changes:** |

| **INTERIM CHANGE APPROVAL** | | | |
|---|---|---|---|
| Document Preparer: John Musgrave | | Reviewer (if applicable): | |
| Signature: John Musgrave | Date: 6/14/01 | Signature: | Date: |
| Site Project QA Officer: M A Garett | | LAAO (if implementing WAP requirements): | |
| Signature: M A Garett | Date: 6/14/01 | Signature: | Date: |
| ☒ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | | Do changes affect WAP data collection, data quality, or performance criteria? | |
| Site Project Mgr/Line Mgr: June Fabryka-Martin | | ☒ Yes ☒ No | |
| Signature: June Fabryka-Martin | Date: 6-13-01 | If yes, date of CBFO approval: _____ (documentation attached) | |
| USQ Screener (if applicable): Not applicable | | | |
| Signature: | Date: | | |
| **NOTE:** Changes can be designated on the document and attached to this form. | | | |
| **Effective date for this interim change:** 06/18/01 | | | |

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge ~~Summary~~ Job Report for Miscellaneous Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-004,R.2 (LA-UR-01-2559)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

**EFFECTIVE DATE:** 05/17/01

**NEXT REVIEW DATE:** 05/17/03

**DOCUMENT PREPARER:**

John Musgrave — NAME — 5/7/01 — DATE

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June Fabryka-Martin — INDEPENDENT TECHNICAL REVIEWER/EDITOR — 5/7/01 — DATE

Mari R Lo — SITE PROJECT MANAGER — 5/12/01 — DATE

Sandy Wander — WASTE CERTIFICATION OFFICIAL — 5/14/01 — DATE

SITE PROJECT QA OFFICER — 5/14/01 — DATE

Charles L. Fox — FACILITY REPRESENTATIVE — 5/7/01 — DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 06/30/00 | — | New report (TWCP-03941) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | 05/17/01 | All | To respond to CBFO review comments and to update to include new AK information |
| 2/IC1 | 06/18/01 | Att. 3, pp. 1, 4 | Remove HWN U213 to make timelines consistent with text |
| 2/IC2 | 03/21/02 | Title page, vi, vii, ix, 1, 2, 20, 24, Table 5, 35 Att. 3, 4 | Clarification and update of information. |

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1 Acceptable Knowledge Roadmap (16 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Timeline for TA-55 Miscellaneous Processes (6 pages)
4 Process Inputs and Outputs (11 pages)
5 Simplified Process Flow Diagram (1 page)
6 Decision/Discrepancies Resolution Documentation (1 page)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| AK Information Summary | *Los Alamos National Laboratory Transuranic Waste Acceptable Knowledge Information* (TWCP-PLAN-0.2.7-001) |
| CFR | *Code of Federal Regulations* |
| CLS | Chemistry and Laser Science [Division]—former name of C Division |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| D | EPA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DBBP | dibutyl butylphosphonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | EPA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| GB | glovebox |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| K | EPA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| M | miscellaneous [identifier for TWCP records for miscellaneous processing] |
| MEGAS | Multiple Energy Gamma Assay System |
| MISC | Miscellaneous [designator for individual documents in miscellaneous operations reports in Attachment 1, Acceptable Knowledge Roadmap] |
| MSE | molten salt extract |
| MT | material type |
| NDA | non-destructive assay |
| OSWER | Office of Solid Waste and Emergency Response (EPA) |
| P | EPA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33(e) |
| PF-4 | Plutonium Facility, Building 4 |
| P/S [code] | process/status [code] |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |

| | |
|---|---|
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| SME | subject matter expert |
| TA | technical area |
| TBP | tributyl phosphate |
| TCLP | toxicity characteristic leaching procedure |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization Program |
| U | RCRA hazardous waste number prefix for toxic waste defined in 40 CFR Subpart D, Section 261.33(f) |
| UCNI | Unclassified Controlled Nuclear Information |
| VOC | volatile organic compound |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request Form |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**Note:** This index indicates the main process AK report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| AC | Actinide Chemistry, R&D | Miscellaneous Operations |
| AC1 | Actinide Chemistry, R&D | Miscellaneous Operations |
| AC2 | Actinide Chemistry, R&D | Miscellaneous Operations |
| AC3 | Actinide Chemistry, R&D | Miscellaneous Operations |
| ACL | Analytical Chemistry Laboratory | Miscellaneous Operations |
| AD | Actinide Processing Demonstration | Miscellaneous Operations |
| APD | Actinide Processing Demonstration | Miscellaneous Operations |
| AX | Solution Assay | Miscellaneous Operations |
| CF | Cement Fixation | Nitrate Operations |
| CK | RD&D Volatile Fluoride Pu Recovery | Miscellaneous Operations |
| CV | R&D Experimental Chlorination Processes | Miscellaneous Operations |
| CX | Chloride Anion Exchange | Chloride Operations |
| EDC | Electrolytic Decontamination | Miscellaneous Operations |
| EOC | Experimental Oxide Characterization | Miscellaneous Operations |
| EV | Evaporator | Nitrate Operations |
| EXT | Extraction RD&D | Miscellaneous Operations |
| FDL | FOOF Demonstration Loop | Miscellaneous Operations |
| FLU | Fluorination RD&D | Miscellaneous Operations |
| HP | Cement Fixation | Nitrate Operations |
| HRS | High Resolution Spectroscopy | Miscellaneous Operations |
| IB | Matrix Study of Pyrochemical Salts | Miscellaneous Operations |
| ICP | ICP–AES Analysis | Miscellaneous Operations |
| IE | Isotope Enrichment | Miscellaneous Operations |
| IS | Incinerator | Nitrate Operations |
| LI | XF6 Experimental Measurements | Miscellaneous Operations |
| LIBS | Laser-Induced Breakdown Spectroscopy System | Miscellaneous Operations |
| ME | Metallography | Miscellaneous Operations |
| NCD | Nonconfirming Drums | Miscellaneous Operations |

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| OR | Direct Oxide Reduction | Pyrochemical Processes |
| PTS | RD&D Pretreatment Study | Nitrate Operations |
| PX | Pyrochemical R&D | Special Processing |
| RASS/RSS | Raman Spectroscopy System | Miscellaneous Operations |
| RB | Roasting and Blending | Nitrate Operations |
| RBJ | Roasting and Blending Jr. | Nitrate Operations |
| RC | Rotary Calciner | Nitrate Operations |
| RD | Repackaging into Retrievable Drums | Miscellaneous Operations |
| RR | Ion Exchange | Nitrate Operations |
| SA | Super Acid RD&D | Miscellaneous Operations |
| SMP | SP Mounting Preparation | Miscellaneous Operations |
| SO | Super Oxidizer, FOOF Program | Miscellaneous Operations |
| SS | Salt Stripping | Pyrochemical Processing |
| STF | Standard Fabrication | Miscellaneous Operations |
| VS | Confirmation, Inspection & Sampling | Miscellaneous Operations |
| WM | Waste Management | Miscellaneous Operations |
| X0 | Inactive or Unspecified P/S Material | Miscellaneous Operations |
| XES | X-Ray Energy Spectroscopy | Miscellaneous Operations |
| XO | Inactive or Unspecified P/S Material | Miscellaneous Operations |
| XP | RD&D Experimental Processes | Miscellaneous Operations |

* Process AK reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Miscellaneous Operations (this report), Nitrate Operations (TWCP-AK-2.1-005,R.2), Pyrochemical Processes (TWCP-AK-2.1-006,R.2), and Special Processing (TWCP-AK-2.1-007,R.2)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Miscellaneous Operations

**P/S codes**:

AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed, combustible and non-combustible debris; liquid wastes sent to the Radioactive Liquid Waste Treatment Facility at TA-50 or immobilized in cement (as part of nitrate operations)

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, as well as associated maintenance operations and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from miscellaneous operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

TA-55 Plutonium Facility (Building PF-4), Rooms 105, 106, 112, 113, 115, 120, 124, 126, 208, 209, 210, 401, 409, 420, and 432

**Description of the process waste (physical form and typical content description):**

Primarily debris waste, including cellulosic materials, plastic, rubber, ceramic, metal and glass debris, and waste sent to nitrate operations to be immobilized in cement.

***Summary Category Group:*** S5000

***Waste Matrix Codes:*** S5100, S5300, S5400

**Description of the waste-generating process:**

The overall goal of the miscellaneous operations is to recover plutonium from metal, metal alloys, scrap, and residues and produce a purified plutonium oxide product or feedstock for

conversion to metal. Processes in miscellaneous operations include pretreatment, dissolution, purification, and hydroxide precipitation.

**Process feed:**

Plutonium metal or metal alloy, oxides and hydroxide cakes; pyrochemical salts; anode heels; ash; and residues from other DOE facilities

**Radioisotopic content of the waste:**

Variety of plutonium material types with different well-defined isotopic compositions. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium, or plutonium and uranium, such that the waste is usually enriched in Am-241 or U-234, but may also be depleted in some cases. Pa-231 and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- No K or P codes
- F001: P/S codes WM, XO, X0 (trichloroethylene and 1,1,2-trichloro-1,2,2-trifluoroethane (freon))
- F002: P/S codes AC, AC1, AC2, AD, APD, SA, WM, X0, XO (chlorobenzene, methylene chloride, tetrachlorocthylene, trichloroethylene)
- F003: AD, APD, ME, SA (acetone, diethyl ether, methanol, xylene)
- F005: P/S codes AC, AC1, AC2, SA, WM, X0, XO (benzene, methyl ethyl ketone, toluene, pyridine)
- D004 (arsenic) and D010 (selenium): P/S codes AD, FDL, FLU, RASS/RSS, SO, XES, XP
- D005 (barium) and D006 (cadmium): P/S codes AD, CK, CV, EXT, FDL, FLU, IB, LI, RASS/RSS, SO, XES, XP
- D007 (chromium) and D009 (mercury): P/S codes AC, AC1, AC2, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, IB, ICP, LI, ME (D007 only), RASS/RSS, SA, SO, STF (D007 only), WM, X0, XES, XO, XP
- D008 (lead, excluding leaded gloves): P/S codes AD, APD, CK, CV, EXT, FDL, FLU, IB, LI, RASS/RSS, SO, WM, X0, XES, XO, XP
- *D008 (leaded gloves only): P/S codes AC, AC1, AC2, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, ME, RASS/RSS, RD, SA, SO, STF, VS, WM, X0, XES, XO, XP
- D010 (selenium): P/S codes AD, FDL, FLU, RASS/RSS, SO, XES, XP
- D011 (silver): P/S codes AC, AC1, AC2, AD, CK, CV, EXT, FDL, FLU, IB, LI, RASS/RSS, SO, XES, XP

- D018 (benzene): P/S codes AC, AC1, AC2, SA
- D019 (carbon tetrachloride): P/S codes AD, APD, CV, RASS/RSS
- D021 (chlorobenzene): P/S code APD
- D022 (chloroform): P/S codes AC, AC1, AC2, APD, WM, X0, XO
- D035 (methyl ethyl ketone): P/S codes WM, X0, XO
- D038 (pyridine): P/S code AC, AC1, AC2, SA
- D039 (tetrachloroethylene): P/S codes AD, APD, CV
- D040 (trichloroethylene): P/S codes ME, WM, X0, XO
- No HWN: P/S codes LIBS, NCD, SMP

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

# PROCESS AK REPORT FOR MISCELLANEOUS OPERATIONS AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes that generate TRU waste in the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for several waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to TA-55 waste streams resulting from miscellaneous (i.e., mixed oxide, uranium, analytical, and research and development) processes covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001) (AK Information Summary) that includes information regarding all TRU waste streams

- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to miscellaneous operations is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No. TWCP-3546. Individual documents in this record have been assigned a separate identifier, M-nnn, where nnn is a sequential 3-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

present in the process wastes, based on subject matter expert (SME) interviews and any relevant data

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) is contained in these records, and is not included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK report is part of a set of closely related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six operational areas. The multiple processes in each area are described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004) (this report)
- *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, miscellaneous processes include 36 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6).

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in miscellaneous operations, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Processes in miscellaneous operation were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes, including those for non-defense activities. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (TWCP-816).

### 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is made on the basis of waste generator information compiled in the AK Information Summary. Waste generator information is reviewed to identify the types and sources of waste items

present in each drum, in order to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

3.3 Waste Physical Form and Content Description

Wastes generated during miscellaneous operations include primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. General debris waste categories from miscellaneous operations include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Metal debris (for example, wire, hose clamps, tools, labware)
- Glass debris

These debris waste items are contaminated with small amounts of radioactive and chemical substances. In addition to these general debris categories, miscellaneous processes also generated waste consisting of organometallic and inorganic solids of various compositions, sand and slag, ash, and crucibles.

3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1979, when miscellaneous processes first began at TA-55, to the present. Process wastes from miscellaneous operations have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding HWNs are shown graphically in Attachment 3, Time Lines. These timelines are based on a review of procedures that guided the experimental and demonstration studies and miscellaneous research and development (R&D) operations at TA-55 and information from SMEs familiar with the operations. Many of the operations were of short duration and/or changed frequently. Initiation or continuation of a process was based on the date of approval for a given procedure. In some cases, a series of procedures or related documents for one process could be located to establish the timeline. In many other cases, discontinuities between procedure titles and numbers made it difficult to determine how long the process may have continued before it was modified or ended. For purposes of this report, the time period for the process is assumed to continue two years beyond the date of the last approved procedure

unless otherwise indicated. Some processes have continued to the present. In cases where a given procedure did not identify the associated P/S code for the operation, a P/S code assignment was applied when the process description matched or was similar to a description in a previous or later revision of the same or a related procedure. Procedures were not available for some P/S codes (see Attachment 4). For these P/S codes, interviews with SMEs were used to develop process descriptions and timelines.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

## 3.5 Waste Generation Processes

The following subsections describe the generation and disposal of waste by miscellaneous operations.

Manufacturing and research operations performed at TA-55 in the production of plutonium also generate plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery and manufacturing operations, as well as associated maintenance operations and TA-55 plutonium research are the sources of TRU waste generated at TA-55. Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352). A full-block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

Research, development, and demonstration (RD&D) projects at TA-55 comprise an array of activities involving applied techniques and methods designed to study and improve processes associated with the purification, separation, extraction, recovery, and characterization of actinides (primarily plutonium) from various matrices. The nature of many of the investigations and experimental activities was such that no one detailed procedure could describe the variety of activities carried out. In many cases a definitive list of chemicals and reagents used in the investigations was not available. The process descriptions that follow are categorized by process group and are arranged within each group in approximate chronological order. A complete listing of P/S codes for miscellaneous operations, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. A simplified process flow diagram for miscellaneous operations is found in Attachment 5.

3.5.1 Extraction, Separation, and Characterization Studies (P/S Code AD)

From July 1979 until September 1994 or later, a series of similar actinide extraction, separation, and characterization R&D studies occurred in Room 208. These studies were conducted under various revisions of three series of procedures: processing of actinide hydroxide cakes from chloride and nitrate operations, development of sensors and instrumentation for online chemical analysis, and purification process development. A P/S code was not assigned to some of the earlier revisions, but is identified as P/S code AD in the latest revision of each series.

In this subsection, each revision of the hydroxide cake processing procedure is described separately because the chemical list and waste produced in the procedure differed in each revision.

- Beginning in July 1979, gloveboxes (GB) 231 and 233 in Room 208 were designated for americium R&D (M-018/TWCP-3546). These wet chemical experiments involved the use of evaporator hydroxide cake samples as the process feedstock. The process accountability flow diagram and procedures for P/S code AD do not identify the P/S codes that feed this operation; however, according to an SME (M-053/TWCP-3546) familiar with this operation, evaporator hydroxide cake samples came from P/S codes EV and HP (part of TA-55 nitrate operations). The hydroxide cake samples were dissolved in concentrated nitric acid, sampled to determine hydrogen, americium, and other principal cations, and subjected to extraction and separation phases to strip off the organics. The reagent list includes concentrated and dilute acids and caustics. Dibutyl butylphosphonate (DBBP) and kerosene were used in the extraction process.

- Presumably, americium activities occurred as indicated above until August 1983 when the procedure was revised. The modified procedure indicates that GB 231 and 233 were no longer limited to americium R&D but were assigned for use in general process R&D studies (M-019/TWCP-3546). Experimental investigations associated with the revised procedure involved chloride anion-exchange separations of plutonium, americium, thorium, neptunium, uranium, magnesium, and calcium. The process feedstock for these experiments is assumed to have been evaporator hydroxide cake samples from P/S codes EV and HP (M-053/TWCP-3546). The reagent list includes concentrated and dilute caustic and acid solutions, DBBP/Isopar (an isoparaffinic hydrocarbon solvent) and tributyl phosphate (TBP)/Isopar for solvent extraction, as well as platinum and platinum-rhodium alloys. Lead hydroxide, oxide and

nitrate are indicated as being used "less frequently." An SME familiar with this P/S code had "not come across any lead compounds" during his tenure beginning June 1989 (M-034/TWCP-3546). However, because the SME's tenure began after the presumed end date of this activity, no definitive determination can be made about the presence or absence of lead in the process waste stream. The SME further stated that mercury was present in the 1984/85 time frame. Other chemical reagents listed in this procedure consist of acids, bases, and other extraction solvents that are not RCRA-listed constituents with associated HWNs.

- It is assumed that operations of a similar nature continued in Room 208, GB 231 and GB 233 until December 1986. At this time, in addition to GB 231 and GB 233, a third glovebox (GB 289) was assigned for general chemical and electrochemical research with actinide solutions (M-020/TWCP-3546). Experimental investigations conducted under the revised procedure appear to be similar to the two previously described procedures. The chemical list is similar except that lead-containing compounds are no longer indicated. (However, see the discussion below about lead as a possible constituent in the feedstock material.) Additional materials used in these studies included gallium and tantalum metals, oxides, or salts as solids or in solution; tetraethylamine hydrochloride, tetraethylamine hydroxide, hydrazine dihydrochloride, and perchloric acid.

- It is presumed that various chemical and electrochemical experimental research with actinide solutions continued in the same room and gloveboxes as indicated above until February 1989, at which time the procedure was revised again. The additional investigations described in the revised procedure involved studies of plutonium (III), plutonium (IV), and plutonium (VI) complexed by nitrate and fluoride (M-021/TWCP-3546). The chemical list is similar to the previously described operations with the exception of dihexyl N, N-diethylcarbamoylmethyl phosphonate (DHDCMP) and octylphenyl-diisobutylcarbamoylmethylphosphine oxide (CMPO) used in extraction experiments. None of the chemical inputs to the process are RCRA-regulated constituents with associated HWNs.

In February 1989, various research studies involving sensors and instrumentation suitable for online chemical analysis took place in Room 208, GB 261 and GB 262 (M-022/TWCP-3546). The list of frequently used chemicals includes concentrated and dilute acids and bases, actinide salts or oxides, and reducing agents.

Purification process development investigations occurred in Room 208, GB 230, GB 238, and GB 274 from May 1988 through September 1994. Processes carried out were of a non-routine developmental nature involving research, process development, small scale "trouble-shooting," and occasionally preparation of various isotopes and isotopic mixtures of plutonium, uranium, americium, and neptunium (M-006/TWCP-3546). Frequently used chemicals included concentrated and dilute acids and bases, analytical standards, and reducing and oxidizing agents. Tetrachloroethylene and diisopropyl benzene are listed as solvent diluents, and methanol and ethanol are listed as "infrequently used chemicals." Waste streams containing or contaminated with tetrachloroethylene would result in the assignment of the EPA HWN F002 for spent halogenated solvents. Carbon tetrachloride is indicated as being used as a solvent diluent from July 1991 to March 1992. Because carbon tetrachloride was not used as a degreaser, the EPA HWN F001 for carbon tetrachloride does not apply; however, the EPA HWN D019 for carbon tetrachloride would be applied unless analytical data indicate that the concentration of the hazardous constituent does not exceed the applicable regulatory threshold limit. The procedure did not clarify how methanol was used in the process; however, an SME (M-034/ TWCP-3546) familiar with the process stated that methanol and ethanol slushes were used in cooling baths outside the glovebox. Methanol used outside the glovebox would not become part of the TRU waste stream and the EPA HWN would not apply. However, methanol and/or ethanol may also have been used for cleaning inside the glovebox (M-034/ TWCP-3546).

Wastes that may be generated under P/S code AD include typical laboratory debris such as labware (e.g., glass, plastic, rubber, or metal materials and supplies), rags from general cleanup, spent solutions, and typical glovebox operations waste, including drybox gloves, windows, gaskets, and high-efficiency particulate air (HEPA) filters. Other wastes include the strip solutions and raffinate, spent organics, and unused hydroxide cake samples. The procedure indicates strip solutions and spent organics were stored but does not address ultimate disposal of these spent solutions. The process accountability flow diagram for P/S code AD indicates outputs from this operation may be sent to the vault, returned to the originating P/S code, or directed to aqueous recovery or cement fixation based on the discard limit (DL). Materials may also be sent for chemical analysis or transferred to P/S code APD for further experimental development. Assuming that evaporator hydroxide cakes comprised the primary feed material for this code, the hazardous constituents associated with the feedstock material may be concentrated in the actinide-containing matrices and solutions that are discarded as waste. Based on information presented in TWCP-AK-2.1-002,R.2 (chloride operations) and TWCP-AK-2.1-005,R.2 (nitrate operations),

hydroxide cakes may contain the heavy metals cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011).

3.5.2 Halogenation Studies (P/S Codes CK, CV, FDL, FLU, IE, LI, SO)

A variety of halogenation (chlorination and fluorination) studies were conducted in various rooms and gloveboxes in Building PF-4, Rooms 105, 106, 113 and 208, from March 1988 to October 1992. Brief descriptions of these related operations are provided below. Standard debris waste items that were generated from these operations included rags from general clean-up, miscellaneous tools, labware (glass, plastic, or metal), typical glovebox operations waste; additional types of wastes are listed with each process description.

R&D efforts utilizing fluorinating agents to fluorinate ash samples containing plutonium residues were conducted in Room 105, GB-177, beginning in March 1988 under P/S code SO. A gas flow loop was used to pass a fluorinating agent through a gas-solid reactor where plutonium in the solid residue reacted chemically to form solid $PuF_4$ or gaseous $PuF_6$ (M-007, M-008/TWCP-3546). Gaseous $PuF_6$ was trapped in a cold trap, distilled, and reduced to $PuF_4$. This process was similar to that used in P/S codes FLU and CK (described later in this section) insofar as they all involved related functions (i.e., extraction of plutonium from various matrices), but each process used a slightly different approach (M-035/ TWCP-3546). Chemicals used in this process included fluorine and various halogen fluorides, aluminum oxide, and sodium bicarbonate. The feed material was ash generated in the incinerator (P/S code IS) and had passed through the rotary calciner (P/S code RC) (M-053/ TWCP-3546). Raw ash from the incinerator contains the heavy metals barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) in concentrations exceeding the Toxicity Characteristic Leaching Procedure (TCLP) limits. Calcined ash also contains these metals (except silver) above the TCLP limits. The process accountability flow diagram for P/S code SO indicated that process outputs (i.e., unreacted ash and solid $PuF_4$) were sent to the vault. Some fluorinated items may have been sent to CLS-1 for analysis. In addition to the standard debris waste items, process waste also included spent aluminum oxide and sodium bicarbonate.

Fluorination of plutonium-containing residues was also carried out in Room 106, GB-185, beginning in October 1990 (M-009/TWCP-3546). Fluorination operations at this location may have occurred prior to 1990 because the procedure reviewed was a revised document and the process was not indicated as being new. The process end date was approximately October 1992 (M-035/TWCP-3546). This process appears to be identical to the fluorination operation (P/S code FDL) described below; however,

the procedure indicates that methanol is used in the cold trap outside the glovebox. In addition to the standard debris waste items, process waste also included spent aluminum oxide and sodium bicarbonate. The process accountability flow diagram for P/S code FDL indicated that process outputs (i.e., solid residues and $PuF_4$ product) were sent to the vault.

P/S code FDL was conducted in Room 105, GB-192, from August 1991 through March 1995, when it was dismantled. This process was part of the dioxygen difluoride (FOOF) program and consisted of a gas flow loop to conduct experiments that demonstrated the feasibility of fluorination at room temperature (M-011, M-036/TWCP-3546). The procedure does not identify the precise nature of the plutonium-bearing matrices. P/S code FDL used FOOF as an oxidizing agent and methane as a reduction agent. Carbon tetrafluoride was a reaction byproduct. Aluminum oxide and sodium bicarbonate were used as "getter" beds for excess fluorine. Liquid nitrogen was used in a cooling bath outside the glovebox and was not contaminated by materials inside the glovebox. Cooling was also accomplished by circulating refrigerant mixtures of freons. Upon dismantling the gas loop, the freon was captured. P/S code FDL did not involve the use of any chlorinated compounds. In addition to the standard debris waste items, process waste also included spent aluminum oxide and sodium bicarbonate. The process accountability flow diagram for P/S code FDL indicated that process outputs (i.e., solid residues and $PuF_4$ product) were sent to the vault.

P/S code CK was a fluorination operation carried out in Room 105, GB-193, beginning in May 1991 (M-010, M-035/TWCP-3546). The procedure does not identify the precise nature of the plutonium-bearing matrices. If ash was a process input (as in P/S codes SO and FDL), the same heavy metals may be important for subsequent processes that use feedstock from P/S code CK. The organic chemicals 1-propanol and trichloroethylene were used in cold traps and cooling baths in the standard TA-55 configuration located outside the glovebox (M-035/TWCP-3546). The process accountability flow diagram for P/S code CK indicated that outputs from this operation were sent to the countroom or vault or transferred to P/S code PTS (RD&D Pretreatment Studies, covered in TWCP-AK-2.1-005,R.1, nitrate operations).

P/S code IE (the Phoenix Project) ran from about 1984/85 until 1990 (M-035/TWCP-3546). It involved the use of $PuF_6$ and refluorinating agents. No RCRA constituents of concern were involved in the operation.

P/S code LI was a fairly pure operation in Rooms 105, 106, and 113 that converted small quantities of $PuO_2$ to $PuF_6$ (M-035/TWCP-3546). The

converted material was given to whomever needed it for further R&D. The timeline is likely similar to that for P/S code IE. No RCRA constituents of concern were involved in the operation.

Separation operations involving experimental chlorination processes similar to the previously described fluorination procedures were initiated in Room 106, GB-165, in March 1991 under P/S code CV (M-026/ TWCP-3546). A gas loop was used to flow carbon tetrachloride and perchlorocarbons (M-035/TWCP-3546) through a gas-solid reactor to chlorinate plutonium oxides to form recoverable plutonium compounds. Once produced, the plutonium compounds and/or plutonium-bearing matrices were subjected to further treatment to achieve complete plutonium recovery. Process chemicals included dilute acids and bases and chlorinated hydrocarbons. Carbon tetrachloride and tetrachloroethylene were used in the cold traps, which were of the standard TA-55 configuration located outside the glovebox (M-035/ TWCP-3546); therefore, the coolant chemicals would not have been part of the TRU waste stream. Process outputs from this operation may have been sent to the vault via the countroom, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit). Sub-accountable samples may have been sent to chemical analysis.

Plutonium chlorination operations were used to recover or purify plutonium compounds and/or plutonium-bearing matrices in Room 208, GB-223, beginning in October 1992. During November 1994 the operation shifted to Room 106, GB-160 (M-027/TWCP-3546). The P/S code for this operation is identified as CV. This operation involves the use of various reagents, which are passed through a gas-solid reaction loop to produce recoverable plutonium compounds. Chemical reagents include dilute acids and bases, carbon tetrachloride, reducing agents, and ammonium chloride. In addition to the standard debris waste, process waste included trace carbon tetrachloride from reagent bottles. Carbon tetrachloride was used as a chlorinating compound in the reaction loop and would have been completely reacted in the chlorination process (M-035/TWCP-3546). Because carbon tetrachloride was not used as a solvent or degreaser, the EPA HWNs F001 and F002 for carbon tetrachloride are not applicable. Process outputs from this operation may have been sent to the vault via the countroom, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the DL). Sub-accountable samples may have been sent to chemical analysis.

A small-scale research operation involving gas-solid and solid-solid fluorination and chlorination chemistry began in March 1992 in Room 113, GB-117 and GB 179, under P/S code FLU (M-012/TWCP-

3546). The process, materials, and chemicals used in this operation were similar to those used in P/S codes SO and CK because they all involved related functions (i.e., extraction of plutonium from various matrices) although each process used a slightly different approach (M-035/ TWCP-3546). The process feedstock (ash) was generated in P/S code IS and also passed through the rotary calciner (P/S code RC) (M-053/ TWCP-3546). Raw ash from the incinerator contains the heavy metals barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) in concentrations exceeding the TCLP limits. Calcined ash also contains these metals (except silver) above the TCLP limits. The process accountability flow diagram indicates that process outputs are sent to the vault or the originating P/S code. Some items were sent to CLS-1 for analysis. No organic chemicals are listed in the procedure. In addition to standard debris waste, other process wastes included used vacuum pump oil, and heating mantles. Hazardous constituents are not expected to be present in these waste items.

3.5.3 Non-Aqueous Dissolution/Extraction Operations (P/S Codes AC, AC1, AC2, AC3, AX, SA)

Several non-aqueous dissolution/extraction operations occurred in Building PF-4 beginning in 1989 and continuing at least until 1994. These operations are described below.

In January 1989, research operations in Room 208, GB 203, involved the dissolution of actinide compounds and actinide-containing matrices in superacid media. (M-004/TWCP-3546). The superacid solutions were evaporated to leave solid products that were analyzed by a variety of methods. Chemical use included anhydrous hydrofluoric acid, antimony pentafluoride, $HSO_3F$, hydrofluoric acid, and "other superacid solvents" (which are not specified in the procedure). The P/S code for this operation is not identified in the procedure but the process description is consistent with P/S code SA (M-024, M-037/TWCP-3546). This P/S code covered two separate activities that did not overlap in time. P/S code SA began in 1989 with superacid work, but the process changed approximately in 1991 to organometallic studies. According to the SME, organic compounds (i.e., solvents) were never used with superacid media. Aluminum oxide and magnesium oxide were used to absorb superacid components. These spent oxides were discarded along with contaminated glass. Hazardous constituents are not expected to be present in any of the waste streams from the superacid work.

The study of the organometallic chemistry of uranium and thorium in non-aqueous solvents (as part of P/S code SA) was conducted in Room 208, GB-216 and GB 230, in 1989 (M-024/TWCP-3546). Chemical reagents and solvents are not specified but the procedure

indicates that materials used in the process may include "hydrocarbon, ethereal, and aromatic solvents, organic reagents, and inorganic salts." The procedure was revised in 1991, at which time the operation was conducted in Room 105 (GB 166 and GB 177) and Room 208 (GB 230 and GB 240). The process consisted of a variety of small-scale organoactinide operations involving fundamental research of the synthesis in non-aqueous media of new actinide compounds, their characterization and reaction chemistry, and application to existing actinide processing technology. Due to the range of experimental studies conducted under this P/S code, a definitive list of chemical reagents does not exist; however, previous studies involved the use of a wide range of hydrocarbon solvents, including the D-listed and F-listed constituents: methylene chloride (F002), diethyl ether (F003), benzene (D018, F005), toluene (F005), and pyridine (D038, F005). Tetrahydrofuran and toluene were also used in the organometallic process. Neptunium and plutonium metal were put into tetrahydrofuran and dried. Bromine and/or iodine were added to create plutonium iodide, the starting material for other studies. In addition to standard debris wastes, process wastes may have included reaction by-products and residues, various pieces of laboratory equipment, spent organic solvents, and filtration media. Process outputs from this operation may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

The procedure associated with the previous operation was revised once again in March 1994. The P/S codes for these operations are indicated as AC, AC1, AC2 and AC3. SMEs (M-038/TWCP-3546) familiar with these activities indicated that the process began as P/S code AC in February 1989 and transformed to P/S code AC2 in February 1994. P/S codes AC2 probably ran concurrently with AC1. This revised procedure indicates that operations occurred in the same rooms and gloveboxes identified in the previous revision. The distinguishing features between AC1 and AC2 were that AC1 was an analytical process using aqueous compounds, predominantly dilute nitric, hydrochloric, and perchloric acid solutions. These acidic solutions would have been neutralized and precipitated to recover the plutonium. Solutions were sent to cementation. The solids were rinsed from rags with water before the rags were discarded. Any perchloric salts would be in the neutralized acidic solutions or in the rinse solutions, which were both sent to cementation. P/S code AC2 involved synthesis of (air-sensitive) new compounds in an inert glovebox. This was a non-aqueous process. P/S code AC3 is not related to P/S codes AC1 or AC2, but is predominantly a metal operation (M-038/TWCP-3545). This code had not yet become active by the time this report was prepared, and no other information was available for it.

The procedure describes operations that comprise a broad range of laboratory activities in support of fundamental and applied actinide chemistry research (M-025/TWCP-3546). These activities include, but are not limited to, preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation. The chemical list indicates the use of a variety of materials, including organic solvents (e.g., pyridine, toluene and benzene), alkaline earth metals, and transition metals. The SMEs (M-038/TWCP-3546) familiar with these activities indicated that a "variety of aromatic, alkaline, and chlorinated solvents" (e.g., tetrahydrofuran, toluene, benzene, methylene chloride, and chloroform) were used in these activities. Hexane and acetonitrile began to be used in P/S code AC2 recently. Acetonitrile and tetrahydrofuran are Appendix VIII VOCs, but their EPA HWNs (U003 and U213 respectively) do not apply in this case. Organic chemicals with applicable EPA HWNs are benzene (D018, F005), chloroform (D022), methylene chloride (F002), tetrahydrofuran, and toluene (F005). The SME stated that waste byproducts from the operations that contain these constituents were not discarded but were held in the glovebox for reprocessing or recovery. Because the SME was not involved with these activities after 1994, he was unable to definitively state how the waste materials were ultimately dispositioned. In a later discussion, other SMEs (M-038/TWCP-3546) indicated that use of the chlorinated solvents associated with P/S code AC1 was discontinued in 1994 and that items contaminated with these constituents mentioned are still in the glovebox and have yet to be discarded as of the date of this report. Transition metals used as reagents in the synthesis of new materials in this process included sodium salts, potassium salts, and silver salts. The precipitated salt byproducts also were not discarded but were held in the glovebox for reprocessing and recovery. In a later discussion, other SMEs confirmed that silver salts associated with P/S code AC1 are still in the glovebox awaiting determination for a path forward for disposition. Other than silver (D011), no RCRA metals were used in the processes (M-038/TWCP-3546). In addition to the standard debris wastes, process wastes may have included reaction by-products and residues, heating mantles, vacuum pump apparatus, various pieces of laboratory equipment, spent organic solvents, and filtration media. Process outputs for both P/S codes may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

P/S code AX was related to the dissolution of actinide compounds in superacid media but involved the assay of plutonium in nitric or hydrochloric acid solutions. This operation occurred in Rooms 401, 409, and 420. The procedure was initiated in 1988 and revised in 1989 (M-005/TWCP-3546). Assay solutions were accumulated for transfer to

P/S code CX (in chloride operations) or P/S code RR (in nitrate operations). The use of RCRA solvents is not indicated in the procedure.

3.5.4 Analytical Operations (P/S Codes ACL, ICP, XP)

P/S code ACL is an umbrella operation that covers all analytical techniques performed in Room 124 (M-042/TWCP-3546). This P/S code began in the 1980s and continues to the present. Processes under this P/S code involve analysis of plutonium and americium, RCRA metals, and trace metals. Originators provide samples, which are prepared for further analyses (e.g., ICP and XES). Analytical preparation may involve the use of nitric acid solutions. Unused liquid samples are returned to the originator, sent to radiochemistry for counting, or sent to recovery operations if established discard limits are exceeded. Discardable wastes (based on discard limits) are disposed to the acid waste line. Some solid wastes (i.e., residues from chromatography) are collected, counted, and sent to recovery operations if the plutonium concentration exceeds the discard limit.

P/S code ICP is one of the plutonium analytical techniques associated with P/S code ACL (M-042/TWCP-3546). This process takes place in Room 106, GB 188 and began in 1987/88. Although still active, this P/S code will eventually be replaced by P/S code ACL.

P/S code XP involved several small-scale R&D efforts primarily focused on plutonium recovery (M-049/TWCP-3546). Operations were conducted in Room 208, GB-227, 228, and 229. This P/S code began in March 1986 and ended in May 1990. It included the following activities:

- Fluoride sintering of $PuO_2$ took advantage of the presence of fluoride to aid the formation of a sintered mass of $PuO_2$ powder at temperatures above 700°C. Process inputs did not involve constituents that would result in the generation of RCRA hazardous waste (M-049/TWCP-3546).

- Chlorination of plutonium oxides involved oxides with tantalum chips from Rocky Flats Environmental Technology Site (RFETS). Chlorination was used to recover plutonium from potassium chloride and sodium chloride matrices. Process inputs did not involve constituents that would result in the generation of RCRA hazardous waste (M-049/TWCP-3546).

- Processing of molten salt extract (MSE) salts generated at LANL and RFETS did not involve constituents that would result in the generation of RCRA hazardous waste (M-049/TWCP-3546).

- Recovery of plutonium from ash involving plutonium/thorium oxide mixtures generated ash residues that are likely to contain a variety of contaminants, including RCRA heavy metals such as cadmium, chromium, and lead (M-049/TWCP-3546). The ash was sent to recovery and ultimately cemented. The feed material was ash generated in the incinerator (P/S code IS) and that had passed through the rotary calciner (P/S code RC) (M-053/TWCP-3546). Raw ash from the incinerator contains the heavy metals barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) in concentrations exceeding the TCLP limits. Calcined ash also contains these metals (except silver) above the TCLP limits.

- Processing of neptunium oxide and metal was performed to remove the protactinium daughter in order to use the neptunium for non-destructive assay (NDA) standards (M-049/TWCP-3546).

Waste from P/S code XP included standard debris items associated with laboratory operations and glovebox maintenance, as well as lead shielding. Phosphine oxide was used as the extracting/complexing agent and diisopropyl benzene, CMPO, and DHDCMP mixtures were used as diluents for processes involving solvent extraction of plutonium leached from a candidate matrix.

3.5.5 Measurement/Detection Operations and Studies (P/S Codes EOC, HRS, LIBS, RASS/RSS, SMP, VS, XES)

P/S code VS took place in Room 209, GB-210, and involved the inspection of high-purity oxides and metals to verify the inventory in the vault (M-045/TWCP-3546). Materials were retrieved from the vault, brought to the glovebox, inspected, assayed by a non-destructive method, sampled if necessary for chemical analysis (under different P/S codes), then repackaged if necessary, and returned to the vault. Waste from this activity would include vials if the inspected material were sampled, and plastic (from the bagout process). No other materials or chemicals were introduced. This P/S code ran only a few months, from August 1987 to early 1988.

P/S code XES is a plutonium assay technique in which samples containing plutonium are excited with X-rays, and the resulting emission spectra are measured to determine plutonium concentrations (M-042/TWCP-3546). Sample preparation may occasionally require the use of acid/base solutions to suspend solids. Unused sample material is returned to the originator. The time period for P/S code XES is 1988 to present. The process occurs in Room 106.

P/S code RASS/RSS involves interrogating small samples (solids or solutions containing less than 1 gram of nuclear material from other P/S

codes) using laser-based spectroscopy (M-043/TWCP-3546). This P/S code was created February 1993 and is still active although the process has not been used in two to three years. The operation takes place in Room 105, GB-165. Sample preparation is not conducted under this P/S code. If samples require preparation prior to spectroscopy (e.g., if the sample must be diluted with an acid solution because plutonium concentrations are too high), the preparation steps are performed by the originating P/S code. Once analyzed, samples are returned to the originating P/S code, sent on to other P/S codes, or sent for recovery/reprocessing. No waste is generated from this P/S code except standard glovebox trash, including gloves that may be leaded or unleaded.

P/S code LIBS used a laser for isotopic analyses of samples of high purity metals and oxides (M-047/TWCP-3546). The process was initiated January 1998 and is still operational. Some developmental work commenced prior to 1998; however, this was before the process went "hot." Process activities are conducted in Room 105, GB 158 and 180. Waste forms include standard glovebox maintenance items. There is no sample preparation involved, and no organic or RCRA metal constituents are introduced or generated during the process.

P/S code SMP has "never gone hot" (M-044/TWCP-3546) but may start up at the end of 2001. The process will take place in Room 120 and will involve mounting samples of plutonium metal and stainless steel using a low-melting bismuth-tin alloy in preparation for electron microscopy. No organic solvents or RCRA metals will be introduced or generated as wastes during the process. No other sample preparation will be done under this P/S code. Any required surface preparation will be done at the originating P/S code, and samples will be returned to the originating P/S code. Waste will consist of standard glovebox maintenance items.

P/S code EOC began in March 1992 in Room 208 as an experiment designed to calculate the surface area and pore size distribution of a sample and to analyze its surface characteristics (M-015/TWCP-3546). Mixtures of helium and nitrogen are passed through a U-shaped cell containing a sample to be analyzed. With the exception of nitrogen and helium, no solvents or chemical are used in this process (M-040/ TWCP-3546). Process outputs from this operation may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

P/S code HRS involved spectroscopic studies in Room 105, GB-189 and 190, from January 1987 through March 1995 (M-036/TWCP-3546). Fluorinated actinide compounds were introduced with compressed gases into a long-path, variable temperature cell for spectroscopic

measurement and in preparation for physical chemistry (M-023, M-036/TWCP-3546). RCRA-regulated constituents were not indicated as being used. Process outputs, which were the experimental items used for analysis, are expected to have been the same as the process inputs; therefore, no RCRA or other waste constituents of concern were involved.

3.5.6 Pyrochemical Matrix Studies (P/S Codes IB, EXT, STF)

A pyrochemical matrix study was conducted from May 1986 through February 1995 in Room 208, GB-264. The process was initiated under P/S code IB (Incoming Oxide Blending) in May 1986 (M-039/TWCP-3546). From 1986-1992, the process involved rod milling prior to screening (M-030/TWCP-3546). This process had two objectives: (1) blending large batches of homogeneous plutonium metal oxides (up to 85 percent purity) for pyrochemical operations, and (2) dissolution of 78 percent pure (or greater) plutonium metal oxides for nitrate operations (M-039/TWCP-3546). The materials or impurities in oxides destined for dissolution consisted of high iron, chromium, and halide salts; therefore, this accounted for the sources of chromium in the evaporator bottoms.

The process changed in August 1992 to become the Matrix Study of Pyrochemical Salts when a need developed to blend oxides to provide feed material for P/S codes RB and RBJ to make NDA standards. This activity continued until February 1995 when the process became P/S code STF, which is still an active code conducted in Room 126, GB-138 and 139. The objective of this activity was to determine the effect of pyrochemical salt matrices on the accuracy of NDA measurements (M-029/TWCP-3546). Process activities involved crushing, pulverizing, blending, roasting, and sieving pyrochemical salts. The results were used to determine handling and processing of the salts and for correction of bias measurements. The feed material consisted of high-purity oxides to use in the fabrication of standards to be used at LANL and throughout the DOE complex (M-039/TWCP-3546). Waste forms included a stainless steel capsule used to contain the standard, and stainless steel cans (similar in size to a paint can) used to contain the oxides. The process did not use or generate wastes containing liquids, solvents, organics or metals (except the stainless steel). Waste included typical glovebox maintenance items (e.g., cheesecloth, rags, HEPA filters, glovebox windows, gloves). Process outputs from this operation were sent to the vault.

P/S code EXT was a small basic research operation that began in March 1992 in Room 106, GB-180. This research effort explored aqueous extraction of plutonium from various waste streams, particularly used

pyrochemical salts (M-013/TWCP-3546), using acids and bases. The procedure does not indicate the use of any RCRA-listed chemicals. Wastes from this operation would include rags and paper products from general clean-up; labware that may include glass, plastic, or metal; heating mantles, and spent pyrochemical salts. The process accountability flow diagram and procedures for this process do not identify the P/S codes that fed this operation. Spent pyrochemical salts contain barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) at concentrations that depend upon the process that generated the salt. Concentrations of RCRA heavy metals are below regulatory limits for pyrochemical salts from direct oxide reduction (P/S code OR) (TWCP-2540), but concentrations are not known for pyrochemical salts from salt stripping (P/S code SS) or special processes (P/S code PX). Residues from the solution extraction process were sent to the vault via the countroom, returned to the originating P/S code, or transferred to chloride (P/S code CX) or nitrate (P/S code CF) operations. The EPA HWN D constituents would carry through to subsequent treatment processes. Solutions were transferred to chloride (P/S code CX) or nitrate (P/S code CF) operations, or were disposed to the acid waste line if the solutions met the waste acceptance criteria for the RLWTF at TA-50.

3.5.7 Hydrothermal Processing (P/S Code APD)

P/S code APD was a hydrothermal processing procedure initiated in March 1996 in Room 208, GB-230 (M-001/TWCP-3546). The operation involves the reaction of aqueous/organic mixtures, pure organic liquids, or contaminated combustible solids (e.g., ion exchange resins, plastic filters, and cellulose rags) under supercritical conditions (i.e., high temperature and pressure). Feed streams include, but are not limited to, analytical laboratory solutions that may contain carbon tetrachloride, tributyl phosphate, and organic solvents (unspecified in the procedure), as well as lead and mercury (Cl-25/TWCP-3547). Process effluents are gases, liquids and salts. Organic components are oxidized to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

The types of chemical wastes generated by hydrothermal processing experiments are predominantly effluents and rags. Hazardous organic constituents, including carbon tetrachloride, are probably destroyed by the hydrothermal process (M-034/TWCP-3546); therefore, organic RCRA-listed constituents in the feed streams would not be expected to be present in the resulting debris waste. Rags contaminated with carbon tetrachloride that were not processed through the hydrothermal reactor

would be assigned the EPA HWN D019. Hazardous inorganic constituents (i.e., RCRA metals) would not be present in the waste (M-034/TWCP-3546) other than any heavy metals present in the feed solutions (e.g., EPA HWNs D008 and D009). Process outputs from this operation may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit). Materials may also be sent to Actinide Chemistry R&D (P/S codes AC1 or AC2) or Raman Spectroscopy (P/S code RASS/RSS) for quantification.

3.5.8 Electrochemistry Experiments (P/S Code EDC)

Under P/S code EDC, various electrochemistry R&D experiments were conducted in Rooms 105, 106, 112, 208, 209, and 210 in December 1995. Electrochemistry methodologies were designed to decontaminate items, replace processes that produce large amounts of waste, or enhance chemical reactions (M-014 and M-031/TWCP-3546). Electrolytes were typically inert nonhazardous salts. Process inputs were from the vault or metallurgy operations. The process involved uranium decontamination of disassembled weapon components from various sites with various levels of surface contamination with plutonium (M-041/TWCP-3546). The operation was strictly an aqueous process in which an alkaline solution was reacted with the components to precipitate uranium. A stainless steel cathode was used; therefore, corrosion was not an issue and the electrolyte was not degraded. Significant amounts of metal could be stripped in a short period of time. The precipitated solution comprised either uranyl hydroxide or uranyl sulfate, which was then dried for mass balance. The distillate contained small amounts of uranium. Rinse water was discarded to the industrial caustic waste line. RCRA metals would be present in the waste stream but the SME stated that there are "reams of analytical data" to support that RCRA metals are below regulatory threshold limits. However, to be conservative, it is assumed that chromium (D007) could be present in the stainless steel removed during this process (M-031/TWCP-3546). Outputs from the process are directed to the vault or nitrate recovery operations (P/S code CF).

3.5.9 Metallography (P/S Code ME)

P/S code ME takes place in Room 115 and involves a standard metallography process that was initiated at TA-55 in 1979 and continues to the present (M-048/TWCP-3546). The purpose of the metallography operation is to characterize the microstructure of metallic or ceramic pieces to verify and establish the quality and effectiveness of welds. Materials examined under this P/S code consist of plutonium and uranium carbides, nitrides, and oxides, as well as zirconium and tantalum alloys, and stainless steel. Metal pieces (pellets) are cut with a

diamond saw. Ceramic pieces are subjected to grinding with standard metal grinding media (e.g., papers impregnated with silicon carbides and diamond). The materials are polished with several different chemical compounds. Prior to May 1992, a mixture of 1–10 percent trichloroethylene and kerosene were used. Ethanol and acetone may also have been used. After May 1992, these materials were replaced with a mineral oil and a derivative from orange peels. The polishing compounds were not used for their solvent properties, but rather for their cooling and lubricating properties. Little liquid waste is generated from the process. The trichloroethylene/kerosene mixture and the alcohols largely evaporated during the polishing process. Waste trichloroethylene and kerosene was accumulated, absorbed onto vermiculite, and discarded in 55-gallon drum.

Metal or ceramic pieces are cleaned with alcohol and etched with various kinds of acid or caustic etchants, which are reused as much as possible. Waste etchants are neutralized; however, their disposal path is uncertain. Analytical data for some of the etchant residues indicated that these residues did not contain excessive concentrations of RCRA constituents; consequently, waste from this process is documented on Chemical Waste Disposal Records as "non-RCRA."

Beryllium and chromium (from the stainless steel) would be present in the grindings. However, the beryllium is not in a form that is RCRA regulated. Other waste includes standard glovebox maintenance items (e.g., rags, glovebox gloves, and HEPA filters), and a large volume of grinding paper. Although generally the gloves were not leaded, leaded gloves are used at the grinding station and for the last 3-4 years only at one glovebox.

3.5.10 Waste Management Operations (P/S Codes NCD, RD, WM, X0, XO)

P/S code RD was used only in 1984–1986 in Room 432 (M-046/TWCP-3546). This P/S code allowed for tracking of demonstration drums (one drum each year) that were packaged and prepared in accordance with the TA-55 Attachments to the *Certification Plan* (TWCP-701) to meet the WIPP requirements at that time. Packaging of these drums did not of itself result in the generation of TRU waste. The SME stated that the waste drums that were packaged contained non-mixed TRU waste.

Operations under P/S code NCD occurred during the period from April 1989 – April 1991 in Room 432 (M-046/TWCP-3546). This P/S code was established to provide a mechanism for dealing with TRU drums that did not confirm specifications (e.g., recorded weight or nuclear material content). Non-confirming drums were temporarily set aside under this P/S code until such time as personnel could reprocess them under P/S code WM to correct the nonconfirming condition. After April

1991, nonconfirming drums were dealt with immediately, and P/S code NCD was no longer needed.

According to an SME (M-046 and M-050/TWCP-3546) who researched the assignment of waste to P/S codes WM, XO, and X0, P/S code WM is currently limited to waste that arises from the TRU solid waste management operation in Room 432. This situation has been the case since the beginning of 1993. Room trash boxes from Building PF-4 have always been handled as low-level waste; however, the boxes were assayed to verify contamination levels and any that were determined to be TRU waste were diverted to Room 432 for repackaging. From May 1987 through 1992, these boxes were created as P/S code XO or X0. These codes were changed to P/S code WM after 1992. Additional controls were placed on room trash after 1992. Trash was assayed with the Multiple Energy Gamma Assay System (MEGAS). When a container was rejected on the basis of MEGAS data, the rejected container was returned to the originator for removal of any "hot" item(s). This process also allowed for greater control to prevent discarding regulated materials (e.g., RCRA constituents) in room trash. Hence, no EPA HWNs apply to waste from P/S code WM after 1993.

The designations for P/S codes XO and X0 are based on the following distinctions:

- P/S code X0 was designated for waste materials that could not be associated with a specific room, such as a hallway, mezzanine offices, rest rooms and change rooms, basement, pump rooms, and trolleys. The waste from all these areas, except the pump rooms and trolleys, would be low-level waste and no RCRA constituents would be associated with the waste items.

- P/S code XO indicated waste materials that were generated within specific rooms but could not be associated with an individual P/S code in that room. The room trash boxes assigned this P/S code, when determined by assay to qualify as TRU waste instead of low-level waste, could contain rags that had contacted ignitable constituents (e.g., ethanol, isopropyl alcohol, and hexane); however, because the waste items were not packaged as free liquids, the EPA HWN D001 for ignitability would not be applicable. Other constituents that may have been present on rags in debris waste from P/S code XO included the degreasing solvents methyl ethyl ketone (D035, F005), trichloroethylene (D040, F001, F002), and 1,1,2-trichloro-1,2,2-trifluoroethane [freon] (F001); methylene chloride (F002) used as a paint stripper until after 1999; and chloroform (D022) used in a cryogenic bath. XO switched to non-RCRA

regulated paint strippers after 1999: Citrapeel until 2001, and Organicstrip at the present time.

However, because of the difficulty in distinguishing X0 from XO on the waste containers and in waste generator records, all EPA HWNs applicable to TRU waste from XO should also be applied to TRU waste under X0 in order to be conservative.

Two other specific situations could also result in the generation of additional waste items under P/S code WM.

- During maintenance of the in-line glove box, changeout of the leaded gloves and windows would be covered under P/S code WM. No solvents or other chemicals were introduced during this routine maintenance activity.

- A spill in Room 432 in 1989 involved the release of a Pu-239-contaminated solution (consisting primarily of water with a minor amount of nitric acid) from a ventilation line. The spill was wiped up with rags and discarded under P/S code WM. Rags with excessive amounts of nitric acid would have been neutralized by dipping them in a calcium hydroxide solution inside a glovebox. No EPA HWN would be applicable to waste from this incident.

## 3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for miscellaneous operations at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for miscellaneous operations consist of the general types of materials listed in Table 1 that are obtained from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites.

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

### 3.6.1 Physical Waste Form Identification

Solid waste from miscellaneous operations primarily consists of debris waste, as well as cemented waste discarded under P/S codes CF or HP. Debris waste contains glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves are also generated as process waste. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams.

**Table 1. Process Feed Materials for Miscellaneous Operations**

| Feed Material | RCRA-Regulated Substances and Associated Hazardous Waste Number | P/S Codes in Miscellaneous Operations |
|---|---|---|
| Analytical laboratory solutions | Solutions from other TA-55 operations: no RCRA constituents<br>Solutions from CLS-1: Potentially contaminated with RCRA-regulated heavy metals, mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (reference Cl-25 in TWCP-3547). | ACL and ICP (TA-55 solutions)<br>APD (CLS-1 solutions) |
| Ash from P/S codes IS, SB, and TDC, or from other DOE sites | Usually suspect contaminated with barium (D005), cadmium (D006), chromium (D007), and lead (D008). Silver (D011), arsenic (D004), mercury (D009), and selenium (D010) may also be present; although volatile at high temperatures if present in the oxide form, these heavy metals may be alloyed to Pu if present in the metal form. | SO, XP |
| Disassembled weapons components | High-purity Pu and U material types | EDC |
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity | AD, CV, EXT, HRS, ME, RASS/RSS, SA, XES, XP |
| Hydroxide cakes | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), chromium (D007), mercury (D009), lead (D008), and silver (D011) | AD |
| MSE salts | Typically fairly pure, suspect contaminated with barium but no other RCRA substances present | XP |
| Pu chlorides and fluorides (from various P/S codes) | Variable purity | FDL, SO |
| Pu metal or metal alloy | High purity, no RCRA-regulated substances, unless noted otherwise | AC, AC1, AC2, EXT, LIBS, SA, SMP, VS |
| Pu oxides | High-purity oxides used for P/S codes EOC, IE, LIBS, STF, and VS. Variable purity for other codes, may be contaminated with RCRA-regulated heavy metals barium (D005), cadmium (D006), chromium (D007), and lead (D008), and silver (D011) | CK, CV, EOC, EXT, FDL, FLU, IB, IE, LI, LIBS, SO, STF, VS, XP |
| Pyrochemical salts | Typically fairly pure, no RCRA-regulated substances other than barium (D005) present | EXT, IB |

Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item ID number and record its matrix material. This form was signed by the waste packager, then reviewed and approved by quality assurance (QA) personnel.

3.6.2 Radionuclide Content Identification

The primary plutonium MT inputs for miscellaneous operations at TA-55 are listed in Table 2, and uranium material types are listed in Table 3. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The MT notation was developed because it is a convenient way to describe MTs that have very consistent isotopic compositions. Tables 2 and 3 indicate the isotopic composition of the MTs at the time the waste was characterized.

The plutonium MT provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. These bounding calculations provide a basis for identifying enrichment or depletion of one radionuclide versus another based on radioassays of individual waste containers. The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest plutonium material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in Am-231 or U-234 depending on whether the source of

## Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments

| Material Type (MT) | Plutonium Isotope (Weight %) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

a These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

## Table 3. Average Isotopic Content of Uranium Material Types and Enrichments (Weight %)

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Source: TWCP-698

contamination is the process product or the process residues (TWCP-882). Americium or neptunium isotopes could also be the dominant radionuclides in some waste items due to their occasional use as primary feed materials in P/S codes such as AD, CV, EXT, HRS, RASS, SA, XES and XP.

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from miscellaneous operations at TA-55.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all, unless the feed material is uranium (such as disassembled weapons components, including uranium, in P/S code EDC). For plutonium feed materials, U-235 in growth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. U-234 would be present in MT 83 as a decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total plutonium would be about 0.14. Pa-231 and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations (TWCP-5164, TWCP-5165).

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). This AK report is updated to incorporate the results of these comparisons.

### 3.6.3 Chemical Content Identification

Chemical inputs to miscellaneous operation processes are listed in Table 4. In Section 4.0, these inputs are evaluated along with constituents present in the feed materials and equipment in order to determine to applicability of EPA HWNs to process waste for each P/S code.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA HWNs to process wastes from miscellaneous operations is summarized in the text below, as well as in Table 5, as well as on the process timelines in Attachment 3, and in the table of process inputs and outputs in Attachment 4. These assignments take into account the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

## Table 4. Chemical Inputs to Processes Described in This Report

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| **Gases and Cryogens** | | |
| Carbon dioxide (gas)<br>Fluorine (gas)<br>Halogen fluorides<br>Krypton fluoride<br>Methane (gas)<br>Nitrogen dioxide (gas)<br>Nitrogen, liquid | | D001 and D002 do not apply to these gases because there are no free liquids in this waste. Also the gas cylinders are outside the building, and the gases are plumbed into the glovebox. |
| **Acids** | | |
| Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Oxalic acid<br>Perchloric acid<br>Sulfuric acid<br>Superacids (e.g., $HSO_3F$) | <br><br><br><br>AD<br><br>SA | D002 does not apply to the solid debris waste because there are no free liquids in this waste. D001 (oxidizer) does not apply to the use of nitric or perchloric acid or to the superacids for the same reason. |
| **Bases** | | |
| Calcium hydroxide<br>Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the solid debris waste because there are no free liquids in this waste. |
| **Inorganic Chemicals** | | |
| Aluminum bifluoride<br>Aluminum chloride<br>Aluminum fluoride<br>Aluminum nitrate<br>Aluminum oxide<br>Ammonium chloride<br>Antimony pentafluoride<br>Bromine<br>FOOF<br>Hydrogen peroxide<br>Hydroxylamine hydrochloride<br>Hydroxylamine nitrate<br>Iodine<br>Iron oxide<br>Lead and lead hydroxide, oxide, or nitrate<br>Magnesium oxide<br>Na, K, Li, Mg, Ca, Fe, nitrates, chlorides, carbonates, bicarbonates, oxalate, nitrites<br>Phosphates<br>Potassium choride<br>Potassium dichromate | <br><br><br><br><br><br><br><br><br><br><br><br><br><br>AD, APD<br><br><br><br><br>AD | <br><br><br><br><br><br><br><br><br><br><br><br><br><br>D008<br><br><br><br><br>D007 |

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| Potassium permanganate | | |
| Potassium salt (not specified) | | |
| Silver salt | AC1 | D011 |
| Sodium bicarbonate | | |
| Sodium carbonate | | |
| Sodium chloride | | |
| Sodium chlorite | | |
| Sodium nitrate | | |
| Sodium salt (not specified) | | |
| Sodium sulfate | | |
| Thorium oxide | | |
| **Metals** | | |
| Alkaline earth metals | | |
| Bismuth-tin alloy | | |
| Gallium metal, oxide or salt | | |
| Lanthanide metals | | |
| Platinum and platinum-rhodium alloys | | |
| Stainless steel | | D007 (chromium) |
| Tantalum metal, oxide or salt | | |
| Zirconium and tantalum alloys | | |
| **Organic Chemicals** | | |
| 1-propanol | | |
| Acetone | ME | F003 |
| Acetonitrile | AC2 | Appendix VIII compound. EPA HWN U003 does not apply due to the manner in which this chemical is used in TA-55 processes. |
| Alkylating agents (unspecified) | | |
| Benzene | AC/AC1/AC2, SA | D018 and F005: solvent use |
| Carbon tetrachloride | AD, CV | D019 applies to AD and CV. F001 does not apply because this chemical was not used for degreasing. |
| Carbon tetrafluoride | | |
| Chloroform | AC/AC1/AC2, APD, XO | D022 |
| Citrapeel | | |
| DBBP (dibutyl butyl-phosphonate) | | |
| DBBP (dibutyl butyl-phosphonate) / Isopar (isoparaffinic hydrocarbon solvent) | | |
| Diethyl ether | SA | F003 |
| Dihexyl N,N-diethylcarbamoylmethyl phosphonate (DHDCMP) | | |
| Diisopropyl benzene | | |
| Ethanol | | |
| Hexane | | |
| Hydrazine dihydrochloride | | |
| Hydrazine hydrochloride | | |
| Isopropanol | | |
| Kerosene | | |

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| Methanol | AD, SO | F003 applies to AD because methanol may have been used for cleaning inside the glovebox. F003 does not apply to SO because methanol was used in a cold trap outside the glovebox. |
| Methylene chloride (also called dichloromethane)<br>n-dodecane<br>Octylphenyldiisobutyl-carbamoylmethylphosphine oxide (CMPO)<br>Organicstrip<br>Perchlorocarbons<br>Phosphine oxide<br>Phosphines | AC1, SA | F002 applies to P/S codes AC1 and SA because methylene chloride was used for solvent properties. |
| Pyridine | AC, AC2, SA | D038, F005: used as solvent in organometallic synthesis process. |
| Sodium dithionate | | |
| Tetrachloroethylene | AD, APD, CV | D039 and F002 apply to AD and APD. However no codes apply to CV because this chemical was only used as a coolant outside the glovebox. |
| Tetraethylamine hydrochloride<br>Tetraethylamine hydroxide<br>Tetracthylammonium hydroxide | | |
| Tetrahydrofuran | AC, AC2, SA | U213 is not applicable to the use of this chemical because there is no evidence of a spill or of spill residues entering TA-55 TRU waste streams. |
| Thionyl chloride | | |
| Toluene | AC, AC2, SA | F005 applies because toluene was used as a solvent in organometallic synthesis |
| Tributyl phosphate (TBP)<br>Tributyl phosphate (TBP)/Isopar | | |
| Trichloroethylene | CK, ME, XO | D040 applies to P/S codes ME and XO; F002 also applies to P/S code XO. Neither EPA HWN applies to P/S code CK because this chemical was used as a coolant outside the glovebox. |
| Vacuum pump oil | | |

**Table 5. Evaluation of the Applicability of EPA Hazardous Waste Numbers to Processes Discussed in This Report**

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process*** | |
| AC | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 | D007, D008, D009 | D007, *D008, D009, D011, D018, D022, D038, F002, F005 |
| AC1 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 | D007, D008, D009 | D007, *D008, D009, D011, D018, D022, D038, F002, F005 |
| AC2 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 | D007, D008, D009 | D007, *D008, D009, D011, D018, D022, D038, F002, F005 |
| AC3 | Actinide Chemistry, R&D | None | None | None | None |
| ACL | Analytical Chemistry Laboratory | None | None | D007, D008, D009 | D007, *D008, D009 |
| AD | Actinide Processing Demonstration | D004, D005, D006, D007, D008, D009, D010, D011, D019 | D008, D019, D039, F002, F003 | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, *D008, F002, F003 |
| APD | Actinide Processing Demonstration | D008, D009, D019, D021, D022, D039, F002, F003 | None | D007, D008, D009 | D007, D008, D009, D019, D021, D022, D039, *D008, F002, F003 |
| AX | Solution Assay | None | None | D007, D008, D009 | D007, *D008, D009 |
| CK | RD&D Volatile Fluoride Pu Recovery | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, *D008, D009, D011 |
| CV | R&D Experimental Chlorination Processes | D005, D006, D007, D008, D011 | D019, D039 | D007, D008, D009 | D005, D006, D007, D008 *D008, D009, D011, D019, D039 |
| EDC | Electrolytic Decontamination | D007 | None | D007, D008 | D007,*D008 |
| EOC | Experimental Oxide Characterization | None | None | D007, D008, D009 | D007, *D008, D009 |
| EXT | Extraction RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, *D008, D009, D011 |
| FDL | FOOF Demonstration Loop | D004, D005, D006, D007, D008, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |
| FLU | Fluorination RD&D | D005, D006, D007, D004, D008, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process*** | |
| HRS | High Resolution Spectroscopy | None | None | D008 | *D008 |
| IB | Matrix Study Of Pyrochemical Salts | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, *D008, D009, D011 |
| ICP | ICP–AES Analysis | None | None | D007, D008, D009 | D007, *D008, D009 |
| IE | Isotope Enrichment | None | None | None | *D008 |
| LI | XF6 Experimental Measurements | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, *D008, D009, D011 |
| LIBS | Laser-Induced Breakdown Spectroscopy System | None | None | None | None |
| ME | Metallography | None | D040, F003 | D007, D008 | D007, *D008, D040, F003 |
| NCD | Nonconfirming Drums | None | None | None | None |
| RASS/ RSS | Raman Spectroscopy System | D004, D005, D006, D007, D008, D009, D010, D011, D019 | None | D007, D008, D009 | D004, D005, D006, D007, D008, *D008, D009, D010, D011, D019 |
| RD | Repackaging into Retrievable Drums | None | None | D008 | *D008 |
| SA | Super Acid RD&D | None | D018, D038, F002, F003, F005 | D007, D008, D009 | D007, D008, *D008, D009, D018, D038, F002, F003, F005 |
| SMP | SP Mounting Preparation | None | None | None | None |
| SO | Super Oxidizer, FOOF Program | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |
| STF | Standard Fabrication | None | None | D007, D008 | D007, *D008 |
| VS | Confirmation, Inspection & Sampling | None | None | D008 | *D008 |
| WM | Waste Management | Must be determined on case-by-case basis | | | **D007, D008, *D008, D009, D022, D035, D040, F001, F002, F005 |
| X0 | Inactive or Unspecified P/S Material | Must be determined on case-by-case basis | | | **D007, D008, *D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-Ray Energy Spectroscopy | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, *D008, D009, D010, D011 |

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process*** | |
| XO | Inactive or Unspecified P/S Material | Must be determined on case-by-case basis. However, HWNs known to be applicable include those for chloroform (D022), trichloroethylene (D040, F001, F002), 1,1,2-trichloro-1,2,2-trifluorethane (F001, F002), methylene chloride (F002, use ended after 1999), and methyl ethyl ketone (D035, F005) because cleaning rags may be contaminated with these RCRA chemicals; also D007, D008, D009 | | | **D007, D008, *D008, D009, D022, D035, D040, F001, F002, F005 |
| XP | RD&D Experimental Processes | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008 (gloves and shielding), D009 | D004, D005, D006, D007, *D008, D008, D009, D010, D011 |

*** EPA HWNs assigned due to the process itself include chromium (D007) when there is the potential for this metal to be leached from stainless steel equipment or items in the process, lead (D008) when leaded gloves are used in the process, and mercury (D009) when there is a potential for a glass mercury thermometer to have been used in the same glovebox.

** P/S codes WM, X0, and XO have conservatively been assigned the same cumulative list of EPA HWNs, regardless of information indicating that specific hazardous constituents are not expected in one or more of these P/S codes, because application of these P/S codes to specific waste containers has been inconsistent at TA-55 (M-050/TWCP-3546).

* D008 due to leaded gloves

4.1 F, K, and P Listings

The following F listings only apply to cellulosic, ceramic, plastic and rubber items. The F listings do not apply to glass or metal debris, even if these items were in contact with the F-listed chemicals, because their non-porous surfaces do not absorb liquids or gases.

| | |
|---|---|
| AC/AC1/AC2 | F002 (methylene chloride), F005 (benzene, toluene) |
| AD | F002 (tetrachloroethylene), F003 (methanol) |
| APD | F002 (chlorobenzene, methylene chloride, tetrachloroethylene); F003 (acetone, methanol, xylene) |
| ME | F003 (acetone) |
| SA | F002 (methylene chloride), F003 (diethyl ether); F005 (benzene, toluene, pyridine) |
| WM, XO, X0 | F001 (trichloroethylene, 1,1,2-trichloro-1,2,2-trifluoroethane (freon)); F002 (methylene chloride, trichloroethylene); F005 (methyl ethyl ketone) |

No K or P listings apply to solid wastes generated from any of the miscellaneous operations because no K-listed or P-listed chemicals were present in the feed materials, chemicals, or equipment used in these processes.

4.2 Toxicity Listings

EPA HWNs D001 (ignitable), D002 (corrosive), and D003 (reactive) do not apply to solid wastes from miscellaneous operations because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 5.0). In addition, EPA HWN D001 does not apply due to flammable organic solvent use because solutions containing these solvents are sent to aqueous recovery. For aqueous recovery, steps include dissolution of any solid plutonium in 8-16 molar nitric acid and purification by ion exchange. After recovery of plutonium from ion exchange, the solutions are below the DL and are sent to the evaporator for volume reduction. Evaporator bottoms are fixed in cement, and ignitability is not a concern in this waste form.

The list below is summarized from Table 5 and lists the EPA HWNs applicable to waste from processes described in this report. P/S codes marked with an asterisk (*) in the list do not contain RCRA-listed constituents in the feed material or in the chemicals used in the process, but have been assigned EPA HWNs due to the potential for chromium (D007) to be leached from stainless steel equipment or items in the process, lead (D008) due to the use of leaded gloves in the process, and mercury (D009) if there is a potential for a glass mercury thermometer to

have been used in the same glovebox. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, leaded gloves were segregated and discarded in the metal debris waste stream. Since May 1992, leaded gloves have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

Activities under P/S codes LIBS, NCD, and SMP do not generate solid waste to which any HWN would be applicable.

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), in use since 1991, includes a statement that must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) re-emphasizing the prohibition on liquids in the waste, and the continuation of waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data are used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of LANL Direct Oxide Reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 5.0 and 6.0.

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the miscellaneous operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 4, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal (TWCP-AK-2.1-005,R.2, Section 8.0); this oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)

- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*

- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*

- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Document Control* (TWCP-QP-1.1-004)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## ACCEPTABLE KNOWLEDGE ROADMAP

**Waste from P/S Codes:** AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, XES, XP, XO, X0

Copies of these documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | Budget information may not be acceptable. |
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-701 | B | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Document controls to meet WIPP WAC were implemented and how independent verification was accomplished | Information is not extremely detailed |
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Waste was co-mingled with room trash, and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits. | None |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process/status code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests were conducted on residues rather than on waste. |
| TWCP-2540 (UCNI) | A | Answers to questions about pyrochemical processes | Jim Foxx, NMT-7-WM/EC-99-118 | Also contains old records of analysis of DOR salts | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| M-001/ TWCP-3546 (UCNI) | D | Process description, P/S diagram - APD | Hydrothermal Processing<br>NMT6-SOP-AT-103-R00 04/16/96 | Describes an organic destruction process to remove organic and nitrate components and facilitate collection and separation of the actinides. | F-listed solvents may have been used. No information was available to confirm or disprove. |
| M-004/ TWCP-3546 (UCNI) | D | Process description | Superacid Research and Development<br>403-GEN-R00; 01/30/89<br>SAS-100-R00; 1/30/89; appears to be the same as 403-GEN-R00 (1/30/89) | Dissolution of actinides and actinide-containing matrices in superacids. Resulting solutions are analyzed by a variety of methods. | P/S code is not identified in procedure but process is consistent with SA. |
| M-005/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – AX | Operation of the Solution Assay Instruments (SAIs)<br>413-GEN-R00 through R02; 8/8/88 and 1/23/89, no date for R02 | Describes rapid, in-process assay of Pu in nitric or hydrochloric acid. Assay solutions are accumulated for transfer to chloride or nitrate processes. Related procedures include Analyst's Procedure for SAI Samples, 420-GEN-R00, 11/12/86; User Procedure for Solution Assay Instruments IO4 and IO5, 513-ACC-R00, 2/9/87; and 531-MST10-R1, 11/88. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| M-006/ TWCP-3546 (UCNI) | D | Process description, chemical list; process code AD identified only in latest procedure (403-GEN-R03.1) | Room 208 Purification Process Development,<br>431-GEN-R00 through R02; 5/6/88 through 7/31/90;<br>Room 208 Process Development Glovebox Operations,<br>431-GEN-R03 through R03.1; 3/23/92 through 9/30/94 | Procedures generally describe a variety of processes involving research, process development, small-scale "trouble-shooting," and special materials preparations of isotopes and isotopic mixtures of Pu, U, Am, and Np. Various acids, caustics, oxidizing and reducing agents, solvent extraction chemicals, and ethanol and methanol ("infrequently"). 431-GEN-R02 indicates the use of carbon tetrachloride as a solvent diluent during the time period 9/91-3/92. | The procedures are brief and state "Because of the variety of operations involved with this research effort, no one detailed procedure can describe all the activities that are carried out." |
| M-007/ TWCP-3546 (UCNI) | D | Process description, P/S diagram - SO | Safety Considerations in the Operation of the MST-12, Room 105, Ash Pretreatment Loop,<br>488-REC-R00; 3/24/88 | A gas flow loop is used for room temperature fluorination of ash samples containing Pu residues. The fluorinating agent causes Pu in the solid residue to react chemically to form solid $PuF_4$ or gaseous $PuF_6$. | Procedure does not contain a chemical list or describe the process inputs. The procedure states "Because the process is in developmental stage, operating procedures and flow configuration are subject to frequent change. |
| M-008/ TWCP-3546 (UCNI) | D | Process description, reagent list, P/S diagram - SO | Super Oxidizer Fluorination of Ash,<br>FPR-101-R00; 6/6/89<br>FPR-101-R00 is also known as 488-REC-R00 | A gas flow loop is used for room temperature fluorination of ash samples containing Pu residues. The fluorinating agent causes Pu in the solid residue to react chemically to form solid $PuF_4$ or gaseous $PuF_6$. | None |

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|---|---|---|---|---|---|
| M-009/ TWCP-3546 (UCNI) | D | Process description, reagent list, P/S diagram - SO | Operation of the Plutonium FOOF Loop, FPR-100-R01; 10/17/90 | The loop is used to flow a gas fluorinating agent through a gas-solid reactor where Pu in the solid residue reacts chemically to form gaseous $PuF_6$. Methanol is used in the cold trap. | None |
| M-010/ TWCP-3546 (UCNI) | D | Process description, reagent list, P/S diagram - CK | Operation of the Plutonium Fluorination Loop, FPR-101-R0-0; 2/7/91 | The loop is used to flow a gas fluorinating agent through a gas-solid reactor where Pu in the solid residue reacts chemically to form gaseous $PuF_6$. 1-propanol and trichloroethylene are used in the cold traps and cooling baths. | Procedure does not describe the configuration of the cold traps and cooling baths, i.e., whether these are located inside or outside the glovebox and whether the chemicals used in cold traps/cooling baths would contaminate the waste stream. |
| M-011/ TWCP-3546 (UCNI) | D | Process description, reagent list, P/S diagram - FDL | Operating the FOOF Demonstration Loop, FPR-102 through R01; 8/7/91 through 3/12/93 | FOOF demonstration line is used to conduct experiments that demonstrate the feasibility for fluorination at room temperature. Pu in solid residue reacts chemically to form gaseous $PuF_6$. | Documents do not mention the use of solvents. |
| M-012/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram - FLU | Halogenation Research and Development, FPR-104-R00; 3/25/92 | Basic research operation involving gas-solid and solid-solid halogenation (i.e., fluorination and chlorination) of actinides, particularly Pu and Np. Procedure describes operations and materials similar to fluorination and FOOF loop procedures. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| M-013/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – EXT | Plutonium Extraction Research and Development, FPR-105-R00; 3/25/92 | Document describes an R&D effort exploring aqueous extraction of Pu from various waste streams, particularly pyrochemical salts. Metals in pyrochemical stream would include Na, K, and Ca when exposed to aqueous materials. | Procedure does not identify process inputs. Equipment and supplies list includes "spent pyrochemical salts." |
| M-014/ TWCP-3546 (UCNI) | D | Process description, P/S diagram – EDC | Electrochemistry R&D Experiments, FRP-108-R00; 12/19/95 | Document describes experiments using electrochemical methodologies to decontaminate items (e.g., gloveboxes), supercede current processes that produce large amounts of waste, or speed up reactions. Electrolytes are typically inert nonhazardous salts. | Process inputs are indicated as being from the vault or P/S code MA, but inputs are not precisely defined or identified. |
| M-015/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – EOC | Surface Area Analysis Using the Quantasorb/Quantector 280-MRD-R00; 3/30/92 through 4/8/94 (Draft) | Mixtures of helium and nitrogen are passed through a U-shaped cell containing a sample to calculate surface area and pore size distribution of the sample, and analyze surface characteristics. | Solvents or other chemicals are not indicated in the reagent list. |
| M-018/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S code not identified (see limitations) | Americium R&D Facilities, 474-REC-R00; 7/17/79 | Experimental operations involve evaporator hydroxide cake dissolution, filtration, sampling and analysis, extraction, separation to remove organics, and determination of Pu and Am. See 474-REC-R02 (M-020). | P/S code not identified in the procedure but process is consistent with process described in 474-REC-R02; therefore, AD seems to be appropriate P/S code. Lead compounds listed in R01 but not in R00 or R02-03. |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| M-019/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S code not identified (see limitations) | Process Research and Development Facilities, 474-REC-R01; 8/29/83 | Various wet chemistry experiments (e.g., chloride anion-exchange separations involving various radioactive elements). Research activities no longer limited to Americium. See 474-REC-R02 (M-020). | P/S code not identified in the procedure but process is consistent with process described in 474-REC-R02; therefore, AD seems to be appropriate P/S code. Lead compounds are listed in this procedure but not in R00, R02 or R03. |
| M-020/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – AD | Research, Development, and Demonstration Facilities, 474-REC-R02; 12/1/86 | Various chemical and electrochemical experimental research with actinide solutions. Chemical list is similar to 474-REC-R01 except for the following: Gallium, Tantalum, and Platinum metals, oxides, or salts; hydrazine dihydrochloride; perchloric acid; tetraethylamine chloride; and tetraethylammonium hydroxide. | Lead compounds are listed in R01 but not in R00, R02 or R03. |
| M-021/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – AD | Research, Development, and Demonstration Facilities, 474-REC-R03; 2/3/89 | Various chemical and electrochemical experimental research with actinide solutions. Chemical list identical to 474-REC-R02, with the exception of the following: "DHDCMP, TBP, and CMPO used in extraction experiments." | Lead compounds are listed in R01 but not in R00, R02 or R03. |
| M-022/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – AD | Sensors and Instrumentation Development, 476-REC-R00; 2/3/89 | Various research studies involving sensors and instrumentation suitable for online chemical analysis. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| M-023/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – HRS | Low Temperature Multiple Reflection Spectroscopic Cell,<br>SAS-106-R00 through R02; 1/9/90 through 3/30/93 | Fluorinated actinide compounds are introduced into a long-path, variable temperature cell for spectroscopic studies. The procedure addresses passivation, filling, cooling, emptying, and maintaining the spectroscopic cell. | Details of procedural information (e.g., chemical lists, diagrams) unavailable for 1/9/90 and 11/12/91 versions of procedure. |
| M-024/ TWCP-3546 (UCNI) | D | Process description, reagent list, P/S diagram – SA | Organoactinide R&D,<br>SAS-107-R00 through R01; 10/23/89 through 5/1/91 | R00 describes studies involving organometallic chemistry of uranium, thorium, neptunium, and plutonium in non-aqueous solvents.<br>R01 describes small-scale organoactinide R&D operations involving fundamental research on the synthesis in non-aqueous media of new actinide compounds, their characterization and reaction chemistry, and application to existing actinide processing technologies. Due to the range of experimental studies, a definitive list of reagents cannot be given. Previous studies have involved the use of aliphatic, ethereal, aromatic, and halocarbons (e.g., tetrahydrofuran, diethyl ether, benzene, toluene, pyridine, and dichloromethane). | Chemical reagents and solvents are not specified but may include hydrocarbon, ethereal, and aromatic solvents, organic reagents, and inorganic salts. |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| M-025/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – AC1 and AC2 | Actinide Chemistry Research and Development, SAS-107-R03; 3/10/94 | Document addresses a broad range of lab activities involving radioactive and non-radioactive materials in support of applied actinide chemistry research. Activities include preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation. A variety of chemicals are used, including organic solvents (e.g., tetrahydrofuran, toluene, benzene, and dichloromethane), organic reagents (e.g., alcohols, phosphines, phosphates), acids and bases, and metals. | The chemical list is not definitive. The procedure states "The chemical list is representative of the types of chemicals that are used in operations covered by this procedure." |
| M-026/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – CV | Actinide Separation R&D Operations, SAS-108-R00; 3/25/91 | A gas loop is used to flow various compounds through a reactor. Pu reacts to form recoverable Pu compounds. Pu compounds or Pu-bearing matrices may be subjected to further treatment to achieve complete recovery. Treatment of ash with carbon tetrachloride to create chlorinated Pu to facilitate further separation. Reagent is destroyed in the process. Chemical list includes acids and bases, chlorinated hydrocarbons (e.g., carbon tetrachloride, tetrachloroethylene), actinides, and compressed gases. | Although not precisely stated in the procedure, it appears that chlorinated hydrocarbons are used as chlorinating agents (therefore, not as solvents) in the reaction loop. |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| M-027/ TWCP-3546 (UCNI) | D | Process description, chemical list, P/S diagram – CV | Plutonium Chlorination, SAS-108-R01 through R02; 10/26/92 through 11/10/94 (See note in limitations.) | Describes the recovery or purification of Pu compounds by reaction with liquid, gaseous, and solid reagents in a gas-flow loop. Process involves conversion of Pu chloride solutions to anhydrous $PuCl_3$. Chemical list includes acids and bases, carbon tetrachloride, hydroxylamine hydrochloride, actinides, and compressed gases. | Procedure revisions appear to be similar with no significant changes indicated. R02 is a draft dated 10/28/93. R01 (11/10/94) incorporates two change sheets (R01.1 and R01.2) that clarified administrative aspects of the procedure. |
| M-029/ TWCP-3546 (UCNI) | D | Process description, P/S diagram – IB | Matrix Study of Pyrochemical Salts, 556-NMT4-R01 through R03; 9/12/90 through 5/31/93 | Feed material inputs may comprise Pu metal, pyrochemical salts of sodium, calcium, and magnesium, and crucible pieces. Describes process for crushing, pulverizing, blending, roasting, and sieving pyrochemical salts in PF-4, Room 208, G264. The research activity determined the effect that pyrochemical salt matrices have on the accuracy of NDA measurements in like materials. The results dictate handling and processing of the salts, and may be used for correction of bias measurements. | None |
| M-030/ TWCP-3546 (UCNI) | D | P/S code title, description, and effective dates | Jim Foxx, SME, 01/00 | SME review of preliminary AK Summary Report for TA-55 Miscellaneous Operations indicated that P/S code IB was referred to as "Incoming Oxide Blending" from May 1986 to July 1992, and that the procedure involved rod milling prior to screening. See also M-029. | A procedure was not identified for this process during the time period indicated. |

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|---|---|---|---|---|---|
| M-031/ TWCP-3546 (UCNI) | D | Process wastes | Jim Foxx, SME, 01/00 | SME review of preliminary AK Summary Report for TA-55 Miscellaneous Operations indicated that chromium may be present in the layer of sand and slag removed during the electrolytic decontamination process. See also M-014. | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-034/ TWCP-3546 (UCNI) | D | P/S code description | Gordon Jarvinen, 02/16/00 | Interview regarding operations for P/S codes AD, APD | Conclusions are based on the SME's recollections of process activities in which he was directly involved. Mr. Jarvinen could only speak to operations for P/S code AD after 1989. |
| M-035/ TWCP-3546 (UCNI) | D | P/S code description | Jerry Foropoulos, 02/16/00 | Interview regarding operations for P/S codes CK, CV, EXT, FLU, SO, IE, LI | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-036/ TWCP-3546 (UCNI) | D | P/S code description | Tom Mills, 02/16/00 | Interview regarding operations for P/S codes FDL and HRS | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-037/ TWCP-3546 (UCNI) | D | P/S code description | Larry Avens, 03/02/00 | Interview regarding operations for P/S codes MAS and SA | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-038/ TWCP-3546 (UCNI) | D | P/S code description | Bill Zwick, 02/29/00; and John Byrd, 03/01/00 | Interview regarding operations for P/S codes AC1 and AC2 | Conclusions are based on the SMEs' recollections of process activities in which they were directly involved. |

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|---|---|---|---|---|---|
| M-039/ TWCP-3546 (UCNI) | D | P/S code description | Steve Long, 02/29/00 | Interview regarding operations for P/S codes IB and STF | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-040/ TWCP-3546 (UCNI) | D | P/S code description | Mary Ann Reimus, 02/17/00 | Interview regarding operations for P/S code EOC | Conclusions are based on the SME's recollections of process activities in which she was directly involved. |
| M-041/ TWCP-3546 (UCNI) | D | P/S code description | Doug Wedman, 02/16/00 | Interview regarding operations for P/S code EDC | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-042/ TWCP-3546 (UCNI) | D | P/S code description | James Barfield, 02/25/00 | Interview regarding operations for P/S codes ACL, ICP, and XES | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-043/ TWCP-3546 (UCNI) | D | P/S code description | John Byrd, 03/01/00 | Interview regarding operations for P/S code RASS/RSS | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-044/ TWCP-3546 (UCNI) | D | P/S code description | Charles Davis, 03/01/00 | Interview regarding operations for P/S code SMP | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-045/ TWCP-3546 (UCNI) | D | P/S code description | Keith Fife, 02/28/00 | Interview regarding operations for P/S code VS | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |

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|---|---|---|---|---|---|
| M-046/ TWCP-3546 (UCNI) | D | P/S code description | Jim Foxx, 02/25/00 through 06/23/00 | Interviews and correspondence regarding operations for P/S codes RD, NCD, WM, and XO/X0 | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-047/ TWCP-3546 (UCNI) | D | P/S code description | Max Martinez, 02/29/00 | Interview regarding operations for P/S code LIBS | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-048/ TWCP-3546 (UCNI) | D | P/S code description | Rick Masen, 03/01/00 | Interview regarding operations for P/S code ME | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-049/ TWCP-3546 (UCNI) | D | P/S code description | Steve Yarborough, 03/10/00 | Interview regarding operations for P/S code XP | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-050/ TWCP-3546 (UCNI) | D | P/S code description | Dennis Wulff, 04/17/00 | Interview regarding P/S code XO | Conclusions are based on the SME's recollections of process activities in which he was directly involved. |
| M-053/ TWCP-3546 (UCNI) | D | Process input information | Jim Foxx, 04/16/00 | Information regarding process inputs to P/S code AD | None. |
| TWCP-3547/Cl-25 | D | RCRA-listed constituents in analytical solutions from CLS-1 | Interview with Jim Foxx, 9/23/99 | Analytical laboratory solutions from CLS-1 are potentially contaminated with RCRA-regulated heavy metals, mercury and lead, as well as RCRA-listed organic substances used as solvents, including acetone, carbon tetrachloride, chlorobenzene, chloroform, methanol, methylene chloride, tetrachloroethylene, xylene | |

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|---|---|---|---|---|---|
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | D | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4162 | D | Answers to questions about P/S codes PB, PuBe, CC, MB, MS, FF, BF, and other issues | Interview with Jim Foxx, 10/12/00 | Answers to questions on use of asbestos at TA-55, non-defense activities, and specific P/S codes in chloride operations. | None |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of Ag, disposal of ash and resins, and use of gases. | None |
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of Ag from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that Ag in ash is below limits of regulatory concern | None |

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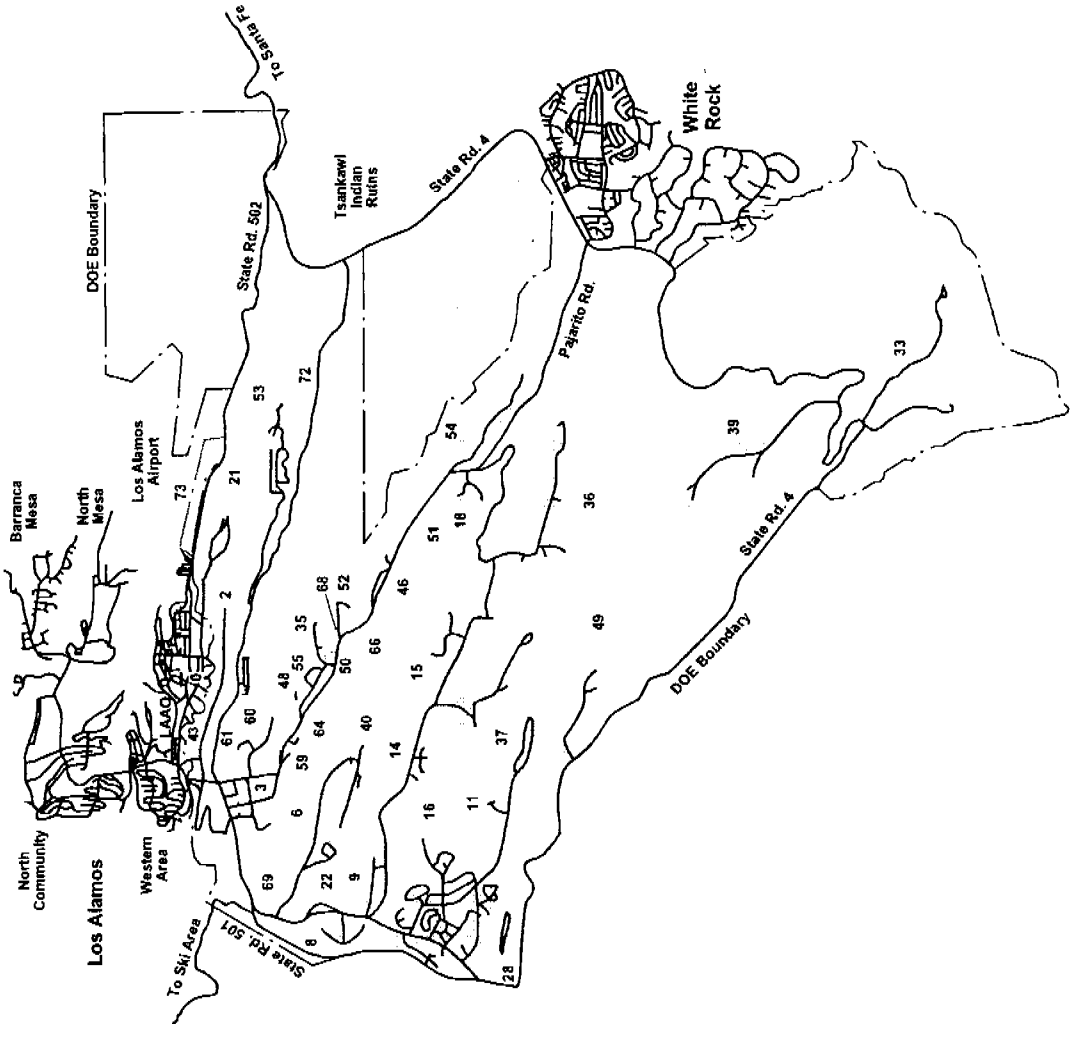
| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-5164 | D | Sources of Cs-137 and Pa-231 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 2, 2001 | Plutonium operations never handled Cs-137 or Pa-231 in any of the Pu processing areas at TA-55. However, Cs-137 is expected to be present in the wastes because it is a fission product of several Pu isotopes. Pa-231 is expected to be present (as a function of the age of the waste) because it is a decay chain daughter of Pu-239 and U-235. | None |
| TWCP-5165 | D | Sources of Cs-137, Pa-231, and Cm-244 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Dominant source of Cs-137 expected to be due to residual contamination from original separation of Pu from production fuel. Cm-244 introduced in P/S code DOP starting in 1988, but could also show up after that date in IS, WE, CA and CF. | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | A | *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for nitrate operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | A | *Process Acceptable Knowledge Report for Pyrochemical Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for pyrochemical operations at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | *Process Acceptable Knowledge Report for Special Processing Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-PLAN-0.2.7-001,R.5 | C | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK reference base on generator's original data | Detailed information on each waste drum and waste stream | None |

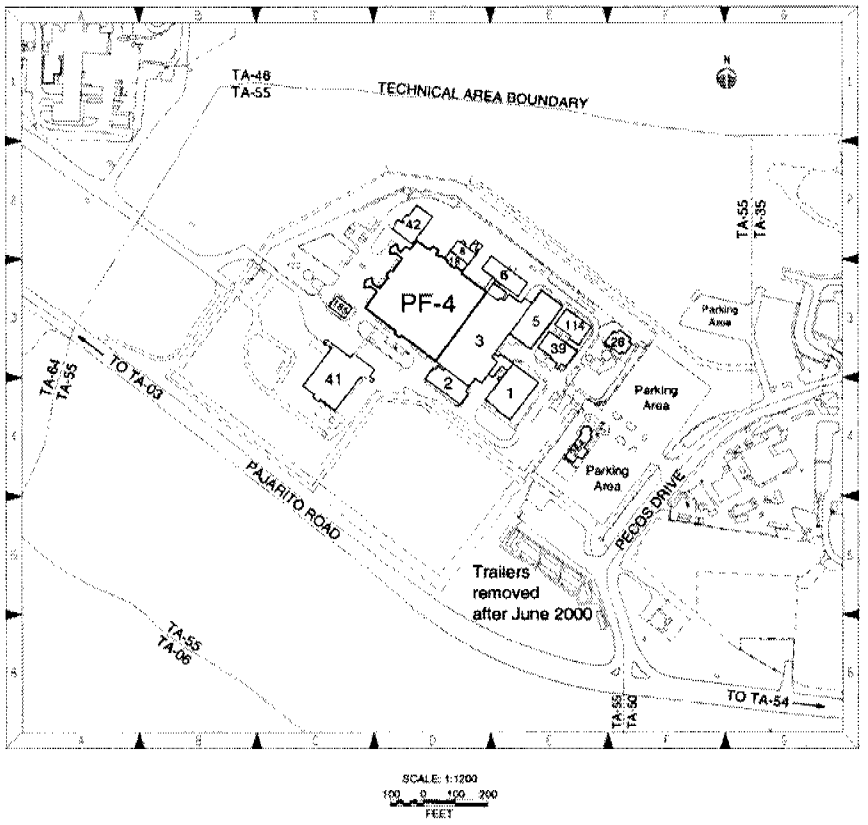
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# MAP OF LANL

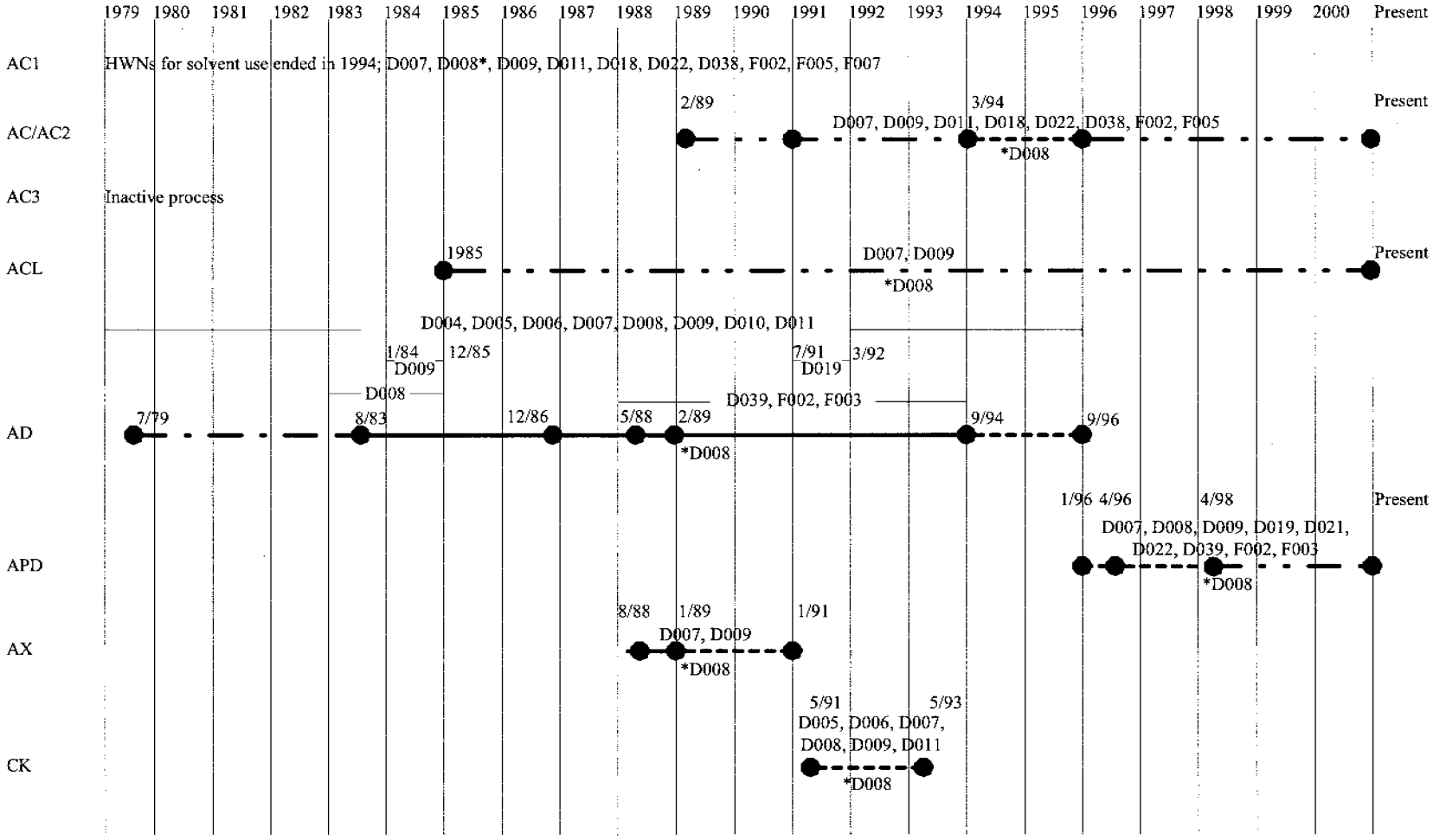

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Barranca Mesa
North Mesa
Los Alamos Airport
LAAO
North Community
Los Alamos
Western Area
To Ski Area
State Rd. 501
DOE Boundary
State Rd. 4

## MAP OF TA-55

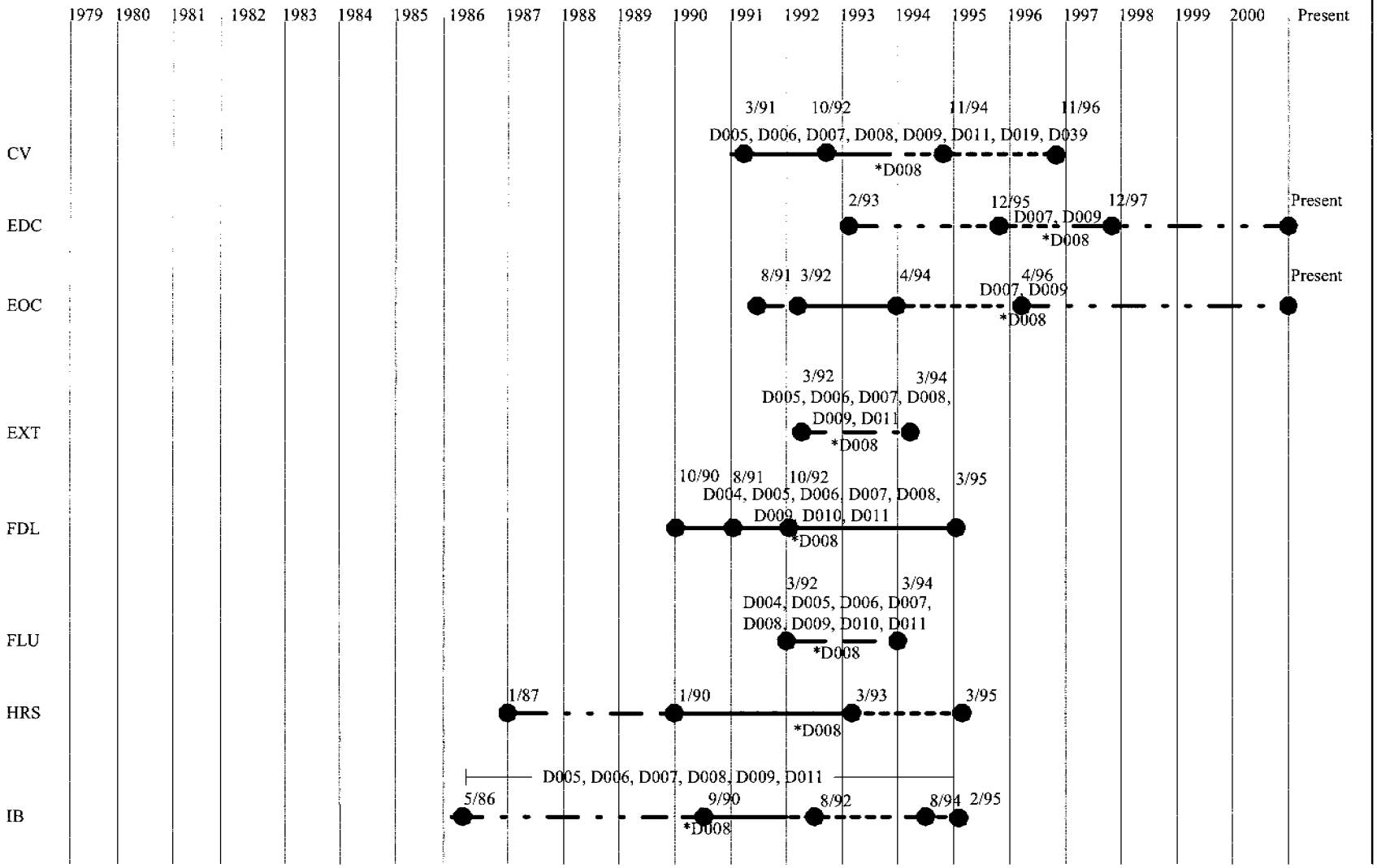
**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.



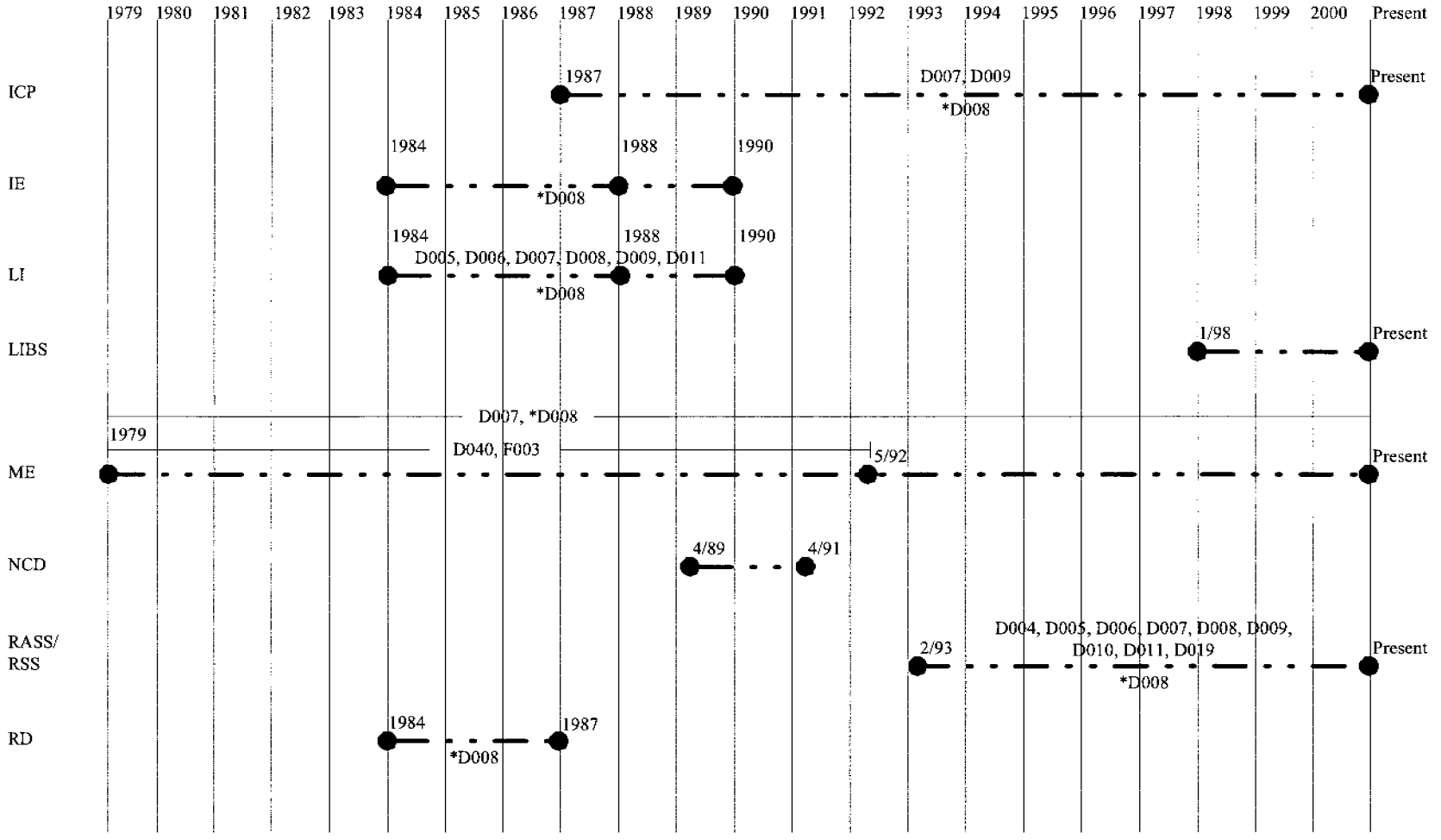
## TIMELINE FOR TA-55 MISCELLANEOUS PROCESSES



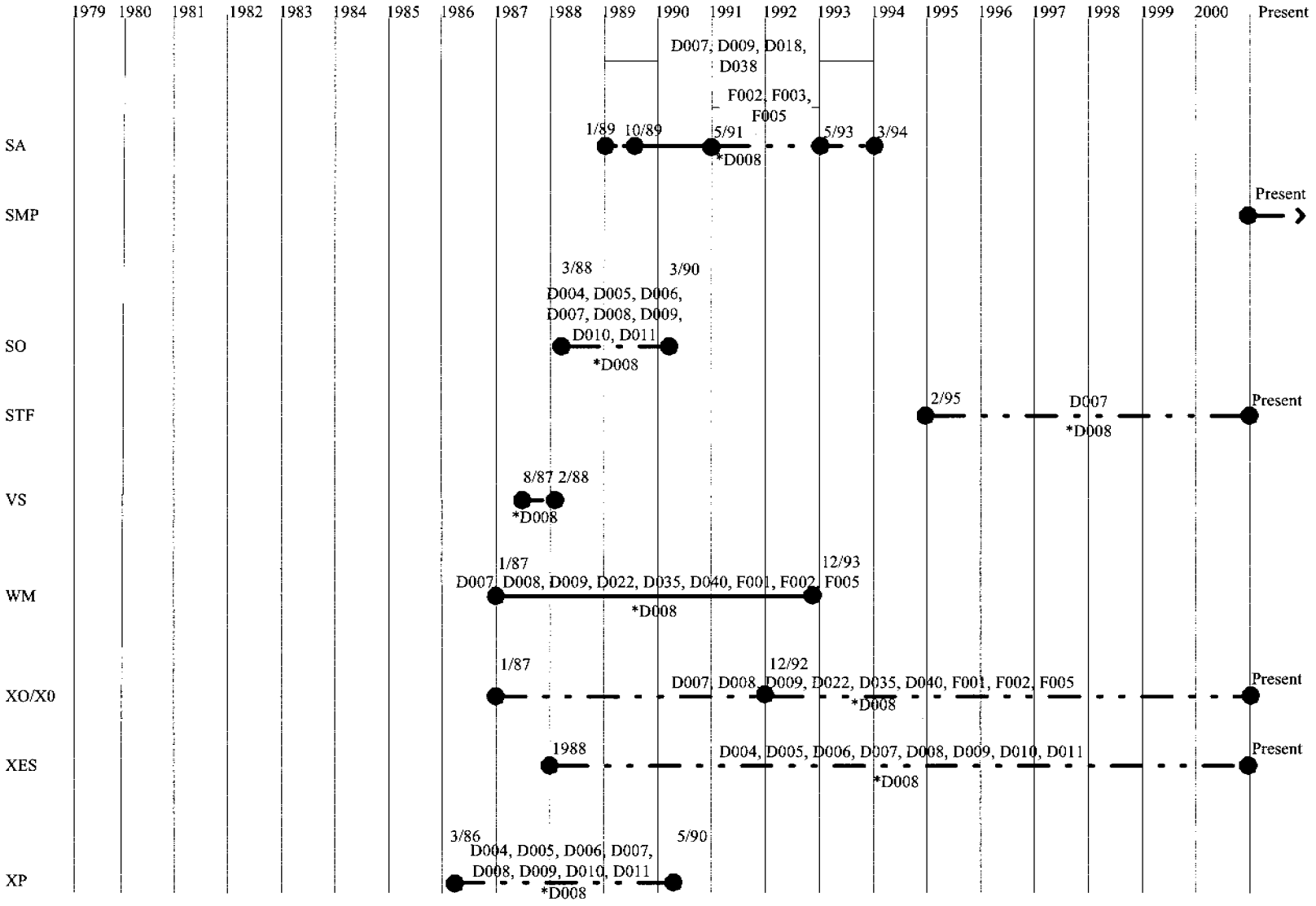
## TIMELINE FOR TA-55 MISCELLANEOUS PROCESSES (continued)



## TIMELINE FOR TA-55 MISCELLANEOUS PROCESSES (Continued)



## TIMELINE FOR TA-55 MISCELLANEOUS PROCESSES (continued)



* Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

**TIMELINE EXPLANATION**



The P/S code is established in either the P/S diagrams or in both (or all) revisions of the procedures designating the start and end dates (e.g., Rev. 0 to Rev. 1; or Rev. 0 to Rev. 5).



The P/S code is not identified in the procedure, but the process description matches the P/S code and the description in previous or later revisions of the same procedure.



Extrapolate out two (2) years beyond the last procedure to next possible review date.



The P/S code is not identified in the procedure, but the process description matches that of the P/S diagram or P/S code description.



Time period based on subject matter expert comments.

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AC<br>AC2 | Actinide Chemistry R&D | Actinide metals | Acetonitrile<br>Actinide (Th-Am) metals<br>Alcohols (unspecified)<br>Alkali metals<br>Alkaline earth metals<br>Alkylating agents (unspecified)<br>Benzene<br>Chloroform<br>Cryogens<br>Dichloromethane<br>Hexane<br>Hydrochloric acid<br>Inorganic reagents/complexes (unspecified)<br>Inorganic salts (unspecified)<br>Lanthanide metals<br>Nitric acid<br>Perchloric acid<br>Phosphates<br>Phosphines<br>Potassium hydroxide<br>Potassium salts<br>Pyridine<br>Silver salts<br>Sodium hydroxide<br>Sodium salts<br>Tetrahydrofuran<br>Toluene<br>Transition metals<br>Transition-lanthanide-, actinide- metal complexes | Solvated halide complexes yielding homoleptic alkyl complexes; and unspecified | Reaction byproducts, residues, precipitated salts, spent solvents, spent acids, filtration media, debris | D007,<br>*D008,<br>D009,<br>D011,<br>D018,<br>D022,<br>D038,<br>F002,<br>F005 | M-025<br>M-038 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AC1 | Actinide Chemistry R&D | Actinide metals | Acetonitrile<br>Actinide (Th-Am) metals<br>Alcohols (unspecified)<br>Alkali metals<br>Alkaline earth metals<br>Alkylating agents (unspecified)<br>Benzene<br>Chloroform<br>Cryogens<br>Dichloromethane<br>Hexane<br>Hydrochloric acid<br>Inorganic reagents/complexes (unspecified)<br>Inorganic salts (unspecified)<br>Lanthanide metals<br>Nitric acid<br>Perchloric acid<br>Phosphates<br>Phosphines<br>Potassium hydroxide<br>Potassium salts<br>Silver salts<br>Sodium hydroxide<br>Sodium salts<br>Toluene<br>Transition metals<br>Transition-lanthanide-, actinide- metal complexes | Solvated halide complexes yielding homoleptic alkyl complexes; and unspecified | Reaction byproducts, residues, precipitated salts, spent solvents, spent acids, filtration media, debris | D007, *D008, D009, D011, D018, D022, F002, F005 D038 | M-025<br>M-038 |
| AC3 | Actinide Chemistry | NA | NA | NA | NA | NA | NA |
| ACL | Analytical Chemistry Lab | Plutonium and americium solutions | Nitric acid | None | Unused liquid samples, chromatography residues | D007, *D008, D009 | M-042 |
| AD | Actinide Processing | Evaporator | Aluminum nitrate | Unspecified | Spent aqueous and | D004, | M-006 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| | Demonstration | hydroxide cakes; and various isotopes and isotopic mixtures of plutonium and uranium, occasionally $^{241}Am$ and $^{237}Np$ | Ascorbic acid<br>Carbon tetrachloride<br>CMPO<br>DBBP<br>DBBP/Isopar<br>DHDCMP<br>diisopropyl benzene<br>Ethanol<br>Gallium metal, oxide or salt<br>Hydrazine dihydrochloride<br>Hydrazine hydrochloride<br>Hydrochloric acid<br>Hydrofluoric acid<br>Hydrogen peroxide<br>Hydroxylamine chloride<br>Hydroxylamine hydrochloride<br>Hydroxylamine nitrate<br>Kerosene<br>Lead and lead hydroxide, oxide, or nitrate<br>Methanol<br>Na, K, Li, Mg, Ca, Fe, nitrates, chlorides, carbonates, bicarbonates, oxalate, nitrites<br>n-dodecane<br>Nitric acid<br>Octyl phenyl-N<br>Oxalic acid<br>Perchloric acid<br>Platinum and platinum-rhodium alloys<br>Potassium dichromate<br>Potassium hydroxide<br>Potassium permanganate | | organic solutions; extraction solvents; spent acids and bases; lead-bearing hydroxides, nitrates, and oxides; reducing agents; actinide salts, oxides, and metals; debris | D005, D006, D007, D008, *D008, D009, D010, D011, D019, D039, F002, F003 | M-018<br>M-019<br>M-020<br>M-021<br>M-022<br>M-034<br>M-053 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| | | | Pu, Am, Np, U, Ga, Pt, Ta metals, oxides, salts<br>$^{239}Pu$ and $^{241}Am$ metal and various chemical states<br>Sodium carbonate<br>Sodium chlorite<br>Sodium dithionate<br>Sodium hydroxide<br>Sulfuric acid<br>Tantalum metal, oxide or salt<br>TBP<br>TBP/Isopar<br>Tetrachloroethylene<br>Tetraethylamine hydrochloride<br>Tetraethylamine hydroxide<br>Tetraethylammonium hydroxide | | | | |
| APD | Actinide Processing Demonstration | Aqueous and organic mixtures of carbon tetrachloride, tributyl phosphate, organic solvents (unspecified), ion exchange resins, vacuum pump oil, plastics, rags | Hydrogen peroxide | Reactor effluent (liquids, gases, salts) | Liberated gases<br>Liquid salts, acids<br>Solid oxides, carbonates, sulfates, | D007, D008, *D008, D009, D019, D021, D022, D039, F002, F003 | M-001<br>M-034 |
| AX | Solution Assay | Nitric and hydrochloric acid solutions with plutonium | Hydrochloric acid<br>Nitric acid | Plutonium chloride solutions to P/S CX<br>Plutonium nitrate solution to P/S RR | Nitric and hydrochloric acid solutions | D007, *D008, D009 | M-005 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| CK | RD&D Volatile Fluoride Plutonium Recovery | Solid residues of $PuO_2$ | 1-propanol (as coolant)<br>Aluminum oxide<br>Fluorine gas<br>FOOF<br>Liquid nitrogen<br>Oxygen<br>Sodium bicarbonate<br>Trichloroethylene | Plutonium hexafluoride, unreacted ash | Spent aluminum oxide and sodium bicarbonate, organic reagents and solvents, debris | D005, D006, D007, D008, *D008, D009, D011 | M-010<br>M-035 |
| CV | RD&D Experimental Chlorination Processes | Plutonium in various chemical forms; solid $PuO_2$ | Dilute acids/bases (unspecified)<br>Ammonium chloride<br>Carbon tetrachloride<br>Hydrochloric acid<br>Hydroxylamine hydrochloride<br>Nitric acid<br>Perchlorocarbons<br>Potassium hydroxide<br>$^{239}Pu$, $^{237}Np$, $^{241}Am$, $^{235/238}U$, $^{232}Th$ in various compounds, residues, metal alloys<br>Sodium bicarbonate<br>Tetrachloroethylene<br>Thionyl chloride | Anhydrous plutonium chloride; plutonium hexafluoride | Spent solvents and reagents, spent sodium bicarbonate, inorganic salts, debris | D005, D006, D007, D008, *D008, D009, D011, D019, D039 | M-027<br>M-035 |
| EDC | Electrolytic Decontamination | Disassembled weapons components | Alkaline solutions<br>Sodium nitrate<br>Sodium sulfate | Decontaminated components | Evaporated uranyl hydroxide and uranyl sulfate, electrolytes (inert, nonhazardous salts), precipitated solids, spent caustic rinses, debris | D007, *D008, D009 | M-014<br>M-041 |
| EOC | Experimental Oxide Characterization | Plutonium oxide (high-purity) | Purified nitrogen and helium<br>Liquid nitrogen | Plutonium oxide | Debris | D007, *D008, D009 | M-015<br>M-040 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| EXT | Extraction RD&D | Various plutonium-containing matrices, pyrochemical salts | Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Potassium hydroxide<br>Sodium hydroxide | Aqueous solutions of plutonium | Spent aqueous and organic solutions, spent pyrochemical salts, debris | D005,<br>D006,<br>D007,<br>D008,<br>*D008,<br>D009,<br>D011 | M-013 |
| FDL | FOOF Demonstration Loop | Solid residues of $PuO_2$ and $PuF_4$ | Aluminum oxide<br>Carbon tetrafluoride<br>Fluorine gas<br>FOOF<br>Krypton fluoride<br>Methane<br>Nitrogen, liquid and gas<br>Oxygen<br>Sodium bicarbonate | Plutonium hexafluoride, unreacted ash | Spent aluminum oxide and sodium bicarbonate, debris | D004,<br>D005,<br>D006,<br>D007,<br>D008,<br>*D008,<br>D009,<br>D010,<br>D011 | M-011<br>M-036 |
| FLU | Fluorination RD&D | Solid $PuO_2$ | Aluminum oxide<br>Ammonium chloride, fluoride, bifluoride<br>Argon<br>Fluorine gas<br>FOOF<br>Hydrochloric acid<br>Krypton fluoride<br>Nitrogen<br>Sodium bicarbonate | Recoverable plutonium | Debris | D004,<br>D005,<br>D006,<br>D007,<br>D008,<br>*D008,<br>D009,<br>D010,<br>D011 | M-012<br>M-035 |
| HRS | High Resolution Spectroscopy | Actinide compounds | Carbon dioxide<br>Fluorine<br>FOOF<br>Liquid nitrogen<br>Nitrogen dioxide<br>Sodium bicarbonate | Gas-phase actinide-containing species ($PuF_6$, $UF_6$, $NpF_6$, $AmF_6$) | Sodium bicarbonate filter (reactive gas traps), debris | *D008 | M-023<br>M-036 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| IB | Matrix Study of Pyrochemical Salts | Plutonium metal oxides and pyrochemical salts | Acids/bases (unspecified) | Solid pyrochemical salts | Pyrochemical salts, metal oxides, debris | D005, D006, D007, D008, D009, D011, *D008 | M-030<br>M-039 |
| ICP | Inductively Coupled Plasma Atomic Emissions Spectroscopy (ICP-AES) Analysis | Plutonium and americium solutions | Unspecified (process related to ACL) | None | Unused liquid samples, analytical laboratory debris, actinide oxides and metals, MSE salts, ash | D007, *D008, D009 | M-042 |
| IE | Isotope Enrichment | Solid $PuO_2$ | High purity inputs | Plutonium hexafluoride | Debris | *D008 | M-035 |
| LI | XF6 Experimental Measurements | Solid $PuO_2$ | Unknown | Plutonium hexafluoride | Debris | D005, D006, D007, D008, D009, D011, *D008 | M-035 |
| LIBS | Laser-Induced Breakdown Spectroscopy System | High purity plutonium metals/oxides | Unknown | | Used samples, debris | | M-047 |
| ME | Metallography | Plutonium/uranium carbides, nitrides, oxides, zirconium and tantalum alloys, stainless steel | Acetone<br>Acid/caustic etchants (unspecified)<br>Ethanol<br>Kerosene<br>Trichloroethylene | | Grinding paper, polishing compounds (including liquid organic and caustic etchants), metal and ceramic powders, debris | D007, *D008, D040, F003 | M-048 |
| NCD | Nonconfirming Drums | NA | NA | NA | NA, no waste generated from this activity | | M-046 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| RASS/ RSS | RAMAN Spectroscopy System | Solids or solutions with plutonium | Dilute acids (unspecified) | None | Used samples, debris | D004, D005, D006, D007, D008, *D008, D009, D010, D011, D019 | M-043 |
| RD | Repackaging into Retrievable Drums | NA | NA | NA | NA | *D008 | M-046 |
| SA | Super Acid RD&D | Various actinide compounds and matrices; actinide (Np, Pu, Th, Am, Cm, U) metals | Aluminum oxide<br>Antimony pentafluoride<br>Benzene<br>Bromine<br>Diethyl ether<br>Hydrofluoric acid<br>Inorganic reagents (such as $NaN0_3$)<br>Iodine<br>Magnesium oxide<br>Methylene chloride<br>Organic reagents (such as CMPO)<br>Pyridine<br>Sulfuric acid<br>Hydrocarbon, ethereal, and aromatic solvents (unspecified)<br>Tetrahydrofuran<br>Toluene | Superacid solutions and evaporated solid superacid complexes; solvated halide complexes yielding homoleptic alkyl complexes | Spent aqueous and organic solvents and reagents, organometallic and inorganic compound residues, debris | D007, D008, *D008, D009, D018, D038, F002, F003, F005 | M-004<br>M-024<br>M-037 |
| SMP | SP Mounting Preparation | NA | NA | NA | NA | | M-044 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| SO | Super Oxidizer-FOOF Program | Ash samples with plutonium residues of $PuO_2$ and $PuF_4$ | Aluminum oxide<br>Bromine and chlorine fluorides<br>Fluorine gas<br>Nitrogen, liquid and gas<br>Methanol<br>Oxygen<br>Dioxygen difluorides (FOOF, FOO)<br>Sodium bicarbonate | Plutonium hexafluoride, unreacted ash | Spent aluminum oxide and sodium bicarbonate, debris | D004, D005, D006, D007, D008, *D008, D009, D010, D011 | M-007<br>M-008<br>M-009<br>M-035 |
| STF | Standard Fabrication | High purity plutonium oxides | Unknown | High purity plutonium standards | Stainless steel cans with metal oxides, debris | D007, *D008 | M-029<br>M-039 |
| VS | Confirmation, Inspection, and Sampling | Plutonium oxides and metals | NA – physical inspection only | Unchanged from process input | Vials (only if input material was sampled), debris | *D008 | M-045 |
| WM | Waste Management | Waste from the TRU solid waste management operation in Room 432. Glovebox maintenance items. "Hot" room trash (i.e., anything not originating in a glovebox). | NA | None | Miscellaneous waste items from room trash or generated by various P/S codes; leaded gloves and glovebox windows | Default HWNs (see Table 5): D007, D008, *D008, D009, D022, D035, D040, F001, F002, F005 | M-046, M-050 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| X0 | Inactive or Unspecified P/S Material | Waste materials from common areas (e.g., hallway, change rooms, basement) that could not be associated with a specific room | NA | None | Miscellaneous trash and debris | Default HWNs (see Table 5): D007, D008, *D008, D009, D022, D035, D040, F001, F002, F005 | M-046, M-050 |
| XES | X-Ray Energy Spectroscopy | Solid plutonium samples | Acid/base solutions (unspecified) | None | Unused/spent solid plutonium samples, spent acid/base solutions from sample preparation | D004, D005, D006, D007, D008, *D008, D009, D010, D011 | M-042 |
| XO | Inactive or Unspecified P/S Material | Waste materials generated within specific rooms but not associated with a specific P/S code; room trash boxes | Chloroform<br>Citrapeel<br>Ethanol<br>Hexane<br>Isopropyl alcohol<br>Methylene chloride<br>Methyl ethyl ketone<br>Organicstrip<br>Trichloroethylene<br>1,1,2-trichloro-1,2,2-trifluoroethane [freon] | None | Rags contaminated with organic chemicals; other room trash and debris | Default HWNs (see Table 5): D007, D008, *D008, D009, D022, D035, D040, F001, F002, F005 | M-046, M-050 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| XP | RD&D Experimental Processes | $PuO_2$, $PuO_2$ with tantalum chips, MSE salts, ash (Pu/Th $O_2$), $NpO_2$ | CMPO<br>DHDCMP<br>Diisopropyl benzene<br>Fluorinating agents (such as HF, $F_2$, FOOF)<br>Phosphine oxide<br>Potassium chloride<br>Sodium chloride | Plutonium hexafluoride, chlorinated plutonium compounds, neptunium standards | lead shielding, actinide oxides, metals, MSE salts, ash, debris | D004, D005, D006, D007, D008, *D008, D009, D010, D011 | M-049 |

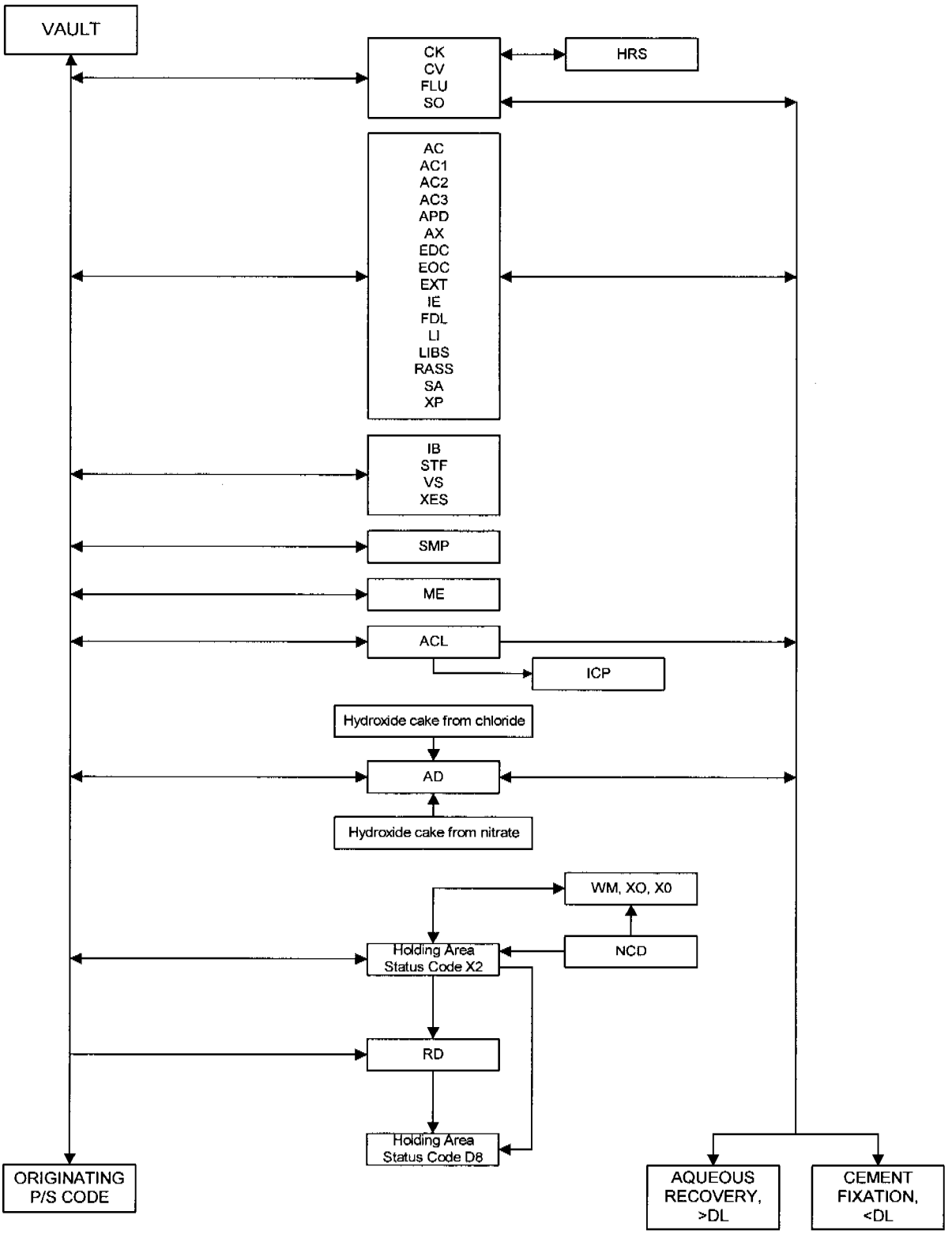
[1] All P/S codes generate routine laboratory debris waste consisting of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated.

[2] See discussion in Section 4.0 for details on the applicability of the EPA Hazardous Waste Numbers (HWNs) listed in this column. The HWNs listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation). The resulting treated waste stream is evaluated for hazardous waste constituents and assigned the applicable HWN. All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other metal debris waste and are assigned the HWN D008 under the originating P/S code.

[3] Refer to the Acceptable Knowledge Roadmap in Attachment 1. References listed as M-*nnn* (where *nn* is a 1- to 3-digit number) are in TWCP-3546.

* D008 due to leaded gloves

## SIMPLIFIED PROCESS FLOW DIAGRAM



# Decision/Discrepancy Resolution Documentation
## TA-55 Miscellaneous Operations

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| AD | No lead in the process per Gordon Jarvinen | TWCP-3546/M-034 | Hydroxide cake samples can contain Cr, Pb, and Cd | TWCP-3546/M-053 | Process report does assign D008 to AD | B |
| EDC | Possible Cr in stainless steel per Jim Foxx. He provides analytical data to support Cr | TWCP-3546/M-031<br><br>TWCP-3546/M-053 | Reams of analytical data to support RCRA metals below regulatory thresholds per Doug Wedman | TWCP-3546/M-041 | Process report assigns D007 as a conservative decision. Does not mention M-053 information. | B—Report needs to be modified to change "sand and slag" to "stainless steel". |
| General | All TA-55 waste is defense | TWCP-614 | Defense and non-defense were commingled until 8/21/97. | TWCP-887 | Reported as commingled process in the report | B |
| | | | Segregation began in 1997-1998 | TWCP-4162 | Reported as commingled process in the report | B |
| | | | Segregation began in 1998 | TWCP-4167 | Supporting memos attached to this record | C—Memo dated 8/27/98 states segregation was begun. See attached meeting notes. TWCP-4167. |

Sandy Wander — Evaluator (Print Name)
AK Investigator — Title
Sandy Wander — Signature
2/25/02 — Date

P Rogers — SPM Review (Print Name)
Pamela Rogers — Signature
2/26/02 — Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other(Specify)]

# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-004 New Rev/IC: R.2/IC2

Preparer: Sandy Wander

Document Title:

Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55

Blank entries are Not Applicable items.

- ☒ Proc
- ☒ Proc — AK-004/IC3 Effective date 3/21/02 – Posted to web on 3/27/02
- ☒ Proc — Pending response from CBFO
- ☒ Pagi — Per Jim Bailey
- ☒ Doc
- ☒ Atta — RMDC 3/27/02
- ☐ Haz
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☑ Signatures and Dates typed on cover page
- Revision History table reflect changes and effective date
- Forms have been marked as SAMPLE, if applicable
- Forms extracted for Web publishing
- Electronic files archived
- Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 3/27/2002 Signed Initials: JJS

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 3/27/02

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 3/27/02
- ☑ Master Index Updated - Date: 3/27/02
- ☑ N/A Archive old revision (Record)

- ☑ Capture Document: __ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date ✓ LAUR ✓ Title ✓ Link ✓ Test
- ☑ On-line test: ✓ Open Doc
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- ☑ N/A CBFO: __ Electronic Copy __ Printed
- ☐ Change Control Notification ____ Sent ____ Printed ✓ NA

Date Completed: [signature] Signed Initials: 3/27/02

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☐ Revision ☒ Interim Change

Date Received: 3/21/2002

Current Rev/IC: R.2/IC1

Document ID: TWCP-AK-2.1-004

Rev/IC: R.2/IC2

Document Title:

Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55

Preparer: Sandy Wander Date to DP Team: 3/21/2002

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

03/27/02: Prepared for transmittal to Document Control

## Step 3: Preliminary Review Cycle

☒ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
| | | | | |
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Comments:

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle

☒ IC - Not Applicable (enter action in comments section)

| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

## Step 5: Final Signature Cycle

☒ IC - Not Applicable (enter action in comments section)

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
| Change Control | G M Polley | 3/21/2002 | 3/25/2002 | NA |
| | | | | |
| | | | | |
| | | | | |
| | | | | |

Comments

# LOS ALAMOS
NATIONAL LABORATORY - TWCP RMDC

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**To: TWCP RMDC** **Mail Stop: M 319** **Please Respond 4/10/2002**

## TWCP-AK-2.1-004,R.2/IC2

**Effective Date** 3-21-2002 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR MISCELLANEOUS OPERATIONS AT TA-55 (LA-UR-02-1714)

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
| ☐ RAMROD | | | | | |
| ☐ RANT | | | | | |
| ☐ DECON | | | | | |
| ☒ QA | | | | | |

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To be signed by the Controlled Document Recipient or their designee.

Signature: _____ Date: 3/27/02

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: Procedure Notification
Cc: fabi,bailey, lpc
Bcc:
Attached:

The following are revised AK reports.

Effective Date: 3/21/02

**TWCP-AK-2.1-004,R.2/IC1 -** Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55 (LA-UR-02-1714)

**TWCP-AK-2.1-005,R.2/IC1 -** Process Acceptable Knowledge Report for Nitrate Operations at TA-55 (LA-UR-02-1715)

**TWCP-AK-2.1-006,R.2/IC1** - Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55 (LA-UR-02-1713)

**TWCP-AK-2.1-007,R.2/IC1 -** Process Acceptable Knowledge Report for Special Processing at TA-55 (LA-UR-02-1712)

**TWCP-AK-2.1-009,R.0/IC1 -** Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55 (LA-UR-02-1709)

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

*Patricia G. Patton*
Los Alamos National Laboratory
E-ET / TWCP
Records Management / Document Control
( RMDC )
557 Oppenheimer
TA-00 - bldg 764
MS M319
Phone: (505) 667-2071
Email: pgp@lanl.gov

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-004 New Rev/IC: R.2/IC1

Preparer: John Musgrave

Document Title:
Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☐ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☐ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 6/15/2001 Signed Initials: JJS

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 6/15/01

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 1
- ☑ Control Stations Updated - Date: 6/18/01
- ☑ Master Index Updated - Date: _____
- N/A Archive old revision (Record)

- ☑ Capture Document: ✓ Word __ PDF
- ☐ Forms: __ Yes __ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ___ Signature Dates ___
- ☑ Dates: ___ Cover ___ Rev. History ___ Review Date
- N/A Add: Controlled Document Original Signatures on File at the RMDC
- N/A Security Set for: ____ Read Only
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date N/A LAUR ✓ Title ✓ Link ✓ Test
- ☑ On-line test: ✓ Open Doc N/A Password
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- N/A CAO: ✓ Electronic Copy ✓ Printed

Date Completed: 6/18/01 Signed Initials: [signature]

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☐ Revision ☒ Interim Change

Date Received: 6/13/2001

Current Rev/IC: R.2

Document ID: TWCP-AK-2.1-004

Rev/IC: R.2/IC1

Document Title:

Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55

Preparer: John Musgrave Date to DP Team: 6/13/2001

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

06/13/01: Made changes in document and routed for signatures. Originally, M. Gavett indicated IC needed to go to CBFO for review, but L. Souza emailed document production with the comment that no AK document needed to go to CBFO for review.

## Step 3: Preliminary Review Cycle

☒ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
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Comments:

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle

☒ IC - Not Applicable (enter action in comments section)

| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

## Step 5: Final Signature Cycle

☒ IC - Not Applicable (enter action in comments section)

| Signature | Position | Sent Out | Returned | Comments |
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Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
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Comments

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: For Training Distribution
Cc: fabi@lanl.gov
Bcc:
Attached:

The following is a revised AK Report:

**TWCP-AK-2.1-004,R.2/IC1 - Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55**

To: wipp.notify@wipp.carlsbad.nm.us
From: Patricia G Patton <pgp@lanl.gov>
Subject: [Procedure]
Cc: Tammy.Bowden@wipp.carlsbad.nm.us
Bcc: fl@lanl.gov
Attached: K:\twcp\RMDC\AK\TWCP-AK-2.1-004\TWCP-AK-2^1-004R2IC1.pdf;

The following are revised AK Reports.

**TWCP-AK-2.1-004,R.2/IC1 - Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55**

# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☒ Revision ☐ Interim Change
Document ID: TWCP-AK-2.1-004 New Rev/IC: R.2
Preparer: John Musgrave
Document Title:
Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 5/17/2001 Signed Initials: JSS

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 5/17/01

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- ☑ Verify Effective Date cover/history
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- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 1
- ☑ Control Stations Updated - Date: 5/17/01
- ☑ Master Index Updated - Date: 5/17/01
- ☑ Archive old revision (Record)

- ☑ Capture Document: __ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- ☑ NA Add: Controlled Document Original Signatures on File at the RMDC
- ☑ NA Security Set for: ____ Read Only
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date NA LAUR ✓ Title ✓ Link ✓ Test
- ☑ On-line test: ✓ Open Doc NA Password
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- ☑ CAO: ✓ Electronic Copy ✓ Printed

Date Completed: 5/17/01 Signed Initials: JS

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle

☐ IC - Not Applicable (enter action in comments section)

Reviewer Comments Incorporated: .....

Redline/DRR Given to Preparer: .....

Reconciled Comments Returned: .....

Modifications Made to Document: .....

Preparer Review of Modifications: .....

Signed/Release for Final Signature: .....

Comments: .....

## Step 5: Final Signature Cycle

☐ IC - Not Applicable (enter action in comments section)

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
| J. Fabryka-Martin | Technical | 5/7/2001 | 5/7/2001 | Independent Technical Reviewer/Editor |
| M. Lin | SPM | 5/12/2001 | 5/12/2001 | Site Project Manager |
| S. Wander | QA | 5/14/2001 | 5/14/2001 | Waste Certification Official |
| M. Gavett | QA | 5/14/2001 | 5/14/2001 | Site Project QA Officer |
| C. Foxx | Fac Mgr | 5/7/2001 | 5/7/2001 | Facility Representative |
| | | | | |
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Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
| Classification | | | 5/16/2001 | LA-UR-01-2559 |
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Comments

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☒ Revision ☐ Interim Change

Date Received: 4/1/2001

Current Rev/IC: R.1

Document ID: TWCP-AK-2.1-004

Rev/IC: R.2

Document Title:

Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55

Preparer: John Musgrave Date to DP Team: 4/1/2001

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

04/01/01 through 05/16/01: Incorporated changes from author, reviewers, and auditors

## Step 3: Preliminary Review Cycle

☐ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
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Comments:

To: rubyannf@lanl.gov, mlgarcia@lanl.gov, prmtz@lanl.gov
From: Louise Garcia <louise@lanl.gov>
Subject: For Training Distribution
Cc: fl@lanl.gov, manmtz@lanl.gov
Bcc:
Attached:

The following are revised AK Reports.

**TWCP-AK-2.1-002,R.2 - Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55**

**TWCP-AK-2.1-003,R.2 - Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55**

**TWCP-AK-2.1-004,R.2 - Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55**

**TWCP-AK-2.1-005,R.2 - Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55**

To: wipp.notify@wipp.carlsbad.nm.us
From: Louise Garcia <louise@lanl.gov>
Subject: [Procedure]
Cc: Tammy.Bowden@wipp.carlsbad.nm.us
Bcc: fl@lanl.gov
Attached: K:\twcp\RMDC\AK\TWCP-AK-2.1-002\TWCP-AK-2^1-002R2.pdf; K:\twcp\RMDC\AK\TWCP-AK-2.1-003\TWCP-AK-2^1-003R2.pdf; K:\twcp\RMDC\AK\TWCP-AK-2.1-004\TWCP-AK-2^1-004R2.pdf; K:\twcp\RMDC\AK\TWCP-AK-2.1-005\TWCP-AK-2^1-005R2.pdf;

The following are revised AK Reports.

**TWCP-AK-2.1-002,R.2 - Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55**

**TWCP-AK-2.1-003,R.2 - Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55**

**TWCP-AK-2.1-004,R.2 - Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55**

**TWCP-AK-2.1-005,R.2 - Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55**

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NATIONAL LABORATORY - TWCP RMDC

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To: **CST-7 RMDC** Mail Stop: **E517** Please Respond By: **5/31/2001**

## TWCP-AK-2.1-004,R.2

**Effective Date** 5-17-2001 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR MISCELLANEOUS OPERATIONS AT TA-55

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
| ☐ RAMROD | | | | | |
| ☐ RANT | | | | | |
| ☐ DECON | | | | | |
| ☐ QA | | | | | |

**Action Required:**

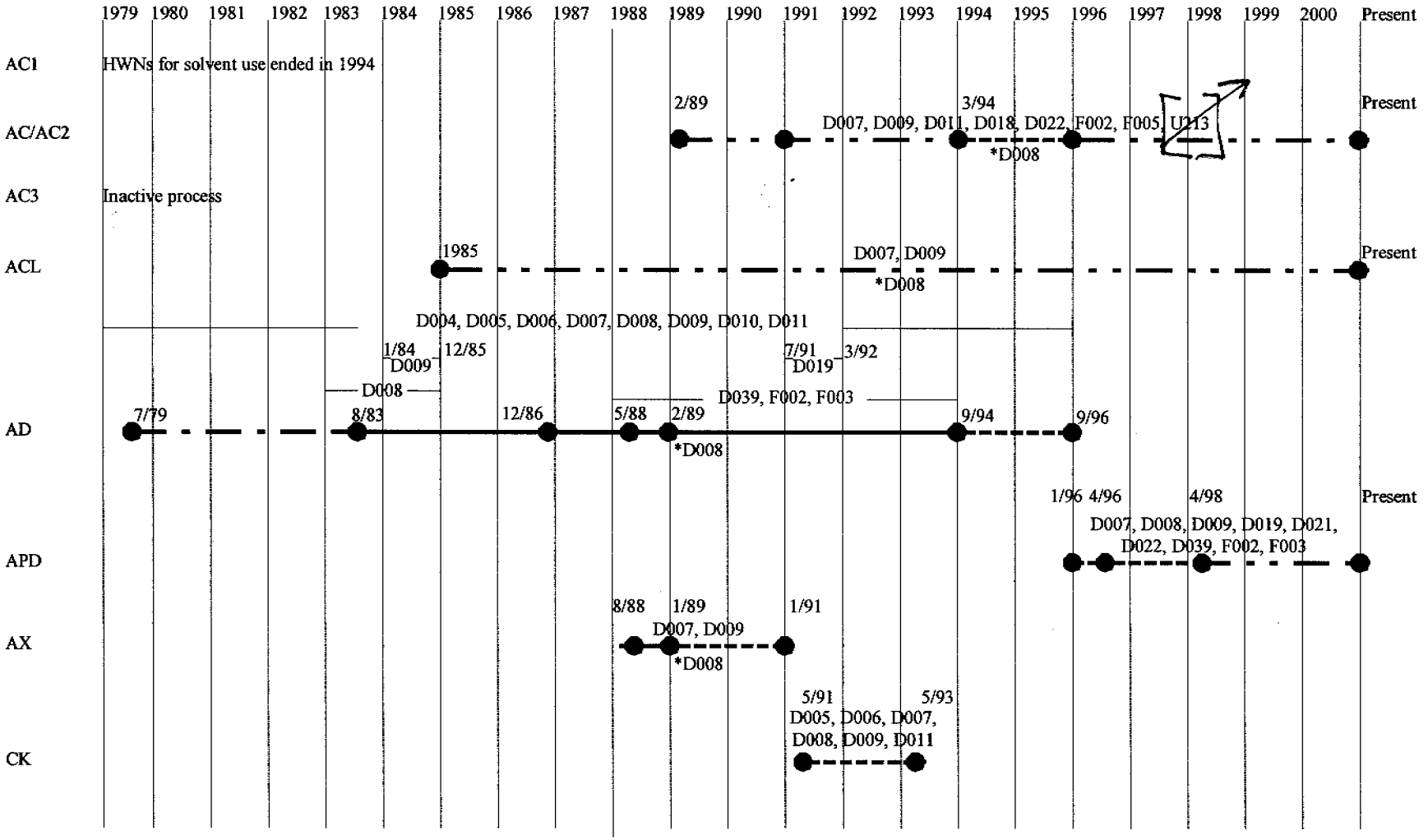
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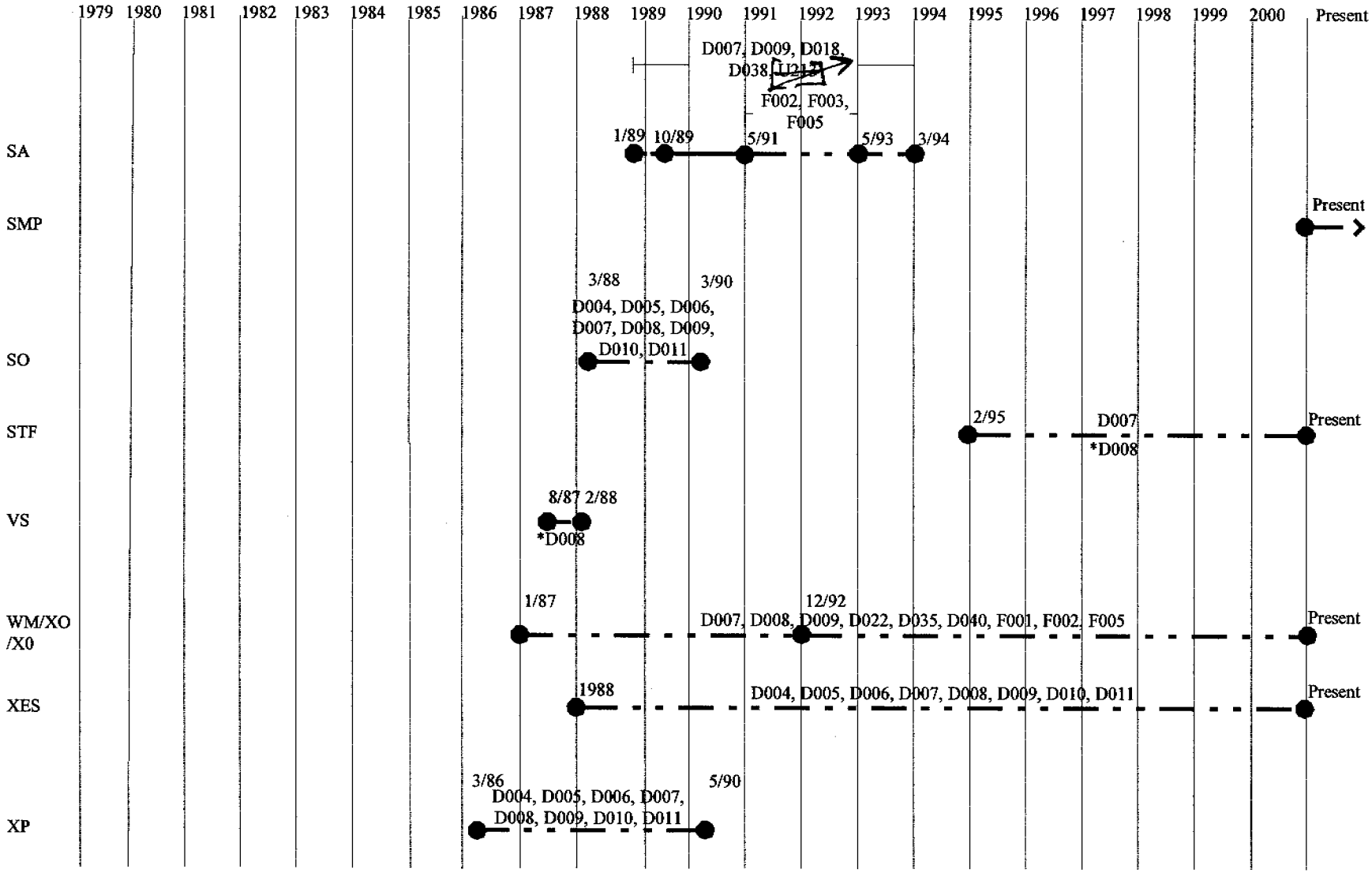
To be signed by the Controlled Document Recipient or their designee.

Signature: _____ Date: 5/17/01

## TIMELINE FOR TA-55 MISCELLANEOUS PROCESSES



## TIMELINE FOR TA-55 MISCELLANEOUS PROCESSES (continued)



All changes made JTM 5/1/01

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-004,R.1 (LA-UR-00-5865)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

**EFFECTIVE DATE:** 12/04/00

**NEXT REVIEW DATE:** 12/04/00

**DOCUMENT PREPARER:**

| | |
|---|---|
| John Musgrave | 12/04/00 |
| NAME | DATE |

**APPROVALS:**

| | |
|---|---|
| June Fabryka-Martin | 12/04/00 |
| INDEPENDENT TECHNICAL REVIEWER/EDITOR | DATE |
| Pamela Rogers | 12/04/00 |
| SITE PROJECT MANAGER | DATE |
| Matt J. Riggs | 12/04/00 |
| WASTE CERTIFICATION OFFICIAL | DATE |
| M A Gavett | 12/04/00 |
| SITE PROJECT QA OFFICER | DATE |
| Charles L. Foxx | 12/04/00 |
| FACILITY REPRESENTATIVE | DATE |

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## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| D | RCRA hazardous waste code for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DBBP | dibutyl butylphosphonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste code for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | oxygen fluoride dioxygen difluoride |
| GB | glovebox |
| HEPA | high-efficiency particulate air |
| HWN | [EPA] hazardous waste number |
| K | RCRA hazardous waste code for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| MEGAS | Multiple Energy Gamma Assay System |
| MSE | molten salt extract |
| MT | material type |
| NDA | non-destructive assay |
| P | RCRA hazardous waste code for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 (e) |
| PF-4 | Plutonium Facility, Building 4 |
| P/S [code] | process/status [code] |
| QA | quality assurance |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3) |
| SME | subject matter expert |
| TA | technical area |
| TBP | tributyl phosphate |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization Program |
| UCNI | Unclassified Controlled Nuclear Information |
| WIPP | Waste Isolation Pilot Plant |

U RCRA hazardous waste code for ~~discarded commercial~~ toxic waste defined in 40 CFR Subpart D, Section 261.33 (f)

Rename
Pyrochemical R&D

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| ME | Metallography | Miscellaneous Operations | 3.4.10, Att. 4 |
| NCD | Nonconfirming Drums | Miscellaneous Operations | 3.4.9, Att. 4 |
| OR | Direct Oxide Reduction | Pyrochemical Processes | 3.4.2, Att. 4 |
| PTS | RD&D Pretreatment Study | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 |
| PX | Multiple DOR with In-Situ Regeneration and Electrorefining | Special Processing | 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, Att. 4 |
| RASS/RSS | Raman Spectroscopy System | Miscellaneous Operations | 3.4.5, Att. 4 |
| RB | Roasting and Blending | Nitrate Operations | 3.4.3, Att. 4 |
| RBJ | Roasting and Blending Jr. | Nitrate Operations | 3.4.3, Att. 4 |
| RC | Rotary Calciner | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 |
| RD | Repackaging into Retrievable Drums | Miscellaneous Operations | 3.4.9, Att. 4 |
| RR | Ion Exchange | Nitrate Operations | 3.4.3, Att. 4 |
| SA | Super Acid RD&D | Miscellaneous Operations | 3.4.3, Att. 4 |
| SMP | SP Mounting Preparation | Miscellaneous Operations | 3.4.5, Att. 4 |
| SO | Super Oxidizer, FOOF Program | Miscellaneous Operations | 3.4.2, Att. 4 |
| SS | Salt Stripping | Pyrochemical Processing | 3.4.3, 3.4.4, 3.4.5, 3.4.7, 3.4.8, Att. 4 |
| STF | Standard Fabrication | Miscellaneous Operations | 3.4.6, Att. 4 |
| VS | Confirmation, Inspection & Sampling | Miscellaneous Operations | 3.4.5, Att. 4 |
| WM | Waste Management | Miscellaneous Operations | 3.4.9, Att. 4 |
| X0 | Inactive or Unspecified P/S Material | Miscellaneous Operations | 3.4.9, Att. 4 |
| XES | X-Ray Energy Spectroscopy | Miscellaneous Operations | 3.4.5, Att. 4 |
| XO | Inactive or Unspecified P/S Material | Miscellaneous Operations | 3.4.9, Att. 4 |
| XP | RD&D Experimental Processes | Miscellaneous Operations | 3.4.4, Att. 4 |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002,R.1), Miscellaneous Operations (this report), Nitrate Operations (TWCP-AK-2.1-005,R.1), Pyrochemical Processes (TWCP-AK-2.1-006,R.1), and Special Processing (TWCP-AK-2.1-007,R.1)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Miscellaneous Operations

**P/S codes**:

AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed, combustible and non-combustible debris; liquid wastes sent to the Radioactive Liquid Waste Treatment Facility at TA-50 or immobilized in cement (as part of nitrate operations)

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from miscellaneous operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

TA-55 Plutonium Facility (Building PF-4), Rooms 105, 106, 112, 113, 115, 120, 124, 126, 208, 209, 210, 401, 409, 420, and 432

**Description of the process waste (physical form and typical content description):**

Primarily debris waste, including cellulosic materials, plastic, rubber, ceramic, metal and glass debris, and waste sent to nitrate operations to be immobilized in cement.

**Description of the waste-generating process:**

The overall goal of the miscellaneous operations is to recover plutonium from metal, metal alloys, scrap, and residues and produce a purified plutonium oxide product or feedstock for conversion to metal. Processes in miscellaneous operations include pretreatment, dissolution, purification, and hydroxide precipitation.

rewrite

**Process feed:**

Plutonium metal or metal alloy, oxides and hydroxide cakes; pyrochemical salts; ~~crucible pieces;~~ anode heels; ash; ~~analytical laboratory solutions;~~ and residues from other DOE facilities.

**Radioisotopic content of the waste:**

Variety of plutonium material types with different well-defined isotopic compositions; americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium or plutonium and uranium. The waste will usually be enriched in americium and uranium, but may also be depleted in some cases.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- No K or P codes
- F001: P/S codes WM, XO, X0 (trichloroethylene and 1,1,2-trichloro-1,2,2-trifluoroethane (freon))
- F002: P/S codes AC/AC1/AC2, AD, APD, SA, WM, X0, XO (chlorobenzene, methylene chloride, tetrachloroethylene, trichloroethylene)
- F003: AD, APD, ME, SA (acetone, diethyl ether, methanol, xylene)
- F005: P/S codes AC/AC1/AC2, SA, WM, X0, XO (benzene, methyl ethyl ketone, toluene, pyridine)
- D004 (arsenic) and D010 (selenium): P/S codes AD, RASS/RSS, SO, XES, SP
- D005 (barium) and D006 (cadmium): P/S codes AD, CK, CV, EXT, FDL, FLU, IB, IE, LI, RASS/RSS, SO, XES, XP, SO
- D007 (chromium) and D009 (mercury): P/S codes AC, AC1, AC2, ACL, AD, APD, AX, CK, CV, EDC (D007 only), EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, ME (D007 only), RASS/RSS, RD, SA, SO, STF (D007 only), VS, WM, X0, XES, XO, XP
- D008 (lead, excluding leaded gloves): P/S codes AD, APD, CK, CV, EXT, FDL, FLU, IB, IE, LI, RASS/RSS, SO, WM, X0, XES, XO, XP
- D008 (leaded gloves only): P/S codes AC, AC1, AC2, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, ME, RASS/RSS, RD, SA, SO, STF, VS, WM, X0, XES, XO, XP
- D010 — FDL, FLU, RASS/RSS, AD, XP, XES, SO
- D011 (silver): P/S codes AD, APD, CK, CV, EXT, FDL, FLU, IB, IE, LI, RASS/RSS, SO, XES, XP
- D018 (benzene): P/S codes AC, AC1, AC2, SA
- D019 (carbon tetrachloride): P/S codes AD, APD, CV, RASS/RSS
- D021 (chlorobenzene): P/S code APD
- D022 (chloroform): P/S codes AC, AC1, AC2, APD, WM, X0, XO

- D035 (methyl ethyl ketone): P/S codes WM, X0, XO
- D038 (pyridine): P/S code SA
- D039 (tetrachloroethylene): P/S codes AD, APD, CV
- D040 (trichloroethylene): P/S codes ME, WM, X0, XO
- No HWN: P/S codes LIBS, NCD, SMP

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

U213 (tetrahydrofuran): P/S codes AC, AC2, SA

consistent with P/S code SA (M-024, M-037/TWCP-3546). This P/S code covered two separate activities that did not overlap in time. P/S code SA began in 1989 with superacid work, but the process changed approximately in 1991 to organometallic studies. According to the SME, organic compounds (i.e., solvents) were never used with superacid media. Aluminum oxide and magnesium oxide were used to absorb superacid components. These spent oxides were discarded along with contaminated glass. Hazardous constituents are not expected to be present in any of the waste streams from the superacid work.

The study of the organometallic chemistry of uranium and thorium in non-aqueous solvents (as part of P/S code SA) was conducted in Room 208, GB-216 and 230, in 1989 (M-024/TWCP-3546). Chemical reagents and solvents are not specified but the procedure indicates that materials used in the process may include "hydrocarbon, ethereal, and aromatic solvents, organic reagents, and inorganic salts." The procedure was revised in 1991, at which time the operation was conducted in Room 105 (GB-166 and -177) and Room 208 (GB-230 and -240). The process consisted of a variety of small-scale organoactinide operations involving fundamental research of the synthesis in non-aqueous media of new actinide compounds, their characterization and reaction chemistry, and application to existing actinide processing technology. Due to the range of experimental studies conducted under this P/S code, a definitive list of chemical reagents does not exist; however, previous studies involved the use of a wide range of hydrocarbon solvents, including the D-listed and F-listed constituents: methylene chloride (F002), diethyl ether (F003), benzene (D018, F005), toluene (F005), and pyridine (D038, F005). Tetrahydrofuran ~~and toluene~~ were also used in the organometallic process. Neptunium and plutonium metal were put into tetrahydrofuran and dried. Bromine and/or iodine were added to create plutonium iodide, the starting material for other studies. In addition to standard debris wastes, process wastes may have included reaction by-products and residues, various pieces of laboratory equipment, spent organic solvents, and filtration media. Process outputs from this operation may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

HWN (U213)

The procedure associated with the previous operation was revised once again in March 1994. The P/S codes for these operations are indicated as AC, AC1, AC2 and AC3. SMEs (M-038/TWCP-3546) familiar with these activities indicated that the process began as P/S code AC in February 1989 and transformed to P/S code AC2 in February 1994. P/S codes AC2 probably ran concurrently with AC1. This revised procedure indicates that operations occurred in the same rooms and gloveboxes identified in the previous revision. The distinguishing features between

AC1 and AC2 were that AC1 was an analytical process using aqueous compounds, predominantly dilute nitric, hydrochloric, and perchloric acid solutions. These acidic solutions would have been neutralized and precipitated to recover the plutonium. Solids were sent to recovery, and solutions were sent to cementation. P/S code AC2 involved synthesis of (air-sensitive) new compounds in an inert glovebox. This was a non-aqueous process. P/S code AC3 is not related to P/S codes AC1 or AC2, but is predominantly a metal operation (M-038/TWCP-3545). This code had not yet become active by the time this report was prepared, and no other information was available for it.

The procedure describes operations that comprise a broad range of laboratory activities in support of fundamental and applied actinide chemistry research (M-025/TWCP-3546). These activities include, but are not limited to, preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation. The chemical list indicates the use of a variety of materials, including organic solvents (e.g., toluene and benzene), alkaline earth metals, and transition metals. The SMEs (M-038/TWCP-3546) familiar with these activities indicated that a "variety of aromatic, alkaline, and chlorinated solvents" (e.g., tetrahydrofuran, toluene, benzene, ~~dimethyl chloride~~ ~~(also known as~~ methylene chloride~~)~~, and chloroform) were used in these activities. These organic chemicals have the following HWNs: benzene (D018, F005), chloroform (D022), methylene chloride (F002), toluene (F005). The SME stated that waste byproducts from the operations that contain these constituents were not discarded but were held in the glovebox for reprocessing or recovery. Because the SME was not involved with these activities after 1994, he was unable to definitively state how the waste materials were ultimately dispositioned. In a later discussion, other SMEs (M-038/TWCP-3546) indicated that use of the chlorinated solvents associated with P/S code AC1 was discontinued in 1994 and that items contaminated with these constituents mentioned are still in the glovebox and have yet to be discarded as of the date of this report. Transition metals used as reagents in the synthesis of new materials in this process included sodium salts, potassium salts, and silver salts. The precipitated salt byproducts also were not discarded but were held in the glovebox for reprocessing and recovery. In a later discussion, other SMEs confirmed that silver salts associated with P/S code AC1 are still in the glovebox awaiting determination for a path forward for disposition. Other than silver (D011), no RCRA metals were used in the processes (M-038/TWCP-3546). In addition to the standard debris wastes, process wastes may have included reaction by-products and residues, heating mantles, vacuum pump apparatus, various pieces of laboratory equipment, spent organic solvents, and filtration media. Process outputs for both P/S codes may be sent to the vault, returned to

Hexane and acetonitrile began to be used in P/S code AC2 recently.

Acetonitrile is an App VIII VOC, but its HWN (U003) does not apply in this case.

and tetrahydrofuran (U213)

- P/S code XO indicated waste materials that were generated within specific rooms but could not be associated with an individual P/S code in that room. The room trash boxes assigned this P/S code, when determined by assay to qualify as TRU waste instead of low-level waste, could contain rags that had contacted ignitable constituents (e.g., ethanol, isopropyl alcohol, and hexane); however, because the waste items were not packaged as free liquids, the EPA HWN D001 for ignitability would not be applicable. Other constituents that may have been present on rags in debris waste from P/S code XO included the degreasing solvents methyl ethyl ketone (D035, F005), trichloroethylene (D040, F001), and 1,1,2-trichloro-1,2,2-trifluoroethane [freon] (F001); methylene chloride (F002) used as a paint stripper; and chloroform (D022) used in a cryogenic bath.

XO switched to non-RCRA regulated paint strippers after 1999: Citrapeel until 2001, and Organicstrip at the present time.

Two other specific situations could also result in the generation of additional waste items under P/S code WM.

- During maintenance of the in-line glove box, changeout of the leaded gloves and windows would be covered under P/S code WM. No solvents or other chemicals were introduced during this routine maintenance activity.

- A spill in Room 432 in 1989 involved the release of a Pu-239-contaminated solution (consisting primarily of water with a minor amount of nitric acid) from a ventilation line. The spill was wiped up with rags and discarded under P/S code WM. Rags with excessive amounts of nitric acid would have been neutralized by dipping them in a calcium hydroxide solution inside a glovebox. No EPA HWN would be applicable to waste from this incident.

move to precede 3.4.9

### 3.4.10 Metallography (P/S Code ME)

P/S code ME takes place in Room 115 and involves a standard metallography process that was initiated at TA-55 in 1979 and continues to the present (M-048/TWCP-3546). The purpose of the metallography operation is to characterize the microstructure of metallic or ceramic pieces to verify and establish the quality and effectiveness of welds. Materials examined under this P/S code consist of plutonium and uranium carbides, nitrides, and oxides, as well as zirconium and tantalum alloys, and stainless steel. Metal pieces (pellets) are cut with a diamond saw. Ceramic pieces are subjected to grinding with standard metal grinding media (e.g., papers impregnated with silicon carbides and diamond). The materials are polished with several different chemical compounds. Prior to May 1992, a mixture of 1–10 percent trichloroethylene and kerosene were used. Ethanol and acetone may also have been used. After May 1992, these materials were replaced with a

## Table 1. Process Feed Materials for Miscellaneous Operations

| Feed Material | RCRA-Regulated Substances and Associated Hazardous Waste Number | P/S Codes in Miscellaneous Operations |
|---|---|---|
| Analytical laboratory solutions | Solutions from other TA-55 operations: no RCRA constituents<br>Solutions from CLS-1: Potentially contaminated with RCRA-regulated heavy metals, mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (reference Cl-25 in TWCP-3547). | ACL and ICP (TA-55 solutions)<br>APD (CLS-1 solutions) |
| Ash from P/S codes IS, SB, and TDC, or from other DOE sites | Usually suspect contaminated with barium (D005), cadmium (D006), chromium (D007), and lead (D008). Silver (D011), arsenic (D004), mercury (D009), and selenium (D010) may also be present; although volatile at high temperatures if present in the oxide form, these heavy metals may be alloyed to Pu if present in the metal form. | SO, XP, FLU, FDL |
| Disassembled weapons components | High-purity Pu and U material types | EDC |
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity | AD, CV, EXT, HRS, ME, RASS/RSS, SA, XES, XP |
| Hydroxide cakes | Typically contaminated with RCRA-regulated heavy metals cadmium (D006), chromium (D007), mercury (D009), lead (D008), and silver (D011) | AD |
| MSE salts | Typically fairly pure, suspect contaminated with barium but no other RCRA substances present | XP |
| Pu chlorides and fluorides (from various P/S codes) | Variable purity | FDL, SO |
| Pu metal or metal alloy | High purity, no RCRA-regulated substances, unless noted otherwise | AC, AC1, AC2, EXT, LIBS, SA, SMP, VS |
| Pu oxides | High-purity oxides used for P/S codes EOC, LIBS and STF. Variable purity for other codes, may be contaminated with RCRA-regulated heavy metals barium (D005), cadmium (D006), chromium (D007), and lead (D008), and silver (D011) | CK, CV, EOC, EXT, FDL, FLU, IB, IE, LI, LIBS, SO, STF, VS, XP |
| Pyrochemical salts | Typically fairly pure, no RCRA-regulated substances other than barium (D005) present | EXT, IB |

## Table 4. Chemical Inputs to Processes Described in This Report

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| **Gases and Cryogens** | | |
| Carbon dioxide (gas)<br>Fluorine (gas)<br>Halogen fluorides<br>Krypton fluoride*<br>Methane (gas)<br>Nitrogen dioxide (gas)<br>Nitrogen, liquid | CK, FLU, SO<br>SO, FDL | D001 and D002 do not apply to these gases because there are no free liquids in this waste. Also the gas cylinders are outside the building, and the gases are plumbed into the glovebox. ~~F003 does not apply because methanol was used as a reducing agent, not as a solvent.~~ |
| **Acids** | | |
| Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Oxalic acid<br>Perchloric acid<br>Sulfuric acid<br>Superacids (e.g., $HSO_3F$) | AD<br>SA | D002 does not apply to the solid debris waste because there are no free liquids in this waste. D001 (oxidizer) does not apply to the use of nitric or perchloric acid or to the superacids for the same reason. |
| **Bases** | | |
| Calcium hydroxide<br>Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the solid debris waste because there are no free liquids in this waste. |
| **Inorganic Chemicals** | | |
| Aluminum bifluoride<br>Aluminum chloride<br>Aluminum fluoride<br>Aluminum nitrate<br>Aluminum oxide<br>Ammonium chloride<br>Antimony pentafluoride<br>Bromine<br>FOOF<br>Hydrogen peroxide<br>Iodine<br>Iron oxide<br>Lead and lead hydroxide, oxide, or nitrate<br>Magnesium oxide<br>Na, K, Li, Mg, Ca, Fe, nitrates, chlorides, carbonates, bicarbonates, oxalate, nitrites<br>Phosphates<br>Potassium choride<br>Potassium dichromate | AD, APD<br><br>AD | D008<br><br>D007 |

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| Potassium permanganate | | |
| Potassium salt (not specified) | | |
| Silver salt | AC1 | D011 |
| Sodium bicarbonate | | |
| Sodium carbonate | | |
| Sodium chloride | | |
| Sodium chlorite | | |
| Sodium nitrate | | |
| Sodium salt (not specified) | | |
| Sodium sulfate | | |
| Thorium oxide | | |
| **Metals** | | |
| Alkaline earth metals | | |
| Bismuth-tin alloy | | |
| Gallium metal, oxide or salt | | |
| Lanthanide metals | | |
| Platinum and platinum-rhodium alloys | | |
| Stainless steel | | D007 (chromium) |
| Tantalum metal, oxide or salt | | |
| Zirconium and tantalum alloys | | |
| **Organic Chemicals** | | |
| 1-propanol | | |
| Acetone | ME | F003 |
| Alkylating agents (unspecified) | | |
| Benzene | AC/AC1/AC2, SA | D018 and F005: solvent use |
| Carbon tetrachloride | AD, CV | D019 applies to AD and CV. F001 does not apply because this chemical was not used for degreasing. |
| Carbon tetrafluoride | | |
| Chloroform | AC/AC1/AC2, APD, XO | D022 |
| DBBP (dibutyl butyl-phosphonate) | | |
| DBBP (dibutyl butyl-phosphonate) / Isopar (isoparaffinic hydrocarbon solvent) | | |
| Diethyl ether | SA | F003 |
| Dihexyl N,N-diethylcarbamoylmethyl phosphonate (DHDCMP) | | |
| Diisopropyl benzene | | |
| Ethanol | | |
| Hexane | | |
| Hydrazine dihydrochloride | | |
| Hydrazine hydrochloride | | |
| Hydroxylamine chloride | | |
| Hydroxylamine nitrate | | |
| Isopropanol | | |
| Kerosene | | |
| Methanol | AD, SO | F003 applies to AD because methanol may have been used for cleaning inside the glovebox. F003 does not |

Acetonitrile (AC2)

Appendix VIII compound. Use began recently. U003 does not apply

Citrapeel

Acetonitrile AC2 Appendix VIII compound. EPA HWN U003 does not apply to the manner in which this chemical is used in TA-55 processes.

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| | | apply to SO because methanol was used in a cold trap outside the glovebox. |
| Methylene chloride (also called dichloromethane) | AC1, SA | F002 applies to P/S codes AC1 and SA because methylene chloride was used for solvent properties. |
| n-dodecane | | |
| Octylphenyldiisobutyl-carbamoylmethylphosphine oxide (CMPO) | | |
| Perchlorocarbons | Organicstrip | |
| Phosphine oxide | | |
| Phosphines | | |
| Pyridine | SA | D038, F005: used as solvent in organometallic synthesis process. |
| Sodium dithionate | | |
| Tetrachloroethylene | AD, APD, CV | D039 and F002 apply to AD and APD. However no codes apply to CV because this chemical was only used as a coolant outside the glovebox. |
| Tetraethylamine hydrochloride | | |
| Tetraethylamine hydroxide | | |
| Tetraethylammonium hydroxide | | |
| Tetrahydrofuran | AC, AC2, SA | U213 applies to AC, AC2 and SA |
| Thionyl chloride | | |
| Toluene | AC, SA<br>& AC2, | F005 applies because toluene was used as a solvent in organometallic synthesis |
| Tributyl phosphate (TBP) | | |
| Tributyl phosphate (TBP)/Isopar | | |
| Trichloroethylene | CK, ME, XO | D040 applies to P/S codes ME and XO; F002 also applies to P/S code XO. Neither EPA HWN applies to P/S code CK because this chemical was used as a coolant outside the glovebox. |
| Vacuum pump oil | | |

**Table 5. Evaluation of the Applicability of EPA Hazardous Waste Numbers to Processes Discussed in This Report**

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| AC | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005, U213 | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005, U213 |
| AC1 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005 |
| AC2 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005, U213 | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005, U213 |
| AC3 | Actinide Chemistry, R&D | None | None | None | None |
| ACL | Analytical Chemistry Laboratory | None | None | D007, D008, D009 | D007, D008, D009 |
| AD | Actinide Processing Demonstration | D004, D005, D006, D007, D008, D009, D010, D011, D019 | D008, D019, D039, F002, F003 | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| APD | Actinide Processing Demonstration | D008, D009, D019, D021, D022, D039, F002, F003 | None | D007, D008, D009 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| AX | Solution Assay | None | None | D007, D008, D009 | D007, D008, D009 |
| CK | RD&D Volatile Fluoride Pu Recovery | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| CV | R&D Experimental Chlorination Processes | D005, D006, D007, D008, D011 | D019, D039 | D007, D008, D009 | D005, D006, D007, D008, D009, D011, D019, D039 |
| EDC | Electrolytic Decontamination | D007 | None | D007, D008 | D007, D008 |
| EOC | Experimental Oxide Characterization | None | None | D007, D008, D009 | D007, D008, D009 |
| EXT | Extraction RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| FDL | FOOF Demonstration Loop | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| FLU | Fluorination RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| HRS | High Resolution Spectroscopy | None | None | D008 | D008 |
| IB | Matrix Study Of Pyrochemical Salts | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| ICP | ICP–AES Analysis | None | None | D007, D008, D009 | D007, D008, D009 |

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| IE | Isotope Enrichment | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| LI | XF6 Experimental Measurements | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| LIBS | Laser-Induced Breakdown Spectroscopy System | None | None | None | None |
| ME | Metallography | None | D040, F003 | D007, D008 | D007, D008, D040, F003 |
| NCD | Nonconfirming Drums | None | None | None | None |
| RASS/ RSS | Raman Spectroscopy System | D004, D005, D006, D007, D008, D009, D010, D011, D019 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RD | Repackaging into Retrievable Drums | None | None | D008 | D008 |
| SA | Super Acid RD&D | None | D018, D038, F002, F003, F005, U213 | D007, D008, D009 | D007, D008, D009, D018, D038, F002, F003, F005, U213 |
| SMP | SP Mounting Preparation | None | None | None | None |
| SO | Super Oxidizer, FOOF Program | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011 |
| STF | Standard Fabrication | None | None | D007, D008 | D007, D008 |
| VS | Confirmation, Inspection & Sampling | None | None | D008 | D008 |
| WM | Waste Management | ~~Must be determined on case-by-case basis~~ None None (stet) | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 (Don't Know stet) |
| X0 | Inactive or Unspecified P/S Material | Must be determined on case-by-case basis | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-Ray Energy Spectroscopy | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011 |
| XO | Inactive or Unspecified P/S Material | Must be determined on case-by-case basis. However, HWNs known to be applicable include those for chloroform (D022), trichloroethylene (D040, F001, F002), 1,1,2-trichloro-1,2,2-trifluorethane (F002), methylene chloride (F002), and methyl ethyl ketone (D035, F005) because cleaning rags may be contaminated with these RCRA chemicals; also D007, D008, D009 (use ended after 1999) | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 (F001, F002) |

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| XP | RD&D Experimental Processes | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008 (gloves and shielding), D009 | D004, D005, D006, D007, D008, D009, D010, D011 |

* EPA HWNs assigned due to the process itself include chromium (D007) when there is the potential for this metal to be leached from stainless steel equipment or items in the process, lead (D008) when leaded gloves are used in the process, and mercury (D009) when there is a potential for a glass mercury thermometer to have been used in the same glovebox.

** P/S codes WM, XO, and XO have conservatively been assigned the same cumulative list of EPA HWNs, regardless of information indicating that specific hazardous constituents are not expected in one or more of these P/S codes, because application of these P/S codes to specific waste containers has been inconsistent at TA-55 (M-050/TWCP-3546).

ME F003 (acetone)

SA F002 (methylene chloride), F003 (diethyl ether); F005 (benzene, toluene, pyridine)

WM, XO, XO F001 (trichloroethylene, 1,1,2-trichloro-1,2,2-trifluoroethane (freon)); F002 (methylene chloride, trichloroethylene); F005 (methyl ethyl ketone)

No K or P listings apply to solid wastes generated from any of the miscellaneous operations because no K-listed or P-listed chemicals were present in the feed materials, chemicals, or equipment used in these processes.

4.2 Toxicity Listings

The list below is summarized from Table 5 and lists the EPA HWNs applicable to waste from processes described in this report. P/S codes marked with an asterisk (*) in the list do not contain RCRA-listed constituents in the feed material or in the chemicals used in the process, but have been assigned HWNs due to the potential for chromium (D007) to be leached from stainless steel equipment or items in the process, lead (D008) due to the use of leaded gloves in the process, and mercury (D009) if there is a potential for a glass mercury thermometer to have been used in the same glovebox. Prior to May 1992, leaded gloves were disposed with other metal waste under the originating P/S code. Since May 1992, the gloves have been routinely segregated from other metal debris (TWCP-4166).

No D001 (ignitable), D002 (corrosive), or D003 (reactive) listings apply to the solid wastes from miscellaneous operations because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 6.0).

move to 4.3

Separate line for AC1 [copy P/S codes from above]

| | | |
|---|---|---|
| AC, ~~AC1~~, AC2 | | D007, D008, D009, D011, D018, D022, ~~D030~~ D038, U213 |
| ACL | * | D007, D008, D009 |
| AD | | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039 |
| APD | | D007, D008, D009, D019, D021, D022, D039 |
| AX | * | D007, D008, D009 |
| CK | | D005, D006, D007, D008, D009, D011 |
| CV | | D005, D006, D007, D008, D009, D011, D019, ~~D030~~ |
| EDC | * | D007 [~~D008~~] stet |
| EOC | * | D007, D008, D009 |
| EXT | | D005, D006, D007, D008, D009, D011 |
| FDL | | D004, D005, D006, D007, D008, D009, D011 D010 |
| FLU | | D004, D005, D006, D007, D008, D009, D011 D010 |
| HRS | * | D008 |
| IB | | D005, D006, D007, D008, D009, D011 |
| ICP | * | D007, D008, D009 |
| IE | | D005, D006, D007, D008, D009, D011 |
| LI | | D005, D006, D007, D008, D009, D011 |
| ME | | D007, D008, D040 |
| RASS/RSS | | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RD | | D008 |
| SA | | D007, D008, D009, D018, D038 |
| SO | | D004, D005, D006, D007, D008, D009, D010, D011 |
| STF | | D007, D008 |
| WM | | D007, D008, D009, D022, D035, D040 |
| ~~X0~~ | | ~~D007, D008, D009, D022, D035, D040~~ stet ~~check~~ |
| XES | | D004, D005, D006, D007, D008, D009, D010, D011 |
| XO | | D007, D008, D009, D022, D035, D040 |
| XP | | D004, D005, D006, D007, D008, D009, D010, D011 |

Activities under P/S codes LIBS, NCD, and SMP do not generate solid waste to which any HWN would be applicable.

Insert from 4.3

4.3 Corrosivity, Reactivity, and Ignitability

~~See Section 6.~~0.

DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 6.0 and 7.0.

## 9.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the miscellaneous operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 4, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal disposal (TWCP-AK-2.1-005,R.1, Section 9.0). This oil does not enter the LANL disposal operations.

## 10.0 VERIFICATION THAT THERE IS NO ASBESTOS IN THE WASTE

Asbestos heating mantles were never used at TA-55. Asbestos gloves were used in glovebox operations in P/S codes OR and RM (TWCP-4162, TWCP-4166), which are discussed in *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006,R.1) and *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007,R.1), respectively. Asbestos-bearing transite was widely used until recently for thermal insulation, including as a coverplate over the furnace in glovebox wells, and as part of end plates on Lindberg furnaces (TWCP-4162, TWCP-4166). Although many Lindberg furnaces have been replaced with newer asbestos-free furnaces, some are still in use at TA-55. The transite would have been disposed either as metal or as ceramic and glass debris waste.

## 11.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)

- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),*

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AC<br>AC1<br>AC2 | Actinide Chemistry R&D | Actinide metals<br><br>Acetonitrile | Actinide (Th-Am) metals<br>Alcohols (unspecified)<br>Alkali metals<br>Alkaline earth metals<br>Alkylating agents (unspecified)<br>Benzene<br>Chloroform<br>Cryogens<br>Dichloromethane<br>Hexane<br>Hydrochloric acid<br>Inorganic reagents/complexes (unspecified)<br>Inorganic salts (unspecified)<br>Lanthanide metals<br>Nitric acid<br>Perchloric acid<br>Phosphates<br>Phosphines<br>Potassium hydroxide<br>Potassium salts<br>Silver salts<br>Sodium hydroxide<br>Sodium salts<br>Tetrahydrofuran<br>Toluene<br>Transition metals<br>Transition-lanthanide-, actinide- metal complexes | Solvated halide complexes yielding homoleptic alkyl complexes; and unspecified | Reaction byproducts, residues, precipitated salts, spent solvents, spent acids, filtration media, debris | D007, D008, D009, D011, D018, D022, F002, F005<br><br>D038<br><br>U213 | M-025<br>M-038 |
| AC3 | Actinide Chemistry | NA | NA | NA | NA | NA | NA |

Separate — for draft, just duplicate row for AC1; will ask Jim Foxx to indicate which chemicals were used in which process

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AX | Solution Assay | Nitric and hydrochloric acid solutions with plutonium | Hydrochloric acid<br>Nitric acid | Plutonium chloride solutions to P/S CX<br>Plutonium nitrate solution to P/S RR | Nitric and hydrochloric acid solutions | D007, D008, D009 | M-005 |
| CK | RD&D Volatile Fluoride Plutonium Recovery | Solid residues of $PuO_2$ | 1-propanol (as coolant)<br>Aluminum oxide<br>Fluorine gas<br>FOOF<br>Liquid nitrogen<br>Oxygen<br>Sodium bicarbonate<br>Trichloroethylene | Plutonium hexafluoride, unreacted ash | Spent aluminum oxide and sodium bicarbonate, organic reagents and solvents, debris | D005, D006, D007, D008, D009, D011 | M-010<br>M-035 |
| CV | RD&D Experimental Chlorination Processes | Plutonium in various chemical forms; solid $PuO_2$ | Dilute acids/bases (unspecified)<br>Ammonium chloride<br>Carbon tetrachloride<br>Hydrochloric acid<br>Hydroxylamine hydrochloride<br>Nitric acid<br>Perchlorocarbons<br>Potassium hydroxide<br>$^{239}Pu$, $^{237}Np$, $^{241}Am$, $^{235/238}U$, $^{232}Th$ in various compounds, residues, metal alloys<br>Sodium bicarbonate<br>Tetrachloroethylene<br>Thionyl chloride | Anhydrous plutonium chloride; plutonium hexafluoride | Spent solvents and reagents, spent sodium bicarbonate, inorganic salts, debris | D005, D006, D007, D008, D009, D011, D019, ~~D030~~ | M-027<br>M-035 |
| EDC | Electrolytic Decontamination | Disassembled weapons components | Alkaline solutions<br>Sodium nitrate<br>Sodium sulfate | Decontaminated components | Evaporated uranyl hydroxide and uranyl sulfate, electrolytes (inert, nonhazardous salts), precipitated solids, spent caustic rinses, debris | D007, D008 | M-014<br>M-041 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| EOC | Experimental Oxide Characterization | Plutonium oxide (high-purity) | Purified nitrogen and helium<br>Liquid nitrogen | Plutonium oxide | Debris | D007, D008, D009 | M-015<br>M-040 |
| EXT | Extraction RD&D | Various plutonium-containing matrices, pyrochemical salts | Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Potassium hydroxide<br>Sodium hydroxide | Aqueous solutions of plutonium | Spent aqueous and organic solutions, spent pyrochemical salts, debris | D005, D006, D007, D008, D009, D011 | M-013 |
| FDL | FOOF Demonstration Loop | Solid residues of $PuO_2$ and $PuF_4$ | Aluminum oxide<br>Carbon tetrafluoride<br>Fluorine gas<br>FOOF<br>Krypton fluoride<br>Methane<br>Nitrogen, liquid and gas<br>Oxygen<br>Sodium bicarbonate | Plutonium hexafluoride, unreacted ash | Spent aluminum oxide and sodium bicarbonate, debris | D005, D006, D007, D008, D009, D011 | M-011<br>M-036 |
| FLU | Fluorination RD&D | Solid $PuO_2$ | Aluminum oxide<br>Ammonium chloride, fluoride, bifluoride<br>Argon<br>Fluorine gas<br>FOOF<br>Hydrochloric acid<br>Krypton fluoride<br>Nitrogen<br>Sodium bicarbonate | Recoverable plutonium | Debris | D005, D006, D007, D008, D009, D011 | M-012<br>M-035 |
| HRS | High Resolution Spectroscopy | Actinide compounds | Carbon dioxide<br>Fluorine<br>FOOF<br>Liquid nitrogen<br>Nitrogen dioxide<br>Sodium bicarbonate | Gas-phase actinide-containing species ($PuF_6$, $UF_6$, $NpF_6$, $AmF_6$) | Sodium bicarbonate filter (reactive gas traps), debris | D008 | M-023<br>M-036 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| RASS/ RSS | RAMAN Spectroscopy System | Solids or solutions with plutonium | Dilute acids (unspecified) | None | Used samples, debris | D004, D005, D006, D007, D008, D009, D010, D011, D019 | M-043 |
| RD | Repackaging into Retrievable Drums | NA | NA | NA | NA | D008 | M-046 |
| SA | Super Acid RD&D | Various actinide compounds and matrices; actinide (Np, Pu, Th, Am, Cm, U) metals | Aluminum oxide<br>Antimony pentafluoride<br>Benzene<br>Bromine<br>Diethyl ether<br>Hydrofluoric acid<br>Inorganic reagents (such as $NaN0_3$)<br>Iodine<br>Magnesium oxide<br>Methylene chloride<br>Organic reagents (such as CMPO)<br>Pyridine<br>Sulfuric acid<br>Hydrocarbon, ethereal, and aromatic solvents (unspecified)<br>Tetrahydrofuran<br>Toluene | Superacid solutions and evaporated solid superacid complexes; solvated halide complexes yielding homoleptic alkyl complexes | Spent aqueous and organic solvents and reagents, organometallic and inorganic compound residues, debris | D007, D008, D009, D018, D038, F002, F003, F005<br>U213 | M-004<br>M-024<br>M-037 |
| SMP | SP Mounting Preparation | NA | NA | NA | NA | | M-044 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| X0 | Inactive or Unspecified P/S Material | Waste materials from common areas (e.g., hallway, change rooms, basement) that could not be associated with a specific room | NA | None | Miscellaneous trash and debris | Default HWNs (see Table 5): D007, D008, D009, D022, D035, D040, F001, F002, F005 | M-046, M-050 |
| XES | X-Ray Energy Spectroscopy | Solid plutonium samples | Acid/base solutions (unspecified) | None | Unused/spent solid plutonium samples, spent acid/base solutions from sample preparation | D004, D005, D006, D007, D008, D009, D010, D011 | M-042 |
| XO | Inactive or Unspecified P/S Material | Waste materials generated within specific rooms but not associated with a specific P/S code; room trash boxes | Chloroform<br>Ethanol<br>Hexane<br>Isopropyl alcohol<br>Methylene chloride<br>Methyl ethyl ketone<br>Trichloroethylene<br>1,1,2-trichloro-1,2,2-trifluoroethane [freon]<br>Organic strip<br>Citra peel | None | Rags contaminated with organic chemicals; other room trash and debris | Default HWNs (see Table 5): D007, D008, D009, D022, D035, D040, F001, F002, F005 | M-046, M-050 |

Checked - all changes made JTM 5/1/01

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-004,R.2 (LA-UR-01-)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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The solids were ~~rang~~ wrong from rags with water before they were discarded. Any perchloric salts were ~~ended up in~~ sent to cementation

AC1 and AC2 were that AC1 was an analytical process using aqueous compounds, predominantly dilute nitric, hydrochloric, and perchloric acid solutions. These acidic solutions would have been neutralized and precipitated to recover the plutonium. ~~Solids were sent to recovery, and~~ Solutions were sent to cementation. P/S code AC2 involved synthesis of (air-sensitive) new compounds in an inert glovebox. This was a non-aqueous process. P/S code AC3 is not related to P/S codes AC1 or AC2, but is predominantly a metal operation (M-038/TWCP-3545). This code had not yet become active by the time this report was prepared, and no other information was available for it.

The procedure describes operations that comprise a broad range of laboratory activities in support of fundamental and applied actinide chemistry research (M-025/TWCP-3546). These activities include, but are not limited to, preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation. The chemical list indicates the use of a variety of materials, including organic solvents (e.g., toluene and benzene), alkaline earth metals, and transition metals. The SMEs (M-038/TWCP-3546) familiar with these activities indicated that a "variety of aromatic, alkaline, and chlorinated solvents" (e.g., tetrahydrofuran, toluene, benzene, methylene chloride, and chloroform) were used in these activities. Hexane and acetonitrile began to be used in P/S code AC2 recently. Acetonitrile is an Ap. VIII VOC, but its HWN (U003) does not apply in this case. These organic chemicals have the following HWNs: benzene (D018, F005), chloroform (D022), methylene chloride (F002), tetrahydrofuran (U213), and toluene (F005). The SME stated that waste byproducts from the operations that contain these constituents were not discarded but were held in the glovebox for reprocessing or recovery. Because the SME was not involved with these activities after 1994, he was unable to definitively state how the waste materials were ultimately dispositioned. In a later discussion, other SMEs (M-038/TWCP-3546) indicated that use of the chlorinated solvents associated with P/S code AC1 was discontinued in 1994 and that items contaminated with these constituents mentioned are still in the glovebox and have yet to be discarded as of the date of this report. Transition metals used as reagents in the synthesis of new materials in this process included sodium salts, potassium salts, and silver salts. The precipitated salt byproducts also were not discarded but were held in the glovebox for reprocessing and recovery. In a later discussion, other SMEs confirmed that silver salts associated with P/S code AC1 are still in the glovebox awaiting determination for a path forward for disposition. Other than silver (D011), no RCRA metals were used in the processes (M-038/TWCP-3546). In addition to the standard debris wastes, process wastes may have included reaction by-products and residues, heating mantles, vacuum pump apparatus, various pieces

P/S code XES is a plutonium assay technique in which samples containing plutonium are excited with X-rays, and the resulting emission spectra are measured to determine plutonium concentrations (M-042/TWCP-3546). Sample preparation may occasionally require the use of acid/base solutions to suspend solids. Unused sample material is returned to the originator. The time period for P/S code XES is 1988 to present. The process occurs in Room 106.

P/S code RASS/RSS involves interrogating small samples (solids or solutions containing less than 1 gram of nuclear material from other P/S codes) using laser-based spectroscopy (M-043/TWCP-3546). This P/S code was created February 1993 and is still active although the process has not been used in two to three years. The operation takes place in Room 105, GB-165. Sample preparation is not conducted under this P/S code. If samples require preparation prior to spectroscopy (e.g., if the sample must be diluted with an acid solution because plutonium concentrations are too high), the preparation steps are performed by the originating P/S code. Once analyzed, samples are returned to the originating P/S code, sent on to other P/S codes, or sent for recovery/reprocessing. No waste is generated from this P/S code except standard glovebox trash, including gloves that may be leaded or unleaded.

P/S code LIBS used a laser for isotopic analyses of samples of high purity metals and oxides (M-047/TWCP-3546). The process was initiated January 1998 and is still operational. Some developmental work commenced prior to 1998; however, this was before the process went "hot." Process activities are conducted in Room 105, GB 158 and 180. Waste forms include standard glovebox maintenance items. There is no sample preparation involved, and no organic or RCRA metal constituents are introduced or generated during the process.

~~P/S code SMP~~ has "never gone hot" (M-044/TWCP-3546) but may start up in the ~~first six months of 2000.~~ end of 2001 The process will take place in Room 120 and will involve mounting samples of plutonium metal and stainless steel using a low-melting bismuth-tin alloy in preparation for electron microscopy. No organic solvents or RCRA metals will be introduced or generated as wastes during the process. No other sample preparation will be done under this P/S code. Any required surface preparation will be done at the originating P/S code, and samples will be returned to the originating P/S code. Waste will consist of standard glovebox maintenance items.

P/S code EOC began in March 1992 in Room 208 as an experiment designed to calculate the surface area and pore size distribution of a sample and to analyze its surface characteristics (M-015/TWCP-3546).

HEPA filters, metal containers, brushes, and small tools. Leaded gloves are also generated as process waste. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item ID number and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance (QA) personnel.

### 3.5.2 Radionuclide Content Identification

The primary plutonium material type inputs for miscellaneous operations at TA-55 are listed in Table 2, and uranium material types are listed in Table 3. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Tables 2 and 3 indicate the isotopic composition of the material types at the time the waste was characterized.

See AK-02

The plutonium material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments (Weight %)**

bounds dimensionless

| Material Type (MT) | Plutonium isotope and half-life | | | | | | Upper limits for weight ratios | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

Source: TWCP-698

**Table 3. Average Isotopic Content of Uranium Material Types and Enrichments (Weight %)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Source: TWCP-698

Footnote: (see AK-02, the Chloride operation rep.)

## Table 4. Chemical Inputs to Processes Described in This Report

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| **Gases and Cryogens** | | |
| Carbon dioxide (gas)<br>Fluorine (gas)<br>Halogen fluorides<br>Krypton fluoride<br>Methane (gas)<br>Nitrogen dioxide (gas)<br>Nitrogen, liquid | | D001 and D002 do not apply to these gases because there are no free liquids in this waste. Also the gas cylinders are outside the building, and the gases are plumbed into the glovebox. |
| **Acids** | | |
| Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Oxalic acid<br>Perchloric acid<br>Sulfuric acid<br>Superacids (e.g., $HSO_3F$) | <br><br><br><br>AD<br><br>SA | D002 does not apply to the solid debris waste because there are no free liquids in this waste. D001 (oxidizer) does not apply to the use of nitric or perchloric acid or to the superacids for the same reason. |
| **Bases** | | |
| Calcium hydroxide<br>Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the solid debris waste because there are no free liquids in this waste. |
| **Inorganic Chemicals** | | |
| Aluminum bifluoride<br>Aluminum chloride<br>Aluminum fluoride<br>Aluminum nitrate<br>Aluminum oxide<br>Ammonium chloride<br>Antimony pentafluoride<br>Bromine<br>FOOF<br>Hydrogen peroxide<br>Iodine<br>Iron oxide<br>Lead and lead hydroxide, oxide, or nitrate<br>Magnesium oxide<br>Na, K, Li, Mg, Ca, Fe, nitrates, chlorides, carbonates, bicarbonates, oxalate, nitrites<br>Phosphates<br>Potassium choride<br>Potassium dichromate | <br><br><br><br><br><br><br><br><br><br><br><br>AD, APD<br><br><br><br><br><br>AD | <br><br><br><br><br><br><br><br><br><br><br><br>D008<br><br><br><br><br><br>D007 |

Hydroxylamine hydrochloride
Hydroxylamine nitrate

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| Potassium permanganate | | |
| Potassium salt (not specified) | | |
| Silver salt | AC1 | D011 |
| Sodium bicarbonate | | |
| Sodium carbonate | | |
| Sodium chloride | | |
| Sodium chlorite | | |
| Sodium nitrate | | |
| Sodium salt (not specified) | | |
| Sodium sulfate | | |
| Thorium oxide | | |
| **Metals** | | |
| Alkaline earth metals | | |
| Bismuth-tin alloy | | |
| Gallium metal, oxide or salt | | |
| Lanthanide metals | | |
| Platinum and platinum-rhodium alloys | | |
| Stainless steel | | D007 (chromium) |
| Tantalum metal, oxide or salt | | |
| Zirconium and tantalum alloys | | |
| **Organic Chemicals** | | |
| 1-propanol | | |
| Acetone | ME | F003 |
| Acetonitrile | AC2 | Appendix VIII compound. EPA HWN U003 does not apply due to the manner in which this chemical is used in TA-55 processes. |
| Alkylating agents (unspecified) | | |
| Benzene | AC/AC1/AC2, SA | D018 and F005: solvent use |
| Carbon tetrachloride | AD, CV | D019 applies to AD and CV. F001 does not apply because this chemical was not used for degreasing. |
| Carbon tetrafluoride | | |
| Chloroform | AC/AC1/AC2, APD, XO | D022 |
| Citrapeel | | |
| DBBP (dibutyl butyl-phosphonate) | | |
| DBBP (dibutyl butyl-phosphonate) / Isopar (isoparaffinic hydrocarbon solvent) | | |
| Diethyl ether | SA | F003 |
| Dihexyl N,N-diethylcarbamoylmethyl phosphonate (DHDCMP) | | |
| Diisopropyl benzene | | |
| Ethanol | | |
| Hexane | | |
| Hydrazine dihydrochloride | | |
| Hydrazine hydrochloride | | |
| ~~Hydroxylamine chloride~~ | | |
| ~~Hydroxylamine nitrate~~ | | |

move to inorganic list

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

(see AK-02!)

- ~~Explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s.~~ Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning.

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA055 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 7.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 6.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 8.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles

## 10.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.5)
- *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002,R.1)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003,R.1)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005,R.1)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006,R.1)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007,R.1)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)

## ACCEPTABLE KNOWLEDGE ROADMAP

**Waste from P/S Codes:** AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, XES, XP, XO, X0

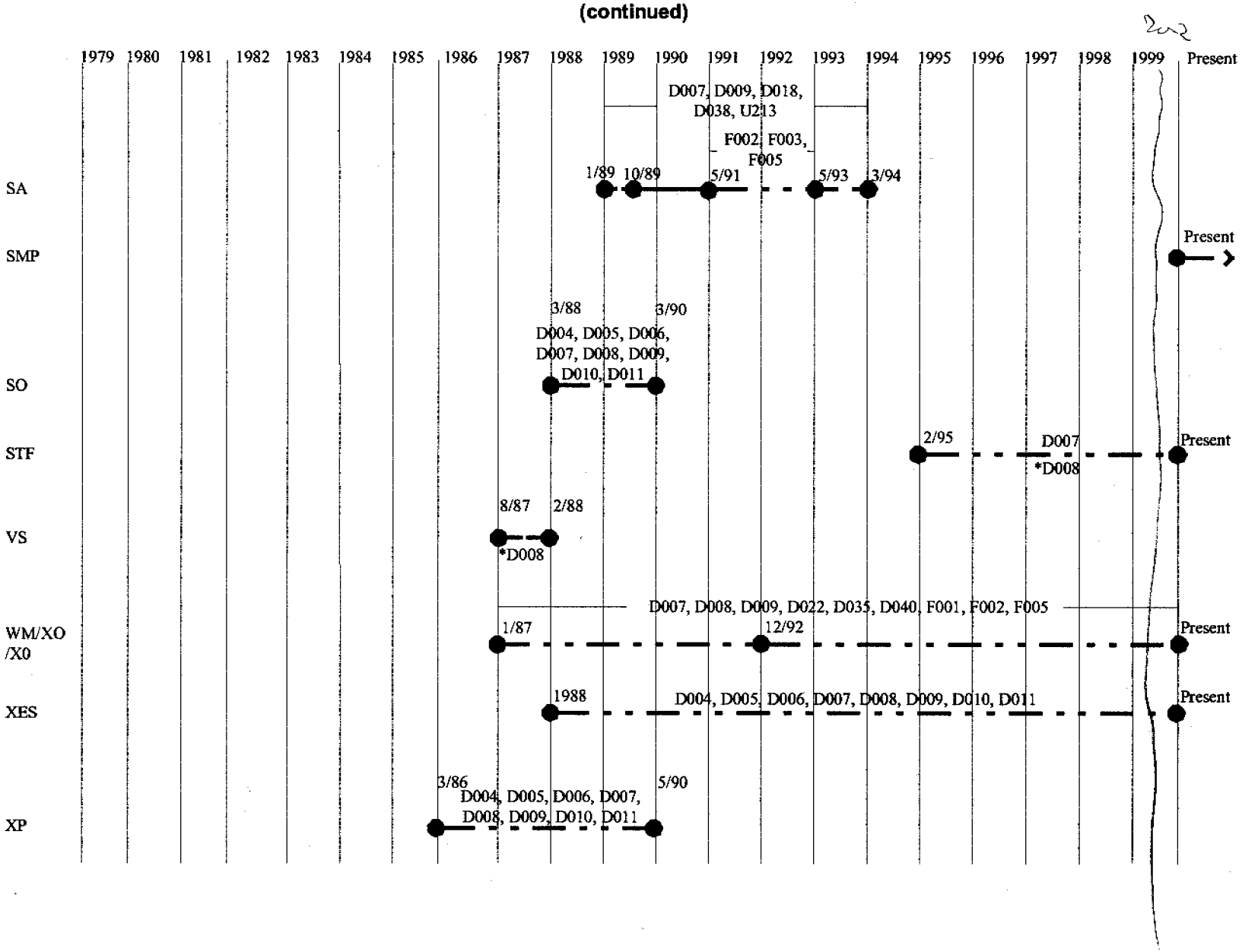
Copies of these documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | Budget information may not be acceptable. |
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

Add to the roadmap: (TWCP sampling plan.) see AK-02!
(AK-reports.)

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

## TIMELINE FOR TA-55 MISCELLANEOUS PROCESSES (continued)



Draft # 2
5/1/01 JTM

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-004,R.2 (LA-UR-01-)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

**EFFECTIVE DATE:** _____

**NEXT REVIEW DATE:** _____

**DOCUMENT PREPARER:**

_____ _____
NAME DATE

**APPROVALS:**

_____ _____
INDEPENDENT TECHNICAL REVIEWER/EDITOR DATE

_____ _____
SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 06/30/00 | — | New report (TWCP-03941) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | | All | To respond to CBFo reviewers comments and to update with new AK information |
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**Attachments**

1 Acceptable Knowledge Roadmap (14 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Timeline for TA-55 Miscellaneous Processes (6 pages)
4 Process Inputs and Outputs (11 pages)
5 Simplified Process Flow Diagram (1 page)

insert new section 3.2 "Basis, Assumption ... from file

Change all 3.4...
to 3.5...



## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**Note:** This index indicates the main process AK summary report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| AC | Actinide Chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 |
| AC1 | Actinide Chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 |
| AC2 | Actinide Chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 |
| AC3 | Actinide Chemistry, R&D | Miscellaneous Operations | 3.4.3, Att. 4 |
| ACL | Analytical Chemistry Laboratory | Miscellaneous Operations | 3.4.4, Att. 4 |
| AD | Actinide Processing Demonstration | Miscellaneous Operations | 3.4.1, Att. 4 |
| APD | Actinide Processing Demonstration | Miscellaneous Operations | 3.4.7, Att. 4 |
| AX | Solution Assay | Miscellaneous Operations | 3.4.3, Att. 4 |
| CF | Cement Fixation | Nitrate Operations | 3.4.5, Att. 4 |
| CK | RD&D Volatile Fluoride Pu Recovery | Miscellaneous Operations | 3.4.2, Att. 4 |
| CV | R&D Experimental Chlorination Processes | Miscellaneous Operations | 3.4.2, Att. 4 |
| CX | Chloride Anion Exchange | Chloride Operations | 3.4.2, 3.4.3, Att. 4 |
| EDC | Electrolytic Decontamination | Miscellaneous Operations | 3.4.8, Att. 4 |
| EOC | Experimental Oxide Characterization | Miscellaneous Operations | 3.4.5, Att. 4 |
| EV | Evaporator | Nitrate Operations | 3.4.4, Att. 4 |
| EXT | Extraction RD&D | Miscellaneous Operations | 3.4.6, Att. 4 |
| FDL | FOOF Demonstration Loop | Miscellaneous Operations | 3.4.2, Att. 4 |
| FLU | Fluorination RD&D | Miscellaneous Operations | 3.4.2, Att. 4 |
| HP | Cement Fixation | Nitrate Operations | 3.4.5, Att. 4 |
| HRS | High Resolution Spectroscopy | Miscellaneous Operations | 3.4.5, Att. 4 |
| IB | Matrix Study of Pyrochemical Salts | Miscellaneous Operations | 3.4.6, Att. 4 |
| ICP | ICP–AES Analysis | Miscellaneous Operations | 3.4.4, Att. 4 |
| IE | Isotope Enrichment | Miscellaneous Operations | 3.4.2, Att. 4 |
| IS | Incinerator | Nitrate Operations | 3.4.1, Att. 4 |
| LI | XF6 Experimental Measurements | Miscellaneous Operations | 3.4.2, Att. 4 |
| LIBS | Laser-Induced Breakdown Spectroscopy System | Miscellaneous Operations | 3.4.5, Att. 4 |

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| ME | Metallography | Miscellaneous Operations | 3.4.10, Att. 4 |
| NCD | Nonconfirming Drums | Miscellaneous Operations | 3.4.9, Att. 4 |
| OR | Direct Oxide Reduction | Pyrochemical Processes | 3.4.2, Att. 4 |
| PTS | RD&D Pretreatment Study | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 |
| PX | Pyrochemical R&D | Special Processing | 3.4.6, 3.4.7, 3.4.8, 3.4.9, 3.4.10, Att. 4 |
| RASS/RSS | Raman Spectroscopy System | Miscellaneous Operations | 3.4.5, Att. 4 |
| RB | Roasting and Blending | Nitrate Operations | 3.4.3, Att. 4 |
| RBJ | Roasting and Blending Jr. | Nitrate Operations | 3.4.3, Att. 4 |
| RC | Rotary Calciner | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 |
| RD | Repackaging into Retrievable Drums | Miscellaneous Operations | 3.4.9, Att. 4 |
| RR | Ion Exchange | Nitrate Operations | 3.4.3, Att. 4 |
| SA | Super Acid RD&D | Miscellaneous Operations | 3.4.3, Att. 4 |
| SMP | SP Mounting Preparation | Miscellaneous Operations | 3.4.5, Att. 4 |
| SO | Super Oxidizer, FOOF Program | Miscellaneous Operations | 3.4.2, Att. 4 |
| SS | Salt Stripping | Pyrochemical Processing | 3.4.3, 3.4.4, 3.4.5, 3.4.7, 3.4.8, Att. 4 |
| STF | Standard Fabrication | Miscellaneous Operations | 3.4.6, Att. 4 |
| VS | Confirmation, Inspection & Sampling | Miscellaneous Operations | 3.4.5, Att. 4 |
| WM | Waste Management | Miscellaneous Operations | 3.4.9, Att. 4 |
| X0 | Inactive or Unspecified P/S Material | Miscellaneous Operations | 3.4.9, Att. 4 |
| XES | X-Ray Energy Spectroscopy | Miscellaneous Operations | 3.4.5, Att. 4 |
| XO | Inactive or Unspecified P/S Material | Miscellaneous Operations | 3.4.9, Att. 4 |
| XP | RD&D Experimental Processes | Miscellaneous Operations | 3.4.4, Att. 4 |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Miscellaneous Operations (this report), Nitrate Operations (TWCP-AK-2.1-005,R.2), Pyrochemical Processes (TWCP-AK-2.1-006,R.2), and Special Processing (TWCP-AK-2.1-007,R.2)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Miscellaneous Operations

**P/S codes**:

AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed, combustible and non-combustible debris; liquid wastes sent to the Radioactive Liquid Waste Treatment Facility at TA-50 or immobilized in cement (as part of nitrate operations)

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from miscellaneous operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

TA-55 Plutonium Facility (Building PF-4), Rooms 105, 106, 112, 113, 115, 120, 124, 126, 208, 209, 210, 401, 409, 420, and 432

**Description of the process waste (physical form and typical content description):**

Primarily debris waste, including cellulosic materials, plastic, rubber, ceramic, metal and glass debris, and waste sent to nitrate operations to be immobilized in cement.

**Description of the waste-generating process:**

The overall goal of the miscellaneous operations is to recover plutonium from metal, metal alloys, scrap, and residues and produce a purified plutonium oxide product or feedstock for conversion to metal. Processes in miscellaneous operations include pretreatment, dissolution, purification, and hydroxide precipitation.

Summary Category Group(s): S5000
Waste Matrix Code(s): S5100, S5300, S5400

**Process feed:**

Plutonium metal or metal alloy, oxides and hydroxide cakes; pyrochemical salts; anode heels; ash; and residues from other DOE facilities

**Radioisotopic content of the waste:**

Variety of plutonium material types with different well-defined isotopic compositions; americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium or plutonium and uranium. The waste will usually be enriched in americium and uranium, but may also be depleted in some cases. Protactinium-231 and Cesium-137 may be present in trace amounts due to their widespread past presence as contaminants in TA-55 operations.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- No K or P codes
- F001: P/S codes WM, XO, X0 (trichloroethylene and 1,1,2-trichloro-1,2,2-trifluoroethane (freon))
- F002: P/S codes AC/AC1/AC2, AD, APD, SA, WM, X0, XO (chlorobenzene, methylene chloride, tetrachloroethylene, trichloroethylene)
- F003: AD, APD, ME, SA (acetone, diethyl ether, methanol, xylene)
- F005: P/S codes AC/AC1/AC2, SA, WM, X0, XO (benzene, methyl ethyl ketone, toluene, pyridine)
- D004 (arsenic) and D010 (selenium): P/S codes AD, FDL, FLU, RASS/RSS, SO, XES, XP
- D005 (barium) and D006 (cadmium): P/S codes AD, CK, CV, EXT, FDL, FLU, IB, IE, LI, RASS/RSS, SO, XES, XP
- D007 (chromium) and D009 (mercury): P/S codes AC, AC1, AC2, ACL, AD, APD, AX, CK, CV, EDC (D007 only), EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, ME (D007 only), RASS/RSS, RD, SA, SO, STF (D007 only), VS, WM, X0, XES, XO, XP
- D008 (lead, excluding leaded gloves): P/S codes AD, APD, CK, CV, EXT, FDL, FLU, IB, IE, LI, RASS/RSS, SO, WM, X0, XES, XO, XP
- D008 (leaded gloves only): P/S codes AC, AC1, AC2, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, ME, RASS/RSS, RD, SA, SO, STF, VS, WM, X0, XES, XO, XP
- D010 (selenium): P/S codes AD, FDL, FLU, RASS/RSS, SO, XES, XP
- D011 (silver): P/S codes AD, APD, CK, CV, EXT, FDL, FLU, IB, IE, LI, RASS/RSS, SO, XES, XP
- D018 (benzene): P/S codes AC, AC1, AC2, SA
- D019 (carbon tetrachloride): P/S codes AD, APD, CV, RASS/RSS
- D021 (chlorobenzene): P/S code APD

- D022 (chloroform): P/S codes AC, AC1, AC2, APD, WM, X0, XO
- D035 (methyl ethyl ketone): P/S codes WM, X0, XO
- D038 (pyridine): P/S code SA, AC, AC2,
- D039 (tetrachloroethylene): P/S codes AD, APD, CV
- D040 (trichloroethylene): P/S codes ME, WM, X0, XO
- U213 (tetrahydrofuran): P/S codes AC, AC2, SA [applicability to be determined]
- No HWN: P/S codes LIBS, NCD, SMP

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

# PROCESS AK SUMMARY REPORT FOR MISCELLANEOUS OPERATIONS AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes ~~used by~~ one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for ~~one~~ several ~~or more~~ waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to ~~Technical Area~~ (TA)-55 waste streams resulting from miscellaneous (i.e., mixed oxide, uranium, analytical, and research and development) processes covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) (Sampling Plan) that includes information regarding all TRU waste streams
- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to miscellaneous operations is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No. TWCP-3546. Individual documents in this record have been assigned a separate identifier, M-nnn, where nnn is a sequential 3-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in miscellaneous operations, and identify the resulting wastes as well as outputs that are sent to other operations, such as nitrate operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Processes in miscellaneous operation were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes, including those for non-defense activities. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (TWCP-816).

Insert new Section 3.2 → 3.2 3 Waste Physical Form and Content Description

(File named Process AK section 3-2.doc)

Wastes generated during miscellaneous operations, primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50, are covered by this process AK report. General debris waste categories from miscellaneous operations include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Metal debris (for example, wire, hose clamps, tools, labware)
- Glass debris

These debris waste items are contaminated with small amounts of radioactive and chemical substances. In addition to these general debris categories, miscellaneous processes also generated waste consisting of organometallic and inorganic solids of various compositions, sand and slag, ash, and crucibles.

## 3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1979, when miscellaneous processes first began at TA-55, to the present. Process wastes from miscellaneous operations have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding HWNs are shown graphically in Attachment 3, Time Lines. These timelines are based on a review of procedures that guided the experimental and demonstration studies and miscellaneous research and development (R&D) operations at TA-55 and information from SMEs familiar with the operations. Many of the operations were short duration and/or changed frequently. Initiation or continuation of a process was surmised based on the date of approval for a given procedure. In some cases, a series of procedures or related documents for one process could be located to establish the timeline. In many other cases, discontinuities between procedure titles and numbers made it difficult to determine how long the process may have continued before it was modified or ended. For purposes of this report, the time period for the process is assumed to continue two years beyond the date of the last approved procedure unless otherwise indicated. Some processes have continued to the present. In cases where a given procedure did not identify the associated P/S code for the operation, a P/S code assignment was applied when the process description matched or was similar to a description in a previous or later revision of the same or a related procedure. Procedures were not available for some P/S codes (see Attachment 4). For these P/S codes, interviews with SMEs were used to develop process descriptions and timelines.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

## 3.5 Waste Generation Processes

The following subsections describe the generation and disposal of waste by miscellaneous operations.

Manufacturing and research operations performed at TA-55 in the production of plutonium also generate plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery and manufacturing operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55. Detailed information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352). A full-block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

Research, development, and demonstration (RD&D) projects at TA-55 comprise an array of activities involving applied techniques and methods designed to study and improve processes associated with the purification, separation, extraction, recovery, and characterization of actinides (primarily plutonium) from various matrices. The nature of many of the investigations and experimental activities was such that no one detailed procedure could describe the variety of activities carried out. In many cases a definitive list of chemicals and reagents used in the investigations was not available. The process descriptions that follow are categorized by process group and are arranged within each group in approximate chronological order. A complete listing of P/S codes for miscellaneous operations, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. A simplified process flow diagram for miscellaneous operations is found in Attachment 5.

3.4.1 Extraction, Separation, and Characterization Studies (P/S Code AD)

From July 1979 until September 1994 or later, a series of similar actinide extraction, separation, and characterization R&D studies occurred in Room 208. These studies were conducted under various revisions of three series of procedures: processing of actinide hydroxide cakes from chloride and nitrate operations, development of sensors and instrumentation for online chemical analysis, and purification process development. A P/S code was not assigned to some of the earlier revisions, but is identified as P/S code AD in the latest revision of each series.

In this subsection, each revision of the hydroxide cake processing procedure is described separately because the chemical list and waste produced in the procedure differed in each revision.

- Beginning in July 1979, gloveboxes (GB) 231 and 233 in Room 208 were designated for americium R&D (M-018/TWCP-3546). These wet chemical experiments involved the use of evaporator hydroxide cake samples as the process feedstock. The process accountability flow diagram and procedures for P/S code AD do not identify the P/S codes that feed this operation; however, according to an SME (M-053/TWCP-3546) familiar with this operation, evaporator hydroxide cake samples came from P/S codes EV and HP (part of TA-55 nitrate operations). The hydroxide cake samples were dissolved in concentrated nitric acid, sampled to determine hydrogen, americium, and other principal cations, and subjected to extraction and separation phases to strip off the organics. The reagent list includes concentrated and dilute acids and caustics. Dibutyl butylphosphonate (DBBP) and kerosene were used in the extraction process.

hydroxide cake samples. The procedure indicates strip solutions and spent organics were stored but does not address ultimate disposal of these spent solutions. The process accountability flow diagram for P/S code AD indicates outputs from this operation may be sent to the vault, returned to the originating P/S code, or directed to aqueous recovery or cement fixation based on the discard limit (DL). Materials may also be sent for chemical analysis or transferred to P/S code APD for further experimental development. Assuming that evaporator hydroxide cakes comprised the primary feed material for this code, the hazardous constituents associated with the feedstock material may be concentrated in the actinide-containing matrices and solutions that are discarded as waste. Based on information presented in TWCP-AK-2.1-002,R.1 (chloride operations) and TWCP-AK-2.1-005,R.1 (nitrate operations), hydroxide cakes may contain the D-listed heavy metals cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011).

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3.4.2 Halogenation Studies (P/S Codes CK, CV, FDL, FLU, IE, LI, SO)

A variety of halogenation (chlorination and fluorination) studies were conducted in various rooms and gloveboxes in Building PF-4, Rooms 105, 106, 113 and 208, from March 1988 to October 1992. Brief descriptions of these related operations are provided below. Standard debris waste items that were generated from these operations included rags from general clean-up, miscellaneous tools, labware (glass, plastic, or metal), typical glovebox operations waste; additional types of wastes are listed with each process description.

R&D efforts utilizing fluorinating agents to fluorinate ash samples containing plutonium residues were conducted in Room 105, GB-177, beginning in March 1988 under P/S code SO. A gas flow loop was used to pass a fluorinating agent through a gas-solid reactor where plutonium in the solid residue reacted chemically to form solid $PuF_4$ or gaseous $PuF_6$ (M-007, M-008/TWCP-3546). Gaseous $PuF_6$ was trapped in a cold trap, distilled, and reduced to $PuF_4$. This process was similar to that used in P/S codes FLU and CK (described later in this section) insofar as they all involved related functions (i.e., extraction of plutonium from various matrices), but each process used a slightly different approach (M-035/ TWCP-3546). Chemicals used in this process included fluorine and various halogen fluorides, aluminum oxide, and sodium bicarbonate. The feed material was ash generated in the incinerator (P/S code IS) and that had passed through the rotary calciner (P/S code RC) (M-053/ TWCP-3546). Raw ash from the incinerator contains the RCRA-listed heavy metals barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) in concentrations exceeding the Toxicity Characteristic Leaching Procedure (TCLP) limits. Calcined ash also

waste included trace carbon tetrachloride from reagent bottles. Carbon tetrachloride was used as a chlorinating compound in the reaction loop and would have been completely reacted in the chlorination process (M-035/TWCP-3546). Because carbon tetrachloride was not used as a solvent or degreaser, the F-listing for carbon tetrachloride is not applicable. Process outputs from this operation may have been sent to the vault via the countroom, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the DL). Sub-accountable samples may have been sent to chemical analysis.

A small-scale research operation involving gas-solid and solid-solid fluorination and chlorination chemistry began in March 1992 in Room 113, GB-117 and 179, under P/S code FLU (M-012/TWCP-3546). The process, materials, and chemicals used in this operation were similar to those used in P/S codes SO and CK because they all involved related functions (i.e., extraction of plutonium from various matrices) although each process used a slightly different approach (M-035/ TWCP-3546). The process feedstock (ash) was generated in P/S code IS and also passed through the rotary calciner (P/S code RC) (M-053/TWCP-3546). Raw ash from the incinerator contains the RCRA-listed heavy metals barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) in concentrations exceeding the TCLP limits. Calcined ash also contains these metals (except silver) above the TCLP limits. The process accountability flow diagram indicates that process outputs are sent to the vault or the originating P/S code. Some items were sent to CLS-1 for analysis. No organic chemicals are listed in the procedure. In addition to standard debris waste, other process wastes included used vacuum pump oil, and heating mantles. Hazardous constituents are not expected to be present in these waste items.

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3.4.3 Non-Aqueous Dissolution/Extraction Operations (P/S Codes AC, AC1, AC2, AC3, AX, SA)

Several non-aqueous dissolution/extraction operations occurred in Building PF-4 beginning in 1989 and continuing at least until 1994. These operations are described below.

In January 1989, research operations in Room 208, GB-203, involved the dissolution of actinide compounds and actinide-containing matrices in superacid media. (M-004/TWCP-3546). The superacid solutions were evaporated to leave solid products that were analyzed by a variety of methods. Chemical use included anhydrous hydrofluoric acid, antimony pentafluoride, $HSO_3F$, hydrofluoric acid, and "other superacid solvents" (which are not specified in the procedure). The P/S code for this operation is not identified in the procedure but the process description is

AC1 and AC2 were that AC1 was an analytical process using aqueous compounds, predominantly dilute nitric, hydrochloric, and perchloric acid solutions. These acidic solutions would have been neutralized and precipitated to recover the plutonium. Solutions were sent to cementation. The solids were ~~wrung~~ from rags with water before they were discarded. Any perchloric salts were sent to cementation. P/S code AC2 involved synthesis of (air-sensitive) new compounds in an inert glovebox. This was a non-aqueous process. P/S code AC3 is not related to P/S codes AC1 or AC2, but is predominantly a metal operation (M-038/TWCP-3545). This code had not yet become active by the time this report was prepared, and no other information was available for it.

The procedure describes operations that comprise a broad range of laboratory activities in support of fundamental and applied actinide chemistry research (M-025/TWCP-3546). These activities include, but are not limited to, preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation. The chemical list indicates the use of a variety of materials, including organic solvents (e.g., toluene and benzene), alkaline earth metals, and transition metals. The SMEs (M-038/TWCP-3546) familiar with these activities indicated that a "variety of aromatic, alkaline, and chlorinated solvents" (e.g., tetrahydrofuran, toluene, benzene, methylene chloride, and chloroform) were used in these activities. Hexane and acetonitrile began to be used in P/S code AC2 recently. Acetonitrile is an Ap. VIII VOC, but its HWN (U003) does not apply in this case. These organic chemicals have the following HWNs: benzene (D018, F005), chloroform (D022), methylene chloride (F002), tetrahydrofuran (U213), and toluene (F005). The SME stated that waste byproducts from the operations that contain these constituents were not discarded but were held in the glovebox for reprocessing or recovery. Because the SME was not involved with these activities after 1994, he was unable to definitively state how the waste materials were ultimately dispositioned. In a later discussion, other SMEs (M-038/TWCP-3546) indicated that use of the chlorinated solvents associated with P/S code AC1 was discontinued in 1994 and that items contaminated with these constituents mentioned are still in the glovebox and have yet to be discarded as of the date of this report. Transition metals used as reagents in the synthesis of new materials in this process included sodium salts, potassium salts, and silver salts. The precipitated salt byproducts also were not discarded but were held in the glovebox for reprocessing and recovery. In a later discussion, other SMEs confirmed that silver salts associated with P/S code AC1 are still in the glovebox awaiting determination for a path forward for disposition. Other than silver (D011), no RCRA metals were used in the processes (M-038/TWCP-3546). In addition to the standard debris wastes, process wastes may have included reaction by-products

and residues, heating mantles, vacuum pump apparatus, various pieces of laboratory equipment, spent organic solvents, and filtration media. Process outputs for both P/S codes may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

P/S code AX was related to the dissolution of actinide compounds in superacid media but involved the assay of plutonium in nitric or hydrochloric acid solutions. This operation occurred in Rooms 401, 409, and 420. The procedure was initiated in 1988 and revised in 1989 (M-005/TWCP-3546). Assay solutions were accumulated for transfer to P/S code CX (in chloride operations) or P/S code RR (in nitrate operations). The use of RCRA solvents is not indicated in the procedure.

### 3.4.4 Analytical Operations (P/S Codes ACL, ICP, XP)

P/S code ACL is an umbrella operation that covers all analytical techniques performed in Room 124 (M-042/TWCP-3546). This P/S code began in the 1980s and continues to the present. Processes under this P/S code involve analysis of plutonium and americium, RCRA metals, and trace metals. Originators provide samples, which are prepared for further analyses (e.g., ICP and XES). Analytical preparation may involve the use of nitric acid solutions. Unused liquid samples are returned to the originator, sent to radiochemistry for counting, or sent to recovery operations if established discard limits are exceeded. Discardable wastes (based on discard limits) are disposed to the acid waste line. Some solid wastes (i.e., residues from chromatography) are collected, counted, and sent to recovery operations if the plutonium concentration exceeds the discard limit.

P/S code ICP is one of the plutonium analytical techniques associated with P/S code ACL (M-042/TWCP-3546). This process takes place in Room 106, GB-188 and began in 1987/88. Although still active, this P/S code will eventually be replaced by P/S code ACL.

P/S code XP involved several small-scale R&D efforts primarily focused on plutonium recovery (M-049/TWCP-3546). Operations were conducted in Room 208, GB-227, 228, and 229. This P/S code began in March 1986 and ended in May 1990. It included the following activities:

- Fluoride sintering of $PuO_2$ took advantage of the presence of fluoride to aid the formation of a sintered mass of $PuO_2$ powder at temperatures above 700°C. Process inputs did not involve constituents that would result in the generation of RCRA hazardous waste (M-049/TWCP-3546).

- Chlorination of Pu oxides involved oxides with tantalum chips from Rocky Flats Environmental Technology Site (RFETS). Chlorination was used to recover plutonium from potassium chloride and sodium chloride matrices. Process inputs did not involve constituents that would result in the generation of RCRA hazardous waste (M-049/TWCP-3546).

- Processing of molten salt extract (MSE) salts generated at LANL and RFETS did not involve constituents that would result in the generation of RCRA hazardous waste (M-049/TWCP-3546).

- Recovery of plutonium from ash involving plutonium/thorium oxide mixtures generated ash residues that are likely to contain a variety of contaminants, including RCRA heavy metals such as cadmium, chromium, and lead (M-049/TWCP-3546). The ash was sent to recovery and ultimately cemented. The feed material was ash generated in the incinerator (P/S code IS) and that had passed through the rotary calciner (P/S code RC) (M-053/TWCP-3546). Raw ash from the incinerator contains the RCRA-listed heavy metals barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) in concentrations exceeding the TCLP limits. Calcined ash also contains these metals (except silver) above the TCLP limits.

- Processing of neptunium oxide and metal was performed to remove the protactinium daughter in order to use the neptunium for non-destructive assay (NDA) standards (M-049/TWCP-3546).

Waste from P/S code XP included standard debris items associated with laboratory operations and glovebox maintenance, as well as lead shielding. Phosphine oxide was used as the extracting/complexing agent and diisopropyl benzene, CMPO, and DHDCMP mixtures were used as diluents for processes involving solvent extraction of plutonium leached from a candidate matrix.

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3.4.5 Measurement/Detection Operations and Studies (P/S Codes EOC, HRS, LIBS, RASS/RSS, SMP, VS, XES)

P/S code VS took place in Room 209, GB-210, and involved the inspection of high-purity oxides and metals to verify the inventory in the vault (M-045/TWCP-3546). Materials were retrieved from the vault, brought to the glovebox, inspected, assayed by a non-destructive method, sampled if necessary for chemical analysis (under different P/S codes), then repackaged if necessary, and returned to the vault. Waste from this activity would include vials if the inspected material were sampled, and plastic (from the bagout process). No other materials or

sample and to analyze its surface characteristics (M-015/TWCP-3546). Mixtures of helium and nitrogen are passed through a U-shaped cell containing a sample to be analyzed. Solvents or chemicals other than nitrogen and helium are not indicated in the reagent list or mentioned in the text of the procedure. The operation might still be active (M-040/TWCP-3546). Process outputs from this operation may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

P/S code HRS involved spectroscopic studies in Room 105, GB-189 and 190, from January 1987 through March 1995 (M-036/TWCP-3546). Fluorinated actinide compounds were introduced with compressed gases into a long-path, variable temperature cell for spectroscopic measurement and in preparation for physical chemistry (M-023, M-036/TWCP-3546). RCRA-regulated constituents were not indicated as being used. Process outputs, which were the experimental items used for analysis, are expected to have been the same as the process inputs; therefore, no RCRA or other waste constituents of concern were involved.

3.4.6 Pyrochemical Matrix Studies (P/S Codes IB, EXT, STF)

A pyrochemical matrix study was conducted from May 1986 through February 1995 in Room 208, GB-264. The process was initiated under P/S code IB (Incoming Oxide Blending) in May 1986 (M-039/TWCP-3546). From 1986-1992, the process involved rod milling prior to screening (M-030/TWCP-3546). This process had two objectives: (1) blending large batches of homogeneous plutonium metal oxides (up to 85 percent purity) for pyrochemical operations, and (2) dissolution of 78 percent pure (or greater) plutonium metal oxides for nitrate operations (M-039/TWCP-3546). The materials or impurities in oxides destined for dissolution consisted of high iron, chromium, and halide salts; therefore, this accounted for the sources of chromium in the evaporator bottoms.

The process changed in August 1992 to become the Matrix Study of Pyrochemical Salts when a need developed to blend oxides to provide feed material for P/S codes RB and RBJ to make NDA standards. This activity continued until February 1995 when the process became P/S code STF, which is still an active code conducted in Room 126, GB-138 and 139. The objective of this activity was to determine the effect of pyrochemical salt matrices on the accuracy of NDA measurements (M-029/TWCP-3546). Process activities involved crushing, pulverizing, blending, roasting, and sieving pyrochemical salts. The results were used to determine handling and processing of the salts and for correction of bias measurements. The feed material consisted of high-purity oxides to

use in the fabrication of standards to be used at LANL and throughout the DOE complex (M-039/TWCP-3546). Waste forms included a stainless steel capsule used to contain the standard, and stainless steel cans (similar in size to a paint can) used to contain the oxides. The process did not use or generate wastes containing liquids, solvents, organics or metals (except the stainless steel). Waste included typical glovebox maintenance items (e.g., cheesecloth, rags, HEPA filters, glovebox windows, gloves). Process outputs from this operation were sent to the vault.

P/S code EXT was a small basic research operation that began in March 1992 in Room 106, GB-180. This research effort explored aqueous extraction of plutonium from various waste streams, particularly used pyrochemical salts (M-013/TWCP-3546), using acids and bases. The procedure does not indicate the use of any RCRA-listed chemicals. Wastes from this operation would include rags and paper products from general clean-up; labware that may include glass, plastic, or metal; heating mantles, and spent pyrochemical salts. The process accountability flow diagram and procedures for this process do not identify the P/S codes that fed this operation. Spent pyrochemical salts contain barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) at concentrations that depend upon the process that generated the salt. Concentrations of RCRA heavy metals are below regulatory limits for pyrochemical salts from direct oxide reduction (P/S code OR) (TWCP-2540), but concentrations are not known for pyrochemical salts from salt stripping (P/S code SS) or special processes (P/S code PX). Residues from the solution extraction process were sent to the vault via the countroom, returned to the originating P/S code, or transferred to chloride (P/S code CX) or nitrate (P/S code CF) operations. The D-listed constituents would carry through to subsequent treatment processes. Solutions were transferred to chloride (P/S code CX) or nitrate (P/S code CF) operations, or were disposed to the acid waste line if the solutions met the waste acceptance criteria for the RLWTF at TA-50.

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3.4.7 Hydrothermal Processing (P/S Code APD)

P/S code APD was a hydrothermal processing procedure initiated in March 1996 in Room 208, GB-230 (M-001/TWCP-3546). The operation involves the reaction of aqueous/organic mixtures, pure organic liquids, or contaminated combustible solids (e.g., ion exchange resins, plastic filters, and cellulose rags) under supercritical conditions (i.e., high temperature and pressure). Feed streams include, but are not limited to, analytical laboratory solutions that may contain carbon tetrachloride, tributyl phosphate, and organic solvents (unspecified in the procedure), as well as lead and mercury (Cl-25/TWCP-3547). Process effluents are

gases, liquids and salts. Organic components are oxidized to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components such as chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

The types of chemical wastes generated by hydrothermal processing experiments are predominantly effluents and rags. Hazardous organic constituents, including carbon tetrachloride, are probably destroyed by the hydrothermal process (M-034/TWCP-3546); therefore, organic RCRA-listed constituents in the feed streams would not be expected to be present in the resulting debris waste. Rags contaminated with carbon tetrachloride that were not processed through the hydrothermal reactor would be assigned the hazardous waste code D019. Hazardous inorganic constituents (i.e., RCRA metals) would not be present in the waste (M-034/TWCP-3546) other than any heavy metals present in the feed solutions (e.g., D008 and D009). Process outputs from this operation may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit). Materials may also be sent to Actinide Chemistry R&D (P/S codes AC1 or AC2) or Raman Spectroscopy (P/S code RASS/RSS) for quantification.

### 3.4.8 Electrochemistry Experiments (P/S Code EDC)

Under P/S code EDC, various electrochemistry R&D experiments were conducted in Rooms 105, 106, 112, 208, 209, and 210 in December 1995. Electrochemistry methodologies were designed to decontaminate items, replace processes that produce large amounts of waste, or enhance chemical reactions (M-014 and M-031/TWCP-3546). Electrolytes were typically inert nonhazardous salts. Process inputs were from the vault or metallurgy operations. The process involved uranium decontamination of disassembled weapon components from various sites with various levels of surface contamination with plutonium (M-041/TWCP-3546). The operation was strictly an aqueous process in which an alkaline solution was reacted with the components to precipitate uranium. A stainless steel cathode was used; therefore, corrosion was not an issue and the electrolyte was not degraded. Significant amounts of metal could be stripped in a short period of time. The precipitated solution comprised either uranyl hydroxide or uranyl sulfate, which was then dried for mass balance. The distillate contained small amounts of uranium. Rinse water was discarded to the industrial caustic waste line. RCRA metals would be present in the waste stream but the SME stated that there are "reams of analytical data" to support that RCRA metals are below regulatory threshold limits. However, to be conservative, it is assumed that chromium (D007) could be present in the sand and slag removed during

this process (M-031/TWCP-3546). Outputs from the process are directed to the vault or nitrate recovery operations (P/S code CF).

3.4.9 Metallography (P/S Code ME)

P/S code ME takes place in Room 115 and involves a standard metallography process that was initiated at TA-55 in 1979 and continues to the present (M-048/TWCP-3546). The purpose of the metallography operation is to characterize the microstructure of metallic or ceramic pieces to verify and establish the quality and effectiveness of welds. Materials examined under this P/S code consist of plutonium and uranium carbides, nitrides, and oxides, as well as zirconium and tantalum alloys, and stainless steel. Metal pieces (pellets) are cut with a diamond saw. Ceramic pieces are subjected to grinding with standard metal grinding media (e.g., papers impregnated with silicon carbides and diamond). The materials are polished with several different chemical compounds. Prior to May 1992, a mixture of 1–10 percent trichloroethylene and kerosene were used. Ethanol and acetone may also have been used. After May 1992, these materials were replaced with a mineral oil and a derivative from orange peels. The polishing compounds were not used for their solvent properties, but rather for their cooling and lubricating properties. Little liquid waste is generated from the process. The trichloroethylene/kerosene mixture and the alcohols largely evaporated during the polishing process. Waste trichloroethylene and kerosene was accumulated, absorbed onto vermiculite, and discarded in 55-gallon drum.

Metal or ceramic pieces are cleaned with alcohol and etched with various kinds of acid or caustic etchants, which are reused as much as possible. Waste etchants are neutralized; however, their disposal path is uncertain. Analytical data for some of the etchant residues indicated that these residues did not contain excessive concentrations of RCRA constituents; consequently, waste from this process is documented on Chemical Waste Disposal Records as "non-RCRA."

Beryllium and chromium (from the stainless steel) would be present in the grindings. However, the beryllium is not in a form that is RCRA regulated. Other waste includes standard glovebox maintenance items (e.g., rags, glovebox gloves, and HEPA filters), and a large volume of grinding paper. Although generally the gloves were not leaded, leaded gloves are used at the grinding station and for the last 3-4 years only at one glovebox.

3.4.10 Waste Management Operations (P/S Codes NCD, RD, WM, X0, XO)

P/S code RD was used only in 1984–1986 in Room 432 (M-046/TWCP-3546). This P/S code allowed for tracking of demonstration drums (one

drum each year) that were packaged and prepared in accordance with the TA-55 Attachments to the *Certification Plan* (TWCP-701) to meet the WIPP requirements at that time. Packaging of these drums did not of itself result in the generation of TRU waste. The SME stated that the waste drums that were packaged contained non-mixed TRU waste.

Operations under P/S code NCD occurred during the period from April 1989 – April 1991 in Room 432 (M-046/TWCP-3546). This P/S code was established to provide a mechanism for dealing with TRU drums that did not confirm specifications (e.g., recorded weight or nuclear material content). Non-confirming drums were temporarily set aside under this P/S code until such time as personnel could reprocess them under P/S code WM to correct the nonconfirming condition. After April 1991, nonconfirming drums were dealt with immediately, and P/S code NCD was no longer needed.

According to an SME (M-046 and M-050/TWCP-3546) who researched the assignment of waste to P/S codes WM, XO, and X0, P/S code WM is currently limited to waste that arises from the TRU solid waste management operation in Room 432. This situation has been the case since the beginning of 1993. Room trash boxes from Building PF-4 have always been handled as low-level waste; however, the boxes were assayed to verify contamination levels and any that were determined to be TRU waste were diverted to Room 432 for repackaging as such. From May 1987 through 1992, these boxes were created as P/S code XO or X0. These codes were changed to P/S code WM after 1992. Additional controls were placed on room trash after 1992. Trash was assayed with the Multiple Energy Gamma Assay System (MEGAS). When a container was rejected on the basis of MEGAS data, the rejected container was returned to the originator for removal of any "hot" item(s). This process also allowed for greater control to prevent discarding regulated materials (e.g., RCRA constituents) in room trash. Hence, waste from no HWNs apply to P/S code WM after 1993.
The designations for P/S codes XO and X0 are based on the following distinctions:

- P/S code X0 was designated for waste materials that could not be associated with a specific room, such as a hallway, mezzanine offices, rest rooms and change rooms, basement, pump rooms, and trolleys. The waste from all these areas, except the pump rooms and trolleys, would be low-level waste and no RCRA constituents would be associated with the waste items.

- P/S code XO indicated waste materials that were generated within specific rooms but could not be associated with an individual P/S code in that room. The room trash boxes assigned this P/S code,

when determined by assay to qualify as TRU waste instead of low-level waste, could contain rags that had contacted ignitable constituents (e.g., ethanol, isopropyl alcohol, and hexane); however, because the waste items were not packaged as free liquids, the EPA HWN D001 for ignitability would not be applicable. Other constituents that may have been present on rags in debris waste from P/S code XO included the degreasing solvents methyl ethyl ketone (D035, F005), trichloroethylene (D040, F001, F002), and 1,1,2-trichloro-1,2,2-trifluoroethane [freon] (F001); methylene chloride (F002) used as a paint stripper until after 1999; and chloroform (D022) used in a cryogenic bath. XO switched to non-RCRA regulated paint strippers after 1999: Citrapeel until 2001, and Organicstrip at the present time.

Because of the difficulty in distinguishing XO from XO in waste generator records, In order to be conservative all HWNs applicable to XO are also applied to XO if it is indicated to contain TRU waste.

Two other specific situations could also result in the generation of additional waste items under P/S code WM.

- During maintenance of the in-line glove box, changeout of the leaded gloves and windows would be covered under P/S code WM. No solvents or other chemicals were introduced during this routine maintenance activity.

- A spill in Room 432 in 1989 involved the release of a Pu-239-contaminated solution (consisting primarily of water with a minor amount of nitric acid) from a ventilation line. The spill was wiped up with rags and discarded under P/S code WM. Rags with excessive amounts of nitric acid would have been neutralized by dipping them in a calcium hydroxide solution inside a glovebox. No EPA HWN would be applicable to waste from this incident.

## 3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for miscellaneous operations at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for miscellaneous operations consist of the general types of materials listed in Table 1 that are obtained from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites:

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

### 3.6.1 Physical Waste Form Identification

Solid waste from miscellaneous operations primarily consists of debris waste, as well as cemented waste discarded under P/S codes CF or HP. Debris waste contains glassware, plastics, ceramic materials, paper, rags,

HEPA filters, metal containers, brushes, and small tools. Leaded gloves are also generated as process waste. Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste was incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item ID number and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance (QA) personnel.

6
3.5.2 Radionuclide Content Identification

The primary plutonium material type inputs for miscellaneous operations at TA-55 are listed in Table 2, and uranium material types are listed in Table 3. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Tables 2 and 3 indicate the isotopic composition of the material types at the time the waste was characterized.

The plutonium material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. * These bounding calculations provide a basis for identifying enrichment or depletion of one radionuclide versus another based on radioassays of individual waste containers. The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

set

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the

* Insert above

**Table 2. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope (Weight %) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 ($8.26 \times 10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

a These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

**Table 3. Average Isotopic Content of Uranium Material Types and Enrichments (Weight %)**

| Material Type | U-234 | U-235 | U-236 | U-238 |
|---|---|---|---|---|
| MT 12 | 0.0015 | 0.23 | 0.008 | 99.77 |
| MT 35 | 0.36 | 37.6 | 0.14 | 61.9 |
| MT 36 | 0.63 | 62.44 | 0.18 | 36.75 |
| MT 38 | 1.03 | 93.04 | 0.41 | 5.53 |
| MT 39 | 1.32 | 97.52 | 0.17 | 0.99 |

Source: TWCP-698

plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in ~~americium~~, depending on whether the source of contamination is the process product or the process residues (TWCP-882).

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from miscellaneous operations at TA-55.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all, unless the feed material is uranium. For plutonium feed materials, U-235 in growth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. U-234 would be present in MT 83 as a decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total Pu would be about 0.14. ~~No U-236 is present~~ Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations (TWCP-5164, TWCP-5165). During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). If warranted, this AK report will be updated to incorporate the results of these comparisons.

3.3 Chemical Content Identification

Chemical inputs to miscellaneous operation processes are listed in Table 4. In section 4, these inputs are evaluated along with constituents present in the feed materials and equipment in order to determine to applicability of ~~EOA~~ EPA HWNs to process waste for each P/S code.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA HWNs to process wastes from miscellaneous operations is summarized in the text below, as well as in Table 5, on the process timelines in Attachment 3, and in the table of process inputs and outputs in Attachment 4. These assignments take into account the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| Potassium permanganate | | |
| Potassium salt (not specified) | | |
| Silver salt | AC1 | D011 |
| Sodium bicarbonate | | |
| Sodium carbonate | | |
| Sodium chloride | | |
| Sodium chlorite | | |
| Sodium nitrate | | |
| Sodium salt (not specified) | | |
| Sodium sulfate | | |
| Thorium oxide | | |
| **Metals** | | |
| Alkaline earth metals | | |
| Bismuth-tin alloy | | |
| Gallium metal, oxide or salt | | |
| Lanthanide metals | | |
| Platinum and platinum-rhodium alloys | | |
| Stainless steel | | D007 (chromium) |
| Tantalum metal, oxide or salt | | |
| Zirconium and tantalum alloys | | |
| **Organic Chemicals** | | |
| 1-propanol | | |
| Acetone | ME | F003 |
| Acetonitrile | AC2 | Appendix VIII compound. EPA HWN U003 does not apply due to the manner in which this chemical is used in TA-55 processes. |
| Alkylating agents (unspecified) | | |
| Benzene | AC/AC1/AC2, SA | D018 and F005: solvent use |
| Carbon tetrachloride | AD, CV | D019 applies to AD and CV. F001 does not apply because this chemical was not used for degreasing. |
| Carbon tetrafluoride | | |
| Chloroform | AC/AC1/AC2, APD, XO | D022 |
| Citrapeel | | |
| DBBP (dibutyl butyl-phosphonate) | | |
| DBBP (dibutyl butyl-phosphonate) / Isopar (isoparaffinic hydrocarbon solvent) | | |
| Diethyl ether | SA | F003 |
| Dihexyl N,N-diethylcarbamoylmethyl phosphonate (DHDCMP) | | |
| Diisopropyl benzene | | |
| Ethanol | | |
| Hexane | | |
| Hydrazine dihydrochloride | | |
| Hydrazine hydrochloride | | |
| Isopropanol | | |
| Kerosene | | |

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| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| Methanol | AD, SO | F003 applies to AD because methanol may have been used for cleaning inside the glovebox. F003 does not apply to SO because methanol was used in a cold trap outside the glovebox. |
| Methylene chloride (also called dichloromethane) | AC1, SA | F002 applies to P/S codes AC1 and SA because methylene chloride was used for solvent properties. |
| n-dodecane | | |
| Octylphenyldiisobutyl-carbamoylmethylphosphine oxide (CMPO) | | |
| Organicstrip | | |
| Perchlorocarbons | | |
| Phosphine oxide | | |
| Phosphines | | |
| Pyridine | SA, AC, AC2 | D038, F005: used as solvent in organometallic synthesis process. |
| Sodium dithionate | | |
| Tetrachloroethylene | AD, APD, CV | D039 and F002 apply to AD and APD. However no codes apply to CV because this chemical was only used as a coolant outside the glovebox. |
| Tetraethylamine hydrochloride | | |
| Tetraethylamine hydroxide | | |
| Tetraethylammonium hydroxide | | |
| Tetrahydrofuran | AC, AC2, SA | U213 ~~applies~~ may be applicable to AC, AC2, and SA |
| Thionyl chloride | | |
| Toluene | AC, AC2, SA | F005 applies because toluene was used as a solvent in organometallic synthesis |
| Tributyl phosphate (TBP) | | |
| Tributyl phosphate (TBP)/Isopar | | |
| Trichloroethylene | CK, ME, XO | D040 applies to P/S codes ME and XO; F002 also applies to P/S code XO. Neither EPA HWN applies to P/S code CK because this chemical was used as a coolant outside the glovebox. |
| Vacuum pump oil | | |

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**Table 5. Evaluation of the Applicability of EPA Hazardous Waste Numbers to Processes Discussed in This Report**

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| AC | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005, U213 | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005, ~~U213~~ (to be determined) |
| AC1 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005 |
| AC2 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005, U213 | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, ~~F005, U213~~ (to be determined) |
| AC3 | Actinide Chemistry, R&D | None | None | None | None |
| ACL | Analytical Chemistry Laboratory | None | None | D007, D008, D009 | D007, D008, D009 |
| AD | Actinide Processing Demonstration | D004, D005, D006, D007, D008, D009, D010, D011, D019 | D008, D019, D039, F002, F003 | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| APD | Actinide Processing Demonstration | D008, D009, D019, D021, D022, D039, F002, F003 | None | D007, D008, D009 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| AX | Solution Assay | None | None | D007, D008, D009 | D007, D008, D009 |
| CK | RD&D Volatile Fluoride Pu Recovery | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| CV | R&D Experimental Chlorination Processes | D005, D006, D007, D008, D011 | D019, D039 | D007, D008, D009 | D005, D006, D007, D008, D009, D011, D019, D039 |
| EDC | Electrolytic Decontamination | D007 | None | D007, D008 | D007, D008 |
| EOC | Experimental Oxide Characterization | None | None | D007, D008, D009 | D007, D008, D009 |
| EXT | Extraction RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| FDL | FOOF Demonstration Loop | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| FLU | Fluorination RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| HRS | High Resolution Spectroscopy | None | None | D008 | D008 |
| IB | Matrix Study Of Pyrochemical Salts | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| ICP | ICP–AES Analysis | None | None | D007, D008, D009 | D007, D008, D009 |
| IE | Isotope Enrichment | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| LI | XF6 Experimental Measurements | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| LIBS | Laser-Induced Breakdown Spectroscopy System | None | None | None | None |
| ME | Metallography | None | D040, F003 | D007, D008 | D007, D008, D040, F003 |
| NCD | Nonconfirming Drums | None | None | None | None |
| RASS/ RSS | Raman Spectroscopy System | D004, D005, D006, D007, D008, D009, D010, D011, D019 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RD | Repackaging into Retrievable Drums | None | None | D008 | D008 |
| SA | Super Acid RD&D | None | D018, D038, F002, F003, F005, U213 | D007, D008, D009 | D007, D008, D009, D018, D038, F002, F003, F005, ~~U213~~ (applicability of U213 to be determined) |
| SMP | SP Mounting Preparation | None | None | None | None |
| SO | Super Oxidizer, FOOF Program | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011 |
| STF | Standard Fabrication | None | None | D007, D008 | D007, D008 |
| VS | Confirmation, Inspection & Sampling | None | None | D008 | D008 |
| WM | Waste Management | Must be determined on case-by-case basis | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| X0 | Inactive or Unspecified P/S Material | Must be determined on case-by-case basis | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-Ray Energy Spectroscopy | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011 |

No K or P listings apply to solid wastes generated from any of the miscellaneous operations because no K-listed or P-listed chemicals were present in the feed materials, chemicals, or equipment used in these processes.

4.2 Toxicity Listings

The list below is summarized from Table 5 and lists the EPA HWNs applicable to waste from processes described in this report. P/S codes marked with an asterisk (*) in the list do not contain RCRA-listed constituents in the feed material or in the chemicals used in the process, but have been assigned HWNs due to the potential for chromium (D007) to be leached from stainless steel equipment or items in the process, lead (D008) due to the use of leaded gloves in the process, and mercury (D009) if there is a potential for a glass mercury thermometer to have been used in the same glovebox. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166).

| | | |
|---|---|---|
| AC, AC2 | | D007, D008, D009, D011, D018, D022, D038, ~~U213~~ [applicability of U213 to be determined] |
| AC1 | | D007, D008, D009, D011, D018, D022, ~~D038, U213~~ [applicability of U213 to be determined] |
| ACL | * | D007, D008, D009 |
| AD | | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039 |
| APD | | D007, D008, D009, D019, D021, D022, D039 |
| AX | * | D007, D008, D009 |
| CK | | D005, D006, D007, D008, D009, D011 |
| CV | | D005, D006, D007, D008, D009, D011, D019 |
| EDC | * | D007, D008 |
| EOC | * | D007, D008, D009 |
| EXT | | D005, D006, D007, D008, D009, D011 |
| FDL | | D004, D005, D006, D007, D008, D009, D010, D011 |
| FLU | | D004, D005, D006, D007, D008, D009, D010, D011 |
| HRS | * | D008 |
| IB | | D005, D006, D007, D008, D009, D011 |
| ICP | * | D007, D008, D009 |
| IE | | D005, D006, D007, D008, D009, D011 |
| LI | | D005, D006, D007, D008, D009, D011 |
| ME | | D007, D008, D040 |
| RASS/RSS | | D004, D005, D006, D007, D008, D009, D010, D011, D019 |

| | |
|---|---|
| RD | D008 |
| SA | D007, D008, D009, D018, D038 [applicability of U213 to be determined] |
| SO | D004, D005, D006, D007, D008, D009, D010, D011 |
| STF | D007, D008 |
| WM | D007, D008, D009, D022, D035, D040 [D-listings are not applicable after 1993] |
| X0 | D007, D008, D009, D022, D035, D040 |
| XES | D004, D005, D006, D007, D008, D009, D010, D011 |
| XO | D007, D008, D009, D022, D035, D040 |
| XP | D004, D005, D006, D007, D008, D009, D010, D011 |

Activities under P/S codes LIBS, NCD, and SMP do not generate solid waste to which any HWN would be applicable.

~~4.3 Corrosivity, Reactivity, and Ignitability~~

Append to end of 4.2

No D001 (ignitable), D002 (corrosive), or D003 (reactive) listings apply to the solid wastes from miscellaneous operations because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 6.0). In addition, D001 does not apply due to flammable organic solvent use because solutions containing these solvents are sent to aqueous recovery. 5

For aqueous recovery, steps include dissolution of any solid Pu in 8–16 molar $HNO_3$ and purification by ion exchange. After recovery of Pu from ion exchange, the solutions are below the DL, which are then set to the evaporator for volume reduction. Evaporator bottoms are fixed in cement; therefore, ignitability is not a concern in these wastes.

## ~~5.0~~ DETERMINATION OF THE RADIOISOTOPIC COMPOSITION

~~See Section 3.5.2.~~

5 6.0 **VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED**

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA055 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 6.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated

for potentially incompatible chemicals in accordance with 49 *Code of Federal Regulations* (CFR) Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 8.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of LANL Direct Oxide Reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 8.0 and 7.0.

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the miscellaneous operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 4, and Attachment 4. Oils used in the reviewed processes include vacuum pump oils, and cutting fluids used for cooling purposes; none of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal disposal (TWCP-AK-2.1-005,R.1, Section 9.0). This oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.3)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AC<br>AC2 | Actinide Chemistry R&D | Actinide metals | Acetonitrile<br>Actinide (Th-Am) metals<br>Alcohols (unspecified)<br>Alkali metals<br>Alkaline earth metals<br>Alkylating agents (unspecified)<br>Benzene<br>Chloroform<br>Cryogens<br>Dichloromethane<br>Hexane<br>Hydrochloric acid<br>Inorganic reagents/complexes (unspecified)<br>Inorganic salts (unspecified)<br>Lanthanide metals<br>Nitric acid<br>Perchloric acid<br>Phosphates<br>Phosphines<br>Potassium hydroxide<br>Potassium salts<br>Silver salts<br>Sodium hydroxide<br>Sodium salts<br>Tetrahydrofuran<br>Toluene<br>Transition metals<br>Transition-lanthanide-, actinide- metal complexes | Solvated halide complexes yielding homoleptic alkyl complexes; and unspecified | Reaction byproducts, residues, precipitated salts, spent solvents, spent acids, filtration media, debris | D007,<br>D008,<br>D009,<br>D011,<br>D018,<br>D022,<br>D038,<br>F002,<br>F005,<br>U213 | M-025<br>M-038 |

Pyridine → Silver salts

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AC1 | Actinide Chemistry R&D | Actinide metals | Acetonitrile<br>Actinide (Th-Am) metals<br>Alcohols (unspecified)<br>Alkali metals<br>Alkaline earth metals<br>Alkylating agents (unspecified)<br>Benzene<br>Chloroform<br>Cryogens<br>Dichloromethane<br>Hexane<br>Hydrochloric acid<br>Inorganic reagents/complexes (unspecified)<br>Inorganic salts (unspecified)<br>Lanthanide metals<br>Nitric acid<br>Perchloric acid<br>Phosphates<br>Phosphines<br>Potassium hydroxide<br>Potassium salts<br>Silver salts<br>Sodium hydroxide<br>Sodium salts<br>~~Tetrahydrofuran~~<br>Toluene<br>Transition metals<br>Transition-lanthanide-, actinide- metal complexes | Solvated halide complexes yielding homoleptic alkyl complexes; and unspecified | Reaction byproducts, residues, precipitated salts, spent solvents, spent acids, filtration media, debris | D007, D008, D009, D011, D018, D022, ~~D038~~, F002, F005, ~~U213~~ | M-025<br>M-038 |
| AC3 | Actinide Chemistry | NA | NA | NA | NA | NA | NA |
| ACL | Analytical Chemistry Lab | Plutonium and americium solutions | Nitric acid | None | Unused liquid samples, chromatography residues | D007, D008, D009 | M-042 |

5/12/01

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-004,R.2 (LA-UR-01-)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AC, AC1, AC2, AC3, ACL, AD, APD, AX, CK, CV, EDC, EOC, EXT, FDL, FLU, HRS, IB, ICP, IE, LI, LIBS, ME, NCD, RASS/RSS, RD, SA, SMP, SO, STF, VS, WM, X0, XES, XO, XP

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_____ _____
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SITE PROJECT MANAGER DATE

_____ _____
WASTE CERTIFICATION OFFICIAL DATE

_____ _____
SITE PROJECT QA OFFICER DATE

_____ _____
FACILITY REPRESENTATIVE DATE

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## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| CMPO | octylphenyldiisobutylcarbamoylmethylphosphine oxide |
| D | EPA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DBBP | dibutyl butylphosphonate |
| DHDCMP | dihexyl N,N-diethylcarbamoylmethyl phosphonate |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | EPA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FOOF | dioxygen difluoride |
| GB | glovebox |
| HEPA | high-efficiency particulate air |
| HWN | [EPA] hazardous waste number |
| K | EPA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| MEGAS | Multiple Energy Gamma Assay System |
| MSE | molten salt extract |
| MT | material type |
| NDA | non-destructive assay |
| P | EPA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33(e) |
| PF-4 | Plutonium Facility, Building 4 |
| P/S [code] | process/status [code] |
| QA | quality assurance |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001,R.3) |
| SME | subject matter expert |
| TA | technical area |
| TBP | tributyl phosphate |
| TCLP | Toxicity Characteristic Leaching Procedure |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization Program |
| U | RCRA hazardous waste number prefix for toxic waste defined in 40 CFR Subpart D, Section 261.33(f) |
| UCNI | Unclassified Controlled Nuclear Information |

present in the process wastes, based on subject matter expert (SME) interviews and any ~~available data~~ relevant record

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) will be contained in these records, and will not be included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK summary report is part of a set of closely related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004) (this report)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, miscellaneous processes include 36 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

present in each drum, in order to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- First by radioisotope content (Pu-238 or Pu-239 material type)
- Then by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- Then by hazardous waste status (mixed, non-mixed, or special case waste streams)

3.3 Waste Physical Form and Content Description

Wastes generated during miscellaneous operations include primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. General debris waste categories from miscellaneous operations include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Metal debris (for example, wire, hose clamps, tools, labware)
- Glass debris

These debris waste items are contaminated with small amounts of radioactive and chemical substances. In addition to these general debris categories, miscellaneous processes also generated waste consisting of organometallic and inorganic solids of various compositions, sand and slag, ash, and crucibles.

3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1979, when miscellaneous processes first began at TA-55, to the present. Process wastes from miscellaneous operations have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding HWNs are shown graphically in Attachment 3, Time Lines. These timelines are based on a review of procedures that guided the experimental and demonstration studies and miscellaneous research and development (R&D) operations at TA-55 and information from SMEs familiar with the operations. Many of the operations were short duration and/or changed frequently. Initiation or continuation of a process was surmised based on the date of approval for a given procedure. In some cases, a series of procedures or related documents for one process could be located to establish the timeline. In many other cases, discontinuities between procedure titles and numbers made it difficult to determine how long the process may have continued before it was modified or ended. For purposes of this report, the time period for

Purification process development investigations occurred in Room 208, GB 230, 238, and 274 from May 1988 through September 1994. Processes carried out were of a non-routine developmental nature involving research, process development, small scale "trouble-shooting," and occasionally preparation of various isotopes and isotopic mixtures of plutonium, uranium, americium, and neptunium (M-006/TWCP-3546). Frequently used chemicals included concentrated and dilute acids and bases, analytical standards, and reducing and oxidizing agents. Tetrachloroethylene and diisopropyl benzene are listed as solvent diluents, and methanol and ethanol are listed as "infrequently used chemicals." Waste streams containing or contaminated with tetrachloroethylene would result in the assignment of the F002 hazardous waste code for spent halogenated solvents. Carbon tetrachloride is indicated as being used as a solvent diluent from July 1991 to March 1992. Because carbon tetrachloride was not used as a degreaser, the F001 hazardous waste code for carbon tetrachloride does not apply; however, the D code for carbon tetrachloride (D019) would be applied unless analytical data indicate that the concentration of the D-listed hazardous constituent does not exceed the applicable regulatory threshold limit. The procedure did not clarify how methanol was used in the process; however, an SME (M-034/TWCP-3546) familiar with the process stated that methanol and ethanol slushes were used in cooling baths outside the glovebox. Methanol used outside the glovebox would not become part of the TRU waste stream and the hazardous waste code would not apply. However, methanol and/or ethanol may also have been used for cleaning inside the glovebox (M-034/TWCP-3546).

→ F003 (F003)

Wastes that may be generated under P/S code AD include typical laboratory debris such as labware (e.g., glass, plastic, rubber, or metal materials and supplies), rags from general cleanup, spent solutions, and typical glovebox operations waste, including drybox gloves, windows, gaskets, and high-efficiency particulate air (HEPA) filters. Other wastes include the strip solutions and raffinate, spent organics, and unused hydroxide cake samples. The procedure indicates strip solutions and spent organics were stored but does not address ultimate disposal of these spent solutions. The process accountability flow diagram for P/S code AD indicates outputs from this operation may be sent to the vault, returned to the originating P/S code, or directed to aqueous recovery or cement fixation based on the discard limit (DL). Materials may also be sent for chemical analysis or transferred to P/S code APD for further experimental development. Assuming that evaporator hydroxide cakes comprised the primary feed material for this code, the hazardous constituents associated with the feedstock material may be concentrated in the actinide-containing matrices and solutions that are discarded as waste. Based on information presented in TWCP-AK-2.1-002,R.1 (chloride operations) and TWCP-AK-2.1-005,R.1 (nitrate operations),

P/S code LI was a fairly pure operation in Rooms 105, 106, and 113 that converted small quantities of $PuO_2$ to $PuF_6$ (M-035/TWCP-3546). The converted material was given to whomever needed it for further R&D. The timeline is likely similar to that for P/S code IE. No RCRA constituents of concern were involved in the operation.

Separation operations involving experimental chlorination processes similar to the previously described fluorination procedures were initiated in Room 106, GB-165, in March 1991 under P/S code CV (M-026/TWCP-3546). A gas loop was used to flow carbon tetrachloride and perchlorocarbons (M-035/TWCP-3546) through a gas-solid reactor to chlorinate plutonium oxides to form recoverable plutonium compounds. Once produced, the plutonium compounds and/or plutonium-bearing matrices were subjected to further treatment to achieve complete plutonium recovery. Process chemicals included dilute acids and bases and chlorinated hydrocarbons. Carbon tetrachloride and tetrachloroethylene were used in the cold traps, which were of the standard TA-55 configuration located outside the glovebox (M-035/TWCP-3546); therefore, the coolant chemicals would not have been part of the TRU waste stream. Process outputs from this operation may have been sent to the vault via the countroom, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit). Sub-accountable samples may have been sent to chemical analysis.

Plutonium chlorination operations were used to recover or purify plutonium compounds and/or plutonium-bearing matrices in Room 208, GB-223, beginning in October 1992. During November 1994 the operation shifted to Room 106, GB-160 (M-027/TWCP-3546). The P/S code for this operation is identified as CV. This operation involves the use of various reagents, which are passed through a gas-solid reaction loop to produce recoverable plutonium compounds. Chemical reagents include dilute acids and bases, carbon tetrachloride, reducing agents, and ammonium chloride. In addition to the standard debris waste, process waste included trace carbon tetrachloride from reagent bottles. Carbon tetrachloride was used as a chlorinating compound in the reaction loop and would have been completely reacted in the chlorination process (M-035/TWCP-3546). Because carbon tetrachloride was not used as a solvent or degreaser, the F-listing for carbon tetrachloride is not applicable. Process outputs from this operation may have been sent to the vault via the countroom, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the DL). Sub-accountable samples may have been sent to chemical analysis.

A small-scale research operation involving gas-solid and solid-solid fluorination and chlorination chemistry began in March 1992 in

P/S code EXT was a small basic research operation that began in March 1992 in Room 106, GB-180. This research effort explored aqueous extraction of plutonium from various waste streams, particularly used pyrochemical salts (M-013/TWCP-3546), using acids and bases. The procedure does not indicate the use of any RCRA-listed chemicals. Wastes from this operation would include rags and paper products from general clean-up; labware that may include glass, plastic, or metal; heating mantles, and spent pyrochemical salts. The process accountability flow diagram and procedures for this process do not identify the P/S codes that fed this operation. Spent pyrochemical salts contain barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011) at concentrations that depend upon the process that generated the salt. Concentrations of RCRA heavy metals are below regulatory limits for pyrochemical salts from direct oxide reduction (P/S code OR) (TWCP-2540), but concentrations are not known for pyrochemical salts from salt stripping (P/S code SS) or special processes (P/S code PX). Residues from the solution extraction process were sent to the vault via the countroom, returned to the originating P/S code, or transferred to chloride (P/S code CX) or nitrate (P/S code CF) operations. The D-listed constituents would carry through to subsequent treatment processes. Solutions were transferred to chloride (P/S code CX) or nitrate (P/S code CF) operations, or were disposed to the acid waste line if the solutions met the waste acceptance criteria for the RLWTF at TA-50.

### 3.5.7 Hydrothermal Processing (P/S Code APD)

P/S code APD was a hydrothermal processing procedure initiated in March 1996 in Room 208, GB-230 (M-001/TWCP-3546). The operation involves the reaction of aqueous/organic mixtures, pure organic liquids, or contaminated combustible solids (e.g., ion exchange resins, plastic filters, and cellulose rags) under supercritical conditions (i.e., high temperature and pressure). Feed streams include, but are not limited to, analytical laboratory solutions that may contain ~~carbon tetrachloride,~~ tributyl phosphate, and organic solvents ~~(unspecified in the procedure),~~ as well as lead and mercury (Cl-25/TWCP-3547). Process effluents are gases, liquids and salts. Organic components are oxidized to carbon dioxide. Nitrate contaminants are converted to nitrogen gas and some nitrous oxide. Components ~~such as~~ chlorine, sulfur, and phosphorus are oxidized and converted to acids or salts. Gases are liberated; solids and liquids are collected for recovery or disposal.

The types of chemical wastes generated by hydrothermal processing experiments are predominantly effluents and rags. Hazardous organic constituents, including carbon tetrachloride, are probably destroyed by the hydrothermal process (M-034/TWCP-3546); therefore, organic

## Table 4. Chemical Inputs to Processes Described in This Report

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| **Gases and Cryogens** | | |
| Carbon dioxide (gas)<br>Fluorine (gas)<br>Halogen fluorides<br>Krypton fluoride<br>Methane (gas)<br>Nitrogen dioxide (gas)<br>Nitrogen, liquid | | D001 and D002 do not apply to these gases because there are no free liquids in this waste. Also the gas cylinders are outside the building, and the gases are plumbed into the glovebox. |
| **Acids** | | |
| Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Oxalic acid<br>Perchloric acid<br>Sulfuric acid<br>Superacids (e.g., $HSO_3F$) | <br><br><br><br>AD<br><br>SA | D002 does not apply to the solid debris waste because there are no free liquids in this waste. D001 (oxidizer) does not apply to the use of nitric or perchloric acid or to the superacids for the same reason. |
| **Bases** | | |
| Calcium hydroxide<br>Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the solid debris waste because there are no free liquids in this waste. |
| **Inorganic Chemicals** | | |
| Aluminum bifluoride<br>Aluminum chloride<br>Aluminum fluoride<br>Aluminum nitrate<br>Aluminum oxide<br>Ammonium chloride<br>Antimony pentafluoride<br>Bromine<br>FOOF<br>Hydrogen peroxide<br>Hydroxylamine hydrochloride<br>Hydroxylamine nitrate<br>Iodine<br>Iron oxide<br>Lead and lead hydroxide, oxide, or nitrate<br>Magnesium oxide<br>Na, K, Li, Mg, Ca, Fe, nitrates, chlorides, carbonates, bicarbonates, oxalate, nitrites<br>Phosphates<br>Potassium choride<br>Potassium dichromate | <br><br><br><br><br><br><br><br><br><br><br><br><br><br>AD, APD<br><br><br><br><br>AD | <br><br><br><br><br><br><br><br><br><br><br><br><br><br>D008<br><br><br><br><br>D007 |

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**Attachments**

1 Acceptable Knowledge Roadmap (16 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Timeline for TA-55 Miscellaneous Processes (6 pages)
4 Process Inputs and Outputs (11 pages)
5 Simplified Process Flow Diagram (1 page)

insert space

The procedure describes operations that comprise a broad range of laboratory activities in support of fundamental and applied actinide chemistry research (M-025/TWCP-3546). These activities include, but are not limited to, preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation. The chemical list indicates the use of a variety of materials, including organic solvents (e.g., pyridine, toluene and benzene), alkaline earth metals, and transition metals. The SMEs (M-038/TWCP-3546) familiar with these activities indicated that a "variety of aromatic, alkaline, and chlorinated solvents" (e.g., tetrahydrofuran, toluene, benzene, methylene chloride, and chloroform) were used in these activities. Hexane and acetonitrile began to be used in P/S code AC2 recently. Acetonitrile is an Appendix VIII VOC but its EPA HWN (U003) does not apply in this case. These organic chemicals have the following EPA HWNs: benzene (D018, F005), chloroform (D022), methylene chloride (F002), tetrahydrofuran, and toluene (F005). The SME stated that waste byproducts from the operations that contain these constituents were not discarded but were held in the glovebox for reprocessing or recovery. Because the SME was not involved with these activities after 1994, he was unable to definitively state how the waste materials were ultimately dispositioned. In a later discussion, other SMEs (M-038/TWCP-3546) indicated that use of the chlorinated solvents associated with P/S code AC1 was discontinued in 1994 and that items contaminated with these constituents mentioned are still in the glovebox and have yet to be discarded as of the date of this report. Transition metals used as reagents in the synthesis of new materials in this process included sodium salts, potassium salts, and silver salts. The precipitated salt byproducts also were not discarded but were held in the glovebox for reprocessing and recovery. In a later discussion, other SMEs confirmed that silver salts associated with P/S code AC1 are still in the glovebox awaiting determination for a path forward for disposition. Other than silver (D011), no RCRA metals were used in the processes (M-038/TWCP-3546). In addition to the standard debris wastes, process wastes may have included reaction by-products and residues, heating mantles, vacuum pump apparatus, various pieces of laboratory equipment, spent organic solvents, and filtration media. Process outputs for both P/S codes may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

P/S code AX was related to the dissolution of actinide compounds in superacid media but involved the assay of plutonium in nitric or hydrochloric acid solutions. This operation occurred in Rooms 401, 409, and 420. The procedure was initiated in 1988 and revised in 1989 (M-005/TWCP-3546). Assay solutions were accumulated for transfer to

**Table 5. Evaluation of the Applicability of EPA Hazardous Waste Numbers to Processes Discussed in This Report**

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| AC | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 ~~U213~~ | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005 |
| AC1 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005 |
| AC2 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 ~~U213~~ | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005 |
| AC3 | Actinide Chemistry, R&D | None | None | None | None |
| ACL | Analytical Chemistry Laboratory | None | None | D007, D008, D009 | D007, D008, D009 |
| AD | Actinide Processing Demonstration | D004, D005, D006, D007, D008, D009, D010, D011, D019 | D008, D019, D039, F002, F003 | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| APD | Actinide Processing Demonstration | D008, D009, D019, D021, D022, D039, F002, F003 | None | D007, D008, D009 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| AX | Solution Assay | None | None | D007, D008, D009 | D007, D008, D009 |
| CK | RD&D Volatile Fluoride Pu Recovery | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| CV | R&D Experimental Chlorination Processes | D005, D006, D007, D008, D011 | D019, D039 | D007, D008, D009 | D005, D006, D007, D008, D009, D011, D019, D039 |
| EDC | Electrolytic Decontamination | D007 | None | D007, D008 | D007, D008 |
| EOC | Experimental Oxide Characterization | None | None | D007, D008, D009 | D007, D008, D009 |
| EXT | Extraction RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| FDL | FOOF Demonstration Loop | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| FLU | Fluorination RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| HRS | High Resolution Spectroscopy | None | None | D008 | D008 |
| IB | Matrix Study Of Pyrochemical Salts | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| ICP | ICP–AES Analysis | None | None | D007, D008, D009 | D007, D008, D009 |

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| IE | Isotope Enrichment | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| LI | XF6 Experimental Measurements | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| LIBS | Laser-Induced Breakdown Spectroscopy System | None | None | None | None |
| ME | Metallography | None | D040, F003 | D007, D008 | D007, D008, D040, F003 |
| NCD | Nonconfirming Drums | None | None | None | None |
| RASS/ RSS | Raman Spectroscopy System | D004, D005, D006, D007, D008, D009, D010, D011, D019 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RD | Repackaging into Retrievable Drums | None | None | D008 | D008 |
| SA | Super Acid RD&D | None | D018, D038, F002, F003, F005 ~~U215~~ | D007, D008, D009 | D007, D008, D009, D018, D038, F002, F003, F005 |
| SMP | SP Mounting Preparation | None | None | None | None |
| SO | Super Oxidizer, FOOF Program | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011 |
| STF | Standard Fabrication | None | None | D007, D008 | D007, D008 |
| VS | Confirmation, Inspection & Sampling | None | None | D008 | D008 |
| WM | Waste Management | Must be determined on case-by-case basis | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| X0 | Inactive or Unspecified P/S Material | Must be determined on case-by-case basis | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-Ray Energy Spectroscopy | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011 |
| XO | Inactive or Unspecified P/S Material | Must be determined on case-by-case basis. However, HWNs known to be applicable include those for chloroform (D022), trichloroethylene (D040, F001, F002), 1,1,2-trichloro-1,2,2-trifluorethane (F001, F002), methylene chloride (F002, use ended after 1999), and methyl ethyl ketone (D035, F005) because cleaning rags may be contaminated with these RCRA chemicals; also D007, D008, D009 | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 |

- D018 (benzene): P/S codes AC, AC1, AC2, SA
- D019 (carbon tetrachloride): P/S codes AD, APD, CV, RASS/RSS
- D021 (chlorobenzene): P/S code APD
- D022 (chloroform): P/S codes AC, AC1, AC2, APD, WM, X0, XO
- D035 (methyl ethyl ketone): P/S codes WM, X0, XO
- D038 (pyridine): P/S code AC, AC1, AC2, SA
- D039 (tetrachloroethylene): P/S codes AD, APD, CV
- D040 (trichloroethylene): P/S codes ME, WM, X0, XO
- ~~Applicability of U213~~ (tetrahydrofuran) is still to be determined: P/S codes ~~AC, AC2, SA~~ Delete
- No HWN: P/S codes LIBS, NCD, SMP

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

materials used in the process may include "hydrocarbon, ethereal, and aromatic solvents, organic reagents, and inorganic salts." The procedure was revised in 1991, at which time the operation was conducted in Room 105 (GB-166 and -177) and Room 208 (GB-230 and -240). The process consisted of a variety of small-scale organoactinide operations involving fundamental research of the synthesis in non-aqueous media of new actinide compounds, their characterization and reaction chemistry, and application to existing actinide processing technology. Due to the range of experimental studies conducted under this P/S code, a definitive list of chemical reagents does not exist; however, previous studies involved the use of a wide range of hydrocarbon solvents, including the D-listed and F-listed constituents: methylene chloride (F002), diethyl ether (F003), benzene (D018, F005), toluene (F005), and pyridine (D038, F005). Tetrahydrofuran ~~(U213)~~ and toluene were also used in the organometallic process. Neptunium and plutonium metal were put into tetrahydrofuran and dried. Bromine and/or iodine were added to create plutonium iodide, the starting material for other studies. In addition to standard debris wastes, process wastes may have included reaction by-products and residues, various pieces of laboratory equipment, spent organic solvents, and filtration media. Process outputs from this operation may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

The procedure associated with the previous operation was revised once again in March 1994. The P/S codes for these operations are indicated as AC, AC1, AC2 and AC3. SMEs (M-038/TWCP-3546) familiar with these activities indicated that the process began as P/S code AC in February 1989 and transformed to P/S code AC2 in February 1994. P/S codes AC2 probably ran concurrently with AC1. This revised procedure indicates that operations occurred in the same rooms and gloveboxes identified in the previous revision. The distinguishing features between AC1 and AC2 were that AC1 was an analytical process using aqueous compounds, predominantly dilute nitric, hydrochloric, and perchloric acid solutions. These acidic solutions would have been neutralized and precipitated to recover the plutonium. Solutions were sent to cementation. The solids were rinsed from rags with water before the rags were discarded. Any perchloric salts would be in the neutralized acidic solutions or in the rinse solutions, which were both sent to cementation. P/S code AC2 involved synthesis of (air-sensitive) new compounds in an inert glovebox. This was a non-aqueous process. P/S code AC3 is not related to P/S codes AC1 or AC2, but is predominantly a metal operation (M-038/TWCP-3545). This code had not yet become active by the time this report was prepared, and no other information was available for it.

The procedure describes operations that comprise a broad range of laboratory activities in support of fundamental and applied actinide chemistry research (M-025/TWCP-3546). These activities include, but are not limited to, preparation of solvents and reagents, synthesis of new chemical compounds, and characterization and analysis of new chemical compounds using wet chemistry methods and analytical instrumentation. The chemical list indicates the use of a variety of materials, including organic solvents (e.g., pyridine, toluene and benzene), alkaline earth metals, and transition metals. The SMEs (M-038/TWCP-3546) familiar with these activities indicated that a "variety of aromatic, alkaline, and chlorinated solvents" (e.g., tetrahydrofuran, toluene, benzene, methylene chloride, and chloroform) were used in these activities. Hexane and acetonitrile began to be used in P/S code AC2 recently. Acetonitrile is an Appendix VIII VOC, but its EPA HWN (U003) does not apply in this case. These organic chemicals have the following EPA HWNs: benzene (D018, F005), chloroform (D022), methylene chloride (F002), tetrahydrofuran (~~U213~~), and toluene (F005). The SME stated that waste byproducts from the operations that contain these constituents were not discarded but were held in the glovebox for reprocessing or recovery. Because the SME was not involved with these activities after 1994, he was unable to definitively state how the waste materials were ultimately dispositioned. In a later discussion, other SMEs (M-038/TWCP-3546) indicated that use of the chlorinated solvents associated with P/S code AC1 was discontinued in 1994 and that items contaminated with these constituents mentioned are still in the glovebox and have yet to be discarded as of the date of this report. Transition metals used as reagents in the synthesis of new materials in this process included sodium salts, potassium salts, and silver salts. The precipitated salt byproducts also were not discarded but were held in the glovebox for reprocessing and recovery. In a later discussion, other SMEs confirmed that silver salts associated with P/S code AC1 are still in the glovebox awaiting determination for a path forward for disposition. Other than silver (D011), no RCRA metals were used in the processes (M-038/TWCP-3546). In addition to the standard debris wastes, process wastes may have included reaction by-products and residues, heating mantles, vacuum pump apparatus, various pieces of laboratory equipment, spent organic solvents, and filtration media. Process outputs for both P/S codes may be sent to the vault, returned to the originating P/S code, or transferred to aqueous recovery or cement fixation (based on the discard limit).

P/S code AX was related to the dissolution of actinide compounds in superacid media but involved the assay of plutonium in nitric or hydrochloric acid solutions. This operation occurred in Rooms 401, 409, and 420. The procedure was initiated in 1988 and revised in 1989 (M-005/TWCP-3546). Assay solutions were accumulated for transfer to

| Chemical input | P/S Codes in which RCRA-Listed Chemicals Are Used | Comments on Applicability of EPA HWN |
|---|---|---|
| Methanol | AD, SO | F003 applies to AD because methanol may have been used for cleaning inside the glovebox. F003 does not apply to SO because methanol was used in a cold trap outside the glovebox. |
| Methylene chloride (also called dichloromethane)<br>n-dodecane<br>Octylphenyldiisobutyl-carbamoylmethylphosphine oxide (CMPO)<br>Organicstrip<br>Perchlorocarbons<br>Phosphine oxide<br>Phosphines | AC1, SA | F002 applies to P/S codes AC1 and SA because methylene chloride was used for solvent properties. |
| Pyridine<br><br>Sodium dithionate | AC, AC2, SA | D038, F005: used as solvent in organometallic synthesis process. |
| Tetrachloroethylene<br><br><br>Tetraethylamine hydrochloride<br>Tetraethylamine hydroxide<br>Tetraethylammonium hydroxide | AD, APD, CV | D039 and F002 apply to AD and APD. However no codes apply to CV because this chemical was only used as a coolant outside the glovebox. |
| Tetrahydrofuran<br>Thionyl chloride | AC, AC2, SA | ~~The applicability of U213is yet to be determined.~~ Copy wording from Table 6 of TA-55-19-20 |
| Toluene<br><br>Tributyl phosphate (TBP)<br>Tributyl phosphate (TBP)/Isopar | AC, AC2, SA | F005 applies because toluene was used as a solvent in organometallic synthesis |
| Trichloroethylene<br><br><br><br>Vacuum pump oil | CK, ME, XO | D040 applies to P/S codes ME and XO; F002 also applies to P/S code XO. Neither EPA HWN applies to P/S code CK because this chemical was used as a coolant outside the glovebox. |

**Table 5. Evaluation of the Applicability of EPA Hazardous Waste Numbers to Processes Discussed in This Report**

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| AC | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005, ~~U213~~ | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005 (~~U213 applicability to be determined~~) |
| AC1 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005 | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005 |
| AC2 | Actinide Chemistry, R&D | None | D011, D018, D022, F002, F005, ~~U213~~ | D007, D008, D009 | D007, D008, D009, D011, D018, D022, F002, F005 (~~U213 applicability to be determined~~) |
| AC3 | Actinide Chemistry, R&D | None | None | None | None |
| ACL | Analytical Chemistry Laboratory | None | None | D007, D008, D009 | D007, D008, D009 |
| AD | Actinide Processing Demonstration | D004, D005, D006, D007, D008, D009, D010, D011, D019 | D008, D019, D039, F002, F003 | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019, D039, F002, F003 |
| APD | Actinide Processing Demonstration | D008, D009, D019, D021, D022, D039, F002, F003 | None | D007, D008, D009 | D007, D008, D009, D019, D021, D022, D039, F002, F003 |
| AX | Solution Assay | None | None | D007, D008, D009 | D007, D008, D009 |
| CK | RD&D Volatile Fluoride Pu Recovery | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| CV | R&D Experimental Chlorination Processes | D005, D006, D007, D008, D011 | D019, D039 | D007, D008, D009 | D005, D006, D007, D008, D009, D011, D019, D039 |
| EDC | Electrolytic Decontamination | D007 | None | D007, D008 | D007, D008 |
| EOC | Experimental Oxide Characterization | None | None | D007, D008, D009 | D007, D008, D009 |
| EXT | Extraction RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| FDL | FOOF Demonstration Loop | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| FLU | Fluorination RD&D | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| HRS | High Resolution Spectroscopy | None | None | D008 | D008 |

| P/S Code | Description | Potential EPA Hazardous Waste Numbers (HWNs) | | | Applicable HWNs |
|---|---|---|---|---|---|
| | | Due to Feed (from Table 1 and text) | Due to Chemical Use (from Table 4) | Due to Process* | |
| IB | Matrix Study Of Pyrochemical Salts | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| ICP | ICP–AES Analysis | None | None | D007, D008, D009 | D007, D008, D009 |
| IE | Isotope Enrichment | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| LI | XF6 Experimental Measurements | D005, D006, D007, D008, D011 | None | D007, D008, D009 | D005, D006, D007, D008, D009, D011 |
| LIBS | Laser-Induced Breakdown Spectroscopy System | None | None | None | None |
| ME | Metallography | None | D040, F003 | D007, D008 | D007, D008, D040, F003 |
| NCD | Nonconfirming Drums | None | None | None | None |
| RASS/ RSS | Raman Spectroscopy System | D004, D005, D006, D007, D008, D009, D010, D011, D019 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011, D019 |
| RD | Repackaging into Retrievable Drums | None | None | D008 | D008 |
| SA | Super Acid RD&D | None | D018, D038, F002, F003, F005, ~~U213~~ | D007, D008, D009 | D007, D008, D009, D018, D038, F002, F003, F005 (~~U213 applicability to be determined~~) |
| SMP | SP Mounting Preparation | None | None | None | None |
| SO | Super Oxidizer, FOOF Program | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011 |
| STF | Standard Fabrication | None | None | D007, D008 | D007, D008 |
| VS | Confirmation, Inspection & Sampling | None | None | D008 | D008 |
| WM | Waste Management | Must be determined on case-by-case basis | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| X0 | Inactive or Unspecified P/S Material | Must be determined on case-by-case basis | | | **D007, D008, D009, D022, D035, D040, F001, F002, F005 |
| XES | X-Ray Energy Spectroscopy | D004, D005, D006, D007, D008, D009, D010, D011 | None | D007, D008, D009 | D004, D005, D006, D007, D008, D009, D010, D011 |

Activities under P/S codes LIBS, NCD, and SMP do not generate solid waste to which any HWN would be applicable.

~~The applicability of EPA HWN U213 (tetrahydrofuran) to waste from P/S codes AC, AC2 and SA is yet to be determined.~~

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), in use since 1991, includes a statement that must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

## Attachment 3 - Acceptable Knowledge Source Document Summary

| Site(s): Los Alamos National Laboratory | Source Document Tracking Number: D036 |
|---|---|
| Waste Stream Number(s): LA-CIN01.001, LA-MHD01.001, LA-MIN02-V.001, LA-MIN04-S.001<br>(Applicable only when site library is not in use) | |
| Acceptable Knowledge Documentation Type:<br>☑ TRU Waste Management Program Information<br>☑ Waste Stream-Specific Information<br>☐ Additional Information | Category:<br>☐ C - Correspondence<br>☑ D - Documents<br>☐ M - Miscellaneous<br>☐ P - Procedures<br>☐ DR - Discrepancy Resolution<br>☐ U - Unpublished Documents |
| Title or Description of Source Document [a]: Process Knowledge Report for Nitrate Operations at TA-55 | |
| Source Document Reference Information (author(s), document and revision number, date, publisher): J. Musgrave, TWCP-AK-2.1-005, Rev 2, 05/17/01, University of California | |

| AK # [b] | Source Doc. Page # [c] | AK Information Summary |
|---|---|---|
| WS3 | xi, 4 | Waste stream volume and time period of generation.<br>Re: waste from 1979, when nitrate operationds first began at TA-55 |
| PR4, WS4 | vi-xl, 4-42 | Waste generating processes. Basically, nitrate operations recovered Pu from metal and other residues to produce purified Pu oxide or other feedstock for conversion to metal. Major processes were pretreatment, dissolution, purification, evaporation, and cement fixation. 43 other processes included in nitrate operations are also described. |
| PR2, WS7 | x, 3 | Description of mission and defense relationship. |
| WS11 | xi, 44-47 | Radioisotopic composition information. Pu isotopes, Am-241, Np-237, U-234, Pa-231, Cm-244, Th-232, and Cs-137 are listed. |
| WS8, WS12 | xi, 7, 11, 13-16, 18-19, 43-44, 46, 48-52, 54 | RCRA constituents are listed, although they are described as varying over different time periods. They include F002, F003, D004, D005, D006, D007, D008, D009, D010, D011, D019, D021, D022, D039, D040. No K or P codes were applicable. Also, no PCBs are believed to have been used in nitrate operations. |
| WS1 | x | This AK report covers retrieveably stored and newly generated, mixed and non-mixed debris and waste immobilized in cement.<br><br>Waste from nitrate operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, and glass debris; and wast immobilized in cement. |

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DATE REC'D 12/13/2012

## Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

| Site(s): Los Alamos National Laboratory | Source Document Tracking Number: D036 |
|---|---|

**Source Document Data Limitations (If any):**

1. Waste stream designation not available

**Acceptable Knowlege Expert:**

Amy Johns Amy Johns Date: 12/3/2012

Print /Sign

[a] Provide description for non-titled information (i.e., container paperwork, MSDS sheets, etc)
[b] Obtain from Acceptable Knowledge Documentation Checklist
[c] For microfilm or microfiche, identify box, tape, reel number and location.

## Attachment 3 - Acceptable Knowledge Source Document Summary

| | |
|---|---|
| Waste Stream Number(s): LA-CIN01.001, LA-MHD01.001, LA-MIN02-V.001 | |
| Site(s): Los Alamos National Laboratory | Source Document Tracking Number: D036 |
| Acceptable Knowledge Documentation Type:<br>✔ TRU Waste Management Program Information<br>✔ Waste Stream-Specific Information<br>Supporting Information | Category:<br>C - Correspondence<br>✔ D - Documents<br>M - Miscellaneous<br>P - Procedures<br>DR - Discrepancy Resolution<br>U - Unpublished Documents |
| Title of Source Document: TA-55 Plutonium Facility Acceptable Knowledge Report, Nitrate Operations | |
| Source Document Reference Information (author(s), document and revision number, date, publisher): J. Musgrave, TWCP-AK-2.1-005, Rev 2, 05/17/01, University of California | |

| AK # [a] | Source Doc. Page # [b] | AK Information Summary |
|---|---|---|
| WS3 | xi, 4 | Waste stream volume and time period of generation.<br>Re: waste from 1979, when nitrate operationds first began at TA-55 |
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| PR2, WS7 | x, 3 | Description of mission and defense relationship. |
| WS11 | xi, 44-47 | Radioisotopic composition information. Pu isotopes, Am-241, Np-237, U-234, Pa-231, Cm-244, Th-232, and Cs-137 are listed. |
| WS8, WS12 | xi, 7, 11, 13-16, 18-19, 43-44, 46, 48-52, 54 | RCRA constituents are listed, although they are described as varying over different time periods. They include F002, F003, D004, D005, D006, D007, D008, D009, D010, D011, D019, D021, D022, D039, D040. No K or P codes were applicable. Also, no PCBs are believed to have been used in nitrate operations. |
| WS1 | x | This AK report covers retrieveably stored and newly generated, mixed and non-mixed debris and waste immobilized in cement.<br><br>Waste from nitrate operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, and glass debris; and wast immobilized in cement. |

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## Attachment 3 - Acceptable Knowledge Source Document Summary

**Waste Stream Number(s):** LA-CIN01.001, LA-MHD01.001, LA-MIN02-V.001, LA-MIN04-S.001

| **Site(s):** Los Alamos National Laboratory | **Source Document Tracking Number:** D037 |
|---|---|
| **Acceptable Knowledge Documentation Type:**<br>✔ TRU Waste Management Program Information<br>✔ Waste Stream-Specific Information<br>✔ Supporting Information | **Category:**<br>C - Correspondence<br>✔ D - Documents<br>M - Miscellaneous<br>P - Procedures<br>DR - Discrepancy Resolution<br>U - Unpublished Documents |

**Title of Source Document:** Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste

**Source Document Reference Information (author(s), document and revision number, date, publisher):** B. Reich, WCP-HES7-CPL-01, 2, 11/01/84, LANL

| AK # [a] | Source Doc. Page # [b] | AK Information Summary |
|---|---|---|
| PR4 | 28 | For processes generating more than a single container of homogeneous waste, each data sheet for the process was to be labeled with a code assigned to the applicable process batch. Process batch records were to be maintained for 25 years by the generator. |
| PR4, PR5, WS10 | 29-30, 32-33, Appendix D | Minimum required documentation for TRU waste included a Certified Waste Storage Record (shown in Appendix D) with completed sections on Generator's Package Information and Generator Site Health Physics Information. Data packages were to be retained by HSE-7 for 25 years and stored on microfilm. Also, a "WIPP Data Package" was to be produced by HSE-7 in accordance with WIPP-DOE-157 "Data Package Format for Certified Transuranic Waste for the Waste Isolation Pilot Plant." Each data sheet was reviewed for validity and compliance with this certification plan. As part of the certification plan attachment each generator was required to prepare, for each waste form, a content code was to be assigned by HSE-7, as well as a waste stream description and/or flow chart and packaging such as liners and inner containers. The content codes that might have been used by the Liquid Waste facility were 0002 "cemented sludge" and 0003 "dewatered sludge." Cemented sludge is defined as caustic sludge stabilized with Portland cement and packaged in drums with 5-mil plastic liners. Dewatered sludge is defined as caustic sludge containing 30-45% solids and packaged in drums "with 90 mil and 5 mil plastic liners and dry Portland cemented" to absorb any separating liquids. A detailed description of the waste-generating process was NOT required. Generators were to address each certification criterion separately and specify how each would be met. Procedures for handling nonconforming drums were also to be specified. |
| PR8, WS10, S16 | 22-26 | The only WIPP-acceptable container was a 55-gallon DOT 17-C steel drum. This was the "preferred TRU waste drum." Containers were to be visually inspected prior to use and be identified in data packages by its serial number or lot code. Corrosive waste (defined as pH <=4.0) was prohibited unless neutralized or treated or packaged "to ensure package integrity through the packaging design life." It was also to be listed on required documentation. Removable radioactive contamination was to be measured in at least three places on the drum surface and kept below WIPP limits of 50 pCi/100 cm2 alpha or 450 pCi/100 cm2 beta-gamma. Drums were to be labeled with a unique serial number of thirteen characters and the package weight in kg. The first four characters were LA for LANL and two numbers indicating the calendar year of package closure. The fifth and sixth numbers were the last two digits of a code on the Certified Waste Storage Record. The last 7 digits were taken from a tag supplied by HSE-7. If overpacked, the packaged were to be assigned new numbers. Color coded bands were also required for drums with surface dose rate > 10 mrem/hr, containing toxic constituents, or having combustible vol% > 25%. |

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## Attachment 3 - Acceptable Knowledge Source Document Summary (continued)

| Site(s): Los Alamos National Laboratory | Source Document Tracking Number: D036 |
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LA-UR-02-1715
LA-UR-01-2555
D036 AK-6
TWCP 15414

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Report for Nitrate Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-005,R.2 (LA-UR-01-2555)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

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| 0 | 06/23/00 | — | New report (TWCP-03940) |
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| 2 | 05/17/01 | All | Respond to CBFO review comments and update to include new AK information |
| 2/IC1 | 03/21/02 | All | Clarification to procedure and SME updates |

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1 Acceptable Knowledge Roadmap (21 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Timeline for Nitrate Operations (10 pages)
4 Process Inputs and Outputs (15 pages)
5 Generalized Process Status Diagram for Nitrate Processes (1 page)
6 Decision/Discrepancies Resolution Documentation (2 pages)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| AK Information Summary | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001) |
| CFR | *Code of Federal Regulations* |
| CLS | Chemistry and Laser Science [Division]—former name of C Division |
| CSMO | Central Scrap Management Office |
| D | RCRA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FFTF | Fast Flux Test Facility |
| HEPA | high efficiency particulate air |
| HWN | [EPA] hazardous waste number |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level [radioactive] waste |
| MSE | molten salt extraction |
| MT | material type |
| N | Nitrate [designator for individual documents in nitrate operations reports in Attachment 1, Acceptable Knowledge Roadmap] |
| OSWER | Office of Solid Waste and Emergency Response [EPA] |
| P | RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| P/S [code] | process status [code] |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| SME | subject matter expert |
| SOP | safe/standard operating procedure |
| TA | technical area |

| | |
|---|---|
| TOPO | trioctyl phosphate oxide |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization/Certification Project |
| UCNI | Unclassified Controlled Nuclear Information |
| WAC | waste acceptance criteria |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WIPP | Waste Isolation Pilot Plant |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request Form |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**NOTE:** This index indicates the main process AK report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| AL | Ash Leach | Nitrate Operations |
| AO | Americium Processing Calcination | Nitrate Operations |
| AP | Americium Purification | Nitrate Operations |
| AS | Anode Heel Dissolution | Nitrate Operations |
| AT | Ash Testing | Nitrate Operations |
| ATL | Advanced Test Line for actinide separation (RD&D) | Nitrate Operations |
| BAC | Bacterial Decomposition of Cellulose Items | Nitrate Operations |
| BF | Unknown name for this P/S code | Nitrate Operations |
| BL | Blending | Nitrate Operations |
| BM | Burning Metal | Nitrate Operations |
| BU | Button Burning | Nitrate Operations |
| CC | Calcination | Nitrate Operations |
| CD | Hydroxide Cake Dissolution | Nitrate Operations |
| CF | Cement Fixation | Nitrate Operations |
| CH | Characterization | Nitrate Operations |
| CK | RD&D Volatile Fluoride Pu Recovery | Miscellaneous Operations |
| CL | Crucible Processing | Chloride Operations |
| CN | C-N-O Analysis | Metal Operation Processes |
| COD | Chlorinated Oxide Dissolution | Nitrate Operations |
| COL | Chlorinated oxide leach | Nitrate Operations |
| CPOD | Catalyzed Electrochemical Plutonium Oxide Dissolver | Nitrate Operations |
| CR | Crushing and Pulverizing | Nitrate Operations |
| CS | Chloride Solutions | Chloride Operations |
| CX | Chloride Anion Exchange | Chloride Operations |
| DF | DS Furnace and Oxide Preparation | Nitrate Operations |
| DP | Dry Processing | Nitrate Operations |
| DS | Ion Exchange | Nitrate Operations |

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| ED | Cascade Dissolver | Nitrate Operations |
| ETD | Experimental Thermal Decomposition | Nitrate Operations |
| EV | Evaporator | Nitrate Operations |
| FA | Americium Processing | Nitrate Operations |
| FC | Canning | Nitrate Operations |
| FX | Cement to Drum | Nitrate Operations |
| GMS | Open Gradient Magnetic Separation | Nitrate Operations |
| HC | Calcination | Nitrate Operations |
| HCD | Hydroxide Cake Dissolution | Nitrate Operations |
| HD | Hydroxide Cake Dissolution | Nitrate Operations |
| HGMS | High Gradient Magnetic Separation | Nitrate Operations |
| HP | Cement Fixation | Nitrate Operations |
| HRA | Hanford Reservation Materials | Nitrate Operations |
| IA | Impure Americium Holding for Discard | Nitrate Operations |
| IB | Matrix Study of Pyrochemical Salts | Miscellaneous Operations |
| IS | Incinerator | Nitrate Operations |
| LC | Uranium/plutonium Processing | Nitrate Operations |
| LG1 | Noncombustible Leach | Nitrate Operations |
| LG2 | Hydroxide Cake Dissolution | Nitrate Operations |
| LR | Ion Exchange | Nitrate Operations |
| MAG | Magnetic Separation | Nitrate Operations |
| MAS | RD&D Experimental Processes | Nitrate Operations |
| MB | Nitric Dissolution of Molten Salts | Chloride Operations<br>Nitrate Operations |
| MELL | Mediated Electro-Oxidation of LLW | Nitrate Operations |
| MF | Metals Furnace | Nitrate Operations |
| ML | Non Pu Metal Leach | Nitrate Operations |
| MPD | Cascade Dissolver | Nitrate Operations |
| NC | Noncombustible Leach | Nitrate Operations |
| NL | Noncombustible Leach | Nitrate Operations |
| NR | Nitrate Recovery | Nitrate Operations |

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| OD | Oxide Dissolution | Nitrate Operations |
| OH | Hydroxide Precipitation | Nitrate Operations |
| OY | Oxalate Precipitation | Nitrate Operations |
| PA | Passivation | Nitrate Operations |
| PAF | Passivation Furnaces | Nitrate Operations |
| PR | Peroxide Precipitation | Nitrate Operations |
| PS | Peroxide Precipitation of MSE Salts | Nitrate Operations |
| PT | Plutonium Thorium Separation | Nitrate Operations |
| PTS | RD&D Pretreatment Study | Nitrate Operations |
| RB | Roasting and Blending | Nitrate Operations |
| RBJ | Roasting & Blending Jr | Nitrate Operations |
| RC | Rotary Calciner | Nitrate Operations |
| RCM | Rich Column Material Ion Exchange | Nitrate Operations |
| RFX | Ion Exchange | Nitrate Operations |
| RO | Oil Recovery | Nitrate Operations |
| RR | Ion Exchange | Nitrate Operations |
| SC | Cascade Dissolver, G437 | Nitrate Operations |
| SE | Solvent Extraction | Chloride Operations |
| SO | Super Oxidizer, FOOF Program | Miscellaneous Operations |
| SP | Scrap Dissolution, G438 | Nitrate Operations |
| SSD | Special Scrap Dissolution | Nitrate Operations |
| SX | Americium Processing Silicon Removal | Nitrate Operations |
| TDC | Thermal Decomposition of Cellulose Items R&D | Nitrate Operations |
| UPS | Uranium/plutonium Separation | Nitrate Operations |
| US | Uranium Separation for Solid Solution Feed | Nitrate Operations |
| US2 | Uranium Separation for Non-solid Solution Feed | Nitrate Operations |
| VC | Variable CSMO Scrap Dissolution | Nitrate Operations |
| VP1 | CSMO Scrap Dissolution | Nitrate Operations |
| VP2 | Polycube Processing | Nitrate Operations |

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| VP3 | Hydroxide Precipitation | Nitrate Operations |
| VUL | Vessel Unloading | Nitrate Operations |
| ZD | Scrap Oxide Dissolution | Nitrate Operations |

* Process AK reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Metal Operations (TWCP-AK-2.1-003,R.2), Miscellaneous Operations (TWCP-AK-2.1-004,R.2), and Nitrate Operations (this report)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Nitrate Operations

**P/S codes**: AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed debris; waste immobilized in cement

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from nitrate operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

Process wastes from nitrate operations are generated in Building PF-4, Rooms 208, 401, 409, 420, and 434, of the TA-55 Plutonium Facility. Plutonium operations included reclaiming plutonium from scrap and residues produced from numerous feed sources.

**Description of the process waste (physical form and typical content description):**

Waste from nitrate operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, and glass debris; and waste immobilized in cement.

***Summary Category Group:*** S3000, S5000

***Waste Matrix Codes:*** S3000, S3100, S3200, S5100, S5300, S5400

**Description of the waste-generating process:**

The overall goal of the nitrate operations is to recover plutonium from metal, metal alloys, scrap, and residues and produce a purified plutonium oxide product or feedstock for conversion to

metal. Processes include pretreatment, dissolution, purification, evaporation, and cement fixation.

**Process feed:**

Plutonium metal or metal alloys, oxides and hydroxide cakes; pyrochemical salts; crucible pieces; anode heels; ash; analytical laboratory solutions; and residues from other DOE facilities.

**Radioisotopic content of the waste:**

Variety of plutonium material types with different well-defined isotopic compositions. Am-241, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium, or plutonium and uranium, so that the waste will usually be enriched in Am-241 or U-234, but may also be depleted in some cases. Pa-231, Cm-244, and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- F002 and F003: P/S codes CF and HP
- No K or P codes
- D004, D010: P/S code HRA prior to 1984
- D008: all P/S codes except NR in nitrate operations for the generation of leaded gloves
- D005: P/S codes COL, CD, DS, HCD, HD, LR, RCM, RFX, RR
- D005, D006, D007, D008, D011: P/S codes AL, AT, ATL, ED, ETD, IS, MPD, PTS, RC, SC, TDC
- D005, D006, D007, D008, D009, D011: P/S code HRA
- D005, D008: P/S code VUL
- D006, D007, D008: P/S codes OD, RB, RBJ, SP, SSD
- D006, D007, D008, D009, D011: P/S codes AO, CD, DS, EV, FX, HCD, HD, HGMS, IA, LG2, LR, MELL, OH, RCM, RFX, RR
- D006, D007, D008, D011: P/S codes AS, BF, BU
- D006, D008: P/S codes LG1, ML, NC, NL, VC
- D006, D008, D040: P/S code RO
- D007: P/S codes PT, SP
- D007, D008 , D009, D011, D019, D021, D022, D039: P/S codes CF, HP
- D007, D009: P/S codes AP, MB
- D009: P/S codes AL, ATL, ED, MPD, SC, VP1, VP3
- D011: P/S code CPOD

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste:** 1979–present

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR NITRATE OPERATIONS AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes that generated TRU waste in the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for several waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to TA-55 waste streams resulting from nitrate operations covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001,R.5) (AK Information Summary) that includes information regarding all TRU waste streams

- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to nitrate operations is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record Nos. TWCP-3548, TWCP-3566, TWCP-3567, and TWCP-3568. Individual documents in these records have been assigned a separate identifier, N-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

present in the process wastes, based on subject matter expert (SME) interviews and any relevant data

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Unclassified Controlled Nuclear Information (UCNI) is contained in these records, and will not be included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK report is part of a set of closely related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six operational areas. The multiple processes in each area are described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005) (this report)
- *Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, nitrate operations include over 80 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6).

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in nitrate operations, and identify the resulting wastes as well as outputs that are sent to other operations, such as pyrochemical operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Most processes in nitrate operations were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (DLs) (TWCP-816).

### 3.2 Basis, Rationale, and Assumption Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the AK Information Summary. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, to evaluate the most appropriate waste

summary group, waste matrix code, and potential for the presence of hazardous constituents. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

3.3 Waste Physical Form and Content Description

Wastes generated during nitrate operations are primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. General debris waste categories from nitrate operations include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles
- Metal debris (for example, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from nitrate operations. The cemented waste includes cemented organics and cemented inorganics, including emulsified oils.

3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1979, when nitrate operations first began at TA-55, to the present. Process wastes from nitrate operations have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding EPA HWNs are shown graphically in Attachment 3, Time Lines.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

3.5 Waste Generation Processes

The following subsections describe the generation of waste by nitrate operations, as well as product and waste outputs to other processes or operations.

Manufacturing and research operations performed at TA-55 in the production of plutonium also generate plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery and manufacturing operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55. Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352 and TWCP-886).

This report addresses the aqueous nitrate-based recovery processes. The primary feed source for the nitrate recovery operations is plutonium residues from other recovery operations (e.g., chloride or pyrochemical), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities (TWCP-3548/N-1). The overall goal of the nitrate recovery operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The nitrate recovery operations can be divided into the following process steps:

- Pretreatment
- Dissolution
- Purification, including conversion to oxide
- Cement fixation

Each of these process categories is described below. The timeframe and EPA HWNs associated with each P/S code are shown on the timelines included as Attachment 3; the dates can be correlated to the dates on the procedures listed in Attachment 1. Attachment 4 contains a complete listing of P/S codes for nitrate operations, their descriptions, feed materials, chemical inputs, outputs and applicable EPA HWNs. A simplified process flow diagram for nitrate operations is found in Attachment 5.

3.5.1 Pretreatment (P/S codes BL, BM, BU, CR, DP, ETD, GMS, HGMS, IS, MAG, MAS, MF, OH, OY, PA, PAF, PTS, RC, RO, TDC, VP2, VUL)

Pretreatment primarily includes physical processes used to prepare scrap and residues for the next step, dissolution (TWCP-3548/N-1). Pretreatment may have included any or all of the following processes: calcination (RC), caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing (CR), distillation, filtering of liquids or oils, incineration (IS), magnetic separation (GMS, MAG, MAS, HGMS), passivation (PA, PAF), scraping, and sorting (TWCP-3548/N-1 through N-18). As materials are received from various operations within TA-55, they are sorted and sent to other pretreatment processes or directly to dissolution depending on the

physical nature of the scrap or residue and on the amount and type of plutonium associated with the material. Loose plutonium may be brushed off of a scrap item and then the item sent to dissolution. Chunks of plutonium-bearing residue (e.g., sand, slag, crucibles) are sent for crushing and pulverizing (CR). Magnetic plutonium-bearing materials are sorted using magnetic separation (GMS, MAG, MAS, HGMS) into either lean or rich plutonium-bearing residues (TWCP-3548/N-1 and N-2). The lean plutonium-bearing residues are sent to cement fixation (CF) if plutonium concentrations are below the DL (TWCP-3548/N-1 and N-2). Finely divided plutonium in sweepings or powder form is sent directly to dissolution. Lapping or grinding oils are filtered if necessary, and the liquid portion is sent to P/S code CF for immobilization in cement, or to P/S code RO for absorption on vermiculite, if plutonium concentrations are below the DL (TWCP-3548/N-10 and N-15). If there are a significant quantity of filtered solids, they are calcined and sent to dissolution (TWCP-3568/N-82).

Thermal pretreatment processes have also been used to prepare plutonium-bearing materials for dissolution (TWCP-3548/N-1). Passivation (PA, PAF) converts pyrophoric plutonium metal and other reactive metals to a stable oxide prior to dissolution. These materials were heated in a tube furnace to approximately 600 °C (PA, PAF) (TWCP-3548/N-7 and N-11). Cellulose materials contaminated with plutonium (e.g., cheesecloth, wood, paper, cardboard) have been incinerated (IS) or thermally decomposed (TDC) (TWCP 3548/N-1, N-5, N-6, N-7, N-11, and N-12). Ash from the incinerator was sent to a calciner (P/S code RC) to remove any residual organic materials and to ensure complete oxidation prior to dissolution. Thermal decomposition of cellulose (P/S code TDC) is performed in an argon atmosphere and the vapors and particulate matter are trapped in a caustic scrubber (TWCP 3548/N-6 and N-12, TWCP 3568/N-82). The caustic solution generated by the scrubber is sent to the TA-50-1 RLWTF after meeting the TA-50-1 waste acceptance criteria (WAC) (TWCP-3548/N-12). The wash water is filtered and sent to purification if plutonium concentrations are above the DL, or to the TA-50-1 RLWTF if it meets the TA-50-1 WAC. The rags are disposed as debris waste or thermally decomposed (TDC) (TWCP 3548/N-4, TWCP 3568/N-76). The ash from the thermally decomposed rags was rotary calcined (RC) before it was sent to dissolution (TWCP 3568/N-79). The burning of plutonium metal (BM), anode heels, and oxides was used to prepare these materials for either dissolution or storage in the vault (TWCP 3548/N-13 and N-14). Distillation was used to recover plutonium from polystyrene cubes (VP2) (TWCP 3548/N-18).

A caustic (hydroxide) leach process has been used to pretreat electro-refining furnace scrapings from the Rocky Flats Plant, and other residues

high in chlorides. Chlorides were removed using sodium hydroxide and the treated residues were then dissolved in nitric and hydrofluoric acid (TWCP 3566/N-26, N-26A, and N-30E). In this case, the caustic solution would be sent to the TA-50-1 RLWTF if it met the TA-50-1 WAC, and the filtered solids would continue through the dissolution process.

In overview, particulate solids from the pretreatment step are sent to dissolution if plutonium concentrations are above the DL and to cement fixation (CF) if concentrations are below the DL (TWCP-3548/N-1 through N-18). Liquids are sent to purification if plutonium concentrations are above the DL and to the RLWTF if they meet the TA-50-1 WAC (TWCP-3548/N-1 through N-18). Chemicals used in the pretreatment steps are listed in Table 5 in Section 3.6.3. Chemicals used in these steps that are covered by 40 *Code of Federal Regulations* (CFR) Part 261, including Appendix VIII of those regulations, are (1) hydrofluoric, nitric, oxalic, and sulfuric acid, (2) potassium and sodium hydroxide, (3) hydrogen peroxide (an oxidizer), and (4) trichloroethylene. EPA HWNs D001 and D002 do not apply to the solid wastes despite the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes. Trichloroethylene was only used in 1979 in P/S code RO, as a diluent for filtering oils (not used for solvent properties [TWCP-3548/N-10 and N-18]). Thus, the EPA HWN D040, but not F002, applies to waste generated under P/S code RO during 1979.

Additional EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the feed materials (see Table 1 in Section 3.6) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (section 4.2). Leaded gloves and other lead-containing items were discarded as described in section 3.6.1.

**NOTE:** For some of these P/S codes, no formal procedures could be found and the necessary information was extracted from process flow diagrams and SME input. More detailed descriptions of such P/S codes that are included in this pretreatment section are provided in section 3.5.6, as follows: P/S codes BL, BU, DP, ETD, HGMS, MF, PA, PTS, RC, RO, and VP2.

3.5.2 Dissolution (P/S codes AL, AS, AT, ATL, BAC, CD, COD, COL, CPOD, ED, HCD, HD, LC, LG1, LG2, MB, MELL, ML, MPD, NC, NL, NR, OD, PS, PT, SC, SP, SSD, UPS, US, US2, VC, VP1, ZD)

Dissolution is comprised of numerous processes that generate a plutonium-nitrate solution for feed to a purification process (TWCP-

3548/N-1, TWCP-3568/N-79). The main chemicals used in dissolution are nitric acid and calcium fluoride and/or hydrofluoric acid, which together form a standard leach solution. Additionally, other chemicals are used for particular dissolution processes. Depending on the particular process involved, dissolution takes place in pots or in cascade systems. Debris waste items may be wiped with a cloth soaked in a nitric acid/calcium fluoride solution to recover surface contamination of plutonium. The cloths are dunked in water a few times and wrung out (TWCP-3568/N-82). The solutions from the cloths are collected and filtered. The solids from the solutions are recycled through the dissolution process if plutonium concentrations are above the DL, or sent to cement fixation or disposed as debris waste if concentrations are below the DL (TWCP-3548/N-1, TWCP-3568/N-79). The plutonium-bearing solutions were sent to purification. The cloths are reused if they are not falling apart; otherwise, they are discarded as solid waste or sent to incineration (IS), depending on the nuclear material content (TWCP-3568/N-82).

Plutonium on the surface of metal and noncombustible debris waste items is also recovered by leaching or dipping the waste item into the standard leach solution (ML, NC) (TWCP-3548/N-1, TWCP-3566/N-22, N-29, N-30, and N-31, TWCP-3568/N-79). Plutonium-bearing solutions are sent to purification, while the leached items below the DL are discarded. Lead-containing waste items (e.g., leaded gloves) below the DL are segregated, packaged separately, and assigned the EPA HWN D008 (TWCP-3567/N-39). Other leached metal items containing RCRA-regulated heavy metals are also segregated from metal debris that is not RCRA-regulated and are assigned the appropriate EPA HWNs (e.g. D006 for cadmium) (TWCP-3568/N-84).

From the late 1970s to the present, many plutonium-bearing materials are dissolved in a standard leach solution of nitric and hydrofluoric acid after appropriate pretreatment or preparation (TWCP-3566/N-30A through N-30F, TWCP-3568/N-79). These materials include alloys, anodes, carbides, casting skulls, electrorefining residues, metals, and plutonium oxide. After dissolution, solids are discarded if below the DL or recycled if above the DL, while solutions are sent to purification. These solutions contain dissolved heavy metals (e.g., lead, cadmium, mercury, or chromium) below the regulatory levels (TWCP-3568/N-82). These metals may be concentrated to above the regulatory levels in the purification step (as a hydroxide cake) or in the evaporator step, as addressed later in this report.

Starting in 1990, plutonium oxide was also dissolved using an electrochemical process that incorporated the chemicals found in the standard leach solution as well as ferric ammonium sulfate, potassium

thiocyanate, and silver nitrate (CPOD) (TWCP-3548/N-1 and TWCP-3566/N-21). The electrochemical cell used in this process relied on silver acting as a catalyst for the dissolution of plutonium. Waste from this process was considered suspect hazardous for the presence of silver and was assigned the EPA HWN D011. This process was replaced in 1994 by a similar electrochemical process (P/S code MELL) that used cobalt nitrate or cerium nitrate in place of silver nitrate to reduce the generation of hazardous and mixed waste at TA-55 (TWCP-3548/N-1 and TWCP-3566/N-33).

Two dissolution processes were designed to remove excess silica from either solid residues during dissolution or from plutonium-bearing solutions after dissolution (TWCP-3567/N-34 and N-35). In both these processes, silica was removed from solutions prior to sending them to purification. One process involved the following steps: adjusting the acidity of the feed solution using nitric acid; distilling to concentrate the solution; oxidizing the plutonium to a valence state of +4 with hydrogen peroxide; heating the solution until the excess hydrogen peroxide is destroyed; and filtering the solution to remove the silica solids (TWCP-3567/N-34). The solution from this process went to anion exchange purification process. The second silica-removal process used a hydrofluorinator with a potassium hydroxide scrubber solution (TWCP-3567/N-35). The solution from this process was sent to the TA-50-1 RLWTF via the caustic waste line if the plutonium content was below the DL or to the lean residue ion exchange (LR) purification process if the content was above the DL. The filtered silica solids from both processes were re-dissolved if plutonium concentrations were above the DL or disposed to cement fixation (CF) if concentrations were below the DL.

Uranium-plutonium oxide mixtures were leached using nitric acid to preferentially dissolve the uranium (UPS) (TWCP-3566/N-19). Aluminum nitrate was added to the solution to complex any fluoride ion that might be present. The uranium-bearing filtrate was disposed to cement fixation (CF). The plutonium-bearing solids were sent to dissolution (ED, MPD, or SP) and then to either an anion-exchange process or the oxalate-precipitation process (OY) for purification.

A caustic (hydroxide) leach process has been used to pretreat electro-refining furnace scrapings from the Rocky Flats Plant and other residues high in chlorides. Chlorides were removed using sodium hydroxide, and the treated residues were then dissolved in nitric and hydrofluoric acid (TWCP-3566/N-26, N-26A, and N-30E). The filtered solids continued through the dissolution process. If the plutonium content in the solution was above the DL, the solution was refiltered (TWCP-3566/N-26). If the

plutonium content was below the DL, the caustic solution was disposed to the TA-50-1 RLWTF (TWCP-3566/N-26A).

Several dissolution processes involved the use of cascading dissolvers or dissolution pots (AL, AT, ED, MPD, OD, SC, SP) (TWCP-3548/N-1). The choice of dissolution equipment is based on the concentration of plutonium present in the feed material and the physical form of the feed material. Feed materials include ash, glovebox sweepings, ground slag or crucibles, oxides, residues, salts, and sand (TWCP-3566/N-23, N-24, N-25, and N-28; TWCP-3567/N-36, N-37, and N-37A).

For P/S code OD, the feed materials came from P/S codes PAF, IB, RB, and RBJ (TWCP-3568/N-81). The possible impurities in the feed materials consisted of cadmium, chromium, and/or lead. These metals would be contained in the filtrate, which was sent to the ion exchange processes for further purification. The debris waste generated from this process is not expected to contain cadmium, chromium, or lead above the regulatory limits because the dissolution involved strong acids (any soluble metals should be in the filtrate). However, without analytical data or other acceptable information confirming that the concentrations of these hazardous constituents are below the regulatory levels, the applicable EPA HWNs (D006, D007, and D008) are assigned pending additional information (TWCP-3568/N-83).

Cascading dissolvers consist of a series of heated columns into which the standard leach solution is introduced along with aluminum nitrate in some instances. Air is bubbled through the columns to promote mixing of the solutions and to keep particles in suspension. Solution from the first column overflows to the second column and so on (TWCP-3548/N-1; TWCP-3566/N-23, N-24, N-24A, and N-25; TWCP-3567/N-36). After dissolution in the dissolvers, the solutions are filtered and then sent to purification. The filtered solids are sent to other dissolution processes if plutonium concentrations are above the DL, or to cement fixation (CF) or disposed as debris waste if concentrations are below the DL.

Another feed material for the nitrate operations is hydroxide filtrate cakes from the chloride operations (TWCP-3548/N-1). This material is dissolved using the standard leach solution, which is then filtered (CD, HCD, HD) (TWCP-3566/N-32). Aluminum nitrate is added to the solution and the solution is re-filtered. The filtrate is sent to purification. Filtered solids are re-dissolved if plutonium concentrations are above the DL, or disposed to cement fixation (CF) if concentrations are below the DL. From 1985 to 1994, the hydroxide cakes from the chloride operations contained cadmium, chromium, lead, mercury, and silver (TWCP-3567/N-39 and N-40). After 1994, silver is not present in the cakes. The debris waste generated from the dissolution of hydroxide

cakes from the chloride operations is not expected to contain the listed metals above the regulatory limit. However, without analytical data or other acceptable information confirming that the concentrations of these hazardous constituents are below the regulatory levels, the applicable D-codes (D006, D007, D008, D009, and D011) are assigned pending additional information (TWCP-3568/N-83).

In overview, filtered solids from the dissolution step are re-dissolved until plutonium concentrations are below the DL, then sent to cement fixation (CF); debris items are disposed after the plutonium contamination is removed from the surface by leaching; plutonium-bearing solutions are sent on to purification or to the metal preparation line (P/S code MP) (TWCP-3548/N-1; TWCP-3566/N-21 through N-33; TWCP-3567/N-34 through N-36).

Chemicals used in the dissolution steps are listed in Table 5 in Section 3.6.3. Chemicals used in these steps that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are (1) ascorbic, formic, hydrochloric, hydrofluoric, nitric, oxalic, and sulfuric acid; (2) potassium and sodium hydroxide, (3) hydrogen peroxide (an oxidizer), and (4) mercuric and silver nitrate (TWCP-3566/N-21, N-22, N-23, N-24, N-25, N-28, N-29, N-30B, N-30C, N-30D, N-30E, N-30F, N-31, N-32, and N-33; TWCP-3567/N-34, N-35, N-36, N-37, and N-37A; TWCP-3568/N-81). EPA HWNs D001 and D002 do not apply to the solid wastes despite the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes. Mercuric nitrate was used as a catalyst in P/S code VP1, which is accordingly assigned the EPA HWN for mercury, D009. Silver nitrate was used in P/S code AT and CPOD, which are therefore assigned the EPA HWN for silver, D011.

Additional EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the material feed (see Table 1 in Section 3.6) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (discussed in section 4.2). For example, RCRA-regulated hazardous constituents introduced to the nitrate operation at the dissolution step from hydroxide filtrate cakes include cadmium, chromium, lead, mercury, and silver (TWCP-3567/N-39, N-40). Leaded gloves were discarded as described in section 3.6.1.

**NOTE:** For some of these P/S codes, no formal procedures could be found and the necessary information was extracted from process flow diagrams and SME input. More detailed descriptions of such P/S codes that are included in this dissolution section are provided in section 3.5.6, as

follows: P/S codes AS, BAC, COD, COL, LC, LG1, LG2, MB, NL, NR, PS, PT, SSD, US, US2, VC, VP1, and ZD.

3.5.3 Purification and Oxide Conversion (P/S codes AO, AP, CC, CH, DF, DS, FA, FC, HC, LR, OH, OY, PR, RB, RBJ, RCM, RFX, RR, SX, and VP3)

A peroxide precipitation process (PR) was used to achieve excellent separation of plutonium from the cationic impurities calcium, chromium, magnesium, cesium, cobalt, and aluminum, as well as americium (TWCP-3567/N-52). Peroxide was added to the oxide dissolution filtrate feed material to convert the plutonium to valence state (+4). Additional peroxide resulted in the precipitation of $Pu_2O_7$. The resulting peroxide filter cake was dissolved in nitric acid and the solution was sent to oxalate precipitation (OY). The filtrate solution from the peroxide precipitation was sent to hydroxide precipitation (OH), also known as the peroxide kill process.

Plutonium-bearing solutions generated in the dissolution step are directed to purification for plutonium recovery (TWCP-3548/N-1). Purification consists of both ion exchange and precipitation processes. There are three primary ion exchange processes based on the concentration of plutonium in solution: rich feed (RCM), dissolver solutions (DS), and lean residue (LR). After ion exchange, plutonium-bearing solutions are directed to oxide precipitation and then to an oxidation process. The oxidation process generates plutonium oxide, a stable form of plutonium suitable for storage or further processing into plutonium metal.

The ion exchange processes use resin-filled columns to collect plutonium (P/S codes DS, RCM, LR, RR, RFX) (TWCP-3548/N-1; TWCP-3567/N-41, N-42, N-43, N-44, N-46, N-47, and N-53). The pH of incoming solutions is adjusted with nitric acid and the plutonium is stabilized by changing the plutonium valence state to (+4) using hydrogen peroxide. Other chemicals used to adjust acidity or to "condition" incoming solutions to address the presence of fluoride, silica, metal impurities, or plutonium (+6) include: aluminum nitrate, ferrous ammonium sulfate, hydrogen peroxide, sodium hydroxide, sodium nitrite, sulfuric acid, and urea. Certain intermediate solutions used to condition the ion exchange feed, especially caustic solutions used to "kill" the peroxide, are filtered and then sent to the TA-50-1 RLWTF if they meet the TA-50-1 WAC.

If solutions high in americium are "conditioned" with hydrogen peroxide, an americium hydroxide precipitate forms when the solutions are dripped into sodium hydroxide to "kill" the peroxide (TWCP-3567/N-55). This precipitate is dissolved using nitric acid, sent

through an ion exchange column, and then sent on to the oxalate precipitation process to recover the americium and convert it to americium oxide (P/S codes AO, AP, FA, and SX).

Plutonium (+4) binds to the resin while impurities such as americium, uranium, and other metals flow through the columns (TWCP-3548/N-1; TWCP-3567/N-41, N-42, N-43, N-44, N-46, and N-47). The plutonium remains on the resin in the (+4) valence state until an eluting agent (hydroxylamine nitrate or 0.35-1.0 M nitric acid) is flowed through the columns. This releases purified plutonium in solution for further processing (i.e., precipitation and oxidation). The plutonium-poor solutions or effluents from the ion exchange columns are sent to the evaporator (EV) for re-concentration. Ion exchange resins are reconditioned using nitric acid; spent ion exchange resins are periodically sent to cement fixation (CF) for disposal.

After ion exchange, plutonium-bearing solutions are sent on to a precipitation process (P/S codes OY and OH) to convert the plutonium solution to plutonium oxide (TWCP-3548/N-1; TWCP-3567/N-41, N-42, N-43, N-47, N-48, N-50, N-51, N-51A, and N-53; TWCP-3568/N-79). This process involves the addition of oxalic acid to form a plutonium oxalate precipitate. The precipitate is then filtered out of the solution, washed, dried, and converted to an oxide using calcination, heat lamps, or hot plates. The plutonium solutions are either sent to the evaporator (EV) for volume reduction or, for a short time, were treated with hydroxide precipitation.

Hydroxide cakes from the chloride operations, which started in 1985 (TWCP-3567/N-40), are introduced to the nitrate operations in the dissolution step (TWCP-3567/N-39). The outputs from the dissolution of chloride operations hydroxide cakes are sent to P/S code LR or DS. Therefore, RCRA-regulated hazardous constituents associated with the feed materials from the chloride operations may carry through to P/S codes DS and LR (TWCP-3567/N-38). The hazardous metal constituents contained in hydroxide cakes from 1982 (based on the start of the chloride operations) until 1994, include cadmium, chromium, lead, mercury, and silver (TWCP-3567/N-40). Beginning in 1994, only cadmium, chromium, lead, and mercury are expected to be present. These metals may be present above the regulatory limits in the waste streams generated by P/S codes DS and LR. Therefore, the EPA HWNs D006, D007, D008, D009, and D011 are assigned to the waste from 1982 to 1994; and D006, D007, D008, and D009 are assigned from 1994 forward.

In overview, plutonium oxide from the purification step is transferred to the vault for storage or to the metal preparation line; solutions are sent to

the evaporator for re-concentration and then returned to ion exchange or sent to P/S codes CF or HP for immobilization in cement. The distillates are sent to the RLWTF if they meet the TA-50 WAC. Spent ion exchange resins are sent to cement fixation (CF) (TWCP-3567/N-41 through N-53).

Chemicals used in the dissolution steps are listed in Table 5 in Section 3.6.3. Chemicals used in these steps that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are (1) hydrofluoric, nitric, and oxalic acid; (2) sodium hydroxide, and (3) hydrogen peroxide (an oxidizer)(TWCP-3567/N-41 through N-47, N-50, N-51, N-53, N-54, and N-55; TWCP-3568/N-81). EPA HWNs D001 and D002 do not apply to the solid wastes despite the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes.

However, EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the material feed (see Table 1 in Section 3.6) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (discussed in section 4.2). For example, RCRA-regulated hazardous constituents introduced to P/S codes DS and LR with the hydroxide filtrate cakes include cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). Similarly, plutonium oxide from the vault may have been roasted and blended in P/S codes RB and RBJ to provide a more homogeneous feed for the metal preparation line (P/S code MP); these oxides may have contained cadmium (D006), chromium (D007), and lead (D008) (TWCP-3567/N-56, N-57, N-57A, and N-57B). Leaded gloves were discarded as described in section 3.6.1.

**NOTE:** For some of these P/S codes, no formal procedures could be found and the necessary information was extracted from process flow diagrams and SME input. More detailed descriptions of such P/S codes that are included in this purification section are provided in section 3.5.6, as follows: P/S codes AO, AP, CC, CH, DF, FA, FC, HC, and VP3.

### 3.5.4 Evaporator (P/S code EV)

Plutonium-poor ion exchange effluents and oxalate precipitation filtrates are sent to the evaporators to re-concentrate plutonium, if possible, and reduce the volume of disposed waste (TWCP-3548/N-1, TWCP-3568/N-61 through N-65). General facility maintenance solutions (e.g., wet vacuum water, mop water, chiller water) are also sent to the evaporator if they do not meet the TA-50-1 WAC (TWCP-3568/N-76). The wet

vacuum water and chilled circulating water are contaminated with nitric acid, hydrochloric acid, or caustic solutions having the same characteristics as those sent to the TA-50-1 RLWTF, only richer in nuclear material content (e.g., diluted processing solutions) (TWCP-3568/N-82). The mop water is taken back into the evaporator only if it has a significant nuclear material content, which means that it originated in the processing solutions before escaping the confines of the glovebox system. There has never been an indication that spilled materials included a solvent.

Plutonium-poor solutions are collected in storage tanks and sent to the evaporators in batches of up to 600 liters (TWCP-3548/N-1; TWCP-3568/N-61 through N-65). These solution batches are then concentrated to approximately 25-liter volumes called "bottoms." As the bottoms cool, salts precipitate out and settle on the bottom of cooling trays. After cooling, the bottoms are sent back to ion exchange if plutonium concentrations are above the DL or to cement fixation (CF) if concentrations are below the DL. Attempts are made to re-dissolve settled salts, but if this is not possible, the bottoms are filtered and the salts are sent to dissolution if plutonium concentrations are above the DL or disposed as uncemented (debris) waste or sent to cement fixation (CF) if concentrations are below the DL. Nitric acid is used in the evaporator process to wash nitrate salts having a plutonium concentration above the DL. Except for approximately one year in 1990/1991, no other chemicals are used in the evaporator step in addition to those found in the ion exchange effluents and oxalate precipitation filtrates waste (TWCP-3548/N-1; TWCP-3558/N-61 through N-65). In the 1990/1991 timeframe, formic acid was added to the evaporator as an experiment to decrease the nitric acid concentration (by converting nitrate to nitrogen oxides) (TWCP-3568/N-76).

Chemicals used in the evaporator that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are nitric and formic acid. However, EPA HWNs D001 and D002 do not apply to the solid wastes from the evaporator because there is no free liquid in these wastes.

However, EPA HWNs apply to waste from P/S code EV as a result of the presence of regulated chemicals in the evaporator feed material. Hydroxide cakes from chloride operations, which started in 1982 (TWCP-3567/N-40), are introduced to nitrate operations in the dissolution step (TWCP-3567/N-39). Therefore, RCRA-regulated hazardous constituents associated with the feed materials from chloride operations may carry through from dissolution to P/S codes DS and LR to the evaporator (TWCP-3567/N-38). The hazardous constituents contained in the hydroxide cakes from 1982 (based on the start of the chloride operations) until 1994 include cadmium (D006), chromium

(D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). After 1994, only cadmium, chromium, lead, and mercury are expected to be present. Analysis of evaporator bottoms at TA-55 and statistical evaluation of analytical results using control charts have also shown that chromium, lead and mercury are above regulatory limits in this waste (TWCP-3568/N-66).

3.5.5 Cement Fixation (P/S codes CF, HP, IA)

In the cement fixation step, various wastes with plutonium concentrations below the DL from nitrate and other operations at TA-55 are collected and immobilized in cement for interim and long-term storage (TWCP-3548/N-1; TWCP-3568/N-67 through N-74). Cement fixation has been carried out in 55-gallon drums under P/S code CF, and in one-gallon cans under P/S code HP (TWCP-3568/N-72).

The cement fixation process came into existence in 1980 under what became P/S code HP. The following information was provided by a SME (TWCP-3568/N-81) because documented procedures for this process could not be identified. Wastes sent to P/S code HP for disposal in one-gallon cans included: americium oxide; calcium chloride salts from direct oxide reduction, pyroredox, and salt stripping; chloride solutions; evaporator bottoms; filter aid; glovebox sweepings; graphite powder; high efficiency particulate air (HEPA) filter media; high-fired ash; leached ash residues; leached particulate solids (e.g., sand, slag, crucible parts); passivated uranium carbide; plutonium/thorium fluoride filter cakes; plutonium/thorium hydroxide filter cakes; pump oils; silica solids; spent ion exchange resins; trioctyl phosphine oxide and iodine in kerosene; uranium oxide; and uranium solutions (TWCP-3568/N-72).

Since 1981, the primary feed to this process was the evaporator bottoms solution. Evaporator bottoms were treated by hydroxide precipitation and filtered. The cakes would dry only very slowly so the wet cakes were rolled in plastic bags with Portland cement powder or were stirred in one-gallon cans with Portland cement to make them set. In 1981, hydroxide precipitation was discontinued and the neutralized bottoms solutions were stirred directly with Portland cement powder in one-gallon cans. In January 1983, Gypsum (calcium sulfate) cement powder (also known as Envirostone cement) replaced the Portland cement powder. The evaporator bottoms solution was adjusted to a pH of about 3 for Gypsum cement or to a basic pH (7-10) for Portland cement. The cement powder was then mixed into the solution. Any particulate matter was added during the stirring operations.

Waste oil/organic solutions set up in cement were restricted to TRU vacuum pump oils and mixtures of trioctyl phosphine oxide (TOPO) and iodine dissolved in kerosene. Some of the miscellaneous solutions sent

for cement fixation included analytical chemistry solution residues that contained RCRA-regulated organics or heavy metals. Oils and organic liquids are emulsified by the addition of a surfactant before they are mixed with the neutralized evaporator bottom solutions (TWCP-3568/N-74). The miscellaneous solutions were treated in a manner much like the evaporator bottoms solution.

The discard of impure americium oxide from P/S code AO (section 3.5.6.1) was mostly accomplished by stirring it into a one-gallon can of evaporator bottom cement paste (up to 140 g americium/can). When all cement was being stirred in one-gallon cans, the americium-containing can was placed in the center of the middle layer of cans in a drum to provide maximum shielding. When storage of the impure americium hydroxide cakes in P/S code AO became a radiation exposure problem, a significant portion of the stored material was placed in P/S code IA until the material could be immobilized in cement for disposal. P/S code IA was active from April 1986 to December 1988. It did not involve any type of processing and, therefore, did not generate any waste.

In July 1988, the cementation process was changed from stirring the cement in one-gallon cans to stirring cement monoliths in 55-gallon drums attached to the glovebox (under P/S code CF). Although P/S code HP is still open, it has not been used since July 1988.

**NOTE:** The strategy proposed for shielding americium-containing cans, after the operation converted to 55-gallon drum monoliths, was to push the one-gallon americium-containing can down into the wet cement paste in the drum. However, the SME did not believe that it was ever attempted.

P/S code CF began in August 1988 and continues to the present time. Wastes collected for disposal in 55-gallon drums include aqueous and organic liquids from analytical chemistry; evaporator bottoms and evaporator salts; fine particulate materials, such as salts filtered from solutions, leached filter paper residues, and ash; oils, organic petroleum-based liquids, and spent ion exchange resins. As was the case for P/S code HP, the primary feed to this process has been the evaporator bottoms solutions. In 1996, the cementation process again converted from Gypsum cement powder (last used in June 1996) back to Portland cement powder (reuse began in July 1996).

Chemicals used in the cement fixation step under P/S codes CF and HP include: cement accelerator, Gypsum cement, nitric acid (pH adjustment), organic liquid emulsifier (which acts as a surfactant), Portland cement, silicon defoamer, sodium citrate retarder, and sodium hydroxide (pH adjustment) (TWCP-3568/N-69, N-71, N-72, N-74).

Phthalate buffer solution for pH 4 and phosphate buffer solution for pH 7 were used in P/S code CF only. EPA HWNs D001 and D002 do not apply to the solid wastes from cement fixation as a result of these chemicals because there is no free liquid in these wastes.

Although RCRA-regulated organics and metals were not used in either of the two cement fixation processes, regulated chemicals were present in the materials sent to be immobilized in cement. Therefore, the waste streams generated by these processes may contain RCRA-regulated solvents and metals above the regulatory limits.

- Analysis of evaporator bottoms at TA-55 between 1994 and 1998 and statistical evaluation of analytical results using control charts have also shown that chromium (D007), lead (D008) and mercury (D009) are above the regulatory limit for this waste (TWCP-3568/N-66).

- Hydroxide cakes from the chloride operations, which started in 1982 (TWCP-3567/N-40), are introduced to the nitrate operations in the dissolution step (TWCP-3567/N-39). Therefore, RCRA-regulated hazardous constituents associated with the feed materials from the chloride operations as well as those derived from other nitrate dissolution processes may carry through to cement fixation (TWCP-3567/N-38). The hazardous constituents contained in the hydroxide cakes from chloride operations include cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). The use of silver in chloride operations ended at the end of 1993. After 1993, heavy metal analyses have been conducted on the solutions, with chromium, lead, cadmium, and mercury being detected at levels above the regulatory levels at times.

- Gypsum cement was found to leach heavy metals above regulatory levels, but the Portland cement does not (N-66/TWCP-3568). Thus, the chromium, lead and mercury are no longer considered hazardous after 1995. In addition, arsenic, barium, cadmium, selenium and silver concentrations were all below the regulatory threshold limits for these metals.

- The presence of RCRA constituents in waste analytical chemistry solutions was noted in the data packages beginning in 1990. The RCRA-regulated organic chemicals found in these solutions included carbon tetrachloride (D019), n-butanol (F003), acetone (F003), methanol (F003), tetrachloroethylene (D039, F003), xylene (F003), methylene chloride (F002), chloroform (D022), and chlorobenzene (D021).

Based on this information, the following EPA HWNs apply to P/S codes CF and HP (until cessation of this process in August 1988):

- P/S codes CF and HP. Applicable EPA HWNs for organic chemicals are F002, F003, D019 (carbon tetrachloride); D021 (chlorobenzene), D022 (chloroform); and D039 (tetrachloroethylene).

- P/S code HP (from 1980 to December 1982): Applicable EPA HWNs for heavy metals for waste immobilized in Portland cement are D007 (chromium), D008 (lead), and D009 (mercury).

- P/S codes HP (from January 1983 to July 1988) and CF (from August 1988 to July 1996): Applicable EPA HWNs for heavy metals for waste immobilized in Gypsum cement are D007 (chromium), D008 (lead), D009 (mercury), and D011 (silver, until its use ended in 1992).

- P/S code CF (from July 1996 to the present time): Applicable EPA HWNs for heavy metals for waste immobilized in Portland cement are D007 (chromium), D008 (lead), and D009 (mercury). However, immobilization with Portland cement is an approved treatment and the final waste form is no longer hazardous.

Because P/S code IA simply held excess americium hydroxide cakes from P/S code AO, the EPA HWNs applicable to P/S code AO also apply to P/S code IA. These EPA HWNs are D007, D008, D009, and D011.

### 3.5.6 Additional P/S codes

Other P/S codes included in the Nitrate Operations, for which no procedures were found during this AK documentation review, are described in this section. The information for these P/S codes was derived from process flow diagrams and SME input (TWCP-3568/N-77 and N-81). The timeframe and EPA HWNs associated with each P/S code are shown on the timelines included as Attachment 3. The inputs, outputs, and applicable EPA HWNs are provided in Attachment 4.

#### 3.5.6.1 Americium Processing Calcination (AO)

This process was active from 1979 to 1984 and from 1986 to 1988 and went through three variations. The process was inactive from 1984 to 1986. From 1979 to 1984, this process received high purity americium oxalate cakes from P/S code FA. These cakes were calcined in a furnace resulting in a pure americium oxide product, which went to the vault and eventually most of this supply was sent to Oak Ridge

National Laboratory for distribution to manufacturers to be used for smoke detectors, well logging, and anti-static brushes. Beginning in February 1986 until about 1987, this process received oxalate cakes from P/S code PS. This impure americium oxalate was calcined to the oxide and sent to the vault as a reserve that could be converted to high purity oxide if a need arose. Finally, from April 1986 to December 1988, impure americium hydroxide cakes were received from chloride ion exchange processing of molten salt extraction salts. Those cakes were calcined and stored in P/S code AO and IA until they were ready for disposal by cement fixation (CF).

RCRA-regulated organic solvents were not used in any variation of this process and were not present in the feed materials; therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. RCRA-regulated metals also were not used in this process and were not introduced by the feed materials from P/S codes FA and PS; therefore, there would not be any RCRA-regulated metals in the waste streams generated from 1979 to June 1986. The presence of RCRA-regulated metals in the chloride operations, however, could carry over into this process. Therefore, waste generated from June 1986 to December 1988 may contain concentrations of cadmium, chromium, lead, mercury, and silver above the regulatory level (TWCP-3567/N-39 and N-40), resulting in EPA HWNs D006, D007, D008, D009, and D011 being assigned. The waste stream generated by this process consisted of the usual glovebox waste items.

3.5.6.2 Americium Purification (AP)

This process was performed from 1979 to June 1986, with a period of inactivity from 1984 to early 1986. The nitric acid concentration in americium solutions from P/S code SX was adjusted to 7 molar and passed through an ion exchange column. The plutonium (+4) would bind to the ion exchange resin and the americium (+3) would pass through the column, resulting in a purified americium solution. At the conclusion of the run, the plutonium was eluted off the column by washing the column with 1 molar nitric acid, and the plutonium solution collected separately. The plutonium solution was then sent to one of the plutonium ion exchange columns for recovery of the plutonium.

RCRA-regulated organic solvents and metals were not used in this process and were not present in the feed material from P/S code SX; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. Chemicals, such as hydroxylamine nitrate, were used to adjust the valence of the plutonium. The waste stream generated by this process consisted of the usual glovebox waste items, such as glass vessels, HEPA filters, and rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.3 Anode Heel Dissolution (AS)

This process was performed from 1980 to November 1988. The plutonium oxide generated as the result of burning anode heels in P/S code BU was dissolved in a nitric acid/hydrofluoric acid mixture or in calcium fluoride, and filtered to remove the nondissolving residues. These residues were dried and collected and sent after assay to P/S code SP for more rigorous dissolution. The filtrate was sent to the rich residue ion exchange column (RR) for purification.

Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium (D006), chromium (D007), lead (D008), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.4 Bacterial Decomposition of Cellulose Items (BAC)

This process was performed from mid-1995 to mid-1996 and was an alternative to thermal decomposition. The process involved the decomposition of cellulose rags using a living organism to digest the cellulose to glucose and other byproducts. Cheesecloth rags, bacteria, and water were added to a flask and allowed to sit while the bacteria digested the rags. The resulting solution was sent to the lean residue ion exchange (LR).

RCRA-regulated organics and metals were not used in this process and were not introduced by the feed materials;

therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process.

3.5.6.5 P/S code BF

Activities under this P/S code were nearly identical to those under P/S code BU because the feed was also anode heel metal. Heels were burned under P/S code BF between September 1985 and November 1986 came from the electrorefining step (P/S codes ER or SS) at TA-55. Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium (D006), chromium (D007), lead (D008), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.6 Blending (BL)

This process was performed from 1979 to May 1988. Various lots of plutonium oxide in the vault or in-house P/S codes were fed into this process. Each container of oxide was weighed, opened, and screened to remove oversized material. The oversized material was ground with a mortar and pestle and rescreened. The individual contents were combined and blended in a V-blender to make a homogeneous lot of feed oxide that was sent as feed to the roasting and blending process (RB).

This is a physical process in which no additional materials or chemicals are used. RCRA-regulated organic solvents and metals were not used in the process and were not introduced with the feed material; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. The waste generated consisted of typical glovebox waste items, such as HEPA filters, glass, ceramic boats and plates, cleaning rags, brushes, metal containers and equipment, and plastics. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.7 Button Burning (BU)

This process was performed from approximately 1979 to 1986. Metal buttons were received from offsite DOE facilities (usually Hanford, but possibly Rocky Flats as well). The metal buttons were burned in a furnace at about 600°C. The oxide produced from six buttons was combined and blended to make up a uniform feed lot for the anode heel dissolution process (AS).

Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium (D006), chromium (D007), lead (D008), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.8 Calcination (CC)

This process was performed from 1979 to November 1988. Plutonium oxalate cakes from the oxalate precipitation process (OY) were calcined by heating in air in a furnace to form pure plutonium oxide. The oxide became feed for the oxide reduction process.

This was a physical process, not involving any chemical reagents. RCRA-regulated organic compounds and metals were not used in this process and were not introduced by the feed materials. The oxalate cakes were of high purity. Therefore, the waste generated from this process would not contain any RCRA-regulated organic compounds or metals. The waste generated from this process consists of the usual glovebox waste items plus metal tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.9 Characterization (CH)

This process was performed from 1979 to February 1989 and received samples of blended lots of oxide from the blending process (BL). Portions of the samples were weighed out for four analyses to demonstrate that the oxide powders met the acceptance criteria for preparation of driver fuel for the Fast

Flux Test Facility (FFTF). The Loss on Ignition Analysis involved heating the powder and measuring the weight loss from driving off adsorbed water and gases. The Surface Area Analysis involved absorption of nitrogen gas on the oxide at liquid nitrogen temperature. The Particle Size Analysis measured the settling rate of oxide particles dispersed in a viscous, water-soluble liquid using the absorption of X-rays by the particles. The slurry was discarded to cement fixation (HP). Finally, some of the powder was pressed into pellets and sintered at 160 degrees C before measuring and weighing them for density. The pellets and oxide residues were packaged separately and sent to the vault as archives and eventually recycled. Oxide powders from other sources were also partially characterized many times. The process was used to make water-dampened plutonium oxide pucks for a criticality experiment and to test the reactivity of calcium nodules from pyrochemical operations.

RCRA-regulated organics and metals were not used in this process and were not introduced by the feed materials. The oxide samples were high-purity materials. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals. The waste generated by this process included the usual glovebox waste of HEPA filters, window glass and glass containers, metal containers and tools, brushes, and cleaning rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.10 Chlorinated Oxide Dissolution (COD)

This process was performed from August 31, 1988 to July 1991. The front-end of this process looked identical to the chlorinated oxide leach process (COL). Chloride pyrochemical salts were dissolved in sodium hydroxide solution and filtered. The filtrate was discarded into the caustic waste line to the TA-50-1 RLWTF or immobilized in cement (CF). The dried plutonium oxide cake was dissolved in a nitric acid-hydrofluoric acid mixture as part of this process, or sent to a cascade dissolver (ED). The solution from the acid dissolution step was filtered and the solids were returned to the dissolution step. The solution volume was reduced by distillation. The distillate was processed in one of the ion exchange columns. The concentrated solution was re-filtered and all of the filter residues were sent to a cascade dissolver (ED) or to the filter residues dissolution process

(SP). The filtrate was sent to one of the ion exchange columns for recovery.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials. The pyrochemical salts should be of high purity. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals.

3.5.6.11 Chlorinated Oxide Leach (COL)

This process was performed from June 13, 1989 to June 1991. Chlorinated oxides or plutonium oxide contained in chloride-based pyrochemical salts from Rocky Flats were subjected to leaching with sodium hydroxide. The chloride salts would dissolve in the solution that would then be filtered. If the filtrate met the TA-50-1 WAC, it would be sent into the process caustic waste line at the TA-50-1 RLWTF. If not, it would be sent to cement fixation (CF). The cake containing the plutonium oxide would be dried and sent to the cascade dissolver (ED) or to chlorinated oxide dissolution (COD).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. RCRA-regulated metals also were not used in this process. However, the Rocky Flats salts that fed this process would contain any barium present in their electrorefining salts. Barium is not expected to be present above the regulatory limits in the waste generated by this process; however, without analytical results or other acceptable information to support this, the EPA HWN for barium (D005) is assigned to the liquid waste sent to cement fixation (CF) (TWCP-3568/N-83). The waste generated by this process consists of the usual glovebox waste, such as glassware, plastic filter boats and tubing, and rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.12 DS Furnace and Oxide Prep (DF)

This process was performed from 1979 to April 1990. The wet plutonium oxalate cake from the ion exchange process (DS) was placed in a metal can and heated in air in a furnace to dry the cake and then decompose the oxalate to an oxide product. The oxide product was returned to the ion exchange process (DS) prior to being sent to the vault.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials. The oxalate cakes were of high-purity. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals. The waste generated by this process consists of the usual glovebox waste items plus metal tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.13 Dry Processing (DP)

This process was performed from 1979 to December 1985 and was the front-end treatment of polycubes, which were blocks of polystyrene with plutonium oxide embedded in them (TWCP-4100). The Hanford polycubes were skinned to remove the uncontaminated surface and perhaps some of the oxide embedded beneath the surface. If the skins met the DL, they would be discarded as plastic waste. If not, the skins would be sent to polycube processing (VP2) along with the bulk of the cube material. In preparation for that treatment, the cubes would be crushed and milled into small fragments.

This is a physical process. RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals. The waste generated by this process consists of the usual glovebox waste items plus plastic, metal tools and equipment, rags, and brushes.

3.5.6.14 Experimental Thermal Decomposition (ETD)

This process has been performed from June 4, 1996 to the present. Combustible residues from various P/S codes are heated in a furnace under argon until the organic matrix is volatilized and decomposed, and a carbon-rich residue containing plutonium oxide and impurities remain. This residue is then sent to a rotary calciner (RC) to remove the carbon.

RCRA-regulated organics and metals are not used in this process. Organics may be introduced with the feed materials depending upon the P/S codes from which the materials come; however, any solvents are dissipated during the heating process. The feed materials may initially contain low levels of RCRA-regulated metals, but the thermal decomposition process drives off most of the mass, thereby

concentrating the non-volatile heavy metals. Therefore, the waste generated from this process may contain RCRA-regulated metals (but no organics). The waste generated by this process consists of the usual glovebox waste items plus metal tools, containers, and equipment; rags; brushes; and a water scrub solution from scrubbing the off-gas.

3.5.6.15 Americium Processing (FA)

This process was performed from 1979 to 1984. The 7 molar nitric acid solution from the americium purification process (AP) was distilled to reduce volume, and the acidity was adjusted to a low concentration of approximately one molar prior to oxalate precipitation in P/S code AO. The oxalate filtrate was sent to one of the hydroxide precipitation processes, such as P/S code VP3.

RCRA-regulated organics and metals were not used in this process. RCRA-regulated organics also were not introduced with the feed materials. Therefore, the waste generated from this process would not contain any RCRA-regulated solvents. Any RCRA-regulated metals present as impurities in the feed materials would be contained in the oxalate filtrate sent to a hydroxide precipitation process. However, the process description for P/S code AP does not indicate the presence of metals above the regulatory limit. The waste generated by this process consists of glass vessels, sintered glass frits, HEPA filters, rags, and other glovebox waste discarded as TRU solid waste. Because this is predominantly americium, waste materials were always discarded. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.16 Canning (FC)

This process has been run from 1979 to the present. Plutonium oxide coming out of the blending process (BL) for storage in the vault is weighed into a food pack can (approximately 1 kg of oxide per can) and a lid is placed on the can in the canning operation. The can is wiped down with a water-dampened rag and passed out into a hand-held plastic bag in a hood. The plastic bag is sealed with vinyl tape and the unit is canned into a second larger food pack can that is entirely uncontaminated, for storage.

This is a physical process. RCRA-regulated organics and metals are not used in this process and are not introduced with the feed materials. The feed material is high-purity

plutonium oxide. Therefore, the waste generated by this process would not contain any RCRA-regulated solvents or metals. The waste generated by this process includes typical glovebox waste, such as HEPA filters and glass windows, as well as rags and stainless steel tools, cans, and equipment. Any wastewater generated by this process is sent to the ion exchange processes. Leaded gloves were disposed of as described in Section 3.6.1 until 1992, when this waste began to be segregated and disposed of as RCRA-regulated waste.

3.5.6.17 Cement to Drum (FX)

This process was performed from 1980 to July 1988. During the time that all cement was stirred in a one-gallon can (HP), the cans were initially bagged out a few cans at a time in a polyvinyl chloride (PVC) plastic bag and placed in a drum as they could best be fitted in. Eventually, a drum-out port was dedicated to this purpose. A 26-lb bag attached to a glovebox would be allowed to fit down into a drum. The one-gallon can would be stacked inside the bag in the drum, seven cans to a layer with five layers, for a total of 35 cans contained inside one bagout bag. No processing of materials was performed in this process.

This is a packaging process. RCRA-regulated organics and metals were not used in this process. Any applicable RCRA codes based on the feed materials are assigned to the cement fixation (CF and HP). The waste generated by this process was the usual glovebox waste, including large amounts of plastic. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.18 Calcination (HC)

This process was performed from 1979 to August 1989. Plutonium oxalate cakes from P/S code OY were first calcined in air up to 700 degrees C. Water vapor was then passed through the cakes as it was heated to 850–900 degrees C to remove any fluoride impurity from the oxide. This prevented fluoride-catalyzed low temperature sintering in the oxide product.

RCRA-regulated organics and metals are not used in this process and are not introduced with the feed materials. The feed materials (oxalate cakes) are of high purity. Therefore, the waste generated by this process would not contain any RCRA-regulated solvents or metals. This process generates

the usual glovebox waste, plus metal tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.19 High Gradient Magnetic Separation (HGMS)

This process has been performed from May 10, 1994 to the present. This P/S code is very similar to P/S codes GMS, MAG, and MAS. In this process, a steel mesh placed in a magnetic field becomes a magnetic attractor for plutonium particles of less than 50 microns. The particles are removed from slurries of soil and clays in water. This method reduces the quantity of soil that must be treated to remove the plutonium. The soil is first screened to separate the particles that are larger than 53 microns and cannot be separated in this process. The less than 53-micron fraction is slurried in water and passed around the magnet. The lean fraction is discarded as waste in cement fixation (CF) or sent to storage if the plutonium concentration is above the DL. The plutonium-rich fraction is stored until can be taken into a dissolution process. The slurry is filtered and the water is reused.

RCRA-regulated organics and metals are not used in this process but are introduced with the feed materials consisting of ash and miscellaneous materials contaminated with D006, D007, D008, D009, and D011. The waste generated by this process includes the usual glovebox waste plus metal screens and tools, rags, brushes, and containers.

3.5.6.20 Hanford Reservation Materials (HRA)

HRA refers to process residues sent from Hanford Reservation to TA-55 for plutonium recovery (TWCP-5371). This material was sent through nitrate operations but waste from processing it was tracked by the source code (HRA) instead of the P/S code in which the waste was generated. To be conservative, all EPA HWNs that are applicable to P/S codes in nitrate operations (other than the cementation processes CF and HP) are also applied to wastes from HRA. These EPA HWNs are D005, D006, D007, D008, D009, and D011.

**NOTE:** Because this code is not a process, there is no timeline associated with it in Attachment 3.

3.5.6.21 Impure Americium Holding for Discard (IA)

This P/S code was active from April 1986 to December 1988. When storage of the impure americium hydroxide cakes in P/S code AO became a radiation exposure problem, a significant portion of the stored material was placed in P/S code IA until the material could be fixed in cement for disposal. This P/S code did not involve any type of processing and, therefore, did not generate any waste.

Because this P/S code simply held excess americium hydroxide cakes from P/S code AO, the EPA HWNs applicable to P/S code AO apply to P/S code IA. These EPA HWNs include D006, D007, D008, D009, and D011.

3.5.6.22 Uranium/Plutonium Processing Nitrate Hydrofluoric Dissolution (LC)

This process was active from August 12, 1985 to August 1987. Plutonium oxides from P/S codes US (later renamed US1) and US2 were dissolved in nitric acid and hydrofluoric acid, concentrated by distillation, and filtered. The distillate solution was sent to P/S code EV. Any filter residues were calcined and recycled into the dissolution process. The uranium-plutonium solution was subjected to an oxalate precipitation with oxalic acid or sodium oxalate to precipitate the plutonium. The slurry was filtered and the plutonium oxalate was sent to a calcination process. The uranium nitrate solution was cemented in P/S code HP.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste, plus glassware, heating mantles, plastic filter boats, filter paper, rags, brushes, and metal tools and equipment.

3.5.6.23 Non Combustible Leach (LG1)

This process was active from October 1982 to December 1985. Metal, glass, and plastic from most PF-4 processes were leached with nitric acid to remove plutonium surface contamination from those matrices. The solution mixture was filtered to separate insoluble residues, which were dried and discarded as solid TRU waste. The plutonium nitrate-containing filtrate was sent to P/S code LR for

purification. This filtrate may have contained chromium, cadmium, and/or lead that was leached out from the stainless steel, shielding, or other metal feed materials (TWCP-3568/N-84).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials (TWCP-3568/N-81). Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. The metal feed materials generally consisted of steel, stainless steel, aluminum, and copper. Any RCRA-regulated metals leached from these feed materials would be in the filtrate sent to P/S code LR. However, the leached materials may still contain concentrations of cadmium and/or lead that may leach out above the regulatory limit, resulting in the debris waste requiring the applicable EPA HWNs (D006, D008) (TWCP-3568/N-84). The chromium in stainless steel does not leach out above the regulatory limit. This process generated the usual glovebox waste, plus metal, glass, plastic, plastic filter boats, filter papers, glassware, rags, and brushes (TWCP-3568/N-81).

3.5.6.24 Hydroxide Cake Dissolution (LG2)

This process was active from October 1982 to December 1985. Hydroxide cakes from P/S codes CS and VP3 were dissolved in nitric acid and the solution was filtered. Any residue or filter cake was sent back to the dissolution step. The filtrate containing the plutonium nitrate was sent to P/S code LR for purification.

RCRA-regulated metals and organics were not used in this process; however, during the 1985 time period, certain metals could have been introduced with P/S code CS (from chloride operations), and mercury could have been introduced with the P/S code VP3 feed material. These metals would be found in the nitric acid filtrate, which fed into P/S code LR. Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. However, there may have been cadmium (D006), chromium (D007), mercury (D009), or silver (D011) in the feed material from 1984 through December 1985. This process generated the usual glovebox waste, plus glassware, metal tools and equipment, plastic filter boats, filter papers, rags, and brushes.

3.5.6.25 Nitric Dissolution of Molten Salts (MB)

This process was active from February 1986 to January 1987 and included both a hydrochloric acid dissolution path and a nitric acid dissolution path. The hydrochloric acid path began with refluxing the molten salt extraction (MSE) salts in hydrochloric acid and filtering the material. The solid residues were sent back into the dissolution process. The plutonium solution was sent to P/S code SE for purification. The distillate from the condenser tube was neutralized if it would meet the process caustic waste WAC for the TA-50-1 RLWTF. If it would not meet the WAC, the material was sent to either P/S code CS or CX. In the nitric acid dissolution, the nitric acid refluxed solution was filtered and sent to P/S code PS. The solid residues were recycled back into dissolution. The distillate from the condenser tube was recycled if there was low plutonium content, but was sent to P/S code LR if the plutonium content was high.

RCRA-regulated organics and metals were not used in this process and organics were not introduced with the feed material.

3.5.6.26 Metals Furnace (MF)

This process was active from May 23, 1986 to February 1989. Plutonium metal items were roasted in air at a carefully controlled temperature. After the metal was completely converted to plutonium oxide, the materials were divided into one-kg lots and canned for storage in the vault to await blending.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials. The metal items feed materials were of reasonable purity. Therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated typical glovebox waste, plus metal tools, containers, plastic bags, metal equipment, ceramic boats, rags, and brushes.

3.5.6.27 Non Combustible Leach (NL)

This process was active from 1979 to February 1989 and is very similar to P/S code LG1. Surface contaminated metal, glass, and plastic were subjected to nitric acid leaching and filtration. The filter residues were dried and discarded if they

met the DL. Otherwise, the residues were recycled back into the leaching step. The bulk matrix materials leached were assayed to see if they met the DL for disposal. If not, they were recycled into the leaching step. The filtrate containing the plutonium nitrate was sent to P/S LR for purification. This filtrate may have contained chromium, cadmium, and/or lead from stainless steel, shielding, and other metal feed materials (TWCP-3568/N-84).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. The metal feed materials may have consisted of steel, stainless steel, aluminum, and copper. Any RCRA-regulated metals leached from these feed materials would be in the filtrate sent to P/S code LR. However, the leached metals may still contain concentrations of cadmium and/or lead above the regulatory limit, resulting in the debris waste requiring the applicable EPA HWNs (D006, D008) (TWCP-3568/N-84). The chromium in stainless steel does not leach out above the regulatory limit. This process generated the usual glovebox waste, plus glassware, metal tools and equipment, plastic filter boats, filter papers, rags, and brushes, as well as the metal, glass, and plastic matrices being leached (TWCP-3568/N-81).

3.5.6.28 Nitrate Recovery (NR)

The processes under P/S codes ED, HCD, MPD, and RFX were combined into this one P/S code; however, this P/S code was never activated. Therefore, waste was never generated under this P/S code.

3.5.6.29 Passivation (PA)

This process was active from 1979 to January 1990. Glovebox sweepings, oxides that may contain unoxidized plutonium metal, carbides, and nitrides that can be very reactive in an oxidizing acid are burned in a tube furnace in air to passivate the material and moderate its reactivity. It can then be sent to a dissolution process such as P/S SP or OD.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the typical glovebox waste, plus metal

tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.30 Peroxide Precipitation of MSE Salts (PS)

This P/S code was active from February 1986 to January 1987. Plutonium-containing nitric acid solutions from P/S code MB were filtered, diluted, stirred, and sampled for nuclear material content and to verify that the proper concentrations of materials existed in the solutions. The plutonium in the solution was precipitated out using hydrogen peroxide. The precipitate was filtered to separate it from the solution. The peroxide cake was redissolved in nitric acid and sent to P/S code SO. The americium-rich filtrate was dripped into sodium hydroxide solution to destroy the peroxide. The hydroxide slurry was acidified with nitric acid and an oxalate precipitation performed on the solution. The americium oxalate was separated as a cake by filtration and the cakes were sent to P/S code AO. The filtrate was sent to P/S code LR for recovery of plutonium.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. RCRA-regulated metals were not used in this process; however, if barium was present in the MSE salt feed material, it would be present in the americium oxalate filtrate that was sent to P/S code LR. According to the SME, however, it is very unlikely that barium was present in the feed material. Therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste materials, plus plastic filter boats, glassware, metal stirrers and column end caps. This waste was disposed as solid TRU waste.

3.5.6.31 Plutonium/Thorium Separation (PT)

This process was active from 1979 to December 1985. Initially, plutonium/thorium oxides were dissolved in nitric and hydrofluoric acid (TWCP-3567/N-54). Sodium chromate and lanthanum nitrate were added to this solution. Thorium was removed from solution through formation of a thorium fluoride precipitate. After filtering out this precipitate, the plutonium and chromium were reduced to the (+3) valence state in solution using hydroxylamine nitrate and then sent to oxalate precipitation to recover the plutonium. Chromium in solution was sent to the evaporator (EV). Because of the

chromium, the waste solution from this activity is assigned the EPA HWN D007.

Later, the process changed to separate plutonium from thorium and americium using technologies similar to those used for ion exchange (TWCP-3567/N-54, N-55). Plutonium/thorium oxide residues were dissolved in nitric acid and passed through a nitrate-based ion exchange column to separate the two actinides. The column effluent containing thorium was subjected to a hydroxide precipitation and filtration. The filtrate was discarded into the process caustic waste line to the TA-50-1 RLWTF. The residue from filtration was calcined and discarded as a solid waste. The plutonium-containing ion exchange eluate was also subjected to a hydroxide precipitation and filtration. Because the plutonium cake is still contaminated with thorium, the slurry was redissolved in nitric acid and passed through a chloride ion exchange column. The thorium effluent underwent a hydroxide precipitation and filtration. The thorium residue is calcined and discarded. The filtrate is discarded into the process caustic waste line to the TA-50-1 RLWTF. The plutonium-bearing hydrochloride eluate undergoes hydroxide precipitation and filtration. The filtrate is discarded into the process caustic waste line to the TA-50-1 RLWTF. The plutonium hydroxide cake is dissolved again in nitric acid and sent to P/S code RR for recovery.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents in the waste streams generated by this process. Chromium (D007) could be present due to the use of a chromate salt in the process from 1979 until December 1985. This process generated the typical glovebox waste streams, plus glassware; metal tools, equipment, and containers; plastic filter boats; filter papers; rags; and brushes.

3.5.6.32 RD&D Pretreatment Study (PTS)

This process was active from January 4, 1990 to February 1992. A variety of residue matrices were pulled into P/S code PTS to be characterized for impurities, state of division, and even pretreatment (milling, grinding, etc.) to achieve a desired state for use in fluoride volatility studies in P/S code CK. Most of the effort was expended on ash from LANL and Rocky Flats.

RCRA-regulated organics and metals were not used in this process, but the ash feed would have been high in heavy metals such that this P/S code would generate waste potentially contaminated with non-volatile heavy metals: barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic, mercury and selenium would not be present because they would have been volatilized. This process generated the typical glovebox waste streams, plus metal tools, containers, and equipment; plastic bags; ceramic furnace elements; ceramic boats; rags; and brushes.

3.5.6.33 Rotary Calciner (RC)

This process has been active from 1985 to the present. Ash from P/S codes IS and TDC and other carbon-containing ash and graphite crucibles are calcined in an oxygen or air stream. This removes organic carbon. The calcined ash is blended and sent to recovery. This process is also used to calcine uranium oxides before uranium separation.

RCRA-regulated organics and metals were not used in this process, but the ash feed would have been high in heavy metals such that this P/S code would generate waste potentially contaminated with non-volatile heavy metals: barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic, mercury and selenium would not be present because they would have been volatilized. This process generated the typical glovebox waste streams, plus metal tools, containers, and equipment; plastic bags; ceramic furnace elements; ceramic boats; rags; and brushes.

3.5.6.34 Oil Recovery (RO)

This process was active from 1979 to March 1989. Vacuum pump oils and other contaminated organics from various PF-4 operations were analyzed for nuclear material content. If they met the DL for plutonium, they were mixed with vermiculite and packaged in a drum for disposal. If the oils or organics contained plutonium above the DL, they were filtered through a glass frit so as to meet the DL. Any plutonium residue caught in the filter was to be sent to recovery operations.

Once in 1979, trichloroethylene (D040) was used as a diluent to reduce the viscosity of vacuum pump oil so that the oil

could be filtered through a glass frit. Otherwise, RCRA-regulated chemicals were not used in this code or present in the feed materials. Therefore, other than EPA HWN D040 in 1979, there would not be any RCRA-regulated solvents in the waste generated by this process.

RCRA-regulated metals were not used in this process. However, metal particles from the wear of vacuum pumps, such as lead, cadmium, and steel, could be in the oil; however, the metals are not soluble. The oils contain less than three percent of solids. Lead is the typical heavy metal in vacuum pump oils, while cadmium is found in hydraulic oils. The chromium from the steel is present in the oils in concentrations below the regulatory limit, based on analyses of similar low-level radioactive waste oils. These metal particles remain with the oil when it is absorbed on vermiculite. In the absence of analytical data or other acceptable information confirming that the concentrations of lead and cadmium are below the regulatory levels, the applicable EPA HWNs D006 and D008 are assigned pending additional information (TWCP-3568/N-83).

This process also generated the typical glovebox waste, plus glassware; metal tools, equipment, and containers; plastic bags and tubing; rags; and brushes.

3.5.6.35 Special Scrap Dissolution (SSD)

This process was active from March 10, 1988 to February 1991. Miscellaneous oxide scrap items were combined, dissolved in nitric acid/hydrofluoric acid, and filtered. The filter residues were dried on a hot plate and assayed. If the residues met the DL for plutonium, they were discarded as solid waste. If the plutonium concentration in the residues did not meet the DL, the materials were recycled back into the dissolution/filtering process. The plutonium nitrate-containing filtrate was sent to one of the ion exchange columns for purification.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials; therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. RCRA-regulated metals were not used in this process; the presence of heavy metals in the feed materials depends on the source of the feed materials. The feed materials could have contained cadmium, chromium, and/or lead as impurities. These metals would be

contained in the filtrate, which was sent to the ion exchange processes for further purification. The debris waste generated from this process is not expected to contain cadmium, chromium, or lead above the regulatory limits because the dissolution involved strong acids (any soluble metals should be in the filtrate). However, without analytical data or other acceptable information confirming that the concentrations of these hazardous constituents are below the regulatory levels, the applicable EPA HWNs D006, D007, and D008 are assigned pending additional information (TWCP-3568/N-83). This process generated the typical glovebox waste, plus glassware; metal containers, tools, and equipment; plastic filter boats; filter papers; rags; and brushes.

3.5.6.36 Americium Processing Silicon Removal (SX)

This process was active from 1979 through 1984. The americium-containing hydroxide cakes from the peroxide kill process (initially P/S code PR, but later P/S code OH) were redissolved in nitric acid and the solution concentrated through distillation to precipitate a gel of silica. The silica gel was separated by filtration, air dried, and discarded as solid waste at first and later immobilized in cement. The americium-containing filtrate was sent to P/S code AP.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the following TRU solid waste: glass vessels, heating mantles, HEPA filters, and other glovebox waste, and rags. Because this process involved predominantly americium-containing feed material, waste materials were always discarded

3.5.6.37 Uranium Separation for Solid Solution Feed (US)

This process was active from January 25, 1984 to January 1986. Calcined solid solutions (consisting of uranium or plutonium oxide from P/S code RC) were dissolved in concentrated nitric acid, followed by oxalate precipitation of plutonium oxalate, and filtration. The uranium-bearing filtrate was partially neutralized, immobilized in cement (HP), and discarded. The plutonium oxalate cake was dried on a hot plate and calcined to the oxide. The oxide was again heated in concentrated nitric acid with the remaining uranium impurity dissolving. The resulting solution went to cement

fixation (HP). The insoluble plutonium oxide was separated by filtration, calcined, and sent to P/S code LC (for dissolution) or RR (for purification).

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials, which were of high purity; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste, plus glassware, metal tools and equipment, plastic filter boats, filter papers, rags, and brushes.

3.5.6.38 Uranium Separation for Non-Solid Solutions (US2)

This process was active from January 25, 1984 to January 1986. The uranium in mixed plutonium-uranium oxide was dissolved in 5 molar nitric acid and filtered. The uranium solution was fixed in cement (HP) and discarded as waste. The solid plutonium oxide separated by filtration was dried on a hot plate and sent to P/S code LC (for dissolution) or RR (for recovery).

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste streams, plus glassware, heating mantles or hot plates, metal tools and equipment, plastic filter boats, filter papers, rags, and brushes.

3.5.6.39 Variable CSMO Scrap Dissolution (VC)

This process was active from April 1986 to December 1989 and is identical to P/S code SSD. Miscellaneous oxide scrap items were combined, dissolved in nitric acid/hydrofluoric acid, and filtered. The filter residues were dried on a hot plate and assayed. If the residues met the DL for plutonium, they were discarded as solid waste. If the plutonium concentration in the residues did not meet the DL, the materials were recycled back into the dissolution/filtering process. The plutonium nitrate-containing filtrate was sent to one of the ion exchange columns for purification. This filtrate may have contained chromium, cadmium, and/or lead from stainless steel, shielding, or other metal scrap items (TWCP-3568/N-84).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. The oxide feed materials have usually been through a heating process that would volatilize/decompose any organics. Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. The presence of heavy metals in the feed materials depends on the source of the feed materials. Any RCRA-regulated metals leached from these feed materials would be in the filtrate sent to ion exchange. However, the leached residues may still contain concentrations of cadmium and/or lead above the regulatory limit, resulting in the debris waste requiring the applicable EPA HWNs D006 and D008 (TWCP-3568/N-84). Any chromium in scrap metal does not leach out above the regulatory limit. This process generated the typical glovebox waste, plus glassware; metal containers, tools, and equipment; plastic filter boats; filter papers; rags; and brushes (TWCP-3568/N-81).

3.5.6.40 CSMO Scrap Dissolution (VP1)

This process was active from September 26, 1985 to April 1986. Plutonium-aluminum alloy from Hanford was dissolved in nitric acid using mercuric nitrate as a catalyst. If the item was pyrophoric, it was first calcined in P/S code PA. The quantity of mercuric nitrate was quite small because it was present as a catalyst. Filtration separated the solution of plutonium from aluminum metal pieces and a sludgy salt of aluminum nitrate. The metal pieces were picked out of the salt, which was discarded into cement. If the metal was discardable, it went to metallic waste. Plutonium-rich metal went back into dissolution. The plutonium solution was subjected to oxalate precipitation using oxalic acid or sodium oxalate, and filtered to form a cake that would be calcined to the oxide. The oxalate filtrate went to P/S code VP3. This process was modified to perform dissolution of the aluminum in sodium hydroxide after the first month because of the difficulty in controlling the reactivity of this system. The undissolved plutonium oxide could be separated by filtration and sent to one of the dissolution processes.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. RCRA-regulated metals were not introduced with the feed materials. However, in the first month of operation of this process (September 1985 to October 1985) mercuric nitrate was used in a very

small quantity as a catalyst in the dissolution step. The mercury would be found in the oxalate filtrate and, therefore, also introduced into P/S code VP3 during this time period. EPA HWN D009 (mercury) applies to waste generated under P/S codes VP1 and VP3 during the latter part of 1985. This process generated the usual glovebox waste streams, plus glassware, heating mantles, metal tools and equipment, rags, and brushes.

3.5.6.41 Polycube Processing (VP2)

This process was active from 1979 to April 1986. The skins and fragments of polycubes from P/S code DP were placed in a furnace and the polystyrene was decomposed to form volatile breakdown products in the form of oils, which were sent to Room 425 for absorption on vermiculite (eventually P/S code RO). The dry oxide residue was stored in the vault or sent to the dissolution processes.

RCRA-regulated organics and metals were not used in this process and were not introduced as feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated glovebox waste, plus furnaces and furnace elements, metal containers and tools, vacuum pump oil, rags, and brushes.

3.5.6.42 Hydroxide Precipitation (VP3)

This process was active from 1979 to April 1986. In the early years of TA-55, the oxalate filtrates from P/S codes LR, RR, LC, SO, and VP1 were brought to P/S code VP3 to perform a hydroxide precipitation and filtration to separate out the plutonium hydroxide cake. The hydroxide cake went to P/S code LG2 for dissolution. The filtrate was discarded through the process caustic waste line to the TA-50-1 RLWTF. The oxalate filtrates from P/S code LC went to P/S code EV after June 1, 1984.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents in the waste streams generated by this process. RCRA-regulated metals were not used in this process; however, mercury (D009) would have entered the process with the feed material from P/S code VP1 (from September 26, 1985 to October 31, 1985). The mercury would have precipitated in the hydroxide

cake. If the hydroxide cake contained plutonium below the DL, the mercury would accompany it to cement fixation (CF); therefore, this waste stream would be RCRA-regulated. If the hydroxide cake could not be discarded, it was sent to dissolution (P/S code LG2). This process generated the usual glovebox waste, plus plastic filter boats, filter papers, glassware, metal tools and equipment, rags, and brushes.

3.5.6.43 Scrap Oxide Dissolution (ZD)

This process was active from September 25, 1984 to November 1988. Scrap oxide from the vault and impure oxide from P/S code CL were dissolved in nitric acid and hydrofluoric acid, and filtered. The residues were collected into 900-gram batches and recycled through the process before being sent to the vault as intractable. The filtrates were sent to P/S code LR or RR ion exchange column for purification of the plutonium.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. RCRA-regulated metals were not used in this process; however, heavy metals are possible in the feed materials. These metals would end up in the filtrate that ultimately goes to the evaporator (EV). This process generated the typical glovebox waste streams, plus glassware; metal tools, containers, and equipment; plastic bags and filter boats; filter papers; rags; and brushes.

## 3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for nitrate operations at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for nitrate operations consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites. Although Pu is usually the radioactive element of interest in the feed materials, in some cases the feed material consisted of other radioactive elements, as indicated by Table 2.

**Table 1. Process Feed Materials for Nitrate Operations**

| Feed Materials | Potential Presence of RCRA-Regulated Substances* | P/S Codes in Nitrate Operations |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• CLS-1 solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (Cl-25/TWCP-3547). | CF, HP (if solutions contained Pu >DL) |
| Anode heels | Typically contaminated with RCRA-regulated heavy metals Cd, Cr, Pb and Ag (D006, D007, D008, D011). Heavy metals As, Hg, and Se are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | AS, BU, NC |
| Ash from P/S codes ETD and TDC; or from other DOE sites such as Hanford | Usually suspect contaminated with Ba, Cd, Cr, Pb, and Ag (D005, D006, D007, D008, D011). As, Hg, and Se may also be present although these metals are volatilized at high temperatures if present in the oxide and chloride forms. | AL, AT, ATL, ED, HGMS, HRA, IS, MPD, PTS, RC, SC |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | MAS, SC |
| Disassembled weapons components | High-purity Pu and U material types, no RCRA substances present | BM, RB, RBJ |
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity; may or may not contain RCRA substances | MAS |
| Hydroxide cakes | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | CD, HCD, HD, LG2 |

| Feed Materials | Potential Presence of RCRA-Regulated Substances* | P/S Codes in Nitrate Operations |
|---|---|---|
| Miscellaneous materials contaminated with Pu (e.g. tools, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters, Hanford [Hanford materials]) | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | ATL, BAC, CPOD, ED, ETD, GMS, HGMS, HRA, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD |
| MSE salts | Typically fairly pure, suspect contaminated with barium (D005) | MB, PS |
| Pu metal or metal alloy, Hanford (Hanford materials) | High purity, no RCRA-regulated substances, unless noted otherwise | ATL, BM, BU, MF, PAF, VP1 |
| Pu oxalates | High purity, no RCRA-regulated substances, unless noted otherwise | CC, DF, HC |
| Pu oxides, Hanford (Hanford materials) | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008)<br>High purity oxides and material from Hanford from P/S codes CA and MA, and from the vault; no RCRA substances | ATL, BL, CH, CPOD, DP, ED, FC, HRA, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2 |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than Ba are present | COD, COL, MB |

* The information in this column is highly generalized. Applicability of specific EPA HWNs to a process as a result of the feed material must be determined on a case-by-case basis because the presence and fate of contaminants is time and function dependent.

**Table 2. P/S Codes with Radionuclides Other Than Pu in Feed Materials**

| P/S code in nitrate operations | Radionuclide in feed material |
|---|---|
| AO, AP, FA, PR | Am-241 |
| ATL | Np-237 |
| CF | Am-341, U, Th-232 |
| HP, IA, OH, SX | Am-241 |
| LC, RC, UPS, US | U |
| PT | Th-232 |

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

3.6.1 Physical Form Identification

Solid waste from nitrate operations primarily consists of metal and debris waste, as well as cemented waste discarded under P/S codes CF or HP. Debris waste contains glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Lead-containing debris items are segregated and packaged separately (TWCP-3567/N-39). Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste were incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), is used to list each item number and record its matrix material. This form is signed by the waste packager, and then reviewed and approved by quality assurance (QA) personnel. Example forms for one drum of waste generated can be viewed in record TWCP-2513.

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for nitrate operations at TA-55 are listed in Table 3. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Please note that Table 3 indicates the isotopic composition of the material types at the time the waste was characterized.

The MT provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. These bounding calculations provide a basis for identifying enrichment or depletion of one

radionuclide versus another based on radioassays of individual waste containers. The results of these calculations are also tabulated in Table 3. The calculations assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in Am-241 or U-234 depending on whether the source of contamination is the process product or the process residues (TWCP-882). Table 4 indicates some P/S codes in which enrichment of radioelements other than Pu are expected to be greater than usual.

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from nitrate operations at TA-55, with exceptions as noted in Tables 2 and 4. In addition, Pa-231 and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations (TWCP-5164, TWCP-5165).

In general, uranium and its isotopes are expected to be present only at trace levels, if at all. U-238 would only be present if uranium was the feed material (e.g., as has been the case for P/S codes LC, RC, UPS, US, and sometimes CF; Table 2). U-235 in growth from the decay of Pu-239 half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. Uranium-234 would be present in MT 83 as a decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total Pu would be about 0.14. No U-236 is present.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). This AK report will be updated to incorporate the results of these comparisons.

### 3.6.3 Chemical Content Identification

Chemical inputs to nitrate operation processes are listed in Table 5. The use of strong acids, bases, or oxidizers does not result in RCRA listings

**Table 3. Average Isotopic Content of Plutonium Material Types and Enrichments**

| Material Type (MT) | Plutonium Isotope (Wt.%) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.
Source: TWCP-698

**Table 4. Secondary Radionuclides in Process Wastes**

| P/S code | Secondary radionuclide in process waste |
|---|---|
| AO | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1985—1987, impure $AmO_2$ for disposal) |
| AP | Am-241 (1979—1984, Am-241 production) |
| ATL | Np-237 (1993—1994, NDA standards material) |
| CD, HCD, HD | Am-241 (1992—present) |
| CF, ED, EV, RB, RFX | Np-237 as decay product in MSE (1992—present) |
| EV | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1992—present) |
| FA | Am-241 (1979—1984, Am-241 production) |
| HP | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1985—1987, impure $AmO_2$ for disposal)<br>Am-241 (1992—present) |
| IS | Cm-244 (March 1987—April 1987) |
| LR, PR | Am-241 (1979—1984, Am-241 production) |
| PS | Am-241 (1985—1987, impure $AmO_2$ for disposal) |
| PT | Th-232 (1980—1985) |

Source: TWCP-882

## Table 5. Chemical Inputs to Processes Described in This Report

| Chemical Input | P/S Codes in Which RCRA-Listed Chemicals Are Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| **Gases** | | |
| Argon gas<br>Nitrogen gas | | |
| **Acids** | | |
| Ascorbic acid<br>Formic acid<br>Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Oxalic acid<br>Sulfuric acid | | D002 does not apply to the TRU solid waste because there are no free liquids in this waste |
| **Bases** | | |
| Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the TRU solid waste because there are no free liquids in this waste |
| **Inorganic Chemicals** | | |
| Aluminum nitrate | | |
| Calcium fluoride | | |
| Calcium nitrate | | |
| Cerium nitrate | | |
| Cobalt nitrate | | |
| Ferric ammonium sulfate hydrate | | |
| Ferric nitrate | | |
| Ferrous ammonium sulfate | | D003 does not apply to the TRU solid waste because there are no free liquids in this waste. |
| Ferrous sulfamate | | |
| Gypsum cement | | |
| Hydrogen peroxide | | |
| Hydroxylamine nitrate | | |
| Lanthanum nitrate | | |
| Magnesium oxide | | |
| Mercuric nitrate | VP1 | D009. Used as catalyst in P/S code VP1; hydroxide cake produced in VP1 is processed in P/S code VP3 |
| Portland cement | | |
| Potassium fluoride hydrate | | |
| Potassium thiocyanate | | |
| Silver nitrate | AT, CPOD | D011, used as catalyst from 1990 to 1994 in CPOD. D011 does not apply to P/S code AT because it was used in a cold lab and did not become part of any TRU waste. |
| Sodium chloride | | |
| Sodium chromate | PT | D007, used in separation of Th from Pu/Am |
| Sodium nitrite | | |
| Sodium oxalate | | |
| **Metals** | | |
| Platinum | | |
| Stainless steel | | |
| Titanium | | |

| Chemical Input | P/S Codes in Which RCRA-Listed Chemicals Are Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| **Organic Chemicals** | | |
| Acetone | OH, OY | F003 if used as a solvent |
| Diethyl oxalate | | |
| Ethanol | | |
| Formamide | | |
| Ion exchange resin | | |
| Oil (engine) | | |
| Organic liquid emulsifier | | |
| Phenolphthalein | | |
| Phosphate buffer solution | | |
| Phthalate buffer solution | | |
| Polyoxyethylene-20-Sorbitan laurate (surfactant) | | |
| Silicon adhesive | | |
| Silicon defoamer (General Electric AF9020, Silicon Antifoam Emulsion) | | |
| Sodium citrate retarder | | |
| Trichloroethylene | RO | D040 applies to P/S code RO; used once in 1979 as diluent for oils |
| Urea | | |
| Vacuum grease | | |

for solid debris waste from these processes because of the absence of free liquids in this waste.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA HWNs to process wastes from nitrate operations is summarized below, as well as on the process timelines in Attachment 3, and the table of process inputs and outputs in Attachment 4. These assignments are based on the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

### 4.1 F, K, and P Listings

F002 and F003 apply to waste discarded under P/S codes CF and HP. Some of the solutions sent to these P/S codes for immobilization in cement contain the following organic chemicals:

- F002: methylene chloride
- F003: acetone, butyl alcohol (n-butanol), methanol, tetrachloroethylene, and xylene.

No K or P listings apply to solid wastes generated from any of the P/S codes in this report because no K-listed or P-listed chemicals were present in the feed materials, chemicals or equipment used in these processes.

### 4.2 Toxicity Listings

D008 (lead) applies to all P/S codes due to the potential to generate leaded gloves. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, leaded gloves were segregated and discarded in the metal debris waste stream. Since May 1992, leaded gloves have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166). Lead-containing debris waste is segregated and packaged separately from other debris waste (TWCP-3567/N-39); these wastes also are assigned D008.

Waste from most P/S codes in nitrate operations carry several EPA HWNs due to the presence of metals with toxicity characteristics in the feed materials. P/S codes covered by this report carry the following codes for heavy metals:

| | |
|---|---|
| AL | D005, D006, D007, D008, D009, D011 |
| AO | D006, D007, D008, D009, D011 |
| AP | D007, D009 |
| AS | D006, D007, D008, D011 |
| AT | D005, D006, D007, D008, D011 |

| | |
|---|---|
| ATL | D005, D006, D007, D008, D009, D011 |
| BF | D006, D007, D008, D011 |
| BU | D006, D007, D008, D011 |
| CD | D005, D006, D007, D008, D009, D011 |
| CF | D007, D008, D009, D011, D019, D021, D022, D039 |
| COL | D005 |
| CPOD | D011 |
| DS | D005, D006, D007, D008, D009, D011 |
| ED | D005, D006, D007, D008, D009, D011 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |
| FX | D006, D007, D008, D009, D011 |
| HCD | D005, D006, D007, D008, D009, D011 |
| HD | D005, D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| HRA | D005, D006, D007, D008, D009, D011 |
| IA | D006, D007, D008, D009, D011 |
| IS | D005, D006, D007, D008, D011 |
| LG1 | D006, D008 |
| LG2 | D006, D007, D008, D009, D011 |
| LR | D005, D006, D007, D008, D009, D011 |
| MB | D007, D008, and D009 (in accordance with discussion in TWCP-AK-2.1-002,R.2, section 3.6.2) |
| MELL | D006, D007, D008, D009, D011 |
| ML | D006, D008 |
| MPD | D005, D006, D007, D008, D009, D011 |
| NC | D006, D008 |
| NL | D006, D008 |
| OD | D006, D007, D008 |
| OH | D006, D007, D008, D009, D011 |
| PT | D007 |
| PTS | D005, D006, D007, D008, D011 |
| RC | D005, D006, D007, D008, D011 |
| RCM | D005, D006, D007, D008, D009, D011 |
| RFX | D005, D006, D007, D008, D009, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SC | D005, D006, D007, D008, D009, D011 |
| SP | D006, D007, D008 |

| | |
|---|---|
| SSD | D006, D007, D008 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1 | D009 |
| VP3 | D009 |
| VUL | D005, D008 |

D001 (ignitable), D002 (corrosive) or D003 (reactive) do not apply to the solid wastes from nitrate operations because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 5.0).

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes that the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), in use since 1991, includes a statement that must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) re-emphasizing the prohibition on liquids in the waste, and the continuation of waste management inspection.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data are used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage are evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166) and were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; and venting was confirmed by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, (3) and no sparking. Experimental results on the reactivity of LANL direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed, or the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 5.0 and 6.0.

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the nitrate operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 5, and Attachment 4. In the cement fixation process (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from initiation of operations of TA-55 in 1978. When any transformer oil is drained, the oil is handled by a subcontractor who is wholly responsible for its disposal; this oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)

- 40 CFR Part 261—Identification and Listing of Hazardous Wastes

- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),*

and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*

- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Records Management* (TWCP-QP-1.1-004)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) (WIPP WAC)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## ACCEPTABLE KNOWLEDGE ROADMAP

Waste from P/S Codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

Copies of these documents are in the TWCP RMDC Center. Refer to *Records Management* (TWCP-QP-1.1-004) for information on obtaining copies of these documents

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | Wastes from Plutonium Conversion and Scrap Recovery Operations, LA-11069, March 1988 | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | Budget information may not be acceptable. |
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-701 | C | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Waste was co-mingled with room trash, and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level DLs. | None |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process status code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Fixx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests were conducted on residues rather than on waste. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-2513 | A | Example of Generator Reports for Drum 54856 | TA-55 Records Management Center | Example of generator records including WPRF #07045 and WODF form showing the waste generator certification statement. | Older forms are often hard to read. |
| Cl-25/ TWCP-3547 (UCNI) | D | Answers to questions about chloride processes | Interview with Jim Foxx, 9/23/99 | Answers to questions on Chloride processes; CLS-1 solvent list | None |
| TWCP-3548/ N-1 (UCNI) | B | General description of the overall Nitrate recovery process. | *TA-55 Final Safety Analysis Report* (07/13/95) | Each step of the nitrate recovery process is described. This includes pretreatment, dissolution, purification, oxidation, and evaporation. | It provides mostly a current (as of 1995) description of the process. It alludes to past practices in places. |
| **Nitrate Pretreatment Procedures** | | | | | |
| TWCP-3548/ N-2 (UCNI) | C | P/S diagram; process diagram; process description (P/S GMS, MAG, MAS) | Magnetic Separation Research and Development; Magnetic Separation, 460-REC-R00 through R01, 1/30/89 through 11/2/92 | Describes magnetic separation processes for lean and rich residues. Lean residues <EDL are sent to cement fixation. | None |
| TWCP-3548/ N-3 (UCNI) | C | Process description | Standard Operating Procedure for Handling Process Generated Residues at TA-55, 503-GEN-R00, 2/28/78 | Procedure for residue handling, including liquid residues sent to recovery, not specified if nitrate or chloride processing. | None |
| TWCP-3548/ N-4 (UCNI) | C | Process description | Standard Operating Procedure for the Packaging of Rags for Recovery, 504-GEN-R00, 2/25/78 | Describes rinsing of nitrated rags in water. Water sent to ion exchange. | None |
| TWCP-3548/ N-5 (UCNI) | C | Chemical list; process description (P/S IS based on description) | Incinerator, 422-REC-R00 through R04, 3/1/78 through 1/15/87 | Describes incinerator process and disposition of ash. | P/S code IS assigned based on title and description |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3548/ N-6 (UCNI) | C | P/S Diagram; process description (P/S TDC) | Thermal Decomposition of Cellulose Items, 402-REC-R00, no date | Describes thermal decomposition of rags in an inert atmosphere and also how nitrated rags were soaked in water and the water sent to ion exchange. | No date is available for this procedure. |
| TWCP-3548/ N-7 (UCNI) | C | Process diagram; chemical list; process description (P/S PAF) | Oxidation of Pu Metal and Alloys Prior to Dissolution; Oxidation of Pu Metal and Alloys; Passivation Furnaces, 429-REC-R00 through R05, 3/1/78 through 12/12/95 | Describes passivation furnace process. | None |
| TWCP-3548/ N-8 (UCNI) | C | Process description | Procedure for Burning of (Pu, U) Carbides; Burning Plutonium and/or Uranium Carbides and Nitrides, 428-REC-R00 through R02, 3/1/78 through 12/8/86 | Pu and U nitrides or carbides are burned to remove pyrophorics. | None |
| TWCP-3548/ N-9 (UCNI) | C | P/S diagram, chemical list, process description (P/S VUL) | Vessel Handling and Unloading, 494-REC-R00, R01, R02, and R04, 11/15/91 through 3/12/93 | | R04 is marked as "Draft" with no approval signatures or date. |
| TWCP-3548/ N-10 (UCNI) | C | Chemical list; process description | Procedure for Disposal of Oils Containing Recoverable Amounts of Pu in the Form of (U, Pu) Carbides, 431-REC-R00, 1/26/78; 431-REC-R01, no date | Oils are filtered for Pu recovery. Oils <EDL are absorbed on vermiculite for disposal. Filtered solids are sent to dissolution. | None |
| TWCP-3548/ N-11 (UCNI) | C | Process description | Passivation, 431-REC-R00, 12/19/86 | Passivation of Pu bearing materials to remove pyrophorics (Ca, Mg metal). | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3548/ N-12 (UCNI) | C | P/S Diagram; chemical list; process description (P/S TDC) | Thermal Decomposition of Cellulose Items, 498-REC-R00 and R02, 6/2/95 and 8/15/97 | Thermal decomposition of rags in inert atmosphere. Off gases removed with caustic scrubber. Caustic is filtered and sent to RLWTF if <EDL. | None |
| TWCP-3548/ N-13 (UCNI) | C | Process description | Anode Heel Burning; Burning Metal, 434-REC-R00 through R01, 2/6/87 through 1/30/89 | Oxidation of the metal heel from electrorefining and preparation of oxide as feed for aqueous recovery. | None |
| TWCP-3548/ N-14 (UCNI) | C | P/S diagram; process description (P/S BM) | Plutonium Metal Burning; The Burning and Brushing of Plutonium Metal; 433-NMT7, R03; 433-REC-R00 through R03, 9/6/90; 5/13/94 through 8/15/97 | Removal of friable plutonium oxide from metal and calcination of the metal. | None |
| TWCP-3548/ N-15 (UCNI) | C | Process description | Processing Lapping Oil and Similar Organics, 435-REC-R00, 3/1/78; 435-REC-R01, no date | Oils are filtered for Pu recovery. Oils <EDL are absorbed on vermiculite for disposal. Filtered solids are sent to dissolution. | None |
| TWCP-3548/ N-16 (UCNI) | C | Process description | Evaluation of Pu (VI) Reduction by Nitrous Oxide, 493-REC-R00, no date | Experimental procedure to use nitrous oxide to reduce Pu (VI) to Pu (IV). | Procedure has no approval signatures or date. Assume this procedure was never implemented. |
| TWCP-3548/ N-17 (UCNI) | C | P/S diagram; chemical list; process description (P/S CR) | Crushing and Pulverizing, 435-REC-R00 through R05, 2/18/87 through 8/25/97 | Crushing and pulverizing residues to approximately 20 mesh for dissolution in nitric acid. | None |
| TWCP-3548/ N-18 (UCNI) | C | Diagram (not P/S); chemical list; process description | Polystyrene Cube Processing, 437-REC-R00 through R02, 1/19/83 through 10/22/84 | Plutonium and depleted uranium is recovered from polystyrene plastic using crushing followed by distillation. | None |

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|---|---|---|---|---|---|
| **Nitrate Dissolution Procedures** | | | | | |
| TWCP-3566/ N-19 (UCNI) | C | P/S diagram; chemical list; process description (P/S UPS) | Preferential Dissolution of Uranium Oxides from a Uranium-Plutonium Oxide Mixture, 445-REC-R00 through R03, 3/14/84 through 4/15/92 | Calcined residues containing depleted uranium and plutonium are dissolved in nitric acid. The uranium is contained in the filtrate and wash solutions, which are discarded to cement fixation. The insoluble plutonium oxide is then recovered by ion exchange or oxalate precipitation. | None |
| TWCP-3566/ N-20 (UCNI) | C | P/S diagram; chemical list; process description (P/S ATL) | Advanced Testing Line for Actinide Separations (ATLAS) Unit Operations, 491-REC-R00 through R03; 12/23/91 through 8/25/97 | The ATLAS unit was a design and development, pilot plant operation that encompassed all steps of the $NO_3$ operations. | None |
| TWCP-3566/ N-21 (UCNI) | C | P/S diagram; chemical list; process description (P/S CPOD) | Catalyzed Electrochemical Plutonium Oxide Dissolver (CEPOD), 490-REC-R00 through R01; 10/10/90 through 10/13/92 | Electrochemical dissolution of Pu residues. Silver nitrate was used as a catalyst. | None |
| TWCP-3566/ N-22 (UCNI) | C | Chemical list; process description | Recovery of Contaminated Platinum, 430-REC-R00, 3/1/78 | Recovery of Pu from platinum boats using nitric/hydrofluoric acid. | None |
| TWCP-3566/ N-23 (UCNI) | C | P/S diagram; chemical list; process description (P/S ED) | Casting Crucible Dissolution, 425-REC-R00 and R01, 1/26/78; Four-Inch Cascading Airlift Dissolvers, 425-REC-R00 through R07, 2/18/87 through 8/15/97 | Casting crucible dissolution for plutonium recovery.<br>Dissolution of Pu residues and finely divided materials using the 4" cascading dissolvers. | None |

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| TWCP-3566/ N-24 (UCNI) | C | P/S diagram; chemical list; process description (P/S SC) | Slag and Crucible Dissolution Procedure; 424-REC-R00, 1/26/78<br>Dissolution of Sand, Slag, and Crucible in 6-inch Cascade Dissolvers; Six-Inch Cascade Dissolvers, 424-REC-R00 and R03 through R08, 5/18/88 through 8/26/97 | Slag and crucible dissolution for plutonium recovery.<br>Later revisions addressed recovery of Pu from residues of sand, slag, and crucible using a 6" cascade dissolver system. | None |
| TWCP-3566/ N-24A (UCNI) | C | Process description | Pneumatic Salt Crusher, 444-REC-R00, 1/29/90 | Salt crusher is used to prepare feed materials for the six-inch cascading dissolver. No chemicals used. | None |
| TWCP-3566/ N-25 (UCNI) | C | P/S diagram; chemical list; process description (P/S MPD) | Multipurpose Cascade Dissolver System, 489-REC-R00 through R01, 10/04/91 through 9/27/94 | Operation of multipurpose cascade dissolver system for processing impure Pu bearing feeds. | None |
| TWCP-3566/ N-26 (UCNI) | C | Process diagram (not P/S); process description | Alkaline Leach of Chloride Contaminated Plutonium Oxides, 450-REC-R00, 08/21/89 | Chloride contaminated Pu oxides are leached using 0.5 M sodium hydroxide to remove chloride contamination. | None |
| TWCP-3566/ N-26A (UCNI) | C | Process description | Dissolution of High Salt and/or Chloride Contaminated Plutonium Dioxide, 448-REC-R00, 1/6/88 | Recovery of plutonium from chlorinated oxide received from Rocky Flats. | This is a hand written, temporary? procedure. It may have been a proposed procedure that was never implemented. No final version of this procedure was found. |
| TWCP-3566/ N-27 (UCNI) | C | Process description | Distillation of Am IX Column Effluents to Reduce Acidity and Volume, 470-REC-R01, 08/27/84 | Distillation of Am ion exchange column effluents to reduce acidity and volume. | None |

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| TWCP-3566/ N-28 (UCNI) | C | Diagram (not P/S); chemical list; process description, (P/S AL based on description) | Ash Leaching, 423-REC-R00 through R05, 1/26/78 through 9/14/90 | Recovery of Pu from on-site and off-site ash by leaching with nitric acid and calcium fluoride. | P/S code of AL assigned based on title and description. |
| TWCP-3566/ N-29 (UCNI) | C | Diagram (not P/S); chemical list; process description (P/S ML based on description) | Leaching of Contaminated Metals in Nitric Acid, 431-REC-R00 and R01, 10/18/90 through 1/27/94 | Recovery of Pu from non-Pu metal pieces by leaching in hot nitric acid – calcium fluoride/hydrofluoric acid. | P/S code of ML assigned based on title and description. |
| TWCP-3566/ N-30 (UCNI) | C | Process description | Processing of Contaminated Solids, 420-REC-R00 and R01, 01/26/78 through 07/09/84 | Processing of contaminated solids for Pu recovery. | None |
| TWCP-3566/ N-30A (UCNI) | C | Process description | Dissolution of Materials, 440-REC-R00 through R01, 2/25/78 through 12/16/85 | Dissolution of metals, alloys, casting skulls and plutonium compounds in nitric acid and hydrofluoric acid. Cr may be in the waste from metals, alloys and skulls. | None |
| TWCP-3566/ N-30B (UCNI) | C | Chemical list, process description. | Plutonium Metal Dissolution, 441-REC-R00 through R01, 2/25/78 through 3/2/83 | Dissolution of plutonium metal and alloys in nitric acid and hydrofluoric acid. | R00 was renewed on 3/2/83. R01 has no approval signatures or date. |
| TWCP-3566/ N-30C (UCNI) | C | Chemical list, process description. | Dissolution of Oxide Derived from Calcination of Oxalate; Standard Operating Procedure for the Dissolution of Oxide Whose Nitrate Solutions are Destined for the Metal Prep Line; The Dissolution of Plutonium Dioxide Derived from Calcined Plutonium Oxalate, 442-REC-R00 through R02, 2/25/78 through 5/23/84 | Dissolution of plutonium dioxide derived from calcined plutonium oxalate in nitric acid and hydrofluoric acid. | None |

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| TWCP-3566/ N-30D (UCNI) | C | Chemical list, process description. | Dissolution of Oxide Derived from Passivation of Carbides, Metal or Casting Skulls, 443-REC-R00 through R01, 2/25/78 through 8/2/78 | Dissolution of plutonium oxides derived from plutonium carbides, anodes, metal or casting skulls that have been passivated in a furnace. The oxides are dissolved in nitric acid and hydrofluoric acid. | None |
| TWCP-3566/ N-30E (UCNI) | C | Diagram (not P/S), chemical list, process description. | Dissolving Chloride Melt Portion of Electrorefining Residues; Dissolving the Chloride Melt Portion of Salt-Stripping Residue, 444-REC-R00 through R01, 2/25/78 through 9/26/83 | Chloride salts from electrorefining are dissolved in sodium hyroxide. Then nitric-hydrofluoric acid is used to dissolve filtered solids. Acid filtrate is sent to ion exchange. Appears to be related to hydroxide cake dissolution. | None |
| TWCP-3566/ N-30F (UCNI) | C | Chemical list, process description. | Dissolution of Residues for Ion-Exchange Feed; Standard Operating Procedure for the Residue for Ion-Exchange Feed, 447-REC-R00 through R01, 7/13/79 through 6/30/81 | Dissolution of plutonium residues from oxide dissolution in nitric acid and hydrofluoric acid. | None |
| TWCP-3566/ N-31 (UCNI) | C | P/S diagram, chemical list, process description (P/S NC) | Pickling or Surface Leaching, 421-REC-R00 and R01, 1/26/78 through ?; Leaching of Noncombustible Materials in Nitric Acid, 421-REC-R03 through R09, 2/18/87 through 3/27/97 | Recovery of Pu from surface contamination of noncombustible material by pickling or surface leaching. | Draft R09 also contains P/S code DO (Dissolution of Oxide) |
| TWCP-3566/ N-32 (UCNI) | C | P/S diagram; chemical list; process description (P/S HD, CD, HCD) | Dissolution of Chloride Generated Cake in Nitric Acid; Dissolution of Pu Hydroxide Cake in Nitric Acid, 442-REC-R00 through R03, 11/14/88 through 01/16/97 | Dissolution of Pu hydroxide cake from chloride operations in nitric acid. | None |

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|---|---|---|---|---|---|
| TWCP-3566/ N-33 (UCNI) | C | P/S diagram; chemical list; process description (P/S MELL) | Mediated Electro-Oxidation of Low-Level Organic Waste (formerly Catalyzed Electrochemical Plutonium Oxide Dissolver), 490-REC-R02, 9/26/94 | Mediation electro-oxidation of low-level organic waste (MELLOW) uses cobalt nitrate or cerium nitrate as a catalyst to recover Pu from cellulose-based material. | None |
| TWCP-3567/ N-34 (UCNI) | C | Chemical list; process description | Silica Removal from Americium Feed Solutions, 468-REC-R00 and R01, 10/06/83 through 11/29/83 | Silica removal from Am feed solution. | None |
| TWCP-3567/ N-35 (UCNI) | C | Diagram (not P/S); chemical list; process description | Residue Leaching, 426-REC-R00, 2/27/87 | Removal of $SiO_2$ from solid residues by hydrofluorination to recover Pu. | None |
| TWCP-3567/ N-36 (UCNI) | C | P/S diagram; chemical list; process description (P/S AT) | Incinerator Ash R&D Facility, 427-REC-R00, 8/22/88 | Incinerator ash R&D facility for processing of incinerator ash from Los Alamos and Rocky Flats. | None |
| TWCP-3567/ N-37 (UCNI) | C | P/S diagram; chemical list; process description (P/S SP) | Dissolution of Filter Residues and Glovebox Sweepings in Hot HNO3-HF; Dissolution of Filter Residues, Impure Oxide, and Glovebox Sweepings, 446-REC-R00 through R06, 2/3/89 through 3/27/97 | Plutonium recovery from residues using nitric acid with a fluoride catalyst. | None |
| TWCP-3567/ N-37A (UCNI) | C | P/S diagram, chemical list, process description (P/S OD and SP) | Dissolution of Impure Plutonium Dioxides, Filter Residues, and Glovebox Sweepings in Hot HNO3-HF, 447-REC-R02, 12/18/86 | Plutonium recovery from residues using nitric acid with a fluoride catalyst. | P/S diagrams were added via memo on 1/28/85 and 2/13/87. Appears as though P/S diagrams were not finalized. |

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| TWCP-3567/ N-38 (UCNI) | D | LANL policy on RCRA F-codes | Interview with Pam Rogers and Alice Barr | Solvent F-codes will apply to all waste streams generated from a processing an intermediate product once solvents are identified in that process. | None |
| TWCP-3567/ N-39 (UCNI) | D | RCRA codes associated with hydroxide cakes. | Interview with Jim Foxx of TA-55 | RCRA codes associated with hydroxide cakes from the chloride process that are fed into the nitrate process. | None |
| TWCP-3567/ N-40 (UCNI) | B | RCRA codes associated with hydroxide cakes from chloride operations that are fed to the nitrate operations at the dissolution step. | Acceptable Knowledge Summary for the TA-55 Chloride Operations | Description of the chloride operations and wastes generated based on review of historic operation procedures from the plutonium facility at TA-55. | None |
| **Nitrate Ion Exchange Procedures** | | | | | |
| TWCP-3567/ N-41 (UCNI) | C | Diagram (not P/S); chemical list; process description (P/S RCM) | Nitrate Anion Exchange for the Rich Column Material System, 472-REC-R00, 2/02/90 | Nitrate anion exchange for the rich column material. | None |
| TWCP-3567/ N-42 (UCNI) | C | P/S diagram; chemical list; process description (P/S LR) | Nitrate Anion Exchange for the Lean Residue System, 471-REC-R00 through R02, 1/29/90 through 3/22/93 | Nitrate anion exchange for the lean residue system to recover and purify Pu to weapon's grade specifications for storage as an oxide. | None |
| TWCP-3567/ N-43 (UCNI) | C | Diagram (not P/S); chemical list; process description (P/S RR) | Nitrate Anion Exchange for the Rich Residues Ion Exchange Column, 470-REC-R00, 11/22/89 | Pu eluate solution from the ion exchange process is precipitated as an oxalate. The Pu oxalate is calcined to an oxide. | None |
| TWCP-3567/ N-44 (UCNI) | C | Diagram (not P/S); chemical list; process description | Nitrate Anion Exchange, 461-REC-R00 through R02, 2/25/78 through 11/29/88 | Nitrate anion exchange utilizing an anion exchange resin in nitric acid that retains the nitrato complex of Pu (IV) over most cationic impurities. | None |

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| TWCP-3567/ N-45 (UCNI) | C | P/S diagram, chemical list, process description (P/S RFX LR DS) | Nitrate Anion Exchange [for the Dissolved Solids (DS) System], 473-REC-R00 through R06, 10/17/89 through 7/24/98 | Nitrate anion exchange process in general. The procedure starts out describing only the dissolved solids system and changes to a general description of nitrate anion exchange. | None |
| TWCP-3567/ N-46 (UCNI) | C | Chemical list; process description | Procedure for Eluting Plutonium From Ion Exchange Columns, 473-REC-R00 and R01, 8/15/79 through 12/2/82 | Recovery of accountable amounts of Pu by eluting the Pu from the ion exchange columns used in Am production. | None |
| TWCP-3567/ N-47 (UCNI) | C | P/S diagram; chemical list; process description (P/S RFX) | Nitrate Anion Exchange for the Rich-Feed Ion-Exchange System, 495-REC-R00 and R01, 4/29/92 through 12/15/93 | Nitrate anion exchange for the rich-feed ion exchange system. | None |
| TWCP-3567/ N-48 (UCNI) | C | Process description | Alternate Procedure for Conversion of Plutonium Oxalate to Oxide; Conversion of Plutonium Oxalate to Oxide Using Heat Lamp and Hot Plate, 477-REC-R00 through R02, 2/03/81 through 5/14/87 | Pu oxalate is converted to an oxide by heating with a heat lamp and hot plate. | None |
| TWCP-3567/ N-50 (UCNI) | C | P/S diagram; chemical list; process description (P/S OY) | Oxalate Precipitation of Nitrate Solutions, 479-REC-R00 through R03, 4/30/81 through 2/14/89 | The feed for this precipitation process comes from the nitrate dissolution of relatively pure on-site and off-site oxides. | None |
| TWCP-3567/ N-51 (UCNI) | C | P/S diagram; chemical list; process description (P/S LR, DS, RCM, RR) | Oxalate Precipitation and Calcination of Ion-Exchange Elutes, 466-REC-R00 through R03, 2/25/78 through 6/15/89 | Pu in ion exchange elutes are precipitated as an oxalate and the oxalate is calcined to an oxide. This operation feeds P/S OY. | None |
| TWCP-3567/ N-51A (UCNI) | C | Process description | Calcination; Hydrocalcination, 437-REC-R00 through R01, 3/5/87 through 2/13/89 | Wet plutonium oxalate cake is burned in a furnace and converted to plutonium oxide. | None |

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| TWCP-3567/ N-52 (UCNI) | C | P/S diagram; chemical list, process description (P/S PR) | Peroxide Precipitation, 480-REC-R00 and R01, 1/21/87 to 2/14/89 | Separation of Pu from catatonic impurities with the use of hydrogen peroxide for precipitation of the Pu. | None |
| TWCP-3567/ N-53 (UCNI) | C | Diagram (not P/S); chemical list; process description | Peroxide Precipitation, 464-REC-R00 and R01, 2/25/78 through ? | Separates Pu from cationic impurities such as Ca, Cr, Mg, Ce, Co, Al, and Am by peroxide precipitation | None |
| TWCP-3567/ N-54 (UCNI) | C | Diagram (not P/S); chemical list; process description | Thorium Fluoride Precipitation, 468-REC-R00 and R01, 1/26/78 through ? | Separates thorium from Pu by forming the insoluble $ThF_4$ precipitate. | None |
| TWCP-3567/ N-55 (UCNI) | C | P/S diagram; chemical list; process description (P/S OH) | Procedure for Americium Hydroxide Precipitation and Filtration ; Filtration of Caustic-Treated Peroxide Filtrates, 469-REC-R00 through R03, 8/15/79 through 12/19/86 | Am recovery from the filtrate which results from the precipitation of Pu peroxide in the FFTF Oxide Production Process.<br>Filtration of caustic-treated peroxide filtrates. These solutions are generated with the peroxide filtrate solutions and are dripped in to a caustic solution to destroy peroxide. | None |
| TWCP-3567/ N-56 (UCNI) | C | Process description | Homogenization of Plutonium Oxide Product by Auger Mixing, 432-REC-R00, 02/14/89 | Homogenization of $PuO_2$ by auger mixing. | None |
| TWCP-3567/ N-57 (UCNI) | C | P/S diagram; process description (P/S RB and RBJ) | Oxide Roasting and Blending, 433-REC-R00 through R01, 1/28/87 through 1/30/89 | Assayed oxide from the vault is blended, sintered, reblended and sampled. This material is then used as feed for Pu metal production or direct oxide reduction. Pu metal may also be burned to an oxide. | None |

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| TWCP-3567/ N-57A (UCNI) | C | P/S diagram; process description (P/S RBJ) | Roasting and Blending JR., 443-REC-R00 and 443-REC-R02, 1/30/89 through 10/30/89 | Pu oxide is reburned, sieved, blended, and sampled. | None |
| TWCP-3567/ N-57B (UCNI) | C | P/S diagram; process description (P/S RBJ, RB) | Roasting and Blending JR., 434-NMT7-R00, 3/6/92; 434-NMT7-R03, 3/3/93; 434-REC-R00 (Draft and Final) through 434-REC-R02, 4/15/94 through 8/15/97 | Pu oxide is reburned, sieved, blended, and sampled. | None |
| TWCP-3567/N-59 (UCNI) | C | Process description (P/S DS and RR) | Sampling Procedure for the Ion-Exchange Process – DS and RR, 417-GEN-R00 and R01, 4/17/86 through 1/23/89 | Collecting samples of nitrate solutions to determine plutonium content and determine which ion exchange process should be used for recovery | None |
| **Nitrate Evaporator Procedures** | | | | | |
| TWCP-3568/ N-61 (UCNI) | C | P/S diagram; chemical list; process description (P/S EV) | Treatment of Evaporator Bottoms, 485-REC-R00 through R02, 7/13/84 through 2/09/89 | Treatment of evaporator bottoms generated from the volume reduction of feed from ion exchange columns. The reduced solution goes to cement fixation and the salts are discarded. | None |
| TWCP-3568/ N-62 (UCNI) | C | P/S Diagram; process description (P/S EV) | Computer Operated Nitric Acid Volume Reduction & Treatment of Evaporator Bottoms, 485-REC-R00 through R03, 10/4/89 through 8/31/95 | Computer operated nitric acid volume reduction and treatment of evaporator bottoms. | None |
| TWCP-3568/ N-63 (UCNI) | C | P/S diagram; process description (P/S EV) | Nitric Acid Process Evaporator, 485-REC-R04 and R05, 11/20/96 through 9/9/97 | Evaporation process for reducing the volume of process-generated nitric acid/salt mixtures. | None |

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| TWCP-3568/ N-64 (UCNI) | C | P/S diagram; chemical list process description (P/S EV) | Process Nitric Acid Volume Reduction, 484-REC-R00 through R02, 10/5/84 through 3/15/90 | Nitric acid volume reduction by processing ion exchange effluent through an evaporator. | None |
| TWCP-3568/ N-65 (UCNI) | C | Chemical list; process description | Volume Reduction of Nitrate Feed Solutions Using a Mini-Evaporator, 496-REC-R00, 10/23/95 | Operation of the mini-evaporator to reduce the volume of nitrate feed solutions. | None |
| TWCP-3568/ N-66 (UCNI) | B | RCRA-codes for evaporator bottoms | Development of Control Charts for the Evaporator Bottoms Newly Generated Waste Stream from TA-55, 3/19/99 | Based on the development of control charts for analytical results, evaporator bottoms were determined to be hazardous for chromium, lead, and mercury. | None |
| **Nitrate Cement Fixation Procedures** | | | | | |
| TWCP-3568/ N-67 (UCNI) | C | Process description (P/S CF) | Auxiliary Activities for Cement Fixation, TRU-NMT2-DP11-R00 (Draft), 04/13/94 | Auxiliary activities for cement fixation, such as preparing the 55-gallon drum, attaching and detaching drums from glovebox, and filing the cement hopper. | None |
| TWCP-3568/ N-68 (UCNI) | C | Process description (P/S CF) | Calibration of the pH Electrode for Cement Fixation, TRU-NMT2-DP-06-R00, no date | Calibration and maintenance of pH electrodes used to measure the pH of waste solutions as part of the CF process. | None |
| TWCP-3568/ N-69 (UCNI) | C | P/S Diagram; chemical list; process description (P/S CF) | Cement Fixation of Process Residues in 55-Gallon Drums, TRU-NMT2-DP-04, R00; TRU-NMT7-DP-04, R01 and R02; TRUWM-TA55-DP-04-R00 (Draft), 8/6/93 through 06/21/94 | Cement fixation of liquid and particulate process residues in 55-gallon drums. | None |

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| TWCP-3568/ N-70 (UCNI) | C | P/S Diagram; Process; description (P/S CF ) | Certification of Waste for Cement Fixation, TRU-NMT2-DP-12, R00; Certifying Waste for Cement Fixation, TRUWM-TA55-DP-12-R00; 4/20/93 through 7/10/97 | Describes how TA-55 personnel ensure waste destined for CF are properly characterized, accounted for, and documented. | None |
| TWCP-3568/ N-71 (UCNI) | C | Process description (P/S CF) | Documentation for Cement Fixation, TRU-NMT2-DP-14, R00 and R01; TRUWM-TA55-DP-14-R00; 3/04/93 through 7/10/97 | Documentation for cement fixation. Describes completing the paperwork and assembling the data package that is required to accompany each drum destined for WIPP. | None |
| TWCP-3568/ N-72 (UCNI) | C | Chemical list; process description (P/S CF) | Cement Fixation of Process Residues in One-Gallon Cans, TRU-MST12-DP-03, R00, 04/27/87 | Process residue TRU waste at TA-55 immobilized for compliance with WIPP WAC. | None |
| TWCP-3568/ N-73 (UCNI) | C | Diagram (not P/S); chemical list; process description | Scrubber System for Cement Fixation Operations, 483-REC-R00, 01/30/89 | Operation of the nitric acid scrubber system to prevent the premature replacement of HEPA filters used in cementing operations. | None |
| TWCP-3568/ N-74 (UCNI) | C | Chemical list; process description (P/S CF) | Organic Liquid Emulsification, TRU-NMT2-DP-13, R00; TRUWM-TA55-DP-13-R00; 8/30/93 through 9/30/94 | Emulsifying waste oil and other organic liquids for cement fixation. | None |
| **General Documents Applicable to the Nitrate Process** | | | | | |
| TWCP-3568/ N-76 (UCNI) | D | Comments on draft Nitrate Process AK Report | Interview with Tim Hayes of TA-55 Nitrate Operations, 1/4/00 | Clarifications on various aspects of the Nitrate process, including P/S codes, time periods for P/S codes and specific operations, and appropriate terminology. | None |

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|---|---|---|---|---|---|
| TWCP-3568/ N-77 (UCNI) | D | Additional P/S diagrams assigned to Nitrate Process | Memo from Jim Foxx of TA-55, 1/17/2000 | P/S diagrams and codes assigned to Nitrate Operations by TA-55 personnel. | The diagrams are provided as "stand-alone" pieces of information. There are no procedures associated with these diagrams and so chemical use, process description, and applicability to the nitrate process can not be established. |
| TWCP-3568/ N-79 (UCNI) | C | Clarification of information for all processes within the nitrates operations | Comments from Tim Hayes and Jim Foxx on the Acceptable Knowledge Summary for TA-55 Nitrate Operations, 2/25/00 | Details provided for all processes within the nitrates operations. | None |
| TWCP-3568/ N-81 (UCNI) | C | Process descriptions, RCRA constituents, dates of generation, waste disposition (various P/S codes) | Nitrate Acceptable Knowledge Report forms completed by SMEs Tim Hayes and Jim Foxx | General process descriptions, RCRA constituents, dates of generation, and waste disposition for P/S codes without procedures. | Procedures do not exist for these P/S codes. This information is based on SME knowledge. |
| TWCP-3568/ N-82 (UCNI) | D | Clarification of specific processes within the Nitrates operations | Jim Foxx, SME, response to comments received on the Acceptable Knowledge Summary for TA-55 Nitrate Operations, 2/25/00 | Resolutions to the questions and issues raised by Pam Rogers during her review of the Acceptable Knowledge Summary for TA-55 Nitrate Operations, 2/25/00 | Information is based on SME knowledge. |
| TWCP-3568/ N-83 (UCNI) | D | Clarification of policy on assigning EPA HWNs to D-listed constituents in TRU waste streams. | Pam Rogers, email to John Musgrave, "Re: A Few Issues," 4/11/00. | All TRU waste streams containing RCRA D-listed hazardous constituents will be assigned the applicable D-code(s) unless analytical data or other acceptable information demonstrates that the concentration of the constituent is below the regulatory limit. The text will establish the caveat that the D-code can be revised (removed) based on obtaining additional information. | This policy is contrary to the WIPP WAP; however, the policy allows revisions to D-code assignments based on additional information obtained. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3568/ N-84 (UCNI) | D | Leaching equipment may result in chromium, cadmium, and/or lead being in the solution.<br>Text regarding ensuring that incompatible waste is not packaged together is provided. | Rosemary Glenn, email to Karen Chandler, "Re: Chromium," 6/8/00 and John Musgrave, email to Karen Chandler, "Re: Light Bulb!" 6/14/00. This email conveys information received from John Musgrave and Pam Rogers. | Processes that leach equipment may have chromium, cadmium, and/or lead in the solutions from stainless steel, shielding, and other metal feed materials.<br>TA-55 runs a DOT incompatibility analysis on waste being sent to TA-54. | |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3941 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3942 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4100 | D | Information on P/S/ code VP2 | Nitrate AK report form completed by SME Jim Foxx, and corrected on 09/26/00 | General process description, RCRA constituents, time line, and waste disposition | Procedures do not exist for these P/S codes. This information is based on SME knowledge |
| TWCP-4162 | D | Answers to questions about P/S codes PB, PuBe, CC, MB, MS, FF, BF, and other issues | Interview with Jim Foxx, 10/12/00 | Answers to questions on use of asbestos at TA-55, non-defense activities, and specific P/S codes in chloride operations. | None |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of Ag, disposal of ash and resins, and use of gases. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of Ag from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that Ag in ash is below limits of regulatory concern | None |
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-5164 | D | Sources of Cs-137 and Pa-231 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 2, 2001 | Plutonium operations never handled Cs-137 or Pa-231 in any of the Pu processing areas at TA-55. However, Cs-137 is expected to be present in the wastes because it is a fission product of several Pu isotopes. Pa-231 is expected to be present (as a function of the age of the waste) because it is a decay chain daughter of Pu-239 and U-235. | None |

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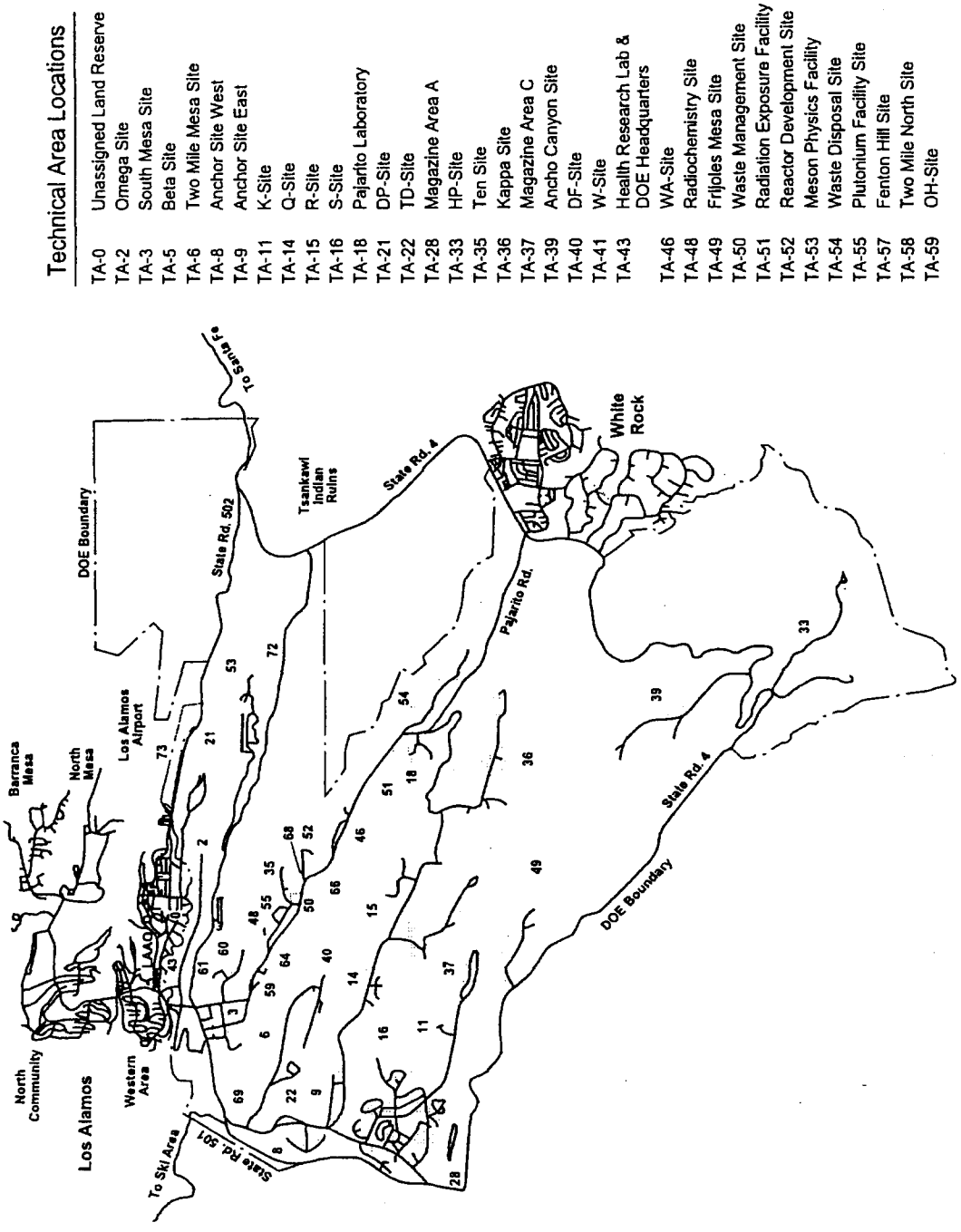
| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5165 | D | Sources of Cs-137, Pa-231, and Cm-244 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Dominant source of Cs-137 expected to be due to residual contamination from original separation of Pu from production fuel. Cm-244 introduced in P/S code DOP starting in 1988, but could also show up after that date in IS, WE, CA and CF. | None |
| TWCP-5371 | D | Source and processing of HRA materials | Interview with Jim Foxx (TA-55 SME) on April | HRA refers to process residues sent from Hanford Reservation to TA-55 for plutonium recovery. This material was sent through nitrate operations but its waste was tracked by its source code (HRA) instead of the P/S code in which the waste was generated. To be conservative, all HWNs that are applicable to P/S codes in nitrate operations (other than the cementation processes CF and HP) are also applied to wastes from HRA. These HWNs are D005, D006, D007, D008, D009, and D011. | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-004,R.2 | A | *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | A | *Process Acceptable Knowledge Report for Pyrochemical Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for pyrochemical operations at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | *Process Acceptable Knowledge Report for Special Processing Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-PLAN-0.2.7-001,R.5 | C | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK reference base on generator's original data | Detailed information on each waste drum and waste stream | None |

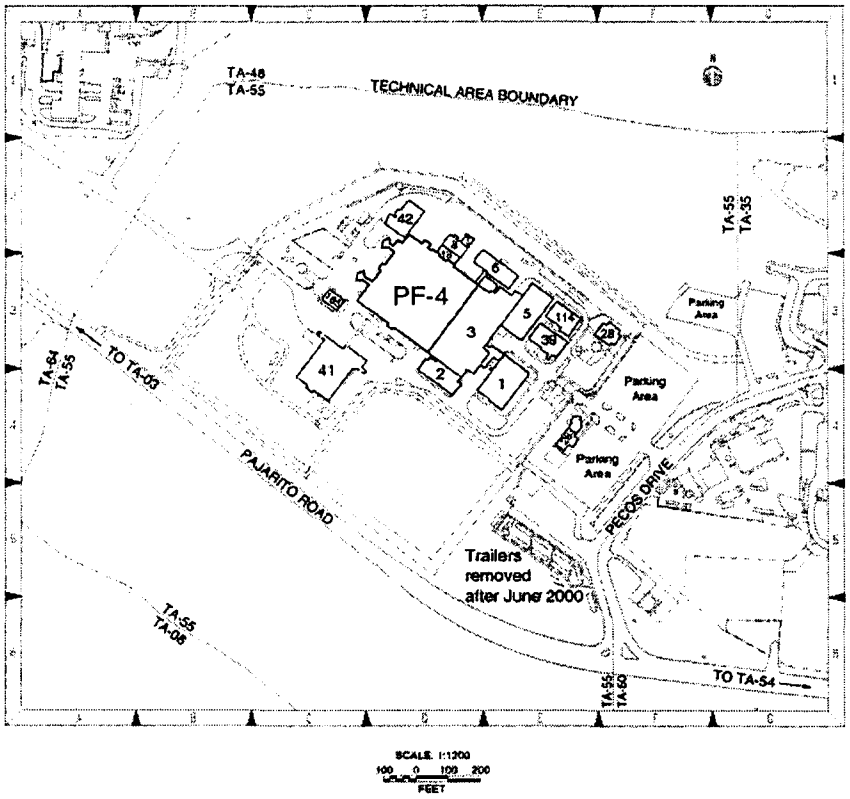
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# MAP OF LANL

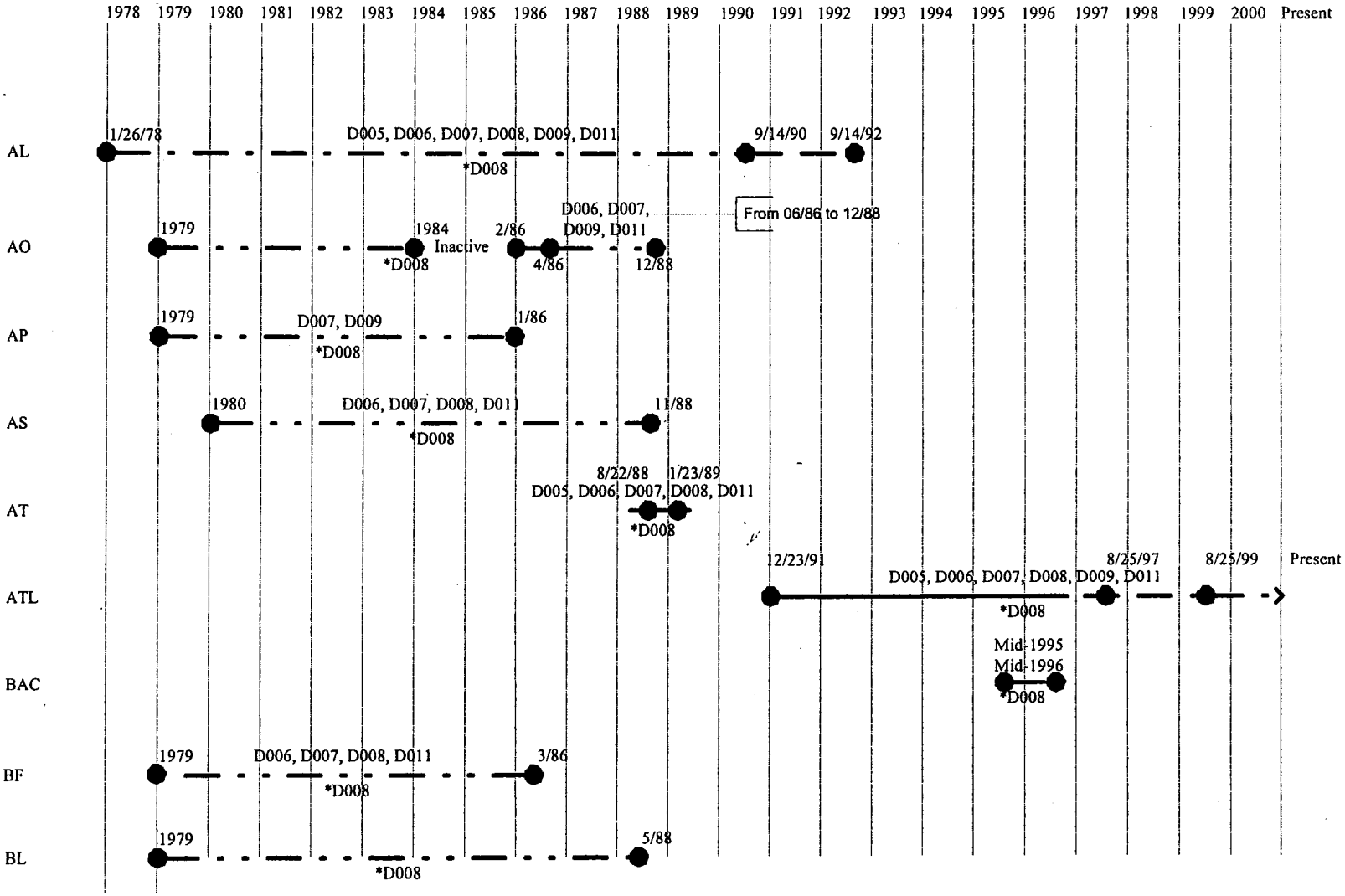

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Barranca Mesa
North Mesa
Los Alamos Airport
North Community
Los Alamos
Western Area
State Rd. 501
To Ski Area
DOE Boundary
State Rd. 4

## MAP OF TA-55

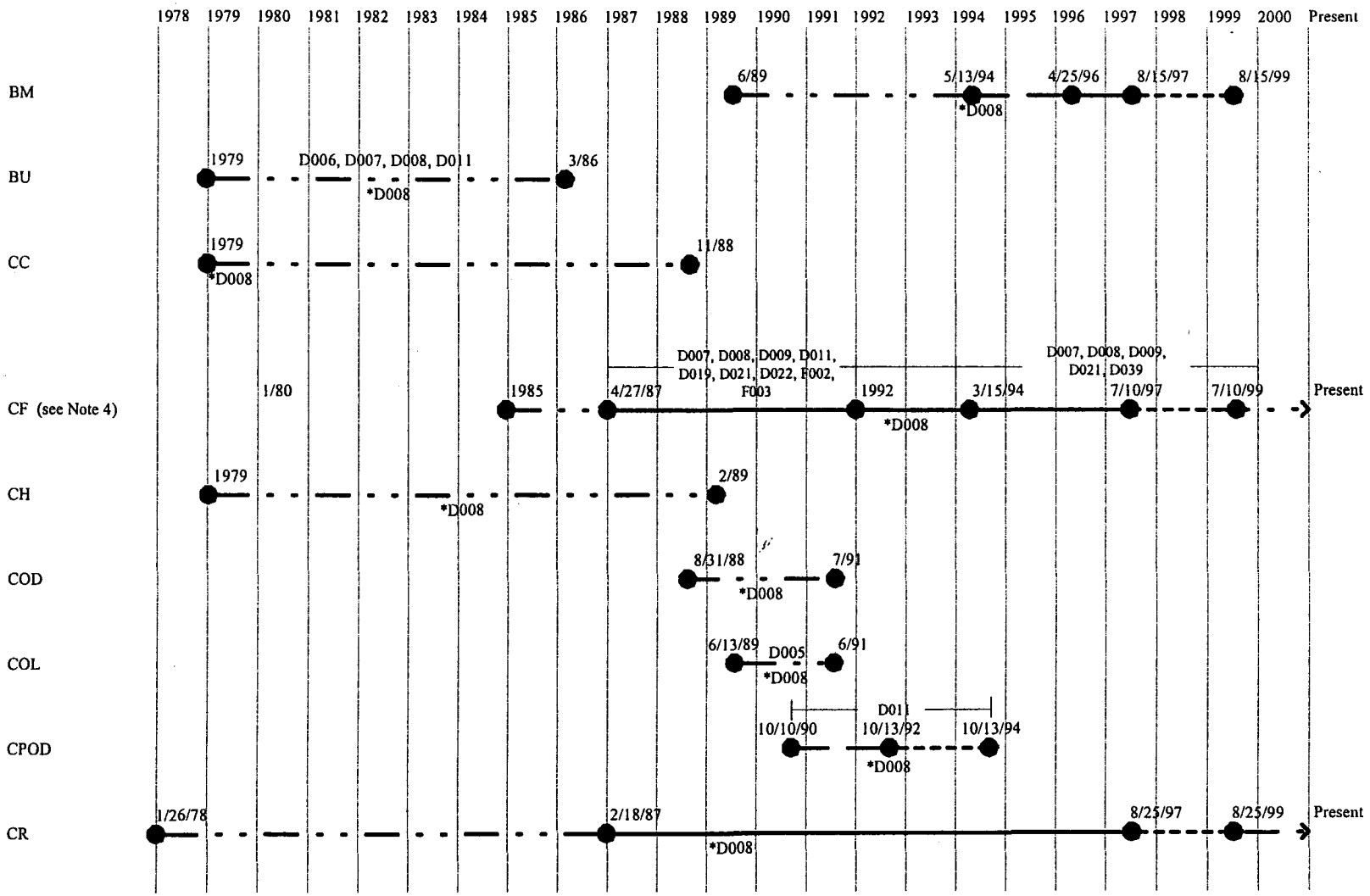
**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.



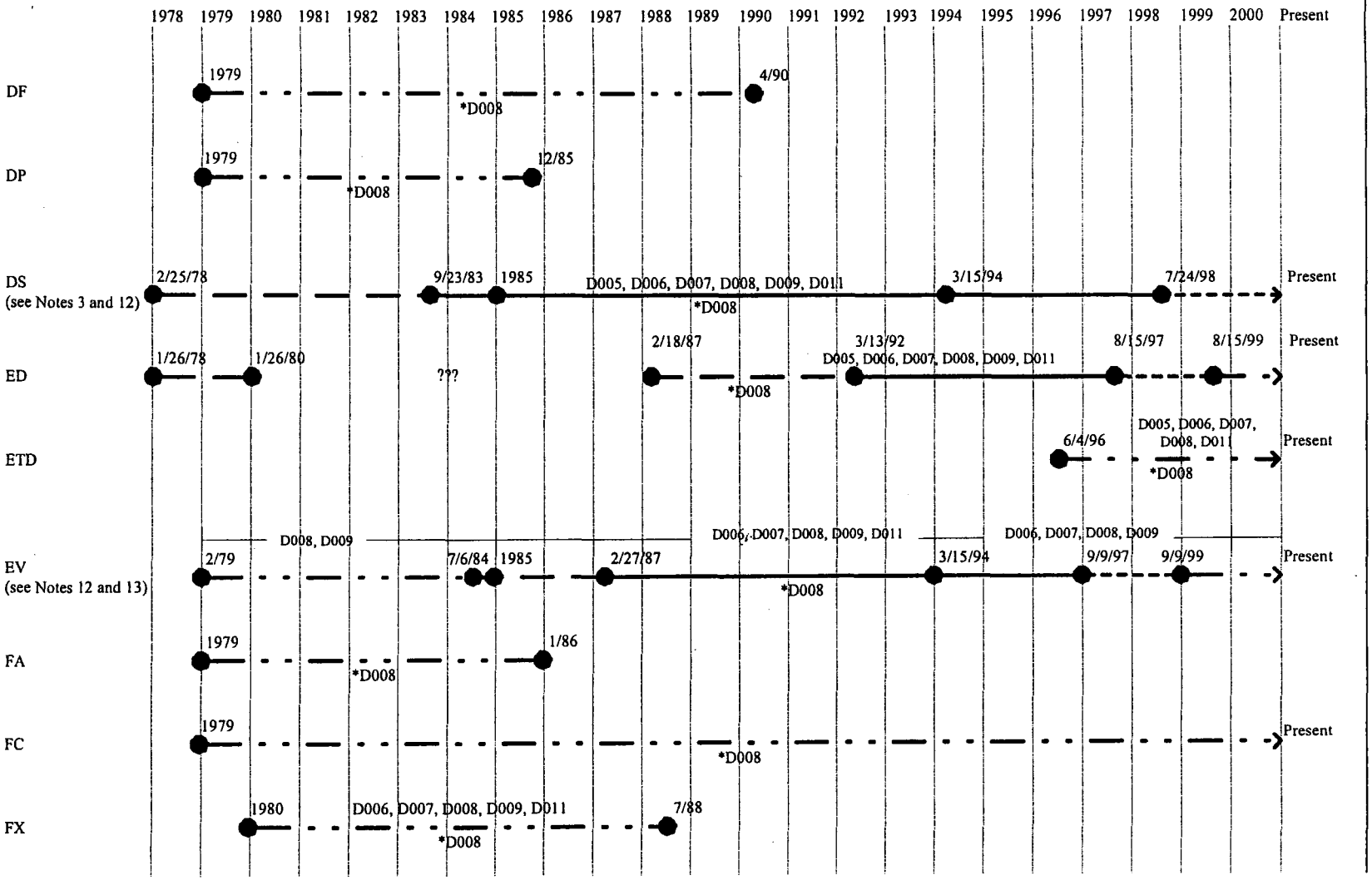
## TIMELINE FOR NITRATE OPERATIONS



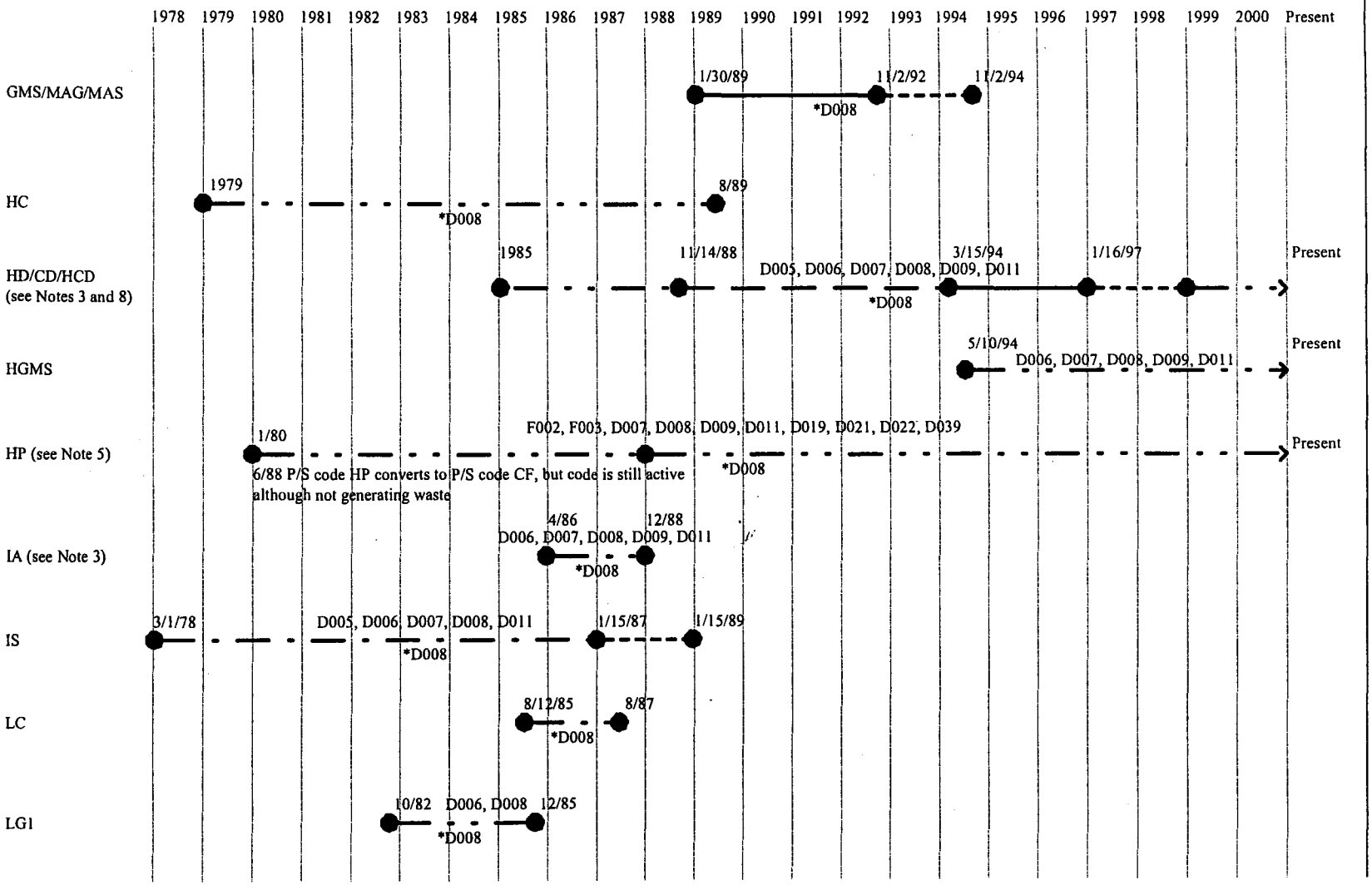
## TIMELINE FOR NITRATE OPERATIONS (continued)



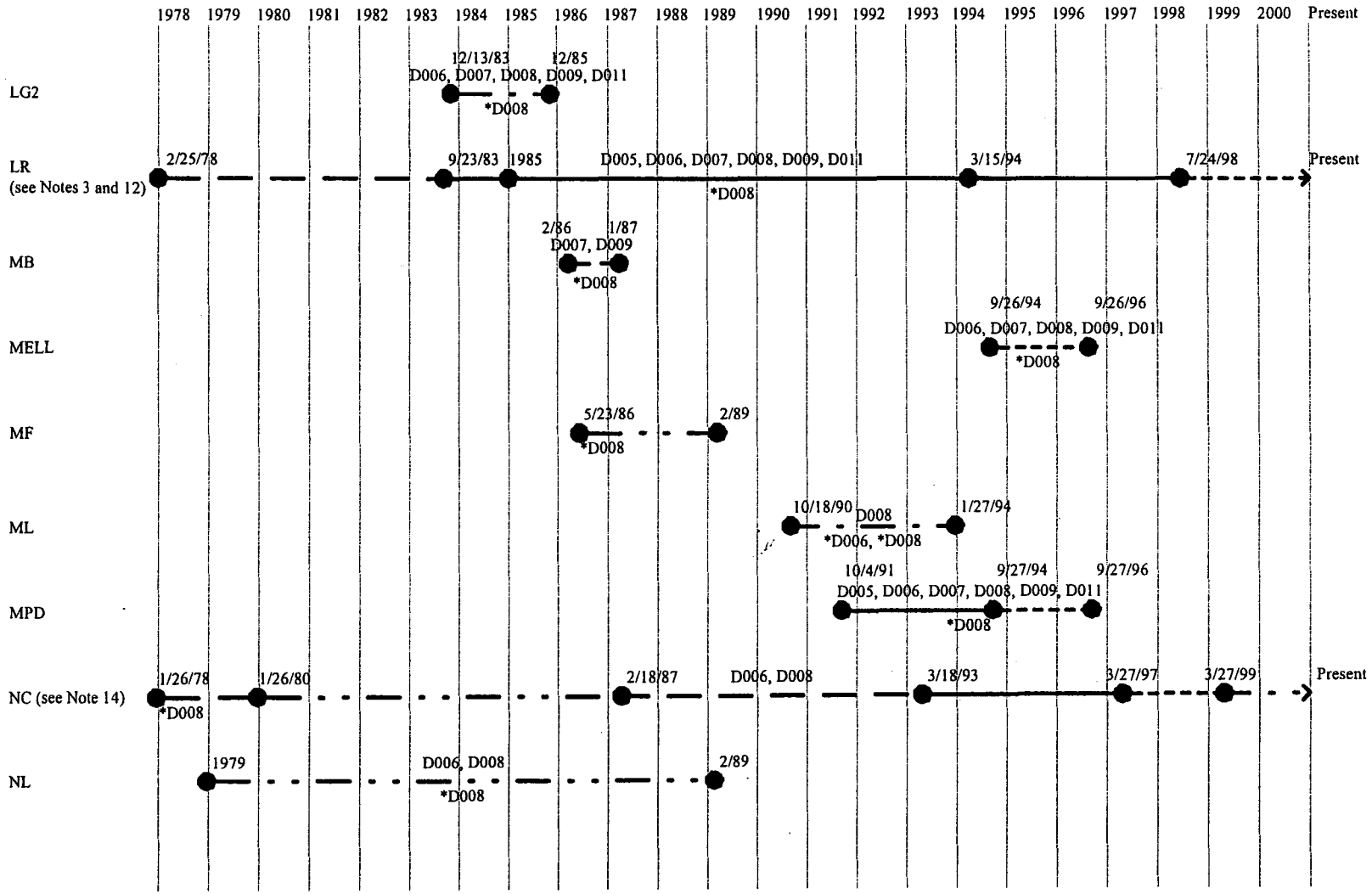
## TIMELINE FOR NITRATE OPERATIONS (continued)



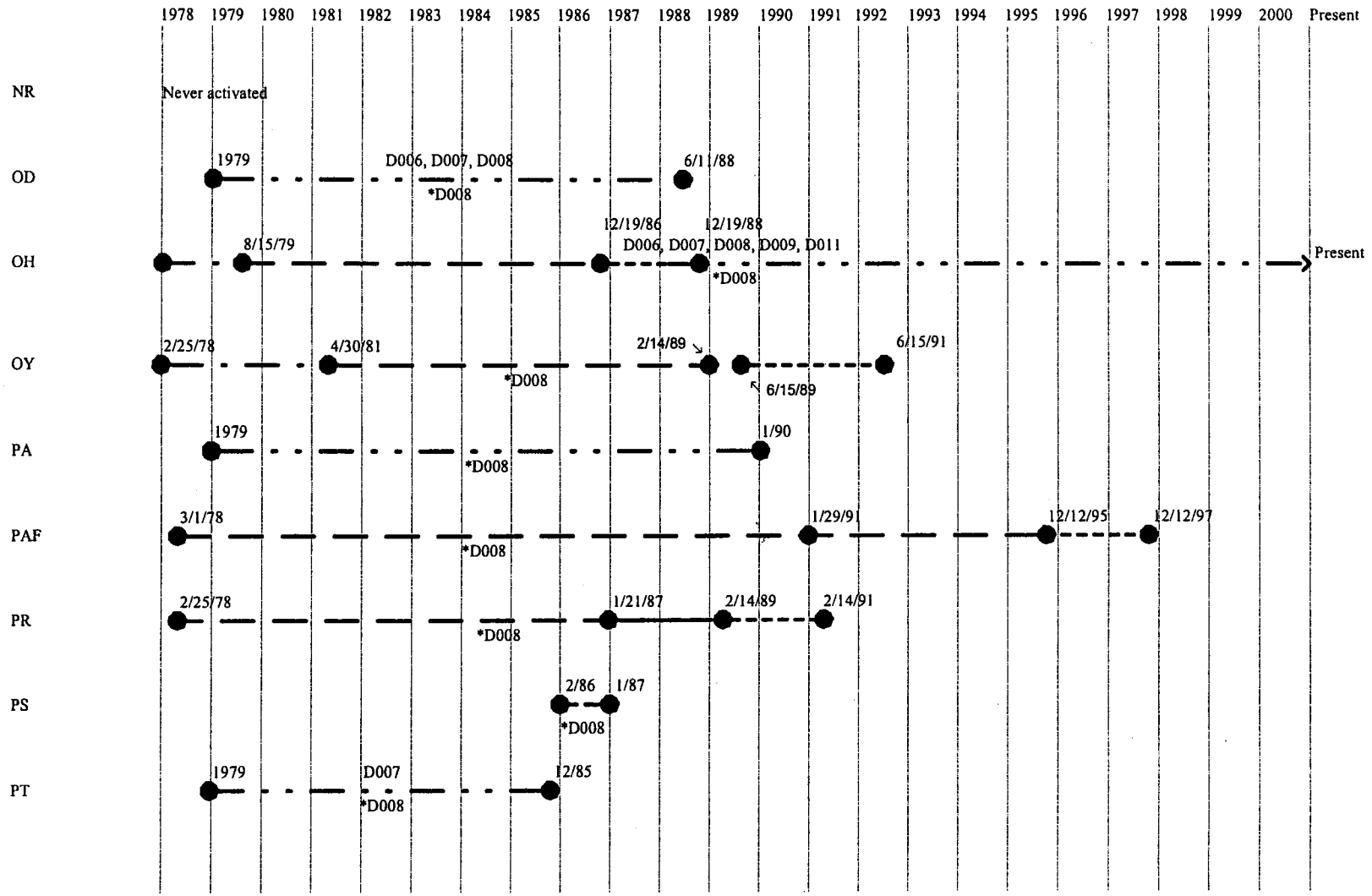
## TIMELINE FOR NITRATE OPERATIONS (continued)



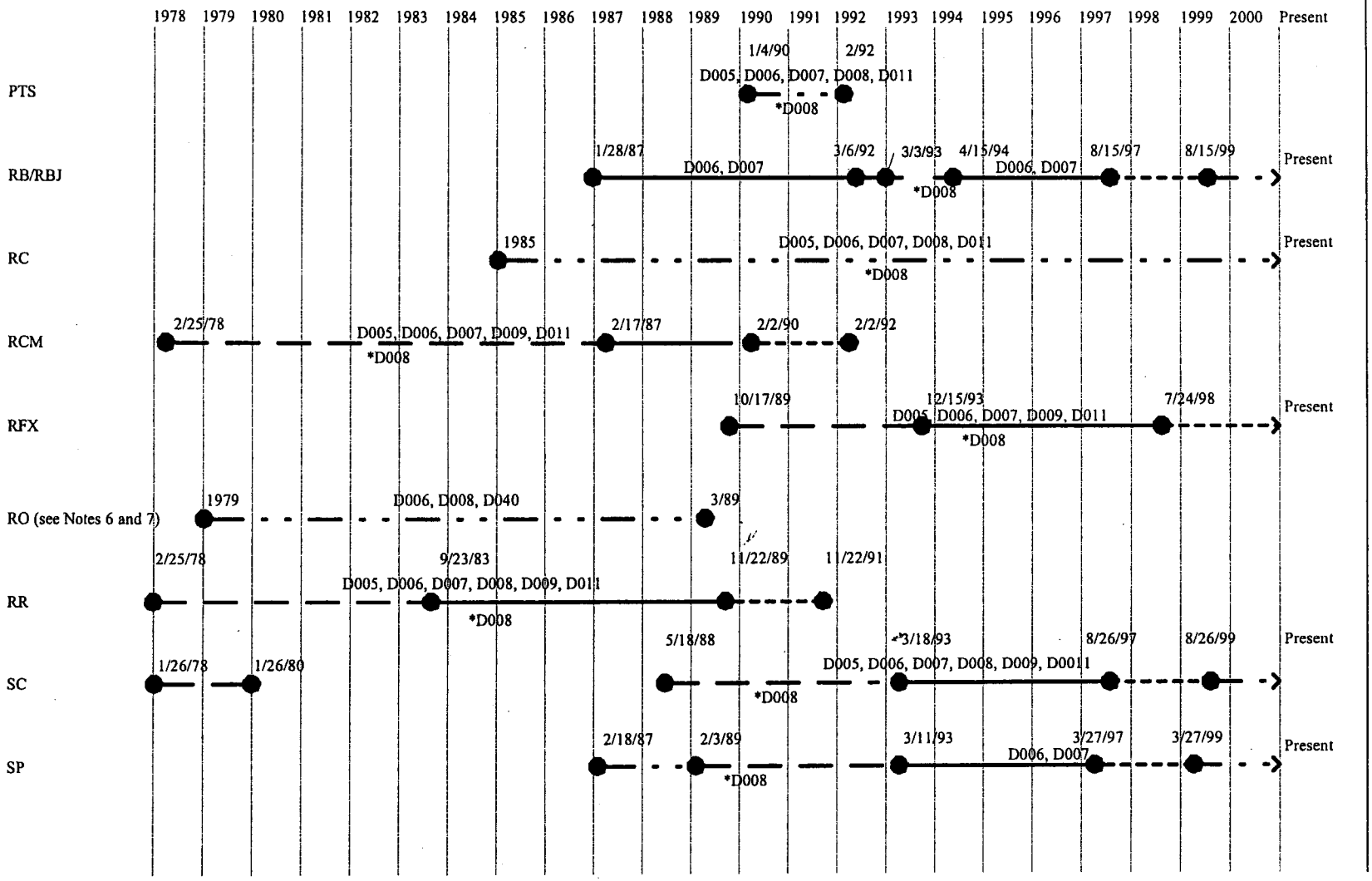
## TIMELINE FOR NITRATE OPERATIONS (continued)



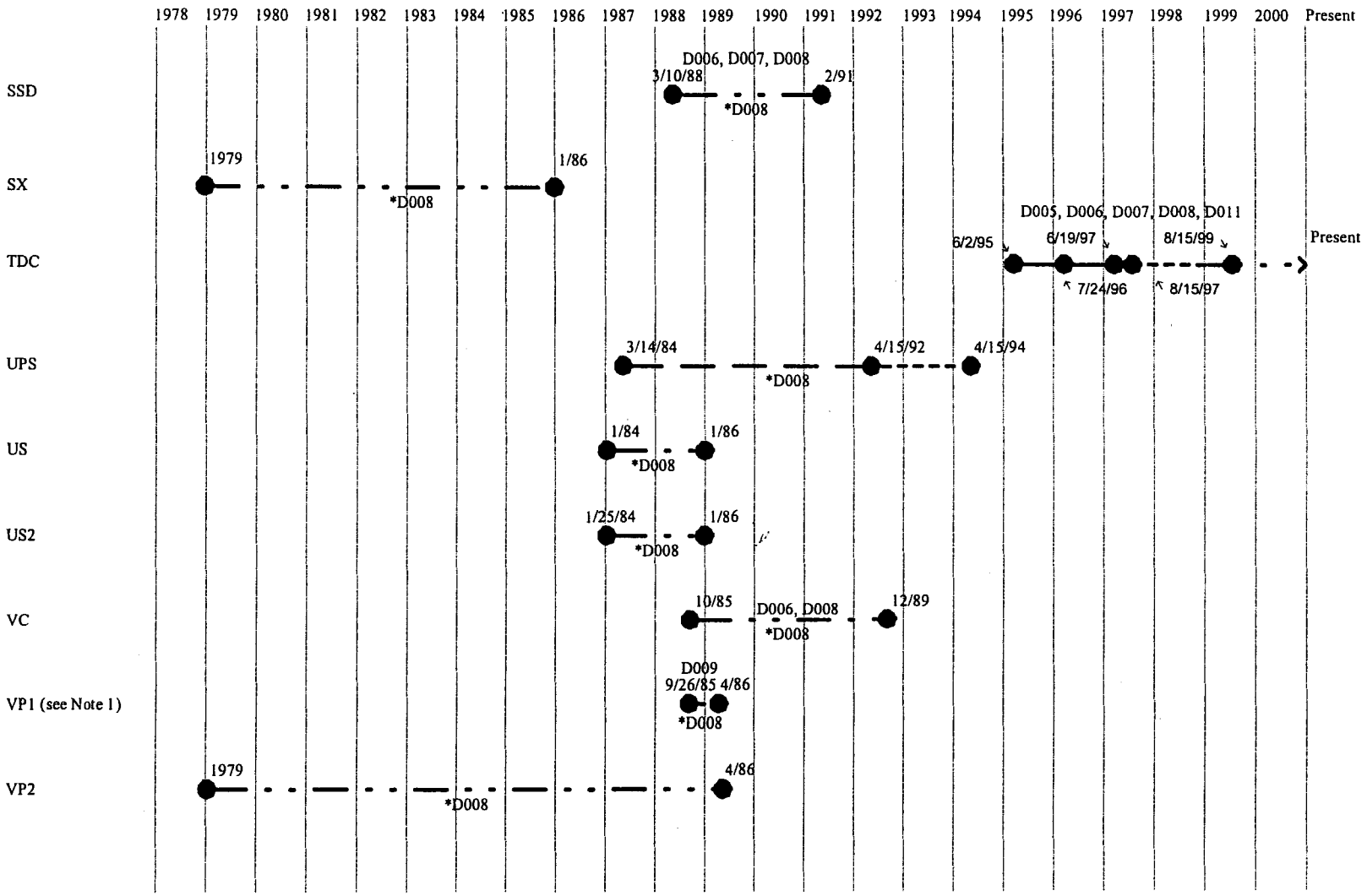
## TIMELINE FOR NITRATE OPERATIONS (continued)



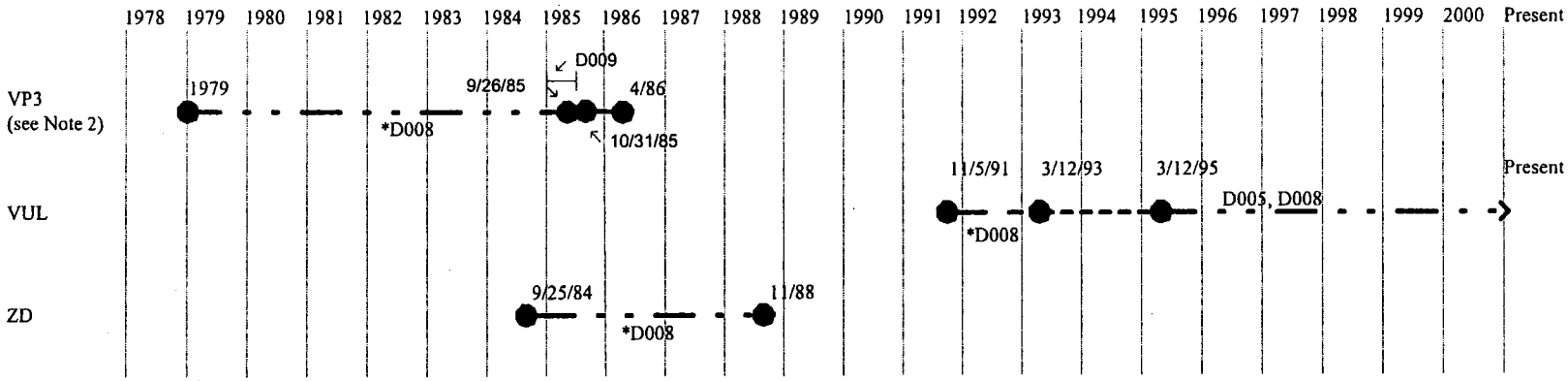
## TIMELINE FOR NITRATE OPERATIONS (continued)



## TIMELINE FOR NITRATE OPERATIONS (continued)



## TIMELINE FOR NITRATE OPERATIONS (continued)




Notes on Time Dependence of RCRA Codes

* D008 - Applies to leaded gloves which were discarded in a separate waste stream after 1992, still under the originating P/S code.
[1] D009 - Mercuric nitrate used in P/S code VP1 from 9/85 to 10/85.
[2] D011 applies to hydroxide cakes in VP3 from 9/85 to 10/85.
[3] D011 -Silver nitrate used in chloride ion exchange from 1985 until end of 1993, hence D011 applies to CD, EV, HCD, HD, IA, DS, and LR.
[4] D011 applies to P/S code CF from 1985 through 1993.
[5] F002 - RCRA-listed solvent use discontinued in chloride operations in 1992, but waste containing these solvents may have been generated until the end of 1993. Affected P/S codes in nitrate are CF and HP.
[6] D006 and D008 applies to P/S code RO from 1979 to 3/89.
[7] D040 applies to P/S code RO during 1979.
[8] D006, D007, D008, D009 applies to P/S codes CD, HCD, and HD from 1985 to the present.
[9] D006 and D008 applies to P/S code ML from 10/18/90 to 1/27/94.
[10] D006 and D008 applies to P/S code VC from 10/85 to 12/89.
[11] D006, D007, and D008 applies to P/S code SSD from 3/88 to 2/91.
[12] D006, D007, D008, D009 applies to P/S codes DS, EV, and LR from 1985 to the present.
[13] D008 and D009 applies from 2/79 to 7/84.
[14] D006 and D008 applies from 1/78 to present.

## TIMELINE EXPLANATION



The P/S code is established in either the P/S diagrams or in both (or all) revisions of the procedures designating the start and end dates (e.g., Rev. 0 to Rev. 1; or Rev. 0 to Rev. 5).



The P/S code is not identified in the procedure, but the process description matches the P/S code and the description in previous or later revisions of the same procedure.



Extrapolate out two (2) years beyond the last procedure to next possible review date.



The P/S code is not identified in the procedure, but the process description matches that of the P/S diagram or P/S code description.



Time period based on subject matter expert comments

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AL | Ash Leach | Incinerator ash | Nitric acid<br>Calcium fluoride<br>Aluminum nitrate | Plutonium solutions | Leached solids<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-28/TWCP-3566 |
| AO | Americium Processing Calcination | Americium oxalate and hydroxide cakes | None (physical process) | Pure americium oxide | Americium oxide cakes<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-81/TWCP-3568 |
| AP | Americium Purification | Americium in nitric acid solutions | Hydroxylamine nitrate<br>Nitric acid<br>Anion exchange resin | Purified americium solutions<br>Plutonium solutions | Leaded gloves | D007, D008, *D008, D009 | N-81/TWCP-3569 |
| AS | Anode Heel Dissolution | Plutonium oxide | Nitric acid<br>Hydrofluoric acid<br>Calcium fluoride | Plutonium solutions<br>Filtered solids | Leaded gloves | D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| AT | Ash Testing | Incinerator ash | Anion exchange resin<br>Sodium nitrite (20% solution)<br>Ferrous sulfamate (20% solution)<br>Nitric acid<br>Calcium fluoride<br>Silver nitrate (only used in a cold lab; not present in TRU waste) | Plutonium solutions<br>Filtered solids | Filtered solids (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-36/TWCP-3567 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| ATL | Advanced Test Line for Actinide Separations RD&D | Oxides<br>Ash<br>Chloride salts<br>Metals<br>Sand, slag, crucibles | Aluminum nitrate solution<br>Calcium nitrate solution<br>Calcium fluoride<br>Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Anion exchange resin<br>Ascorbic acid<br>Ferrous ammonium sulfate<br>Hydrogen peroxide<br>Hydroxylamine nitrate<br>Sodium nitrite<br>Urea<br>Diethyl oxalate<br>Formamide<br>Formic acid<br>Oxalic acid<br>Sodium hydroxide<br>Sulfuric acid | Plutonium oxide cakes | Residues<br>Nitrate salt solutions<br>Bottoms solutions<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-20/TWCP-3566 |
| BAC | Bacterial Decomposition of Cellulose Items | Cellulose rags (cheesecloth) | Bacteria | Solutions of glucose and other byproducts | Leaded gloves | *D008 | N-81/TWCP-3568 |
| BF | Unknown name for this code | Anode heel metal (plutonium oxide) | None (physical process) | Plutonium oxide | Leaded gloves | D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| BL | Blending | Plutonium oxide | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| BM | Burning Metal | Plutonium oxide<br>Plutonium metal | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-14/TWCP-3548 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| BU | Button Burning | Plutonium metal buttons; anode heels | None (physical process) | Plutonium oxide | Leaded gloves | D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| CC | Calcination | Plutonium oxalate cakes | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| CD | Hydroxide Cake Dissolution | Hydroxide cakes (from chloride operations) | Hydrofluoric acid<br>Nitric acid<br>Aluminum nitrate<br>Calcium fluoride | Plutonium in nitric acid solutions | Residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-32/TWCP-3566 |
| CF | Cement Fixation | Aqueous analytical solutions<br>Organic analytical solutions<br>Evaporator bottoms<br>Evaporator salts<br>Fine particulate materials<br>Oils<br>Organic petroleum-based liquids<br>Spent ion exchange resins<br>Americium oxide<br>Calcium chloride salts<br>Chloride solutions<br>Filter aid<br>Glovebox sweepings<br>Graphite powder<br>HEPA filter media<br>High-fired ash<br>Leached ash residues<br>Leached particulate solids | Cement accelerator<br>Nitric acid<br>Organic liquid emulsifier<br>Silicon defoamer<br>Sodium citrate retarder<br>Sodium hydroxide<br>pH 4 phthalate buffer solution<br>pH 7 phosphate buffer solution<br>Gypsum cement | Cemented TRU waste | Leaded gloves | D007, D008, *D008, D009, D011, D019, D021, D022, D039, F002, F003 | N-1/TWCP-3548<br>N-67/TWCP-3568<br>N-68/TWCP-3568<br>N-69/TWCP-3568<br>N-70/TWCP-3568<br>N-71/TWCP-3568<br>N-72/TWCP-3568<br>N-73/TWCP-3568<br>N-74/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| CF (continued) | | Passivated uranium carbide<br>Plutonium/thorium fluoride filter cakes<br>Plutonium/thorium hydroxide filter cakes<br>Plutonium/uranium filings<br>Pump oils<br>Silica solids<br>Trioctyl phosphine oxide (TOPO) and iodine in kerosene<br>Uranium oxide | | | | | |
| CH | Characterization | Plutonium oxide | Nitrogen gas<br>Viscous water-soluble liquid | Plutonium oxide | Plutonium oxide slurries<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| COD | Chlorinated Oxide Dissolution | Chloride pyrochemical salts | Sodium hydroxide solution<br>Nitric acid<br>Hydrofluoric acid | Plutonium oxide cakes<br>Plutonium solutions<br>Plutonium residues | Caustic liquids<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| COL | Chlorinated Oxide Leach | Chlorinated oxides<br>Chloride pyrochemical salts | Sodium hydroxide solution | Plutonium oxide cakes (may contain barium) | Caustic liquids<br>Leaded gloves | D005, *D008 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| CPOD | Catalyzed Electrochemical Plutonium Oxide Dissolver | Plutonium oxide<br>Filter residues<br>Glovebox sweepings<br>Plastic | Nitric acid<br>Silver nitrate<br>Hydrochloric acid<br>Ferric ammonium sulfate hydrate<br>Potassium thiocyanate<br>Calcium fluoride<br>Sodium chloride<br>Water<br>Argon | Plutonium solutions | Electrolytic solutions<br>Silver chloride residues<br>Leaded gloves | *D008, D011 | N-21/TWCP-3566 |
| CR | Crushing and Pulverizing | Sand, slag, crucible residues<br>Skull oxide<br>Graphite<br>Magnesium oxide<br>Ash | None (physical process) | Crushed materials | Leaded gloves | *D008 | N-17/TWCP-3548 |
| DF | DS Furnace and Oxide Preparation | Plutonium oxalate cake | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| DP | Dry Processing | Polycubes (polyethylene with plutonium oxide) | None (physical process) | Crushed polycubes | Leaded gloves | *D008 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| DS | Ion Exchange | Plutonium in nitric acid | Anion exchange resin<br>Aluminum nitrate<br>Nitric acid<br>Sodium nitrite<br>Hydroxylamine nitrate<br>Hydrogen peroxide (30%)<br>Oxalic acid<br>Hydrofluoric acid<br>Sodium hydroxide<br>Ferrous sulfamate<br>Ferrous ammonium sulfate<br>Urea<br>Phenolphthalein in ethanol<br>Potassium fluoride hydrate | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluents and filtrate solutions<br>Ion exchange resins<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-45/TWCP-3567<br>N-51/TWCP-3567<br>N-59/TWCP-3567 |
| ED | Cascade Dissolver | Magnesium oxide crucibles<br>Plutonium oxide<br>Oxidized metal, skulls, etc.<br>Incinerator ash | Nitric acid<br>Calcium fluoride<br>Aluminum nitrate | Plutonium in nitric acid solutions | Crucible and metal residues<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-23/TWCP-3566 |
| ETD | Experimental Thermal Decomposition | Combustible residues | Argon gas | Plutonium oxide<br>Ash | Water scrub solutions | D005, D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| EV | Evaporator | Ion exchange solutions<br>Nitrate salts<br>Oxalate filtrates<br>Nitric acid distillates<br>Vacuum pump seal waters<br>Negative-chilled waters | Nitric acid<br>Formic acid | Plutonium in nitric acid solutions | Nitrate salts<br>Distillate solutions<br>Filtrate solutions<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-61/TWCP-3568<br>N-62/TWCP-3568<br>N-64/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| FA | Americium Processing | Americium/nitric acid solution | Oxalic acid<br>Sodium oxalate | Americium oxalate cakes<br>Americium oxalate solutions | Leaded gloves | *D008 | N-81/TWCP-3568 |
| FC | Canning | Plutonium oxide | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| FX | Cement to Drum | Cemented waste, evaporator bottoms | None (physical process) | None | Packaged cemented waste<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-81/TWCP-3568 |
| GMS | Open Gradient Magnetic Separation | Magnesium oxide<br>Graphite<br>Sand, slag, and crucible residues<br>Plutonium processing residues | None (physical process) | Plutonium-rich materials | Plutonium-lean materials (< DL)<br>Leaded gloves | *D008 | N-2/TWCP-3548 |
| HC | Calcination | Plutonium oxalate cakes | Water vapor | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| HCD | Hydroxide Cake Dissolution | Hydroxide cakes (from chloride operations) | Hydrofluoric acid<br>Nitric acid<br>Aluminum nitrate<br>Calcium fluoride | Plutonium in nitric acid solutions | Residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-32/TWCP-3566 |
| HD | Hydroxide Cake Dissolution | Hydroxide cakes (from chloride operations) | Hydrofluoric acid<br>Nitric acid<br>Aluminum nitrate<br>Calcium fluoride | Plutonium in nitric acid solutions | Residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-32/TWCP-3566 |
| HGMS | High Gradient Magnetic Separation | Soil and clay | Water | Plutonium residues | Plutonium residues (< DL) | D006, D007, D008, D009, D011 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| HP | Cement Fixation | Evaporator bottoms<br>Vacuum pump oils<br>Tributylphosphate and iodine in kerosene<br>Analytical chemistry solutions<br>Salts<br>Leached filter paper residues<br>Ash<br>Miscellaneous solutions<br>Americium oxide | Sodium hydroxide<br>Portland cement<br>Gypsum cement<br>Surfactant (polyoxy-ethylene-20-sorbitan) | | Cemented waste<br>Leaded gloves | D007, D008, *D008, D009, D011, D019, D021, D022, D039, F002, F003 | N-81/TWCP-3568 |
| HRA | Hanford Reservation materials | Process residues from Hanford Reservation | Not specified | Recovered plutonium | Not specified | D004, D005, D006, D007, D008, *D008, D009, D010, D011 | TWCP-5371 |
| IA | Impure Americium Holding for Discard | Americium hydroxide cakes | None (no processing performed) | Americium hydroxide cake | Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-81/TWCP-3568 |
| IS | Incinerator | Combustible materials (e.g., rags, paper wipes, wood) (less than 10% plastic and rubber) | Sodium hydroxide solution<br>Potassium hydroxide solution | Scrubber solutions | Ash<br>Scrubber solutions (< DL)<br>Pump seal solutions<br>Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-5/TWCP-3548 |
| LC | Uranium/ Plutonium Processing | Plutonium oxide | Nitric acid<br>Hydrofluoric acid<br>Oxalic acid<br>Sodium oxalate | Plutonium oxalate | Acidic solutions<br>Uranium nitrate solutions<br>Leaded gloves | *D008 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| LG1 | Non Combustible Leach | Debris (metal, glass, plastic) | Nitric acid | Plutonium in nitric acid solutions | Leaded gloves | D006, D008, *D008 | N-81/TWCP-3568 |
| LG2 | Hydroxide Cake Dissolution | Hydroxide cakes | Nitric acid | Plutonium in nitric acid solutions | Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-81/TWCP-3568 |
| LR | Ion Exchange | Plutonium in nitric acid solutions | Ferrous ammonium sulfate<br>Nitric acid<br>Hydroxylamine nitrate<br>Oxalic acid<br>Aluminum nitrate<br>Hydrofluoric acid<br>Urea<br>Anion exchange resin<br>Sodium nitrite<br>Hydrogen peroxide<br>Ferrous sulfamate<br>Phenolphthalein in ethanol<br>Potassium fluoride hydrate | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluents<br>Acidic filtrate solutions<br>Anion exchange resins<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-42/TWCP-3567<br>N-45/TWCP-3567<br>N-51/TWCP-3567 |
| MAG | Magnetic Separation | Magnesium oxide<br>Graphite<br>Sand, slag, and crucible residues<br>Plutonium processing residues | None (physical process) | Plutonium-rich materials | Plutonium-lean materials (< DL)<br>Leaded gloves | *D008 | N-2/TWCP-3548 |
| MAS | RD&D Experimental Process | Magnesium oxide<br>Graphite<br>Sand, slag, and crucible residues<br>Plutonium processing residues | None (physical process) | Plutonium-rich materials | Plutonium-lean materials (< DL)<br>Leaded gloves | *D008 | N-2/TWCP-3548 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| MB | Nitric Dissolution of Molten Salts | Molten salt extraction salts | Hydrochloric acid<br>Nitric acid | Plutonium solutions | Acidic solution<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| MELL | Mediated Electro-Oxidation of Low Level Waste (LLW) | Cellulose-based materials | Nitric acid<br>Cobalt nitrate<br>Cerium nitrate<br>Platinum anode<br>Titanium anode<br>Stainless steel cathode | Plutonium solutions<br>Plutonium oxide | Plutonium oxide (< DL)<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-33/TWCP-3566 |
| MF | Metals Furnace | Plutonium metal items | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| ML | Non-Plutonium Metal Leach | Metal equipment w/ Pu surface contamination | Nitric acid<br>Calcium fluoride<br>Hydrofluoric acid | Plutonium solutions | Metal equipment<br>Leaded gloves | D006, D008 *D008 | N-29/TWCP-3566 |
| MPD | Cascade Dissolver | Plutonium oxide (salts or residues)<br>Incinerator ash | Nitric acid<br>Calcium fluoride<br>Potassium hydroxide<br>Sodium hydroxide<br>Aluminum nitrate | Plutonium solutions | Plutonium residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-25/TWCP-3566 |
| NC | Non-Combustible Leach | Noncombustible material w/ surface Pu contamination | Calcium fluoride<br>Nitric acid<br>Hydrofluoric acid<br>Aluminum nitrate<br>Argon | Plutonium solutions | Leached noncombustible solids<br>Leaded gloves | D006, D008 *D008 | N-31/TWCP-3566 |
| NL | Non-Combustible Leach | Debris (metal, glass, plastic) | Nitric acid | Plutonium in nitric acid solutions | Residues (< DL)<br>Leaded gloves | D006, D008 *D008 | N-81/TWCP-3568 |
| NR | Nitrate Recovery | None (not activated) | None | None | None | None | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| OD | Oxide Dissolution | Coarse oxides | Nitric acid<br>Hydrofluoric acid<br>Aluminum nitrate<br>Calcium fluoride<br>Argon | Plutonium in acidic solutions | Plutonium residues (< DL)<br>Leaded gloves | D006, D007, D008, *D008 | N-37A/TWCP-3567<br>N-81/TWCP-3568 |
| OH | Hydroxide Precipitation | Americium hydroxide solutions from the FFTF and Breeder Oxide Production processes | Nitric acid<br>Sodium Hydroxide | Americium solutions<br>Plutonium solutions | Americium solutions (<DL)<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-55/TWCP-3567 |
| OY | Oxalate Precipitation | Plutonium nitrate solution (eluate from anion exchange) | Oxalic acid<br>Urea<br>Hydroxylamine nitrate<br>Nitric acid<br>Aluminum nitrate solution | Plutonium oxalate cakes<br>Plutonium oxide<br>Plutonium solutions | Plutonium solutions (< DL)<br>Leaded gloves | *D008 | N-50/TWCP-3567 |
| PA | Passivation | Glovebox sweepings, oxides containing unoxidized plutonium metal, carbides, and nitrides | None (physical process) | Plutonium oxide<br>Passivated materials | Leaded gloves | *D008 | N-81/TWCP-3568 |
| PAF | Passivation Furnaces | Pyrophoric plutonium metal and alloys | Argon gas | Plutonium oxide | Leaded gloves | *D008 | N-7/TWCP-3548 |
| PR | Peroxide Precipitation | Oxide dissolution filtrate | Hydrogen peroxide<br>Nitric acid<br>Sulfuric acid<br>Sodium hydroxide | Plutonium in nitric acid solutions | Leaded gloves | *D008 | N-52/TWCP-3567 |
| PS | Peroxide Precipitation of MSE Salts | Plutonium-containing nitric acid solutions | Hydrogen peroxide<br>Nitric acid<br>Sodium hydroxide solution | Plutonium in nitric acid solutions<br>Americium oxalate cakes | Leaded gloves | *D008 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| PT | Plutonium/ Thorium Separation | Plutonium/thorium oxide residues | Nitric acid<br>Nitrate-based ion exchange resin<br>Sodium hydroxide<br>Chloride-based ion exchange resin | Plutonium in nitric acid solutions | Caustic liquids<br>Thorium-containing residues<br>Leaded gloves | D007, *D008 | N-81/TWCP-3568 |
| PTS | RD&D Pretreatment Study | Variety of residue matrices, including ash | None (physical process) | None | Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| RB | Roasting and Blending | Plutonium oxide | None (physical process) | Plutonium oxide | Leaded gloves | D006, D007, *D008 | N-57 N-57A N-57B (all in TWCP-3567) |
| RBJ | Roasting and Blending Jr | Plutonium oxide | None (physical process) | Plutonium oxide | Leaded gloves | D006, D007, *D008 | N-57 N-57A N-57B (all in TWCP-3567) |
| RC | Rotary Calciner | Ash<br>Graphite crucibles<br>Uranium oxide | None (physical process) | Calcined ash | Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-81/TWCP-356 |
| RCM | Rich Column Material Ion Exchange | Plutonium in nitric acid solutions | Anion exchange resin<br>Aluminum nitrate<br>Nitric acid<br>Sodium nitrite<br>Hydroxylamine nitrate<br>Hydrogen peroxide<br>Oxalic acid<br>Hydrofluoric acid | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluent solutions<br>Filtrate solutions<br>Leaded gloves | D005, D006, D007, *D008 D008, D009, D011 | N-41/TWCP-3567<br>N-51/TWCP-3567 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| RFX | Ion Exchange | Plutonium in nitric acid solutions | Anion exchange resin<br>Aluminum nitrate<br>Nitric acid<br>Hydroxylamine nitrate<br>Hydrogen peroxide<br>Oxalic acid<br>Hydrofluoric acid<br>Sodium Nitrite<br>Sodium Hydroxide<br>Phenolphthalein in ethanol<br>Potassium fluoride hydrate | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluents and filtrate solutions<br>Ion exchange resins<br>Leaded gloves | D005, D006, D007, *D008 D008, D009, D011 | N-45/TWCP-3567<br>N-47/TWCP-3567 |
| RO | Oil Recovery | Vacuum pump oils<br>Contaminated organics | Trichloroethylene (used once in 1979) | Plutonium residues | Oils and organics on vermiculite<br>Leaded gloves | D006, *D008, D040 | N-81/TWCP-3568 |
| RR | Ion Exchange | Plutonium in nitric acid solutions | Anion exchange resin<br>Aluminum nitrate<br>Nitric acid<br>Sodium nitrite<br>Hydroxylamine nitrate<br>Hydrogen peroxide<br>Oxalic acid<br>Hydrofluoric acid | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluents and filtrate solutions<br>Ion exchange resins<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-43/TWCP-3567<br>N-51/TWCP-3567<br>N-59/TWCP-3567 |
| SC | Cascade Dissolver, G437 | Sand, slag, and crucible residues<br>Ash<br>Magnesium oxide crucibles | Potassium hydroxide<br>Sodium hydroxide<br>Nitric acid<br>Aluminum nitrate<br>Calcium fluoride<br>Hydrofluoric acid | Plutonium in nitric acid solutions<br>Plutonium oxide residues | Alkaline scrubber solutions<br>Residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-24/TWCP-3566 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| SP | Scrap Dissolution, G438 | Filter residues<br>Glovebox sweepings<br>Coarse oxides | Nitric acid<br>Hydrofluoric acid<br>Aluminum nitrate<br>Calcium fluoride<br>Argon | Plutonium oxide residues<br>Plutonium filtrate solutions | Acidic scrubber solutions<br>Residues (<DL)<br>Leaded gloves | D006, D007, D008, *D008 | N-37/TWCP-3567<br>N-37A/TWCP-3567 |
| SSD | Special Scrap Dissolution | Miscellaneous oxide scrap items | Nitric acid<br>Hydrofluoric acid | Plutonium in nitric acid solutions | Residues<br>Leaded gloves | D006, D007, D008, *D008 | N-81/TWCP-3568 |
| SX | Americium Processing Silicon Removal | Americium-containing hydroxide cakes | Nitric acid | Americium solutions | Silica gels<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| TDC | Thermal Decomposition of Cellulose Items R&D | Cellulose items | Potassium hydroxide<br>Argon<br>Filter Aid | Plutonium solutions<br>Plutonium residue<br>Ash | Caustic scrubber solutions<br>Plutonium solutions (<DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-6/TWCP-3548<br>N-12/TWCP-3548 |
| UPS | Uranium/ Plutonium Separation | Uranium-plutonium oxide mixtures | Aluminum nitrate<br>Nitric acid | Plutonium oxide | Uranium wash and filtrate solutions<br>Leaded gloves | *D008 | N-19/TWCP-3566 |
| US | Uranium Separation for Solid Solution Feed | Calcined solid solutions containing uranium or plutonium oxide | Nitric acid<br>Oxalic acid<br>Sodium oxalate | Plutonium oxide | Acidic uranium solutions<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| US2 | Uranium Separation for Non-Solid Solution Feed | Plutonium/uranium oxide | Nitric acid | Plutonium oxide | Acidic uranium solutions<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| VC | Variable CSMO Scrap Dissolution | Miscellaneous oxide scrap items | Nitric acid<br>Hydrofluoric acid | Plutonium nitrate solutions | Residues (< DL)<br>Leaded gloves | D006, D008, *D008 | N-81/TWCP-3568 |

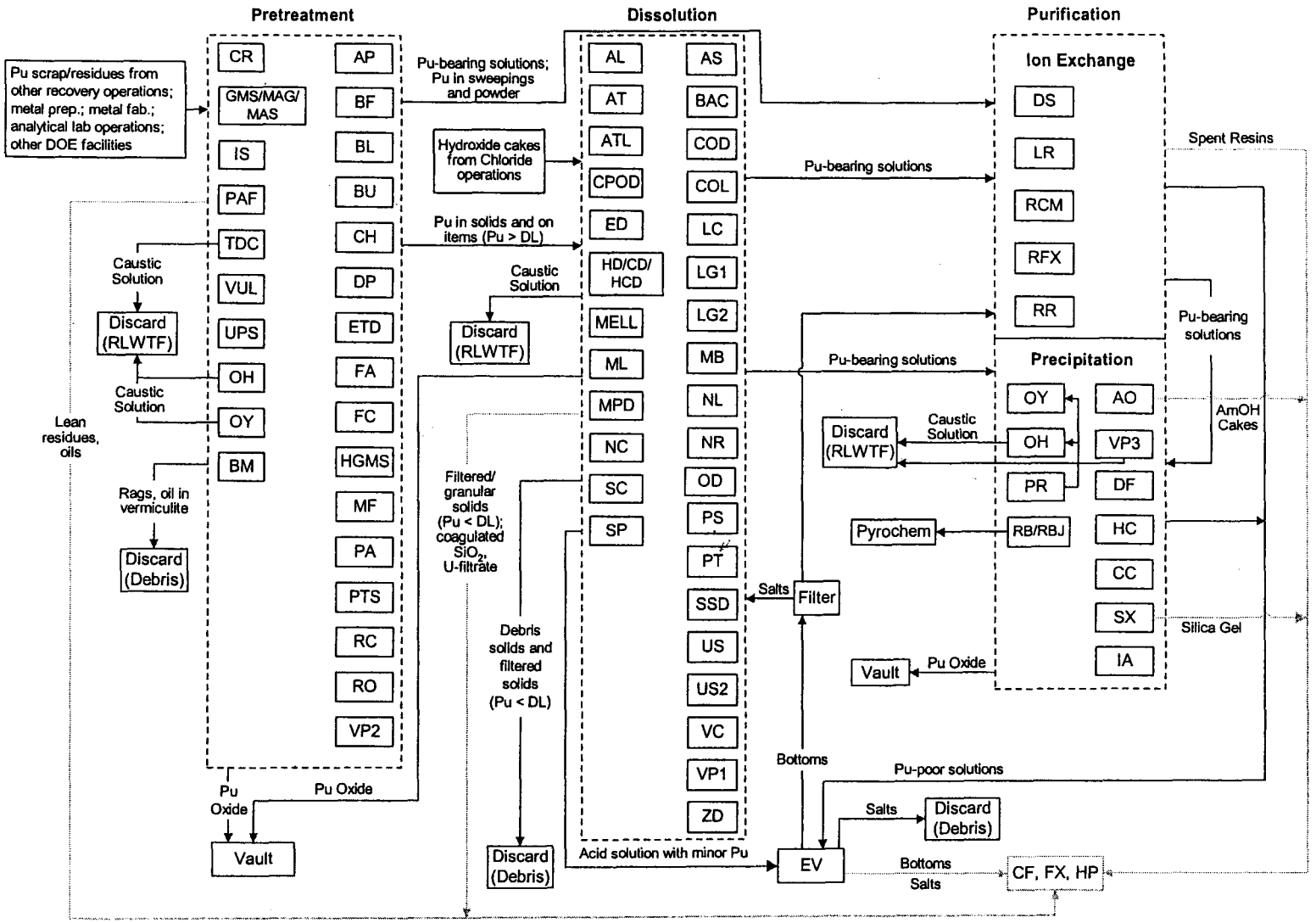
| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| VP1 | CSMO Scrap Dissolution | Plutonium/aluminum alloy | Nitric acid<br>Mercuric nitrate (catalyst)<br>Sodium hydroxide<br>Oxalic acid<br>Sodium oxalate | Plutonium oxide cakes<br>Plutonium oxalate solutions | Aluminum metal pieces<br>Aluminum nitrate sludge<br>Leaded gloves | *D008, D009 | N-81/TWCP-3568 |
| VP2 | Polycube Processing | Skins and fragments of polycubes | None (physical process) | Plutonium oxide | Polystyrene breakdown products (oils)<br>Vacuum pump oil<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| VP3 | Hydroxide Precipitation | Oxalate solutions | Sodium hydroxide | Plutonium hydroxide cakes | Caustic waste<br>Hydroxide cakes (< DL)<br>Leaded gloves | *D008, D009, D011 | N-81/TWCP-3568 |
| VUL | Vessel Unloading | Vessels | WD-40<br>Vacuum grease<br>Silicon adhesive<br>Pneumatic tool oil | Vessels<br>Residues | Metal and wire debris<br>Leaded gloves | D005, D008, *D008 | N-9/TWCP-3548 |
| ZD | Scrap Oxide Dissolution | Scrap and impure plutonium oxide | Nitric acid<br>Hydrofluoric acid | Plutonium oxide<br>Plutonium solutions | Leaded gloves | *D008 | N-81/TWCP-3568 |

[1]All P/S codes generate routine laboratory debris waste. For those P/S codes that generate only debris waste, this column is left blank. The debris waste may consist of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools.

[2]The EPA hazardous waste codes listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation) before becoming the final waste form to be shipped to the WIPP. The resulting treated waste stream in its final waste form is evaluated for hazardous waste constituents and assigned the applicable EPA hazardous waste codes at that time. All P/S codes have the potential to generate leaded gloves. See discussion in sections 3.6.1 and 4.2 for the disposition of these gloves.

*D008 due to leaded gloves

## GENERALIZED PROCESS STATUS DIAGRAM FOR NITRATE PROCESSES



## Decision/Discrepancies Resolution Documentation
### TA-55 Nitrate Operations

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| HRA | Waste codes D004 and D010 are also applicable to this P/S code | TWCP-5371 | Process report does not address D004 or D010 | Summary report | Discrepancy between report and interview | C—SME indicated add D004 and D010 to timeline pre 1984. After 1984, no D004 or D010 per SME. See attached meeting notes attached. |
| CF | Process report lists D006 as a HWN | Process report | Per Jim Foxx, does not indicate D006 | TWCP-3567 | Process report indicates D006 due to other information | B—SME provided analytical information. Submit data as a record. See attached meeting notes. |
| RO | Page change indicates that no RCRA organic were formed in the process and no RCRA metals were introduced into the process. | TWCP-4100 | AK process report lists D006, D008, and D040<br><br>These sources indicate toluene and styrene are possible contaminants | TWCP-3568/N-83, TWCP-3548/N-10, N-18. | Process report lists the HWN to be conservative | A—SME said to add these codes to be conservative. Possible contamination from pump oils used in process. See attached meeting notes. |
| AL | Per Jim Foxx, Ag (D011) not above regulatory limits | TWCP4167 | Process reports list D011 | Process Report | Reported D011 | B—cannot locate analytical data. Applying D011 to be conservative. See attached meeting notes. |

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| IS and CF | Indicates possibility of Cm-244 in ash produced by the IS operation. After 1988, interview suggests Cm-244 could be present in CF from evaporator bottoms | TWCP-5165 | Process report does not indicate Cm-244 | Process report | Process report does not indicate Cm-244. | B—SME wants Cm-244 added to report as it is important to NDA measurements. Submit email to records. See attached email. |
| All | TA-55 waste was defense related based on other interviews and budget | TWCP-614 | Commingling of defense and non-defense, segregation after 1997 and 1998. Estimated to be 80/20, defense/non-defense for Pu.-239 and 50/50 for Pu-238 processing | TWCP—887, TWCP-4162 | Summary report states commingling and segregation timeline. | C—Memo dated 8/27/98 says segregation begun. See attached meeting notes. TWCP-4167 |

Sandy Wander — AK Investigator — Sandy Wander — 2/25/02
Evaluator (Print Name) — Title — Signature — Date

P Rogers — Pamela Rogers — 2/26/02
SPM Review (Print Name) — Signature — Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other (Specify)]



Source: TWCP-07910

# CCP Records Transmittal/Receiving Form

CCP Central Records/Records Custodian, 4021 National Parks HIghway - MS: GSA 203, Carlsbad, New Mexico 88220

Telephone Number: 505-234-7523, 505-234-7233, 505-234-7617
Fax Number: 505-234-7014

☒ Original Record
☐ Faxed Record

| | | | |
|---|---|---|---|
| Attn: | Records Custodian | From: | Trey Greenwood |
| Ship to: | CCP Central Records/ CCP Records Custodian | Site: | Los Alamos National Laboratory |
| | 4021 National Parks Highway - MS GSA 203 | Company: | Technical Specialists |
| | Carlsbad, NM 88220 | Telephone Number: | 505-302-6000 |
| | | Date Sent: | 11/23/04 |
| Telephone Number: | 505-234-7523 | | |

| Document Number | Title/Description | Record Date | Total Pages |
|---|---|---|---|
| D036 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-6 | 9/17/2004 | 1 |
| | TA-55 Plutonium Facility Acceptable Knowledge Report, Nitrate Operations | 5/17/2001 | 117 |
| | | | |
| | | | |
| | N/A | | |
| | | | |

| Comments |
|---|
| None |

## CCP Records Center
## Acceptance/Rejection Signature and Date

Records Accepted ☒ Susan Keathley (Signature) Susan Keathley (Printed Name) 2/14/05 (Date)

Records Rejected ☐ _____ (Signature) _____ (Printed Name) _____ (Date)

Reason for Rejection: _____

Re-submittal: _____ (Signature) _____ (Printed Name) _____ (Date)

# DIVIDER PAGE ONLY

Not part of page count

## Attachment 2 - CCP Records Transmittal/Receiving Form

CCP Central Records / Records Custodian, 4021 National Parks Highway - MS: GSA 203, Carlsbad, New Mexico 88220

Telephone Number: 505-234-7523

Fax Number: 505-234-7014

☒ Original Record
☐ Fax Record
☐ E-mail Record

| | | | |
|---|---|---|---|
| Attn: | Sheila Pearcy | From: | Amy Johns |
| Ship to: | CCP Central Records/ CCP Records Custodian<br>4021 National Parks Highway - MS GSA 203, Carlsbad, NM 88220 | Site: | Los Alamos National Laboratory, CCP-AK-LANL-006 |
| | | Company: | Technical Specialists, LLC |
| | | Telephone Number: | 505-302-8669 |
| Telephone Number: | 505-234-7523 | Date Sent: | 1/26/2009 |

| | | | |
|---|---|---|---|
| D036 | Attachment 3 - Acceptable Knowledge Source Document Summary for CCP-AK-LANL-6 | 1/14/2009 | 2 |
| | N/A | | |

Please supercede existing Attachment 3.

Acceptance/Rejection Signature and Date

| | | | |
|---|---|---|---|
| Records Accepted ☑ | Sonia Gonzalez<br>Signature | SONIA GONZALEZ<br>Printed Name | 02.17.09<br>Date |
| Records Rejected ☐ | Signature | Printed Name | Date |

Reason for Rejection: N/A

Re-submittal:

| | | |
|---|---|---|
| Signature | Printed Name | Date |

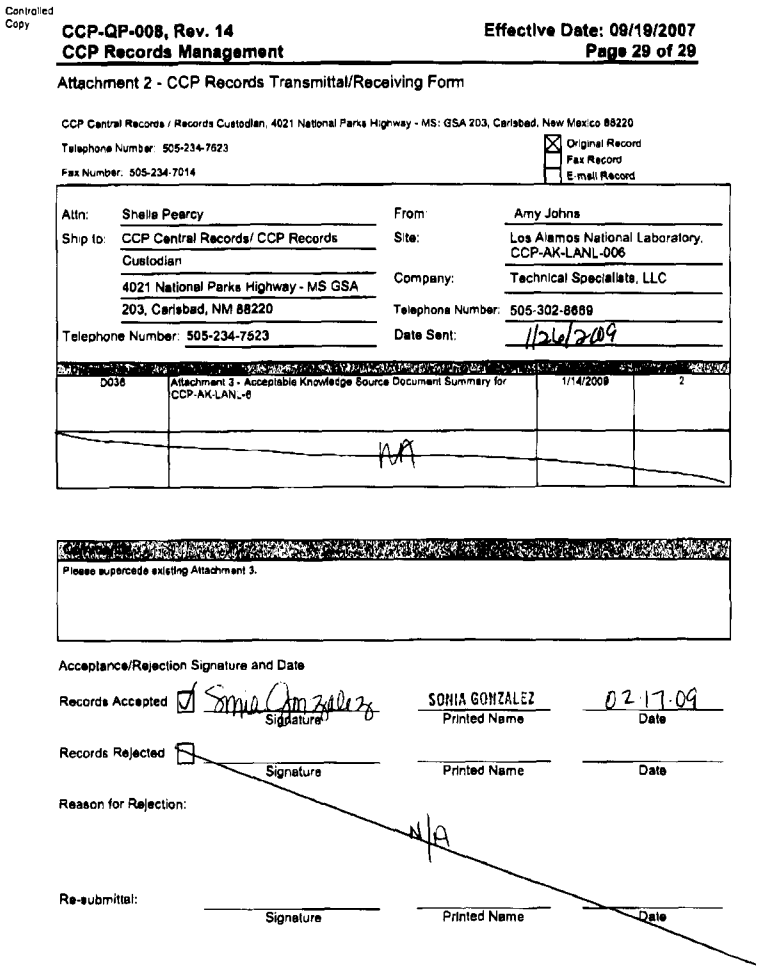
**HP LaserJet** *M2727nf MFP*

# Fax Confirmation Report

HP LASERJET FAX

Feb-18-2009 8:55AM

| Job | Date | Time | Type | Identification | Duration | Pages | Result |
|---|---|---|---|---|---|---|---|
| 5138 | 2/18/2009 | 8:54:39AM | Send | 96283238 | 0:32 | 1 | OK |



Controlled Copy

**CCP-QP-008, Rev. 14** **Effective Date: 09/19/2007**
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# *Wastes from Plutonium Conversion and Scrap Recovery Operations*

*D. C. Christensen*
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# WASTES FROM PLUTONIUM CONVERSION AND SCRAP RECOVERY OPERATIONS

by

D. C. Christensen, D. F. Bowersox, B. J. McKerley, and R. L. Nance

ABSTRACT

This report deals with the handling of defense-related wastes associated with plutonium processing. It first defines the different waste categories along with the techniques used to assess waste content. It then discusses the various treatment approaches used in recovering plutonium from scrap. Next, it addresses the various waste management approaches necessary to handle all wastes. Finally, there is a discussion of some future areas for processing with emphasis on waste reduction.

## I. INTRODUCTION

Although very small quantities of plutonium exist in nature, it is essentially a manmade element produced in uranium-fueled power reactors. It is element number 94 and is a member of the actinide series. Researchers have identified isotopes ranging in mass from 232 through 246, all of which are radioactive. The most abundant isotope, and therefore the most important, is $^{239}Pu$.

Since its discovery by G. T. Seaborg and coworkers in 1940, an immense amount of research into the physical and chemical properties of the element has taken place. Scientists now know more about the chemistry and metallurgy of plutonium than they know about many of the more common elements. The chemistry and metallurgy are complex because plutonium exists in six allotropic phases and forms compounds in five different valence states. These complex properties both aid and hinder the handling and processing of plutonium. The separation of plutonium from other

elements generally depends on the ability to control the oxidation state and to adjust it at will.

In the national defense complex, plutonium is first produced in production reactors. It is then extracted by solvent-extraction techniques and concentrated as a liquid plutonium nitrate. The nitrate is then converted to either an oxide or a fluoride and reduced to metal. The resulting product metal is sent for fabrication of various parts and components. It is this fabrication process that generates the major portion of waste and scrap.

Generation of nonspecification plutonium and plutonium-containing residues occurs in all phases of the production and recycle of components and in the chemical processing of scrap residues to recover that plutonium. The recovery of this scrap and the recycle of plutonium is the charter of the residue-processing facilities. Recovery of the plutonium from these residues is essential for a number of reasons. The plutonium is expensive to produce in the reactors. The scrap is not amenable to waste disposal because of scrap matrix, intrinsic radiation, and plutonium content. The scrap therefore must be stored in certified storage vaults, a costly process. Finally, the plutonium is a fissile material that requires extensive safeguards procedures to insure that the material is maintained in a secure environment. It is much easier and therefore much less costly to safeguard material in high-density and easily measured forms such as high-purity metals and oxides.

Plutonium-containing scrap can conveniently be divided into two categories. The first, primary scrap, is scrap that occurs in the plutonium foundry and results from the casting, alloying, forging, and machining of the metal. Another component of primary scrap is items that are removed from service and must be reprocessed. The primary scrap category includes graphite from molds, fused salts from extractive metallurgy, plutonium oxide from burned casting and machining residues, impure plutonium metal, and a small amount of equipment and supplies such as cleaning rags, dry-box gloves, and dry-box windows.

Secondary scrap, the second category of scrap, results from the processing of the primary scrap items. The ultimate goal for processing scrap is to return the plutonium to a usable form as quickly and efficiently as possible. Unfortunately, plutonium is an outstanding getter and exhibits a propensity to oxidize in an oxygen environment. These characteristics, together with the fact that plutonium readily forms compounds in five different valence states, make the task of efficient separation and recovery a challenging one. The processing of impure metals and oxides generates a wide variety of leaner scrap forms including ash, undissolved oxide heels, metal reduction slags and salts, ceramics, sludges, chloride salts, and miscellaneous items. These items constitute secondary scrap. They are characteristically leaner in plutonium content and more difficult to process.

A number of facilities have been established to recover both primary and secondary scrap. The technology used in these facilities ranges from 1950s vintage processes up to state-of-the-art methods. Much of this technology was designed into the facilities just before commissioning and has not undergone much renovation. Most facilities are now undergoing new capital construction, and management realizes the need to update the technology to improve process efficiency, reduce scrap generation, reduce waste generation, reduce radiation exposure to workers, improve accountability and safeguards, and improve cost efficiency. Future facilities will take advantage of improved process-control technologies, automation and robotics, and on-line or at-line analytical capabilities. In addition, waste management will play an ever-increasing role in dictating how plutonium residues will be handled and processed.

This report first defines how residues/wastes from plutonium conversion are classified and then discusses the state of technology for residue-processing methods. (We do not intend the discussion to be a comprehensive treatise on residue processing, but rather a summary of proven techniques. References, where appropriate, allow the reader to quickly find more detailed information on a particular subject.) Next, we

review current waste-treatment techniques and conclude with a statement on the potential of emerging technologies.

## II. DEFINITIONS AND CHARACTERIZATION OF RECOVERABLE MATERIALS

### A. Processing Concerns

Any chemical processing system seeks to provide a high-quality product while generating a minimum quantity of sidestream material. The sidestream quite often contains a concentration of reactants as well as a concentration of the product. It also quite often is made up of more than one type of item. Almost always, economic considerations determine if this sidestream warrants further processing or whether discard is appropriate. The criteria for determining the economics include the cost of recovery of materials, waste disposal including transportation, the value of reactants and products, and social or political consequences (social risk).

Although most plutonium facilities use this same approach in evaluating the disposition of sidestreams in plutonium processing, there are significant differences that add to the costs. These differences include additional costs for safeguards, accountability, criticality safety, and protection from radiation exposure.

1. Safeguards. Because plutonium is a fissile material, facilities must provide safeguards to insure limited access to the material. Safeguards are also important when material leaves facilities in transit to processing sites. Safeguards includes all physical and mechanical barriers, guard forces to insure active response, and security-awareness training and certification.

2. Accountability. Because plutonium is a fissile material, facilities must account for it in much the same way banks account for money. The variety of plutonium isotopes, each having different radioactive properties and different masses, causes the biggest accountability problem. Many isotopes exist in a homogeneous mixture in

each plutonium-containing item. The techniques used for accountability include physical-property measurements (weight and density), radioactive-property measurements (neutron counts and gamma scans), and chemical-property measurements. None of these are exact sciences. Accountability is therefore a technique of using the best approach available to arrive at a close estimate of the quantity of plutonium in each item.

3. Criticality Safety. Some isotopes of plutonium undergo spontaneous fission and therefore pose a hazard because of small critical masses. Process equipment is designed to prevent assembly of a critical mass if the equipment or process undergoes an upset. For this reason, many processes are designed with limited flow rates, limited reactor dimensions (small sizes), and/or limited batch sizes. Economics of scale, realized by large chemical-processing plants, are rarely transferable to plutonium processing facilities. These considerations directly affect processing costs.

4. Radiation Exposure. Plutonium emits alpha particles, neutrons, and gamma rays. These forms of radiation can be damaging to biological tissue if the exposure time and intensity of the radiation are sufficient. Alpha radiation is a nonpenetrating form of radiation and is generally eliminated by the glove-box operations. On the other hand, shielding can moderate neutron and gamma radiation but not completely eliminate it under normal working environments. All plutonium facilities observe personnel radiation-exposure guidelines deemed to be safe. To comply with these guidelines, facilities quite often need additional shielding. In areas of particularly high radiation exposure, personnel are often rotated among jobs so that one employee does not receive an excessive level of exposure. Both of these activities add cost to the operations. An additional burden to the operations is the constant monitoring required to assess radiation exposure levels.

5. Summary. These four items do not constitute a comprehensive list of challenges to the plutonium-processing industry, but they are major examples of unique cost impacts. The costs associated with these processing concerns are generally hidden within the direct operating costs

because they are, indeed, considered necessary to perform the direct operation. These unique costs, therefore, are incorporated into the cost of plutonium recovery and become part of the considerations in deciding the disposition of sidestreams.

B. Economic Discard Limit (EDL)

The result of calculations that take into account all costs of plutonium handling is the economic discard limit (EDL),[1] a level of plutonium concentration above which recovery would be economical. In other words, the EDL represents the plutonium concentrations at which recovery costs would equal the value of the recovered plutonium. The procedure for calculating EDL values is easily derived from the following definition:

| Value of Plutonium Recovered Metal | ≥ | Head-End Recovery Costs | - Avoided Waste Mgt Costs | + New Waste Mgt Costs | + Metal Conversion Costs . |
|---|---|---|---|---|---|

Substitution of costs in the above expression and rearrangement of the terms yield the following relationship for the EDL:

$$EDL = \frac{C_r + C_w(1-f)}{(V - C_c)Y} , \qquad (1)$$

where

EDL = economic discard limit, concentration of plutonium in the residue or scrap material (g Pu/kg bulk),

$C_r$ = unit cost of recovering plutonium from bulk and converting it to a concentrated nitrate or oxide ($/kg bulk),

$C_w$ = total waste management cost of initial bulk residue, including packaging, storage, and shipping ($/kg),

f = ratio of the quantity of new waste (after processing) to original bulk,

V = value of plutonium ($/g),

$C_c$ = cost of converting purified plutonium concentrate as oxide or nitrate to spec-grade metal ($/g Pu), and

Y = yield, or fraction of plutonium in original residue converted to spec-grade metal (includes immediate recycle but not secondary recoveries).

Two important terms emerge from the use of this calculation: scrap and waste. Scrap is that material having a plutonium concentration above the EDL value for that matrix and is therefore material that will undergo further processing for plutonium recovery. (Often the terms scrap and residue are used interchangeably to define recoverable material.) Waste, on the other hand, is that material having a plutonium concentration below the EDL value for that matrix and is therefore destined for disposal.

The operating costs used to derive the unit-cost terms include all direct and indirect costs related to the recovery operations such as direct labor, indirect labor, materials and supplies, technical and engineering support, health protection, and analytical/standard laboratories. Also included are shared or distributed building costs such as building maintenance and utilities.

The term V in the equation above represents the value of plutonium. In reality, it represents the cost of producing and recovering virgin plutonium from production reactors and converting it to usable metal. Historically, the value of plutonium and the cost of recovery ($C_r$) have been the predominant factors in determining the EDL. More recently, the costs associated with waste management ($C_w$) have become more significant. Indeed, they will likely become the dominant aspect in determing EDLs in the future.

Waste-management costs also include direct labor, indirect labor, materials, supplies, technical and engineering support, health protection, analytical/standard laboratories, and building maintenance and utilities. Other indirect charges include packaging, certification, storage, shipment, and final disposal including monitoring. At present, the only site

certified for receipt of plutonium-contaminated waste is the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico. The facility has developed an extensive waste acceptance criteria (WAC) for defining such things as packaging, radiation levels, material content, reactivity, and particle size.

The Department of Energy (DOE) provides the following official definition of transuranic (TRU waste):[2]

> TRU Waste. Without regard to source or form, radioactive waste that at the end of institutional control periods is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nCi/g. Regarding the Waste Isolation Pilot Plant, high-level waste and spent nuclear fuel as defined by this Order are specifically excluded by this definition.

C. Levels of Recovery

The EDL now becomes the criteria for defining the level of recovery for scrap items. Scrap, unfortunately, exists as a large number of different items and in a large variety of matrices. To simplify the evaluation of scrap items, researchers have developed a list of categories and have clustered scrap items using categorical criteria. The initial criteria segregate material into three major catagories: High-Level, Major Low-Level, and Other Low-Level.

The High-Level category encompasses high-plutonium-concentration items that can be processed quickly and inexpensively. Items in this category generically include oxides and impure metals in which plutonium concentrations are generally above 80%.

The Major Low-Level category encompasses items that involve moderate turnaround times, routine processing sequences, and well-established and routine techniques. These items are almost exclusively processed by aqueous dissolution and purification, although in some instances high-

temperature extractive metallurgical techniques offer acceptable alternatives. Items in this category generically include reduction slags and salts, impure oxides, and ash.

The Other Low-Level category encompasses items that are not routinely processed, items that are not produced in high enough volumes to justify routine processing, and items that require special handling. They generally have very low plutonium concentrations and, because of their unusual nature, are somewhat more expensive to process than items in the Major Low-Level category. Items in this category include ceramic crucibles, graphite, combustibles, and insulation.

Unfortunately, breaking the plutonium scrap into these three categories does not sufficiently allow definition of recovery cost or assessment of a proper EDL value for these items. There are simply too many different techniques used to recover items in each broad category to accurately assess recovery costs. Therefore, to further facilitate the analysis of recovery cost, the specific materials commonly processed for plutonium recovery are further broken into the following 24 higher-order categories:

Low-Level Scrap

1. Graphite
2. Combustibles
3. Incinerator Ash (Major Low-Level)
4. Oxide Heels (Major Low-Level)
5. Reduction Slags (Major Low-Level)
6. Insulation
7. Ceramics
8. Scrap Metal (Iron, Plutonium)
9. Glass
10. Rubber
11. Sludge
12. Chloride-Based Salts
    a. Extractive Metallurgy (Major Low-Level)
    b. Electrolyte (Major Low-Level)
    c. Solvent
13. Pu/U Mixtures
14. Pu/Th Mixtures
15. Pu/Be Mixtures
16. Pu/Np Mixtures
17. Pu/Zr Mixtures
18. Pu/Al Mixtures

High-Level Scrap

19. Impure Metal
    a. Nonspecification Metal
    b. Anode Heels
20. Rich Plutonium Oxide (>85%)
21. Lean Plutonium Oxide (<85%)

The materials within each of the 24 categories have similar properties and require basically the same processing steps for plutonium recovery. We can therefore measure the cost of recovery and calculate an independent EDL for each category.

## D. Assay of Scrap

The application of the EDL is straightforward. The units associated with the EDL are grams of plutonium per kilogram of bulk weight. When a discrete scrap item is generated, the operator must assay the scrap and measure the concentration of plutonium.[3] There are a variety of satisfactory techniques for determining the plutonium concentration, but all fall within two categories: destructive and nondestructive.

1. Destructive Techniques. Destructive techniques involve taking representative samples from the scrap matrix and performing detailed chemical analysis. Plutonium assay, for instance, involves dissolving the sample in hydrochloric acid (HCl), reducing it with a lead reductant, rinsing it, titrating it with cerium(IV), and detecting the end point potentiometrically. Each sample requires that a reagent blank be run in parallel to compensate for reagent interference. The reliability varies with the quality of the feed sample but can be accurate to within 0.05%. Certain elements, including iron, molybdenum, titanium, uranium, tungsten, vanadium, and chrome, interfere with the reliability of the analysis and can cause serious deviations in results if the analyst does not compensate for them.

Another very important destructive technique is the determination of different plutonium isotopes by mass spectrometry. This process involves sample dissolution in HCl, ion exchange, elution, and rinsing. The analyst then injects the sample into the mass spectrometer, which shows the distribution of isotopes within the sample. This analysis is important because of its use in conjunction with the various nondestructive techniques for providing quantitative analysis.

2. Nondestructive Techniques. Nondestructive assay (NDA) techniques used in assaying plutonium-bearing scrap include alpha counters, neutron counters, gamma scans, and calorimetry. All techniques used for nuclear-material assay must be calibrated with appropriate and approved reference standards. All calibration standards should be traceable to the appropriate National Measurement System standards.

a. Alpha Counters. Alpha spectrometry is an isotope-specific rather than element-specific analytical method that is particularly well-suited to measuring low plutonium concentrations in waste streams. The method also has been applied to the determination of plutonium in dissolver solutions following such processes as solvent extraction. Quantitative alpha-particle spectrometry is based on measurement of the alpha-radiation intensity of the sample. The major problem is that alpha particle energy interactions with electrons rapidly degrade and are completely attenuated by as little as 5 cm of air. Attenuation by water and self-absorption are even more rapid. Analysts perform normal alpha spectrometry on thin, dry films using standard alpha detectors such as proportional, scintillation, and solid-state counters.

b. Neutron Counters. NDA techniques using neutron counting are either passive or active. Passive assay uses naturally occurring neutrons as direct elemental or isotopic signatures. Active assay involves irradiating the sample with neutrons or photons to induce nuclear or electronic interactions in the sample matrix. The resulting neutrons are interpreted to determine the amount of the desired element present.

Neutrons from plutonium samples arise from either $(\alpha,n)$ reactions or fission. The $(\alpha,n)$ neutrons result from the alpha decay of plutonium and the subsequent action of the alpha particles on light elements in the sample matrix. The neutron yield is a function of alpha-particle energy, the $(\alpha,n)$ cross sections of the matrix elements, and the matrix configuration. Furthermore, the alpha-particle intensity depends on the isotopic composition and is particularly sensitive to $^{238}Pu$ content. As a consequence, $(\alpha,n)$ neutrons ordinarily are not useful as a quantitative signature for plutonium, and, in fact, they usually constitute a large background that must be eliminated from most measurements.

Fission neutrons result from spontaneous fission or from fissions induced by an external neutron source such as $^{252}Cf$. Because the fission process produces more than one neutron per fission, coincidence counting can differentiate fission neutrons from $(\alpha,n)$ neutrons.

With passive neutron methods, analysts can measure both spontaneous fission and $(\alpha,n)$ neutrons. The $(\alpha,n)$ neutron yield is sensitive to the light-element content, particularly fluoride. Using coincidence-counting techniques can make this method specific for spontaneous fission neutrons, but some sensitivity will be lost.

c. Gamma-Ray Measurements. Passive gamma-ray techniques benefit conventional materials accounting of uranium and plutonium because investigators can use these emission techniques to quantify any $^{235}U$ and $^{239}Pu$ contained in the solid low-level waste generated by reprocessing and conversion operations.

For assay of $^{235}U$ and $^{239}Pu$ contained in 55-gal. drums of low-level waste, analysts measure the 186-keV and 414-keV lines, respectively. A drum scanner that uses a sodium iodide (NaI) detector to measure the 414-keV gamma ray from $^{239}Pu$ can detect ~1 g of $^{239}Pu$ in a 5-min scan; a lithium-drifted germanium (GE[Li]) detector can provide much higher resolution. The relative accuracy for measuring >10 g of $^{239}Pu$ can be as good as 10% in matrices of low atomic number and ranges to 50% in unknown

matrices. Hence, the measurement accuracy depends largely on the administrative control exercised in sorting waste to ensure reproducible matrices.

In addition to NaI and Ge(Li) detectors, intrinsic germanium detectors also provide gamma-ray measurements. The Ge(Li) and intrinsic germanium detectors provide much better energy resolution for adjacent peaks, but they require liquid-nitrogen cooling. Nevertheless, one or the other is required if good quantitative data on isotopic abundances are to be obtained. Because it is a rugged on-line instrument, investigators prefer the NaI detector if overlapping spectra are not a problem.

d. Calorimetry. Plutonium calorimetry is an NDA technique based on measuring heat generated by the radioactive decay of plutonium and americium. All but a negligible part of the decay energy is transformed into heat when the sample and calorimeter walls absorb the decay particles and rays (alpha, beta, and low-energy gamma). In plutonium from processed reactor fuels, the energy from alpha decay predominates, and the energy release from $^{238}Pu$, the plutonium isotope with the highest specific activity, is dominant.

The calorimetric method consists essentially of measuring the electrical energy needed to duplicate or balance the rate of heat emission (power) from the sample. A thermal resistance separates the heat source (standard or unknown sample) in the calorimeter chamber from a constant-temperature environment (heat sink). In steady-state operation, establishing a constant temperature difference between the calorimeter chamber and the surrounding environment determines equilibrium; the thermal energy transferred to the environment must equal that generated in the calorimeter chamber.

Calorimetry is applicable to the assay of materials such as oxide powder or metals that have high plutonium concentrations. An analyst can determine the total power of a sample without subsampling or aliquoting, permitting assay of sealed containers of material. Furthermore,

calorimetry is relatively insensitive to the geometry and matrix effects that are major concerns in many other NDA methods.

Calorimetry is both precise and accurate. In spite of potential sources of error, the precision of a plutonium assay by calorimetry, expressed in terms of relative standard deviation (RSD), typically is 0.5% or better. However, because the design and construction of a calorimeter depend on the magnitude of the sample power, the physical size of the sample, and the type of radiation emitted, a universal calorimeter for all measurement is neither practical nor economical.

e. Other NDA Techniques. Other NDA techniques, not elaborated on here, include balances and densitometers. Naturally, these types of equipment require regular calibration verification. They are frequently used for confirmation measurements in concert with other analytical techniques but in some cases are used as the primary means of accounting for plutonium.

3. Summary. Evaluating the variety of techniques for determining the plutonium content of a scrap item makes obvious the fact that no one technique can be used in all cases. In fact, investigators generally use two or more techniques to assay every discrete item. No single technique is absolute, and a certain margin of variability exists with each technique. These are crucial points in evaluation processing parameters, operational safety, and, in particular, criticality safety.

The way that material is categorized together with the assay techniques represents the basis for designing recovery techniques. Processing approaches are designed around the feed matrices. The desired end product and ways to minimize waste are also crucial considerations. Operating constraints including criticality, radiation exposure, and batch sizes further help to design the processing approach. The following sections further discuss the various approaches used in recovering plutonium from different scrap matrices.

## III. PRODUCTS RECOVERY AND UTILIZATION

### A. Primary Treatment Approaches

The processing technology for plutonium is especially interesting and challenging because of the many scrap matrices, the wide range of chemical contaminants, and the stringent health, safety, and materials accountability requirements employed in the nuclear industry. In addition, plutonium possesses the unique chemical property that allows the simultaneous existence in solution of the III, IV, V, and VI oxidation states. To make the situation even more challenging, there is a relatively small oxidation potential difference between each state. This multiplicity of states and plutonium's ability to form complexes in the III and IV states provide the foundation for the separation and purification of the plutonium from other elements.

Plutonium solution-processing technology is composed of unit operations that can be conveniently divided into four main categories:

- head-end operations,
- separation and purification by precipitation,
- nitrate anion exchange, and
- chloride operations.

Processes must provide the flexibility to handle extremely low level combustible and noncombustible scrap such as cheesecloth, glove-box gloves, and high-efficiency particulate air (HEPA) filters; chloride-based residues such as direct oxide reduction (DOR) and electrorefining (ER) salts; and residues such as impure oxides and impure plutonium metal containing high percentages of plutonium.

1. Head-End Operations. The principal unit operations involved in this area of plutonium processing include incineration, leaching of noncombustibles, conversion of pyrophoric metal and compounds to stable oxides, and dissolution.

Plutonium-recovery cost depends upon the plutonium concentration in the residues to be processed and upon the matrix material involved. The more dilute the plutonium is, the more nonradioactive material has to be processed to obtain a given amount of plutonium. The ratio of the weight of the nonradioactive material to the weight of plutonium is often significantly greater in solid residues, such as rags, than in feed solutions. Recovering plutonium from solution by solvent-extraction, ion-exchange, or precipitation techniques can be quite easy. Unfortunately, no single method now exists that will scavenge the plutonium from solid materials.

Incineration, the preferred method for cellulosics such as rags and paper (Fig. 1), reduces the original volume of dry rags by approximately one order of magnitude. Because completely burning rubber and plastics is difficult and because burning polyvinyl chloride (PVC) liberates corrosive HCl, researchers developed an alternate processing method that involves pickling compatible plastics such as PVC and polypropylene in boiling nitric acid ($HNO_3$) and fluoride ion ($F^-$)[4,5] (Fig. 2). However, some sites prefer to burn rubber and plastics in an oxygen-fed incinerator constructed with a stainless steel shell lined with fire brick. For reasons explained on page 21, experts do not recommend incineration of leaded glove-box gloves that have been exposed to $HNO_3$ for extended periods.

Depending upon feed material, the incinerator operates between 200°C and 900°C. When the incinerator burns cellulosic material such as paper and cheesecloth, lower temperatures are sufficient. However, more complete combustion of plastics and rubber occurs only at higher temperatures. This high-temperature incineration tends to create refractory oxides of plutonium that are significantly more difficult to leach from the resultant incinerator ash.

A pretreatment calcination step ameliorates the potential difficulties in processing incinerator ash from the combustion of rubber and plastics. At Los Alamos, this operation uses rotary calciners to remove incompletely oxidized organic material from the incineration of materials such as

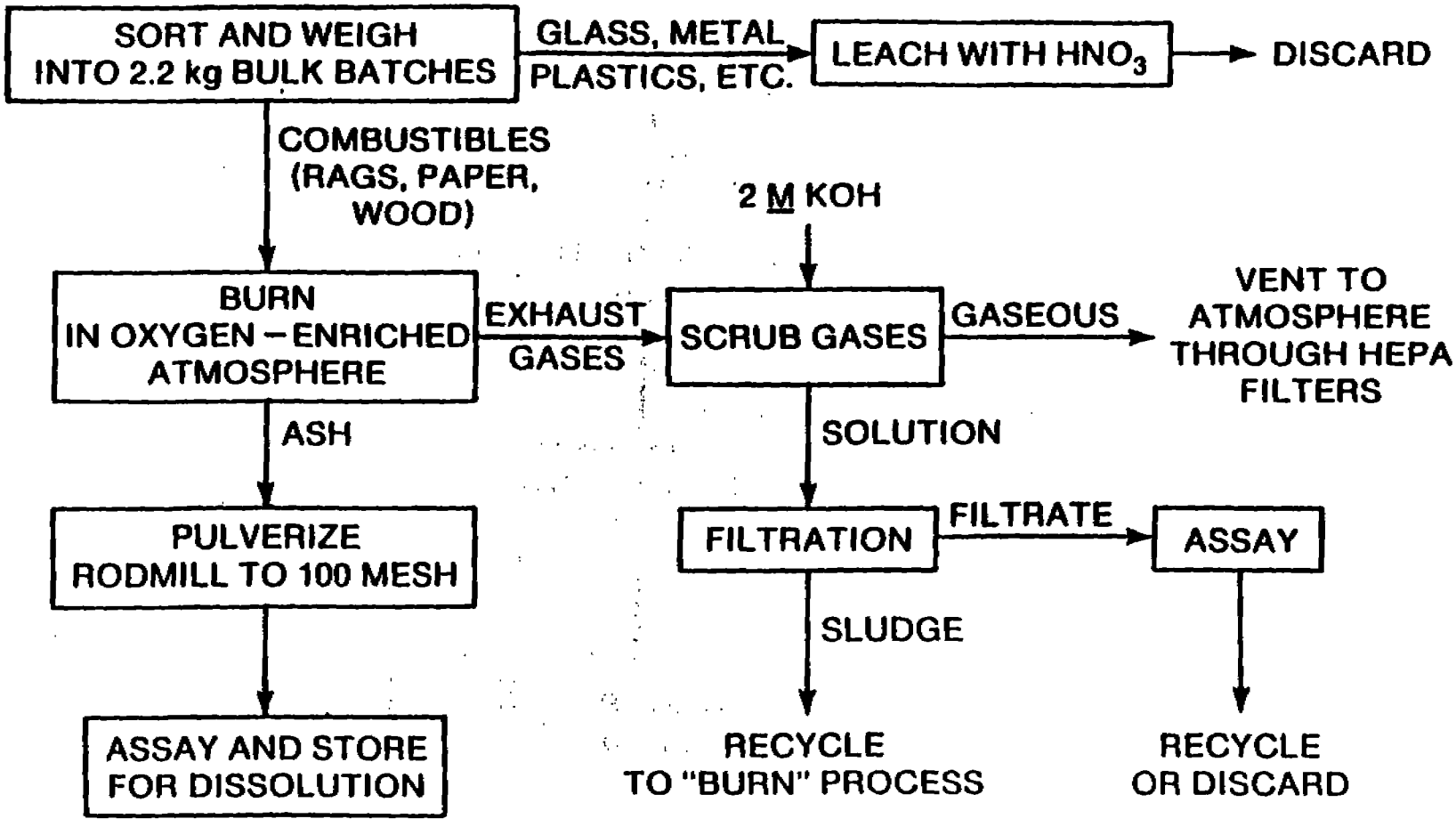



Fig. 1. Incineration of nongraphite combustibles.

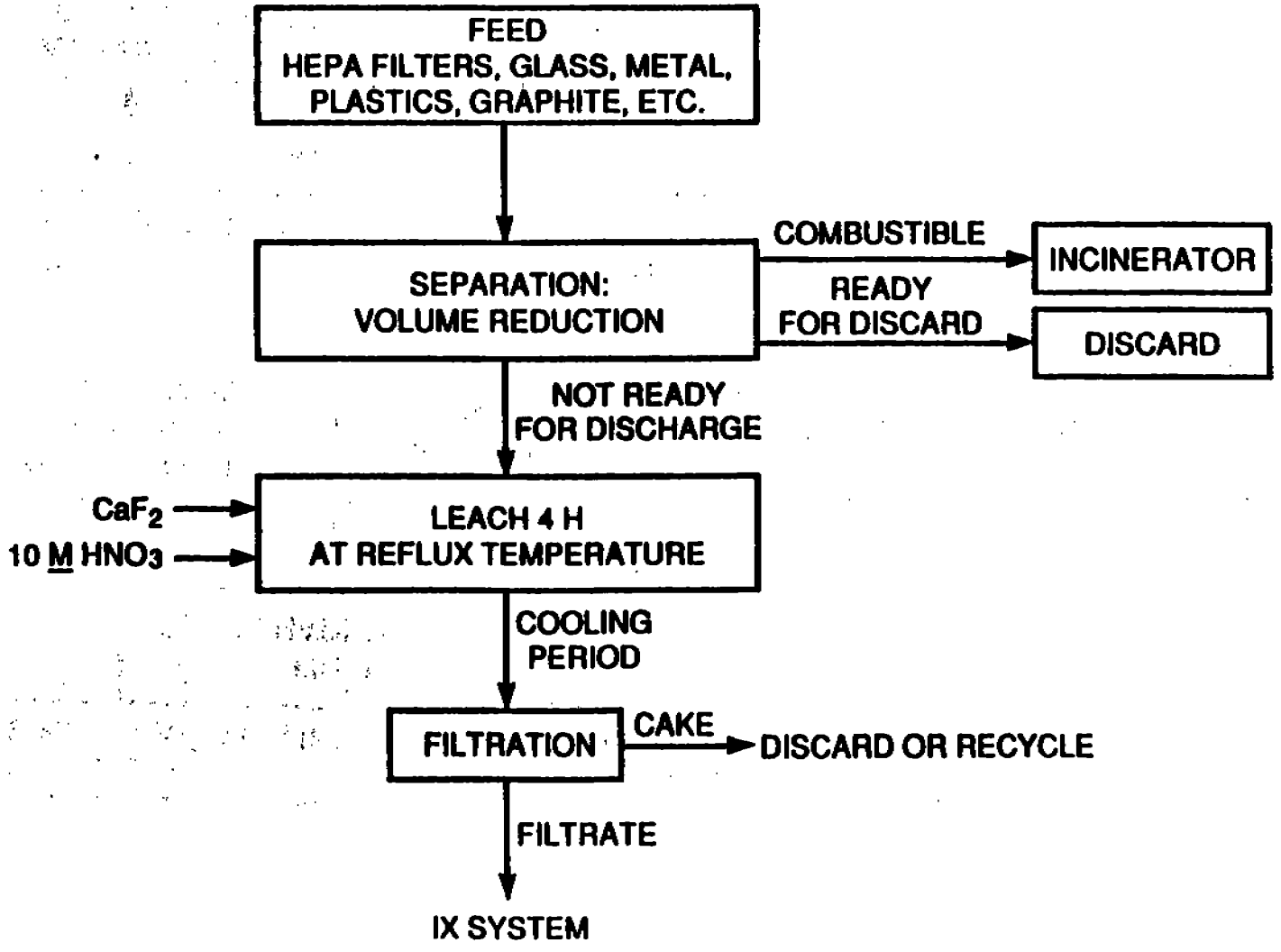



Fig. 2. Noncombustible leaching process.

plastics, rubber, wood, cellulose, and oil (Fig. 3). This calcination step requires the flow of pure oxygen for a length of time and at a temperature (550°C) that will result in almost total oxidation of the organic materials.[6] A rotary calciner consists of a stainless steel tube encased in large resistance heaters and containing the material that is being calcined. A rotating paddle inserted in the calcination tube keeps the material agitated so that the ash particles will be evenly exposed to oxygen and heat and will burn more completely. Agitation also prevents both localized overheating because of combustion and the subsequent melting of the ash to form chunks. This pretreatment process is quite advantageous for the following reasons:

- Organic materials sometimes react vigorously and foam when treated with strong $HNO_3$.
- Emulsions that impede filtration may form when $HNO_3$ reacts with the organic material.
- These viscous residues also coat the ash-leaching equipment, gloves, and glove box, resulting in severe housekeeping problems.
- Some of the organic materials dissolve in the $HNO_3$ to yield a dark solution that in turn severely discolors the ion-exchange resin.
- Organic materials impede the dissolution process. Consequently, following their removal, leaching operations require less $HNO_3$.

Graphite molds used in foundry operations generate graphite residues. The general process for plutonium recovery from these residues includes pretreatment, multiple leaching, and purification. Pretreatment includes the mechanical removal of the surface of the graphite containing most of the plutonium. The remaining graphite is usually sufficiently decontaminated to be discarded. The accumulated scrapings become candidate material for leaching in $HNO_3$ and $F^-$ until the leached residue meets discard limits. Experience has shown that 50% to 90% of the plutonium becomes soluble during each leaching operation and that four passes are sufficient. The graphite scrapings may also be burned in an oxygen atmosphere and the residue from this operation treated as an impure oxide.[4] Rubber and plastics, as mentioned earlier, can be classified as either

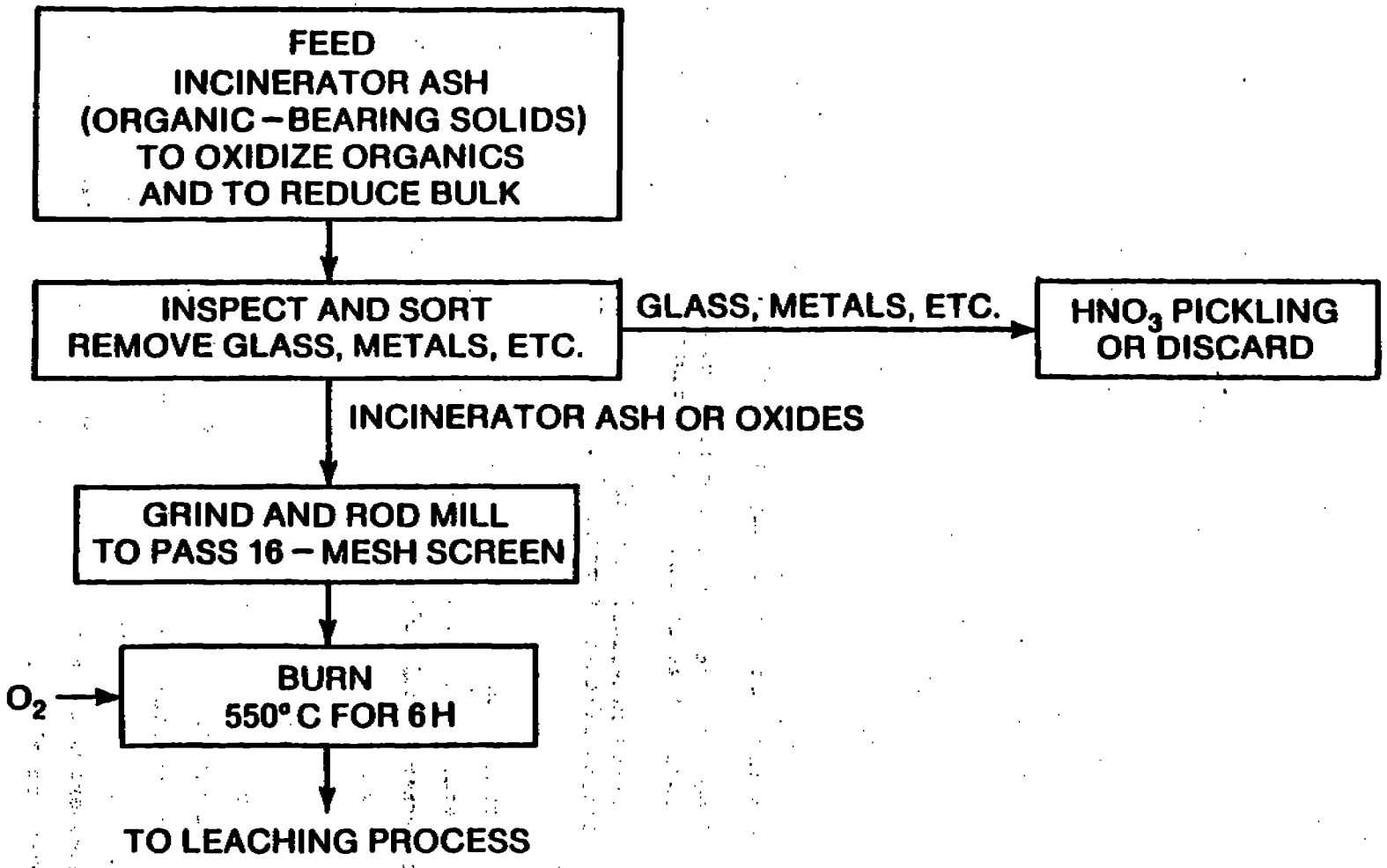



Fig. 3. Rotary calciner.

combustible or noncombustible. If these materials are treated as noncombustibles, wiping the surface with $HNO_3$ and $F^-$ frequently provides decontamination. Wiping is particularly effective on items that have been generated a short time before processing. Older, stored materials require more drastic processing techniques, including leaching in boiling $HNO_3$ and $F^-$ (Fig. 2). Monitoring the material and removing hot spots can reduce the volume of material to be leached.

Long and Smith[7] report that an explosive material, identified as a mixture of carboxylic acids containing nitro groups and lead nitrate, was formed when leaded glove-box gloves were exposed to $HNO_3$ and then dried. The time required for the nitration reaction depended upon the area of leaded layer exposed, the temperature, and acid concentration. One hour was sufficient when the leaded layer was in contact with hot, concentrated $HNO_3$ (15.7M). Approximately two weeks were required when operators used Hypalon* or neoprene to separate the leaded layer from 7M acid at room temperature. The diffusion of $HNO_3$ through the protective surface limited the rate of reaction, but the action of $HNO_3$ vapors on the leaded layer also contributed to the reaction. Soaking the explosive material in water at 95°C for 15 min yielded a nonexplosive solid and a liquid. The liquid could safely be evaported to dryness and safely decomposed by heat.

Glove-box operations and R&D projects routinely generate nonplutonium scrap metal. Washing or leaching this material in $HNO_3$ and $F^-$ (Fig. 2) is a relatively easy decontamination method. Several techniques allow for the removal of gross quantities of plutonium that have been deposited on metallic scrap. Hydriding converts plutonium metal to a plutonium hydride that can be easily removed from the base material. The plutonium can also be oxidized, or in some cases compounds can be thermally decomposed. Abrasion of the metallic surfaces may also remove the contamination. Dissolution or leaching of these plutonium-bearing products makes the plutonium soluble. Researchers are also testing techniques such as

* E.I. du Pont de Nemours & Co., Wilmington, DE 19898.

vibratory polishing, electropolishing of stainless steel, and electrolytic dissolution for possible use on these residues.

Plutonium-processing facilities generate contaminated glass residues, including materials such as Raschig rings, glove-box windows, and processing equipment. The leaching process for these materials uses $HNO_3$ and hydrofluoric acid (HF) or calcium difluoride ($CaF_2$) (Fig. 2). Several leachings might be necessary to achieve a glass residue that may be discarded. A potential hazard in processing glass residues is the presence of glass shards that can easily penetrate gloves and injure the operator.

HEPA filters are another type of material widely used in the plutonium-processing facilities. After the filters have reached their filtering capacity, they may be discarded or, if they contain concentrations above the discard limit, they must be processed. The general steps in treating this type of material include disassembling the filters, leaching the filter media in refluxing $HNO_3$ and $F^-$ (Fig. 2), and discarding the residues. The frames that house the filtering media may usually by discarded without processing.

Some production facilities use the generic term sludge to designate material that has settled to the bottom of solution-storage tanks or other process vessels. The precipitate found in most waste and process streams may also be referred to as sludge. Depending upon the nature and source of the residue, facilities may treat this material by washing, leaching, or dissolution in $HNO_3$ plus HF or $CaF_2$.

Sand, slag, and crucibles are the residues from the calcium reduction of plutonium tetrafluoride ($PuF_4$) to form plutonium metal. The sand and crucible materials are magnesium oxide (MgO), which may contain a silicon dioxide binder, and slag, which is principally a mixture of $CaF_2$ and minor amounts of calcium oxide (CaO). Sand, slag, and crucibles from some sites contain large amounts of calcium iodide, which operators add before the initiation of the reduction step to boost the reaction temperature and allow the reaction to go to completion. Careful sorting of this material

may allow discard of low-level plutonium residues. Material requiring further processing is sent to a pretreatment operation where a crusher/pulverizer converts it to a powder. This step allows an auger feeder to add the material to the first stage of a 6-in. cascade dissolution system.[8,9] Technicians add pulverized sand, slag, and crucible, $HNO_3$, and aluminum nitrate [$Al(NO_3)_3 \cdot 9H_2O$] concurrently to the first dissolver, and air-lift mixing provides for adequate solid/liquid contact (Figs. 4 and 5). An immersion steam loop heats the material to about 90°C. The solution cascades through the second and third stages before filtration. The small heel remaining after dissolution is usually combined with the next feed material. The off-gas from this process passes through a condenser and is then scrubbed in caustic solution to neutralize the volatilized iodine and to retard the corrosion of process equipment. After filtration, the solution is processed by solvent extraction or ion exchange. Several facilities also use pot dissolvers and slab dissolvers in the dissolution step.

Ceramics is another category of scrap generated in pyrochemical operations and analytical chemistry. Pyrochemical processes, including DOR and ER, use magnesia crucibles. Analytical chemistry employs LECO crucibles in the determination of carbon in plutonium dioxide ($PuO_2$), a procedure that results in a refractory $PuO_2$ imbedded in the crucible. The magnesia crucibles from $Ca/PuF_4$ reductions may be processed in the same manner as sand, slag, and crucibles, or the crucible pieces may be pickled in HCl. The LECO crucibles are a particularly intractable residue, and no one has yet developed a suitable process to recover the plutonium from this category of material.

We have already described dissolution in $HNO_3$ for sand, slag, crucibles, and incinerator ash and $HNO_3$ pickling of extraneous materials. High-percentage plutonium in oxide is normally dissolved with 10-16M $HNO_3$ and 0.05-0.4M $F^-$ from HF or a fluoride salt such as $CaF_2$ (Fig. 6). At Los

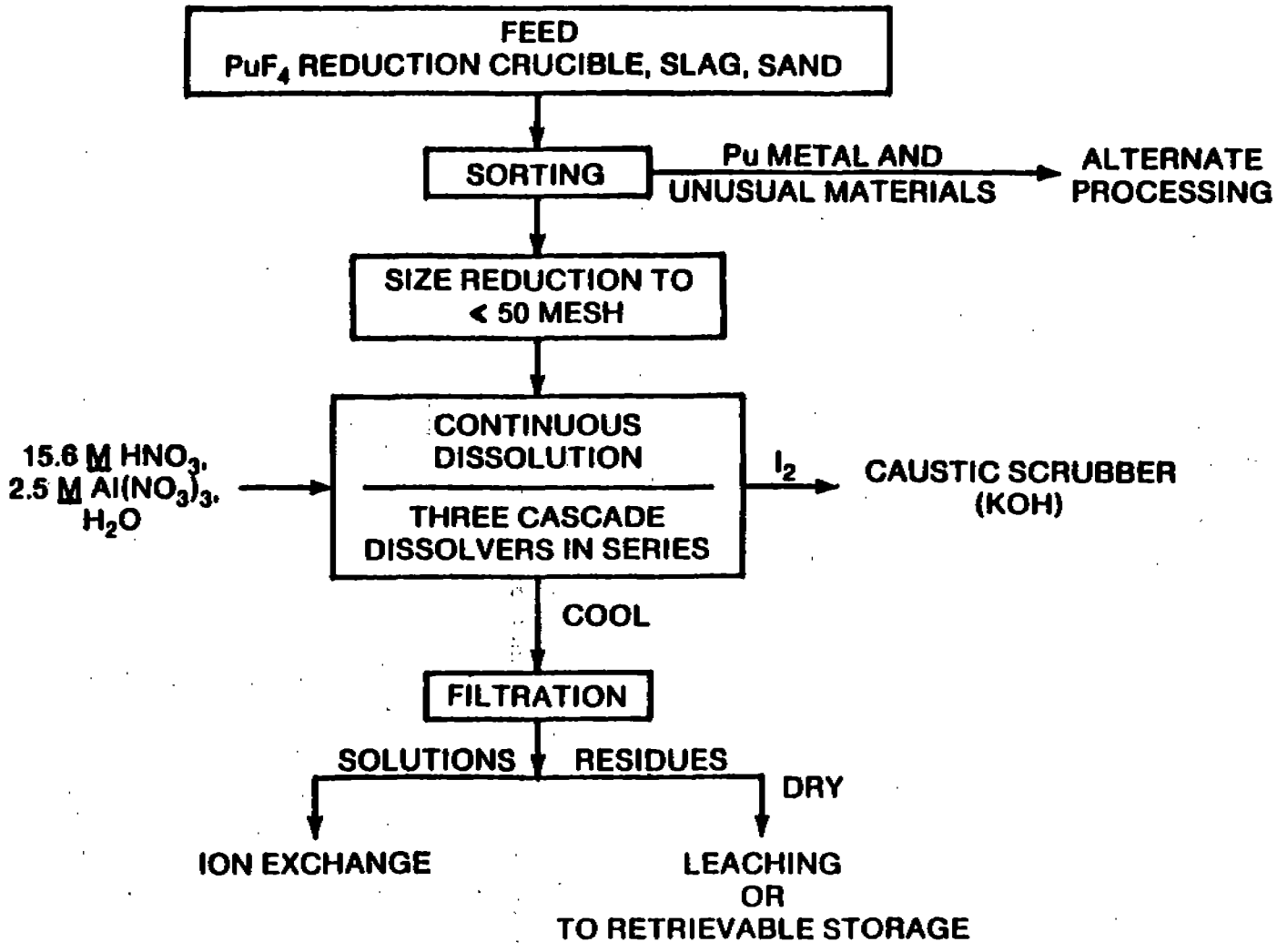



Fig. 4. Slag and crucible dissolution.

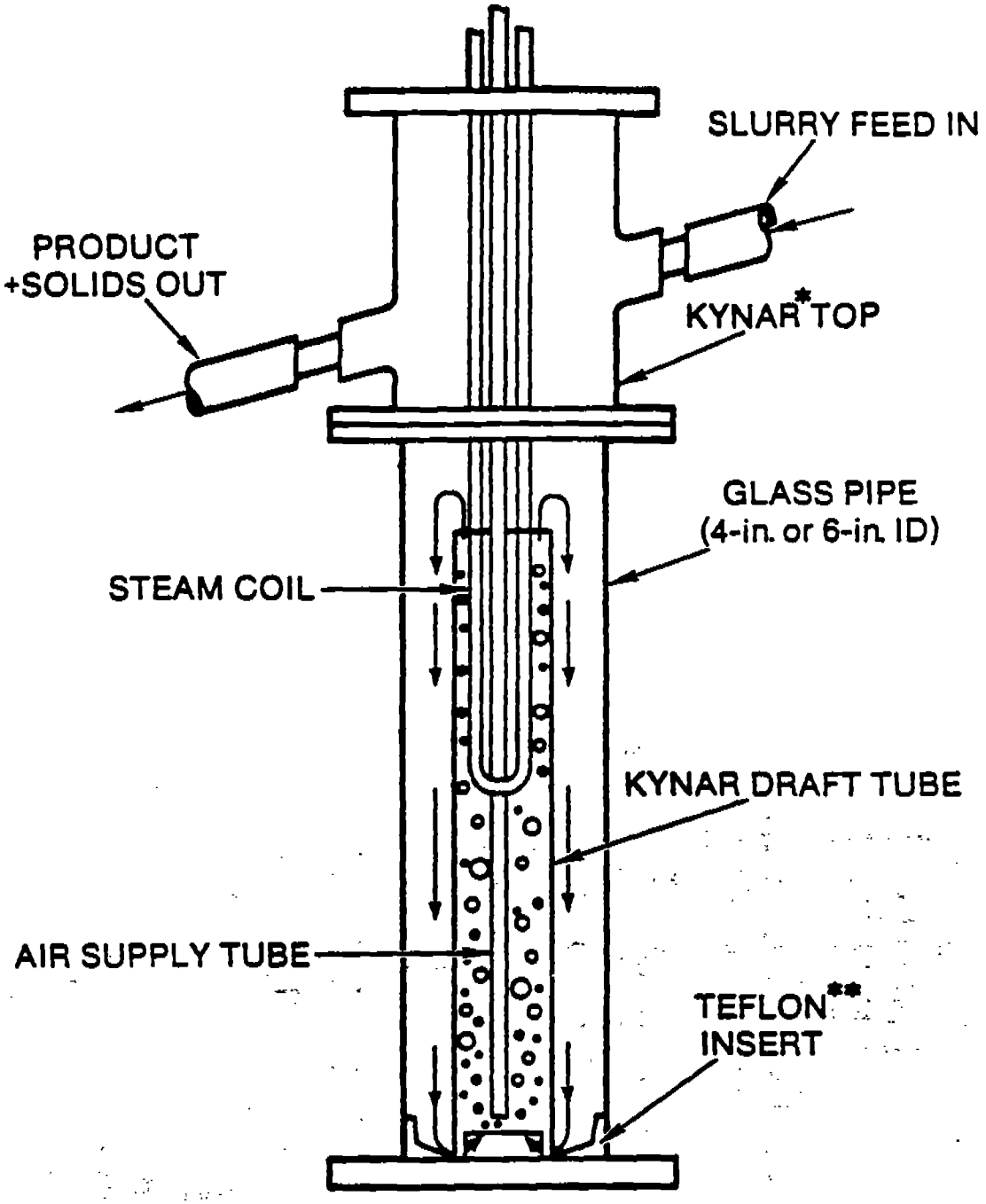



Fig. 5. Operating principle of 4-in. and 6-in. cascade dissolvers. (Normal operation requires three dissolvers in series.)

* Pennsalt Chemicals Corp., 3 Penn Center, Philadelphia, PA 19102.
** E. I. du Pont de Nemours Co., Wilmington, DE 19898.

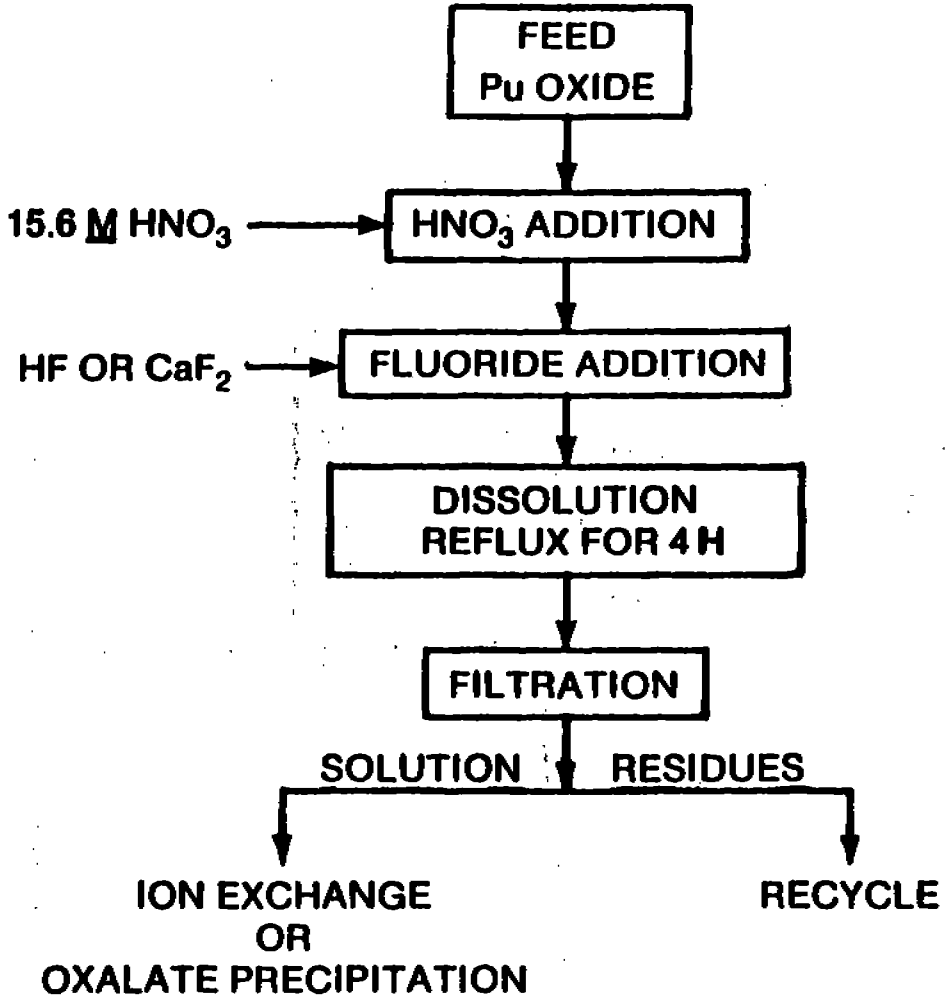



Fig. 6. Dissolution of $PuO_2$.

Alamos, traditional dissolutions, dating from the early 1950s,[4] involved the spherical 5-ℓ Pyrex* dissolution vessel with heating mantle, sparge inlet, and reflux or distillation condenser. Although the earlier system was convenient for special lots of material, a more efficient method utilizes the 4-in. cascade dissolution system, which is a scaled-down version of the 6-in. system described earlier (Fig. 5). Rocky Flats Plant (RFP) developed the cascade dissolvers, which were recently installed, tested, and put into routine use at Los Alamos National Laboratory. Advantages include higher efficiency, a higher rate or production, and lower plutonium(VI) content in the product.

Heels, a particularly prolific category of residue, are the undissolved residue of a feedstock after one or more leaching/dissolving cycles. The original feedstock may have been $PuO_2$, incinerator ash, impure metal, blasting grit, or nitrate salts. Generally, heels are repeatedly leached in $HNO_3$ plus HF or $CaF_2$. The usual method of processing permits the addition of fresh feed material to the heels to make the repeated leachings more efficient.

$PuO_2$ that has been subjected to high temperatures is a very refractory material and is difficult to dissolve by normal techniques. Oxides that have been heated to less than 600°C are usually easier to dissolve than are oxides heated to temperatures between 600°C and 1000°C. Oxides that have been fired at temperatures greater than 1000°C require more extreme dissolution measures.[4] Researchers often cite the ability of refluxing $HNO_3$/HF to dissolve $PuO_2$[10,11]; however, the high-temperature oxide dissolves only very slowly in this acid mixture. Bjorkland and Staritzky[12] found an increase in the refractive index of $PuO_2$ prepared from plutonium(III) or plutonium(IV) oxalate as the ignition temperature increased. Experimental results indicate that perfection of the originally

* Corning Glass Works, Corning, NY 14832.

In the following sections we describe some of the more important precipitations and the disposal of their filtrates.

a. Plutonium(III) Oxalate. Since the early days of the Manhattan Project, researchers have found it advantageous to produce large-particle-size precipitate by reducing plutonium to the III state and precipitating $Pu_2(C_2O_4)_3 \cdot 10H_2O$[4,18,19] (Fig. 7) by the controlled addition of aqueous oxalic acid ($H_2C_2O_4$). Solid $H_2C_2O_4$ will produce a smaller-particle-size precipitate. The typical precipitate filters readily and has a practical production solubility of 0.1-0.5 g Pu/ℓ. The solubility is directly proportional to the free $H^+$ and inversely proportional to the concentration of $H_2C_2O_4$. As the percentage of plutonium(IV) increases from 0% to 100%, the plutonium oxalate color changes from turquoise-blue to blue-grey and finally to light tan. At 500°C - 600°C both plutonium(III) and plutonium(IV) oxalate convert readily in air to a reactive, slightly substoichiometric oxide that is quite reactive[4,20] during hydrofluorination or dissolution in $HNO_3$/HF. Plutonium(III) oxalate purifications give good decontamination factors from such impurities as $Al^{+3}$, $Fe^{+3}$, and $UO_2^{+2}$. There is less decontamination from sodium, potassium, and calcium and none from americium(III).

b. Plutonium(IV) Oxalate. Plutonium(IV) oxalate [$Pu(C_2O_4)_2 \cdot 6H_2O$] precipitates readily from dilute acids[16,17,21,22] but is usually quite fine and often gummy. Precipitation at elevated temperatures can greatly improve precipitate characteristics. Experience at Los Alamos indicates the best precipitate is produced by the simultaneous addition of plutonium nitrate solution and 1M $H_2C_2O_4$ solution to well-stirred 1.5M $HNO_3$ maintained at about 60°C (Fig. 8). The precipitate is quite coarse and compares favorably with the best plutonium(III) oxalate precipitates. Hanford[23,24] treats the fairly pure plutonium-nitrate feed with hydrogen peroxide ($H_2O_2$) to reduce plutonium(VI) to plutonium(IV) because plutonium(VI) oxalate is quite soluble. Investigators found the higher iron content of the miscellaneous feed solutions at Los Alamos increased $H_2O_2$ decomposition for a similar pretreatment. They added the $H_2O_2$ at the

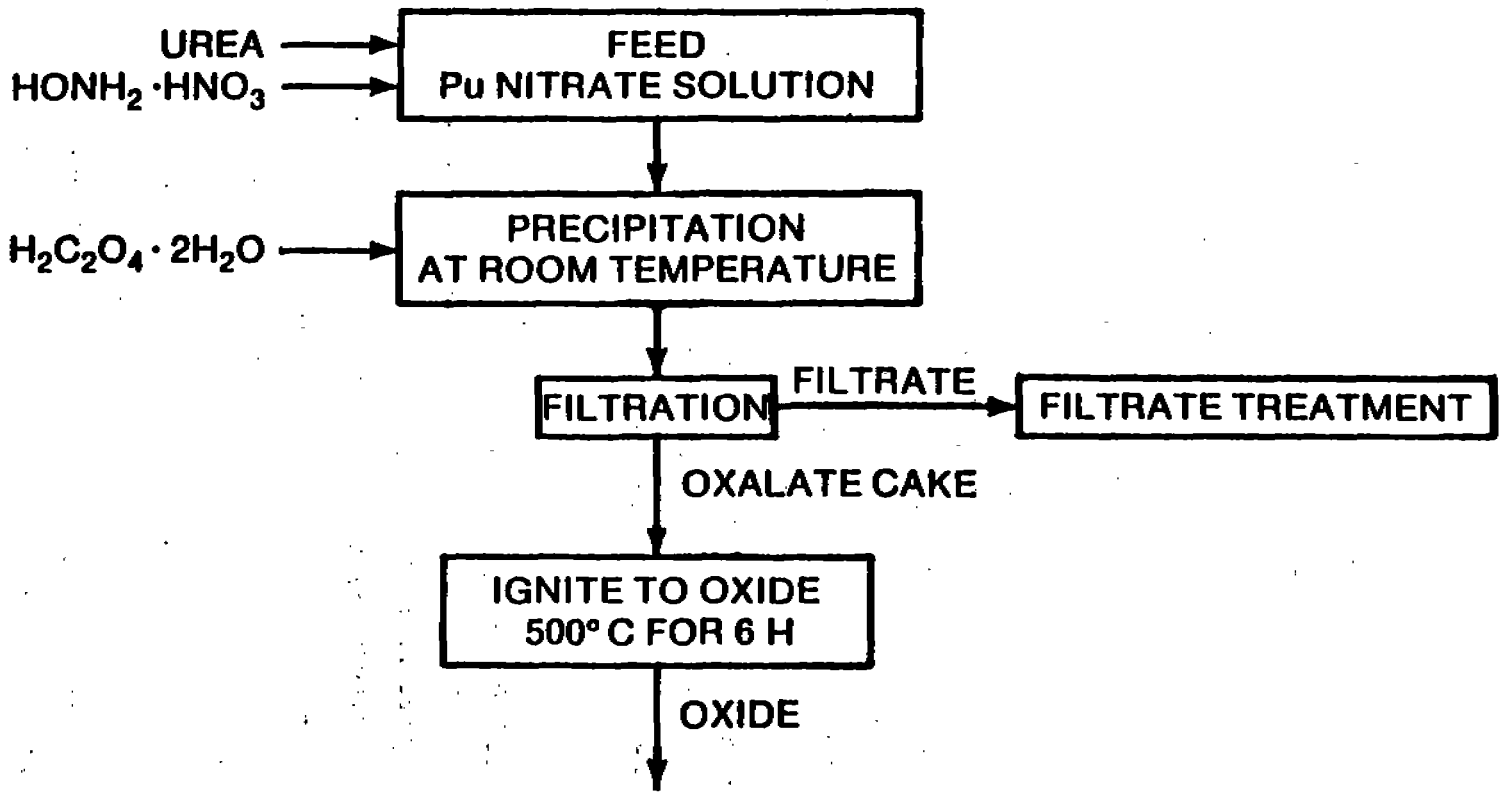



Fig. 7. Plutonium(III) oxalate precipitation.

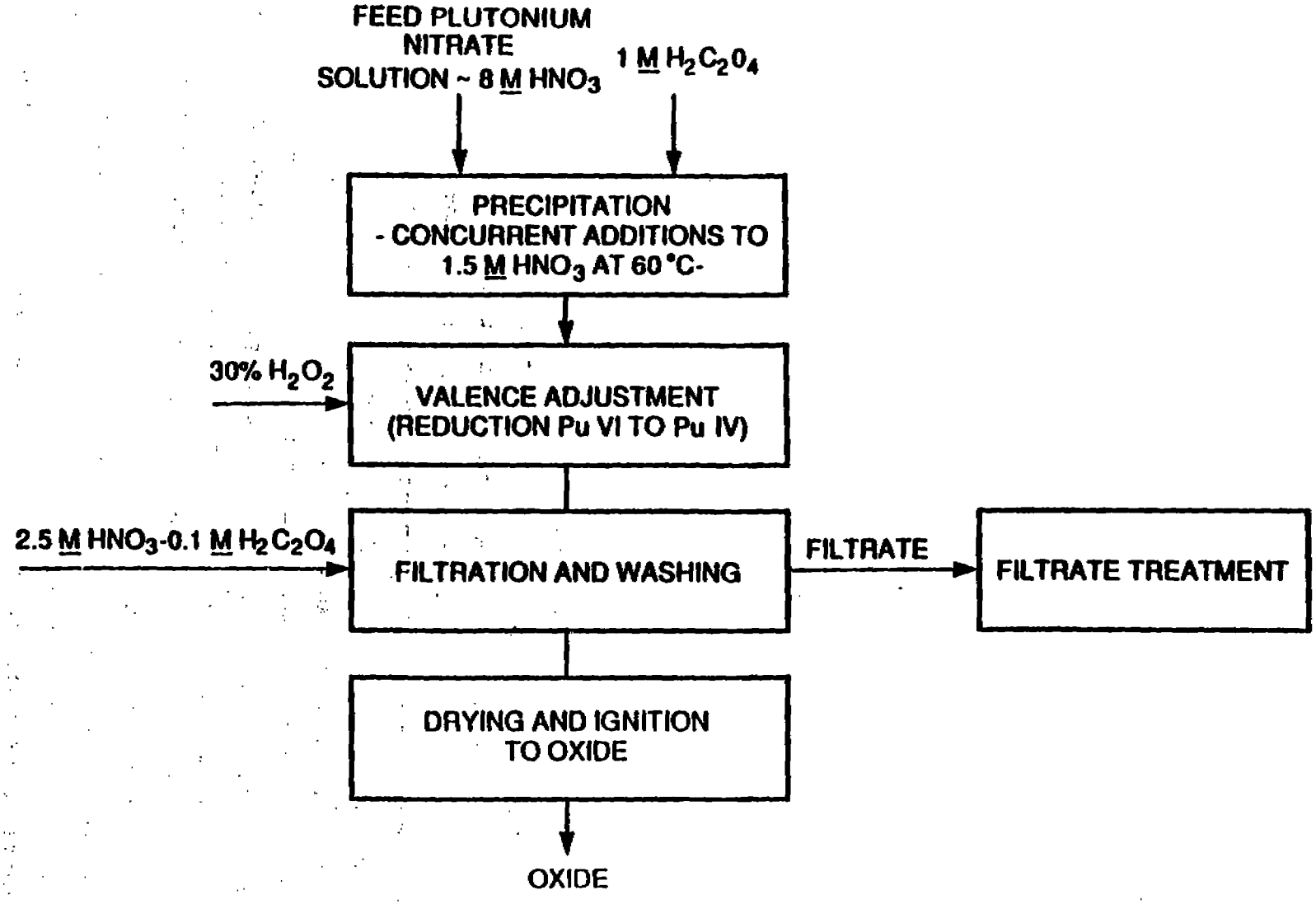



Fig. 8. Plutonium(IV) oxalate precipitation.

end of the precipitation because the ferric iron was complexed by oxalate ion and was therefore less effective in $H_2O_2$ destruction. The Hanford precipitation is continuous, whereas the Los Alamos precipitation is a batch process. The Los Alamos precipitate is medium tan and quite coarse. Filtration and washing are very rapid, and the oxide product is a free-flowing powder with few or no lumps. Recovery filtrate losses are approximately 0.2-0.5 g Pu/ℓ. Because of their higher acidity, $Fe^{+3}$, $Al^{+3}$ and $UO_2^{+2}$ have higher decontamination factors than do plutonium(III) oxalates. The solubility of plutonium(IV) oxalate in the presence of excess $H_2C_2O_4$ generally exhibits a minimum value in the range of 1-3M free $H^+$. At lower acidities, a strong oxalate complex increases the solubility, and at higher acidities the solubility increases because of the solvent action of the strong acid.

c. Plutonium Peroxide. Plutonium peroxide is an olive-green precipitate formed by the addition of 30%-50% $H_2O_2$ to a solution of plutonium(IV) (Fig. 9). The useful range for nitric solution is 2.5-5.5M $H^+$. A brown peroxy complex forms during the first addition of $H_2O_2$; a red complex follows.[25] Finally, the olive-green peroxide precipitate forms. To prevent appreciable $H_2O_2$ decomposition, operators hold the temperature at 10°C-15°C; however, if the reaction is stable, 15°C-20°C is appropriate. High levels of iron, copper, manganese, or nickel will catalyze the destruction of $H_2O_2$, producing a rapid decomposition. In respect to other precipitations, the peroxide purification probably gives the best overall decontamination from cations. Unlike oxalates, peroxides give excellent decontamination from $^{241}Am$. At higher acidities and with careful $H_2O_2$ addition, the readily filterable hexagonal form of plutonium peroxide will precipitate.[26] At lower acidities, an undesirable, gelatinous, cubic form will precipitate. Mixtures of hexagonal and cubic phases do occur. Sulfate ion added to the plutonium-nitrate feed solution at 0.1-0.3M concentration tends to improve precipitate characteristics. Plutonium peroxide is not a stoichiometric compound, but its O/Pu ratio may approximate 3.5. Anions such as $NO_3^-$, $SO_4^{--}$, and $Cl^-$ are incorporated into the structure. RFP hydrofluorinates

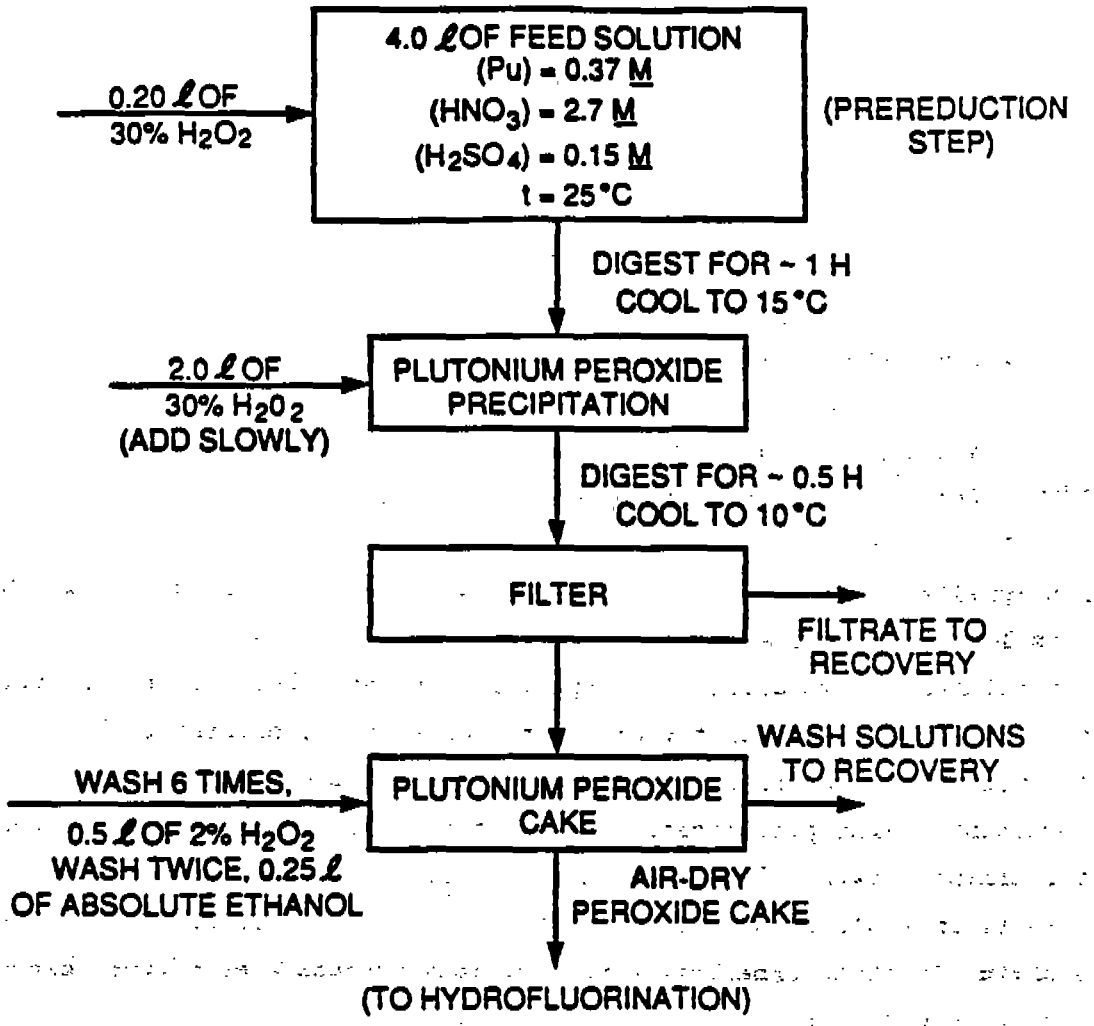



Fig. 9. Plutonium peroxide precipitation.

plutonium peroxide to obtain plutonium tetrafluoride ($PuF_4$) for calcium reduction to metal. Los Alamos formerly used this process but now uses plutonium peroxides exclusively for purification. The dissolution of the peroxides is followed by a plutonium(III) oxalate precipitation and calcination either to provide oxide for the Fast Flux Test Facility breeder-reactor experiment or to provide a feed for metal production. It should be noted that calcination of oxalates is more easily controlled than calcination of peroxides.[27]

d. Plutonium Hydroxide. As we noted earlier, hydroxide precipitations are quite useful for producing a filtrate that can be discarded to final waste management. Frequently, facilities treat oxalate and peroxide filtrates with sodium hydroxide (NaOH) or potassium hydroxide (KOH) for precipitation of plutonium and $^{241}Am$ hydroxides and destruction of $H_2O_2$. If plutonium(III) is present, plutonium(III) hydroxide will precipitate, but it will then slowly oxidize to plutonium(IV), which is much less soluble and has a solubility product of $10^{-52}$ to $10^{-56}$.[25] The plutonium(IV) hydroxide is generally a green gelatinous precipitate that occludes many ions from the solution. As we noted before, the objective is to use the precipitation as a scavenger because purification is not very good. Hydroxide precipitations are particularly valuable as a method for discarding waste chloride solutions because there are no serious corrosion effects in stainless steel if the solutions are alkaline. One difficult problem is the handling of voluminous precipitates of such elements as magnesium and calcium, unless the pH can be carefully controlled.

e. Plutonium Fluoride. Although the process is not as common as oxalate and peroxide precipitations, some facilities have precipitated plutonium as $PuF_3$ and $CaPuF_6$[16,17] to provide precursors to metal reduction. Both compounds can be precipitated, filtered, and dried, although HF, $O_2$, and elevated temperatures are necessary for pure $PuF_3$, and argon or nitrogen is used to dry $CaPuF_6$. Dried $PuF_3$ may be roasted in $O_2$ to produce a mixture of $PuF_4$ and $PuO_2$, which will give 95%-97% yields of plutonium metal upon reduction with calcium metal. Precipitated $PuF_4 \cdot 2.5H_2O$ is hard

to filter, handle, and dehydrate, so it is not a metal-reduction precursor. Decontamination from many impurities is not good for plutonium fluoride, so the feed solutions must be relatively pure. Savannah River has used variations of the $PuF_3$ process, but Los Alamos, Hanford, and RFP use hydrofluorination of oxalates, oxides, or peroxides.

f. Disposal of Oxalate and Peroxide Filtrates. Because facilities cannot directly discard oxalate and peroxide filtrates to final waste management, the materials must undergo further treatment. Oxalate filtrates cannot be easily and directly recycled because $H_2C_2O_4$ interferes appreciably with tributylphosphate (TBP) solvent extraction and with absorption of plutonium on a nitrate anion-exchange column. Addition of $Al(NO_3)_3$ or increasing the $HNO_3$ to 9M $HNO_3$ can allow the nitrate anion-exchange technique to be used.[4] At Los Alamos, evaporation of the oxalate filtrates destroys a relatively large amount of the oxalate ion while allowing a more economical volume of solution to be recycled through the ion-exchange column. Hanford and Savannah River use 0.02-0.04M $Mn^{+2}$ to catalyze elevated-temperature destruction of $H_2C_2O_4$. Heat will decompose $H_2O_2$, but operators must use caution to prevent violent decomposition.

As we noted above, both peroxide and oxalate filtrates are amenable to hydroxide precipitation and subsequent discard of their filtrates. The hydroxide cakes can be recycled for recovery of the plutonium and americium.

3. Nitrate Anion Exchange. At Los Alamos and RFP, nitrate anion exchange is the major technique employed in the aqueous concentration and purification of plutonium. Originally, the resin of choice was a gel-type Dowex* 1 × 4 (50-100 mesh),[4,28] which was used at Los Alamos and other sites for many years. However, Los Alamos now uses a macroporous resin in production-scale columns.[29]

* The Dow Chemical Co., Midland, MI 48640.

Nitrate anion exchange is an extremely powerful technique for recovering and separating plutonium from most of the elements in the periodic table. Figure 10 presents distribution coefficients for certain elements in a nitrate anion-exchange system operated at room temperature and using 7M $HNO_3$ and Dowex 1 x 4 (50-100 mesh) resin.[30] The hexanitrato complex, $Pu(NO_3)_6^{-2}$, formed by plutonium under these conditions results in the large distribution coefficient (Kd ~1000).[4] The $HNO_3$ concentration of the feed solution may vary depending upon the amount of nitrate salts present. The absorption of plutonium increases with increasing nitrate concentration at constant acidity. Aluminum will complex such anions as fluoride and oxalate,[4,25] which would normally complex the plutonium and prevent full plutonium absorption on the resin.[4,31] The plutonium must be in the IV state to form the hexanitrato complex and, as is well known, plutonium in aqueous solutions can exist in a multiplicity of the four possible valences. The potentials separating the oxidation states, although small, are sufficient to allow operators to obtain the desired oxidation state by a judicious selection of the sequence and type of reducing and oxidizing agents.

Ion-exchange operations may be conveniently divided into the following steps: (1) oxidation-state feed adjustment, (2) loading, (3) washing, (4) elution, and (5) readjustment of the column from the low-acid elution step to 7M $HNO_3$ in preparation for the next step.

Although plutonium operations have used many reducing and oxidizing agents, the major reagents used in production operations include hydroxylamine nitrate ($NH_2OH \cdot HNO_3$),[32] ferrous ammonium sulfate [$Fe(SO_4) \cdot (NH_4)_2SO_4 \cdot 6H_2O$] sodium nitrite ($NaNO_2$), urea [$CO(NH_2)_2$] and $H_2O_2$. Depending upon the processing history of the plutonium solution, the plutonium(VI) content may vary over a wide range. Generally speaking, solutions that have been boiled for extended periods (for example, recycle solutions from the production-scale thermosiphon evaporator) or solutions that have been maintained at less than 3M $HNO_3$ at elevated temperatures[33] tend to contain large amounts of plutonium(VI). Consequently, Los Alamos

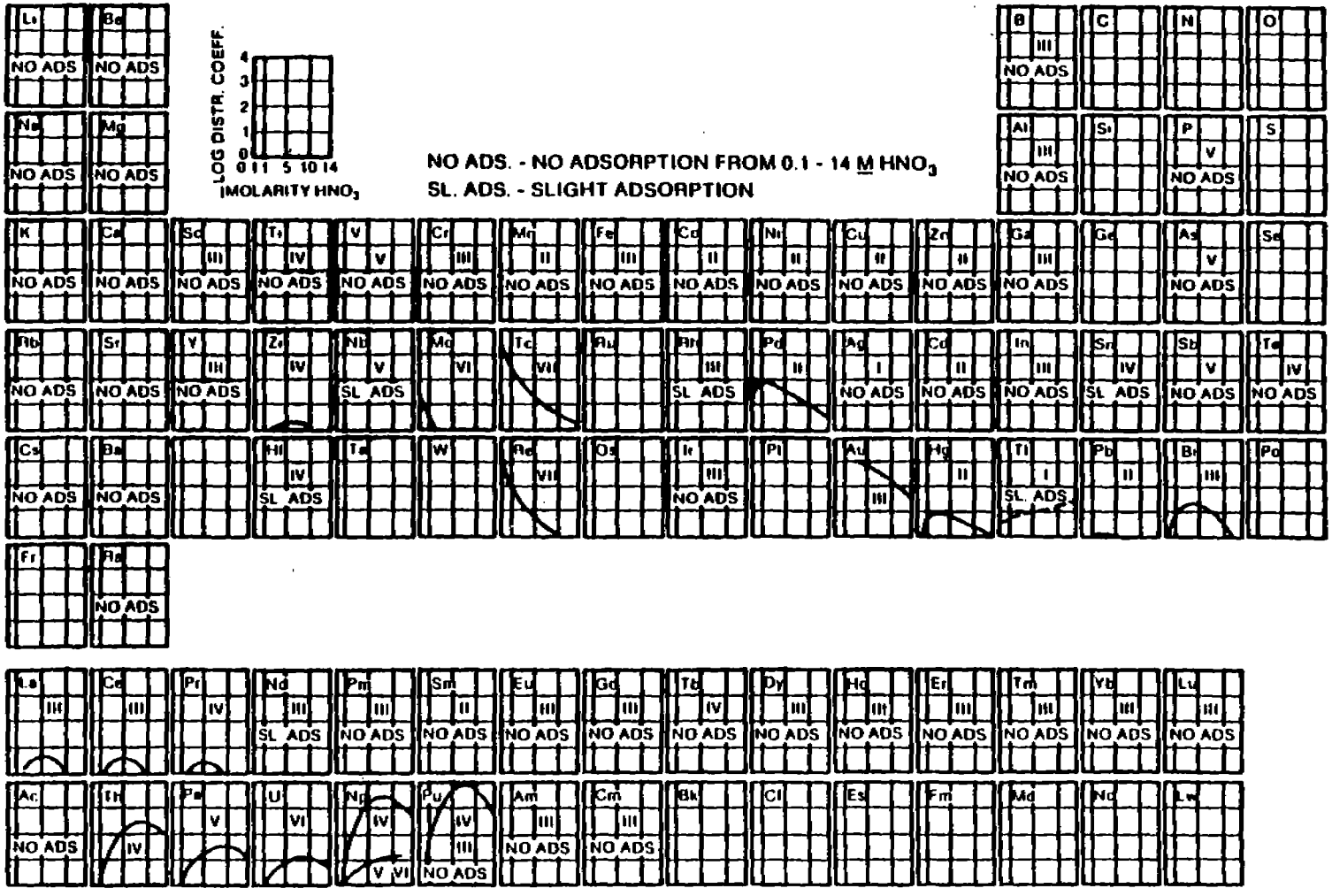



Fig. 10. Anion-exchange relative exchange efficiency.

uses two oxidation-state adjustment schemes, the full-reduction flow sheet and the partial-reduction flow sheet.

a. Valence and Feed Adjustment. For the solutions suspected of having large quantities of plutonium(VI) the full-reduction flow sheet is indicated (Fig. 11).[6] This flow sheet consists of the following steps:

1. Operators reduce the $H^+$ concentration to <3M to prevent a violent reaction. The addition of $CO(NH_2)_2$ before $NH_2OH \cdot HNO_3$ destroys the nitrite that would otherwise consume the reducing agent before it could react with the plutonium. Then technicians add 1.5 moles of $NH_2OH \cdot HNO_3$ per mole of plutonium.

2. The addition of $Fe(SO_4) \cdot (NH_4)_2SO_4 \cdot 6H_2O$ ensures the complete reduction of the plutonium(VI). The process requires a digestion period of at least 45 min.

3. The addition of $AL(NO_3)_3 \cdot 9H_2O$ enhances plutonium absorption by complexing the $F^-$ ion and increasing $NO_3^-$ concentration.

4. Operators add $NaNO_2$ to oxidize the plutonium(III) to plutonium(IV). The process requires a digestion period of at least 15 min to ensure complete oxidation.

5. Operators adjust the $HNO_3$ concentration to 7M by adding 15.6M $HNO_3$ and then feed the solution to the anion-exchange column.

This flow sheet is extremely effective in converting all plutonium to plutonium(IV). However, it adds relatively large amounts of salts and causes a significant volume increase.

For feed solutions containing a low concentration of plutonium(VI), the experimental partial reduction flow sheet discussed below may work successfully.

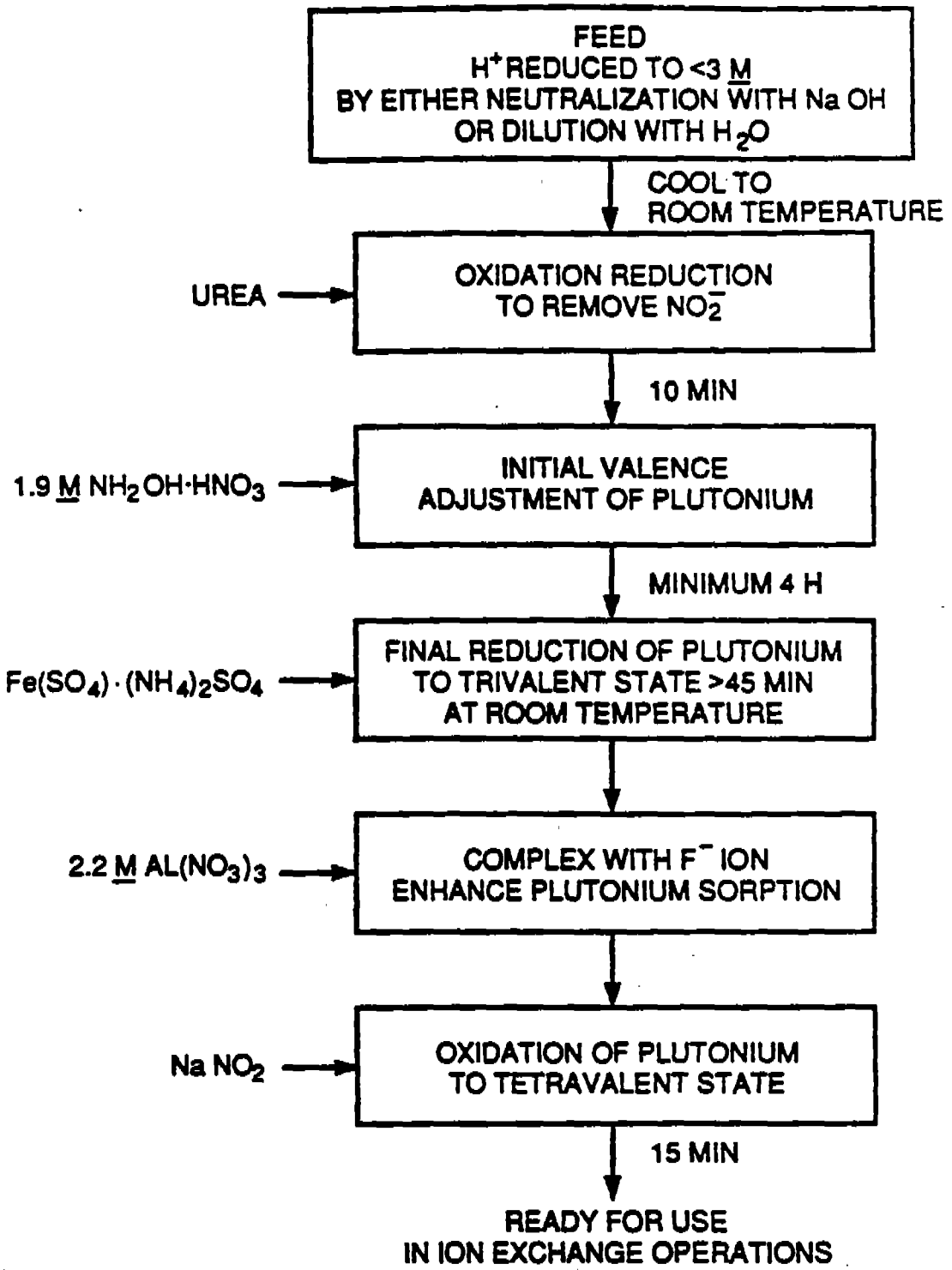



Fig. 11. Stabilization of plutnoium(IV).

1. In the past, $NaNO_2$ was added initially. However, researchers doubt its efficiency in the reduction of plutonium(VI) to plutonium(IV). Based on earlier work, current experiments by S. F. Marsh at Los Alamos involve the production-scale use of $H_2O_2$ as an agent for reducing plutonium(VI) to plutonium(IV).[34]

2. The addition of $Al(NO_3)_3$ complexes the $F^-$ ion.[4] S. F. Marsh has quantified this effect.[31]

3. Operators adjust the $HNO_3$ concentration to 7M.

4. Technicians load the treated feed solution on the anion-exchange resin bed.

b. Loading. Flow rates for feed solutions passing through the resin bed vary according to plutonium concentration. At Los Alamos, solutions containing up to 10 g Pu/ℓ are pumped through the bed at a rate of 60 ℓ/h. Recent work by Marsh[35] indicates that these flow rates may be increased by use of the new macroporous resin LEWATIT MP-500-FK.* For solutions containing >10 g Pu/ℓ, operators decrease the flow rate to 10 ℓ/h. A recently developed on-line gamma detector allows the constant monitoring of the behavior of uranium, plutonium, and americium during the process, and column breakthrough is readily identified.[36,37] Also, technicians can see the plutonium band through the glass column and can vary flow rates to meet the prevailing conditions. Scientists at Savannah River are also evaluating on-line passive gamma analyzers.[38]

c. Washing. After loading the plutonium on the resin bed, technicians wash the impurities from the bed using 7M $HNO_3$. The plutonium content of the wash requires most of this solution to be recycled. The fraction of

*Mobay Chemical Corporation, Pittsburgh, PA 15205.

impurity remaining on the column is a function of the wash volume. As a rule of thumb, elements having a distribution coefficient of zero can be washed from the resin bed with 1-2 column volumes (here defined as void volume) of 7M $HNO_3$. Elements having higher distribution coefficients exhibit a more complex behavior and several column volumes may be required for the wash, depending upon the element. Separation of elements such as thorium, neptunium, and the precious metals by standard flow sheets is relatively ineffective, and other separation techniques must be utilized.[4] However, thorium and neptunium can be absorbed on the resin if the plutonium is reduced to the III state by hydrazine/ferrous sulfamate using Savannah River techniques.[39] Note that these are guidelines only. For example, uranium has a Kd of approximately 15, yet operating experience at Los Alamos indicates that uranium is rather efficiently removed in most cases.

d. Elution. Following the washing of the impurities from the resin bed with 7M $HNO_3$, technicians pump 10 ℓ of 1M $HNO_3$ through the bed, thus reducing the acid concentration in preparation for the elution step. At Los Alamos, the addition of 10 ℓ of 0.3M $NH_2OH \cdot HNO_3$ reduces plutonium(IV) to the III state and elutes it from the column. The elution is completed using 0.3M $NH_2OH \cdot HNO_3$/0.5M $HNO_3$. The acid added to the second volume of eluate prevents polymer formation, but the acid is not necessary in the first volume of eluate because the residual $HNO_3$ in the resin bed keeps the acid concentration >0.5M.[4] At RFP, elution uses only low concentrations of $HNO_3$ that destroy the absorbed hexanitrato complex; however, experience at Los Alamos has shown that the increased rates and associated volumes are unacceptable from a production-volume standpoint for columns operated at room temperature. James[40] has described this low $HNO_3$ elution.

For safety, elution is done at room temperature at Los Alamos. Van Slyke[41] addresses some safety concerns of elevated-temperature column operation.

The $NH_2OH \cdot HNO_3$/plutonium(III) eluate at Los Alamos is suitable for plutonium(III) oxalate precipitation. The parameters are discussed in Section 2.a, the section on precipitations.

4. Chloride Operations. Chloride salts are a very important category of residues and are by-products from many pyrochemical operations. The pyrochemical chloride-based operations currently in operation include the following:

- DOR,
- ER,
- molten salt extraction (MSE), and
- pyroredox.

These chloride-based residues are especially challenging for aqueous recovery because of the difficulty of handling this material in stainless steel equipment. Los Alamos will soon install Kynar-lined glove boxes to monitor their behavior in production-scale operations. RFP has also had extensive experience in aqueous recovery of chloride-based residues.[42,43]

The pyrochemical conversion of $PuO_2$ to metal generates DOR residues.[15] This process utilizes a molten calcium chloride ($CaCl_2$) solvent and a calcium metal reductant and is described in more detail in Section III.B. The scrap consists of $CaCl_2$/CaO and may contain up to several percentage points of plutonium by weight, a percentage that depends on the type of oxide feed. Active oxides such as those resulting from the calcination and roasting of plutonium oxalate give yields up to 99%. Foundry oxides, which are less reactive, produce lower yields.

Los Alamos facilities have recovered plutonium from DOR salts using the chloride anion-exchange process (Fig. 12). The general flow scheme, presented below, is an outgrowth of research described by James[44] and Clifton.[45]

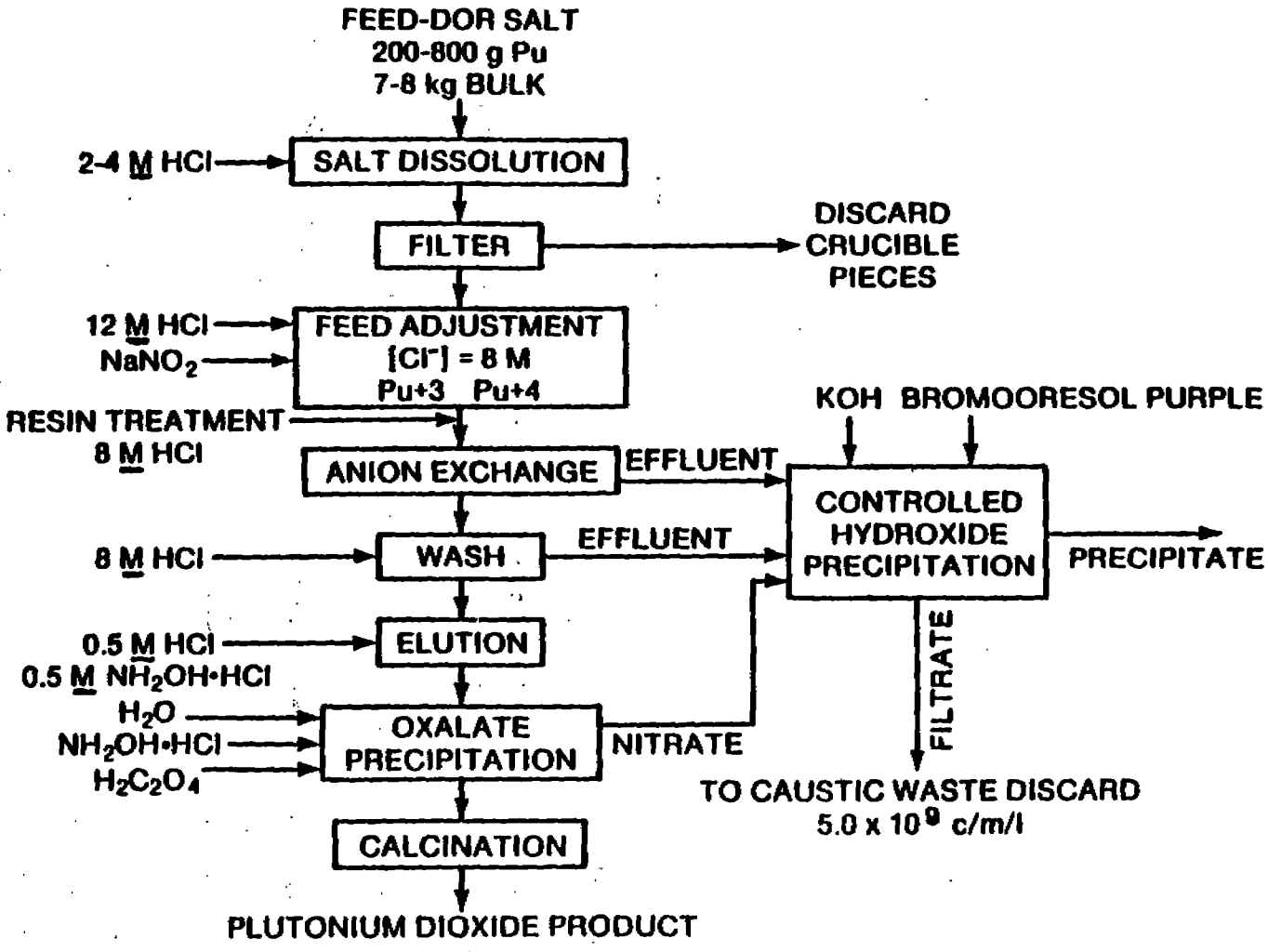



Fig. 12. Chloride anion exchange.

1. The salt is dissolved in a minimum amount of 2-4M HCl.

2. The addition of $NaNO_2$ stabilizes the plutonium in the IV state and the operator adjusts the chloride concentration to 8-10M and the $H^+$ concentration to 2M.

3. The feed solution then passes through a 6-in. by 24-in. glass column filled with chloride-form anion-exchange resin. The plutonium(IV) is absorbed on the resin.

4. The operator washes the impurities from the column with 8M HCl.

5. The plutonium is reduced to the III valence and is eluted from the resin bed with 0.5M HCl and 0.5M HCl/0.5M $NH_2OH \cdot HCl$.

6. The addition of solid oxalic acid precipitates the plutonium(III) from the eluate solution.

7. The operator collects the plutonium(III) oxalate by filtration, washes it with dilute HCl, and transfers it to a calcination vessel.

8. The oxalate cake is thermally converted to $PuO_2$ at 500°C for 5 h.

9. The chloride effluent undergoes a controlled hydroxide precipitation up to pH 7-8 in an attempt to reduce the amount of cations precipitating with the plutonium.

10. The operator discharges the hydroxide filtrate to the caustic-waste treatment area if discard limits are met.

11. The precipitate, depending upon plutonium content, is either dried and discarded or sent to the chloride head-end processing for recycle.

12. The filtrate from step 6 is reprocessed through steps 9-11.

13. The oxide generated by this process is then suitable for conversion to metal and purification by ER techniques.

The major process for the pyrochemical purification of impure plutonium metal is ER. The residues from ER are the anode heel, the solvent salt consisting of sodium chloride/potassium chloride (NaCl/KCl), and lesser amounts of plutonium, americium, and magnesium in the form of metals, oxides, and chlorides. Also, the MgO reaction crucible, which is mechanically broken at the completion of the ER cycle in order to recover the pure plutonium metal ring, is part of the ER residues requiring additional processing. A pyroredox operation can recover the plutonium from the spent anode heel. Also, the pyrochemical salt-stripping operation recovers a large portion of the ER salt residues. These residues are also recovered using aqueous techniques. Facilities often recover the spent anode using the flow sheet for impure plutonium metal. The anode heel can be oxidized in air to form impure $PuO_2$ and then purified using the standard nitrate flow sheet. Los Alamos has recovered ER salts using chloride anion exchange. The flow sheet is very similar to the one used for DOR salts. The MgO crucible fragments are leached in 6M HCl and can usually be discarded after one or two passes. The leachate can be handled by either the chloride anion-exchange or solvent-extraction flow sheets presented in this section.

A pyrochemical process for the rapid and economical extraction of very active metals from plutonium metal is MSE. Section III.C.3 gives more detailed information. It is primarily used for the efficient removal of $^{241}Am$, which is the radioactive decay product of $^{241}Pu$. This pyrochemical method uses magnesium chloride ($MgCl_2$) in equimolar NaCl/KCl to oxidize americium (and some plutonium), thus allowing it to extract into the salt phase. The very prevalent 60-keV gamma emission from the americium necessitates great care and extensive shielding for any glove-box hands-on

MSE salt-recovery operations. Where possible, operators should use remote control for recovery operations.

Recovering plutonium from MSE salts has involved either direct aqueous techniques or indirect techniques where a pyrochemical, aluminum reduction product of the plutonium, americium, and magnesium is then processed by aqueous methods. Los Alamos produced an experimental calcium reduction product that was subsequently processed by nitric dissolution and peroxide purification.[46] At RFP, the all-aqueous process for plutonium recovery from MSE salts consists of the following steps:

1. The salt is crushed and dissolved in a large volume of dilute HCl; this step is followed by absorption of plutonium and americium on a cation column and, finally, by column washing.

2. Technicians then elute the plutonium and americium with $HNO_3$. Following feed adjustment, the plutonium is absorbed on a nitrate anion-exchange column. The effluent, containing the americium, is concentrated for either waste-management disposal or subsequent recovery of the americium, depending upon the prevailing economic factors.

3. Operators elute the plutonium from the nitrate anion-exchange column and merge it with other fairly pure feed streams.

At Los Alamos, the first all-aqueous method for the MSE salts had to meet severe process-volume constraints for chloride solutions. Consequently, the Laboratory developed the following precipitation process.[47]

1. Technicians dissolve the salt in a minimal volume of 1M HCl.

2. The plutonium and americium are coprecipitated as their trivalent oxalates.

3. A controlled-pH hydroxide precipitation conducted on the oxalate filtrate results in minimal magnesium precipitation and a hydroxide filtrate that can be discarded.

4. Technicians filter and thoroughly wash the coprecipitated oxalates. This process is followed by thermal (350°C-500°C) conversion to mixed oxides, dissolution in $HNO_3$/HF, and distillation to remove chlorides and some acid.

5. The plutonium is purified by a peroxide precipitation that attains americium decontamination factors of 100 to 200.

6.An excess of NaOH destroys $H_2O_2$ in the peroxide filtrate. Operators reacidify the slurry and americium oxalate precipitates with about 10% of the precipitate being plutonium oxalate.

7. Thermal conversion of the dense and relatively easily handled americium-oxalate cake gives an impure oxide. This is a convenient form for either further purification or waste-management disposal.

Originally, steps 6 and 7 consisted solely of the hydroxide steps, but filtration problems and a low-density, gummy, hard-to-handle precipitate made the hydroxide/oxalate procedure attractive.

A recent process developed initially at Argonne National Laboratory and placed under further development at Los Alamos utilizes solvent extraction to immediately separate plutonium from the large amounts of americium and salts.[48]

1. After technicians dissolve the MSE salt in a small volume of dilute HCl, the plutonium is oxidized to the IV state and is extracted with TBP in tetrachloroethylene. This process is followed by a dilute HCl strip and plutonium oxalate precipitation.

2. Current development work involves extracting the americium from the TBP raffinate with carbamoylmethylphosphineoxide (CMPO) in tetrachloroethylene and stripping with dilute HCl/1M $H_2C_2O_4$. These steps are followed by an americium oxalate precipitation. Depending upon the market for americium, a simple oxalate precipitation on the TBP raffinate-may suffice for waste-management purposes.

Los Alamos is performing the extraction and stripping in centrifugal annular contactors (Fig. 13) designed by Argonne National Laboratory for the TRUEX process,[49,50,51] and built by Los Alamos using Hastelloy C* for corrosion resistance.

## B. Metal Preparation

A number of operations such as conversion to fluoride, oxide, or chloride can prepare plutonium metal from scrap or oxide.[52,53] The compound can then be reduced to metal, usually in an impure form. In pyrochemical operations, a series of processes changes this impure metal to high-purity metal. In this section, we describe operations now used to purify the material, the waste streams generated, and methods available to recover plutonium from the residues.

1. Fluorides. Reactive oxides formed by the calcination of oxalate or peroxide precipitates formed by the addition of oxalate and $H_2O_2$ to a suitable aqueous solution of plutonium(III) can be treated in a hydrofluorinator to form $PuF_4$.[54] In addition, $PuF_3$ can be precipitated

* Union Carbide Corporation, 270 Park Avenue, New York, NY 10017.

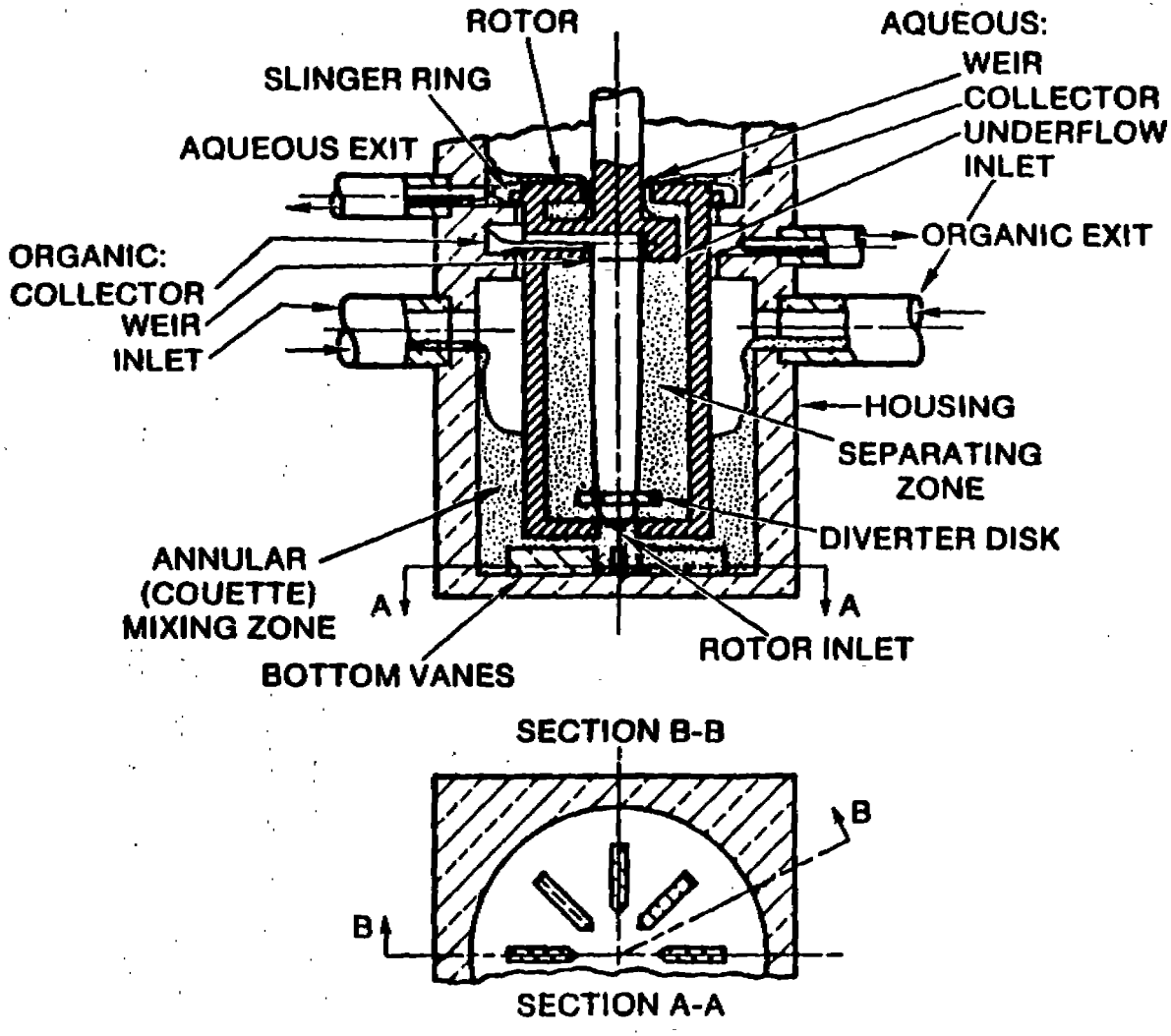



Fig. 13. Centrifugal annular contactors.

directly from nitrate solution through the reaction with HF. Controlled heating can then convert this $PuF_3$ to $PuF_4 \cdot PuO_2$. Mixing the $PuF_4$ or $PuF_4 \cdot PuO_2$ with calcium and heating it to reaction forms $CaF_2$ and metal plutonium. Quite often a booster (such as iodine) both initiates the reaction and provides sufficient energy to ensure the complete reaction:

$$PuO_2 + 4\ HF \rightarrow PuF_4 + 2\ H_2O \quad \text{and} \tag{2}$$

$$PuF_4 + 3Ca + I_2 \rightarrow Pu + 2\ CaF_2 + CaI_2\ . \tag{3}$$

This method of preparation does not produce any purification; however, it does not introduce impurities.[55] With a high-purity oxide such as that often produced by the PUREX process, the fluoride process can produce a metal that meets purity specifications for most applications. Wastes generated include MgO sand (which is added for heat transfer), $CaF_2$, and the MgO reaction crucible. As we stated earlier, these residues are treated by aqueous methods to recycle any plutonium. The subsequent wastes are discarded.

The major disadvantage of the process is the high neutron-radiation field from the $(\alpha,n)$ reaction, which constitutes a hazard to personnel.

2. Oxides. Most scrap containing plutonium can be converted to oxide by burning it at an elevated temperature in air. The oxide, if reactive, can then be converted to fluoride for reduction. However, unreactive or high-fired oxide does not react to form fluroide; instead the addition of a strong reducing agent in a solvent salt can reduce the oxide to metal.[55] The impure metal product forms a button in the bottom of the crucible that is covered by a fused oxide/salt layer. The reaction is

$$PuO_2 + n\ M^o \rightarrow Pu + M_nO_2\ (\text{salt}), \tag{4}$$

where $M^o$ is the reductant.

The salt acts as a heat sink and a solvent for the oxide of the reductant that forms during the reaction. The button can be separated mechanically from the salt. In DOR, one pass produces yields of up to 99%; the residue, under present criteria, is less than the EDL value and is discarded or placed in long-term storage.

3. Chlorides. Another alternative for treating plutonium oxides is to convert the oxide to chloride.[56] The synthesis of plutonium metal by bomb reduction of the trichloride with calcium metal and an iodine booster has, in fact, been demonstrated on the same scale as the fluoride reduction.[57] The reactions are

$$2\ PuO_2 + 3\ Cl_2 \rightarrow 2\ PuCl_3 + 2\ O_2 \quad \text{and} \tag{5}$$

$$2\ PuCl_3 + 3\ Ca \rightarrow 2\ Pu + 3\ CaCl_2\ . \tag{6}$$

$PuCl_3$ is extremely hygroscopic, and investigators have not solved the engineering problems associated with moisture. Furthermore, although the chloride process was initially proposed for converting oxide formed by direct calcination of $PuO_2(NO_3)_2 \cdot 6H_2O$ solutions to the chloride, the oxide was not active enough to promote the reaction.

The chloride, however, would decrease the neutron-radiation problem present with $PuF_4$. Engineering problems could be addressed from the 1980s materials position. Finally, the use of inert boxes could overcome the problem of the hydroscopic nature of the salt.

$PuCl_3$ could also be a good replacement for $MgCl_2$ in several steps of the integrated pyrochemical process. Its use would significantly decrease the introduction of magnesium into the metal stream.

4. Hydriding. Hydriding and dehydriding or hydriding followed by oxidation can recover plutonium metal scrap adhering to other metals.[58] Even at room temperature, plutonium reacts with hydrogen to form a metallike powder. The reaction is

$$2\ Pu + 3\ H_2 \rightarrow 2\ PuH_3\ . \qquad (7)$$

Heating the hydride in a vacuum removes the hydride powder from the inert substrate and recovers the plutonium metal. As an alternative, the hydride can be slowly oxidized in air to form the oxide by the reaction

$$4\ PuH_3 + 7\ O_2 \rightarrow 4\ PuO_2 + 6\ H_2O\ . \qquad (8)$$

The oxide can then be treated to recover metal.

5. Pyroredox. Pyroredox is a two-step process in which plutonium is initially oxidized to remove impurities less reactive than the oxiding agent. The plutonium is subsequently reduced back to metal, leaving impurities more reactive than the reducing agent in the salt phase.[59-61] The reactions are

$$Pu(0) + (Ox) \rightarrow Pu(III) + (Ox) \quad \text{and} \qquad (9)$$

$$Pu(III) + (Re) \rightarrow Pu(0) + (Re)\ , \qquad (10)$$

where (Ox) and (Re) are the oxidizing and reducing agents, respectively. Table I provides relative reactivities for estimating separation factors. The resulting metal contains impurities such as zinc, calcium, anda which can be removed by vacuum distillation, MSE, and metal liquidation.

TABLE I

FREE ENERGIES OF FORMATION OF CHLORIDES AT 1000 K

$-\Delta G_f^o$ (kcal/g-EQUIVALENT Cl)

| | | | |
|---|---|---|---|
| $BaCl_2$ | 83.4 | $CmCl_3$ | 58.8 |
| KCl | 81.4 | $PuCl_3$ | 58.5 |
| RbCl | 81.2 | $MgCl_2$ | 57.7 |
| $SrCl_2$ | 81.0 | $NpCl_3$ | 54.1 |
| CaCl | 80.0 | $UCl_3$ | 51.8 |
| $SmCl_2$ | 80.0 | $ZrCl_2$ | 49.2 |
| LiCl | 78.8 | $ClCl_2$ | 49.2 |
| $CaCl_2$ | 77.9 | $FeCl_2$ | 26.6 |
| NaCl | 75.7 | $NbCl_5$ | 24.6 |
| LaCl | 67.0 | $M_DCl_2$ | 8.0 |
| $PrCl_3$ | 66.3 | $TcCl_3$ | 7.0 |
| $CeCl_3$ | 66.3 | RhCl | 5.8 |
| $NdCl_3$ | 64.2 | $PdCl_2$ | 3.8 |
| $YCl_3$ | 61.2 | $RuCl_3$ | 1.4 |

The pyroredox process can upgrade lower-purity plutonium metal for further purification, usually by ER. The next section describes specific processes.[62]

C. Metal Purification

In this section we describe the integrated pyrochemical process to present a fairly systematic approach for recovering plutonium and for treatment of residues. Over the last six years, Los Alamos has produced significant quantities of high-purity metal from impure refractory oxides by this approach.[15,63] RFP conducts similar operations, and both the Atomic Weapons Establishment in the UK and Lawrence Livermore National Laboratory

plan to use this approach. A pyrochemical method is also proposed for recovering plutonium and uranium in the Integrated Fast Reactor (IFR) at Argonne National Laboratory. As part of the IFR program, Argonne is evaluating halide slagging and ER.

Figure 14 shows the present system at Los Alamos. The major processes are

- bomb reduction of $PuF_4$,
- DOR,
- MSE,
- anode casting, and
- ER.

As the figure shows, each operation produces residues that are treated either by pyrochemical or aqueous means to recover plutonium. We will discuss the pyrochemical processes in detail.

1. Metal Preparation Line (MPL). The MPL produces plutonium metal from $PuF_4$ by the high-pressure reaction between the fluoride and calcium metal.[13] After fluorination of oxide, a booster, such as iodine, initiates the second reaction:

$$PuO_2 + 4\ HF \rightarrow PuF_4 + 2\ H_2O \quad \text{and} \tag{11}$$

$$PuF_4 + 3Ca + I_2 \rightarrow Pu + 2CaF_2 + CaI_2\ . \tag{12}$$

Figure 15 shows the reduction furnace. The action of HF converts plutonium peroxide, oxalate, or a low-fired (under 800°C) oxide to fluroide. About 2 kg of the tetrafluoride, calcium metal, and magnesia slag are thoroughly mixed in a molded, open-porosity magnesia crucible. Iodine, added before the equipment is assembled and heated, acts as an initiator and reaction booster. At approximately 325°C, calcium and iodine react exothermally to rapidly raise the temperature. At 600°C the reduction of tetrafluoride begins and, with reaction, the system temperature rises rapidly to nearly 2000°C. The slag remains molten while the molten plutonium sinks to the

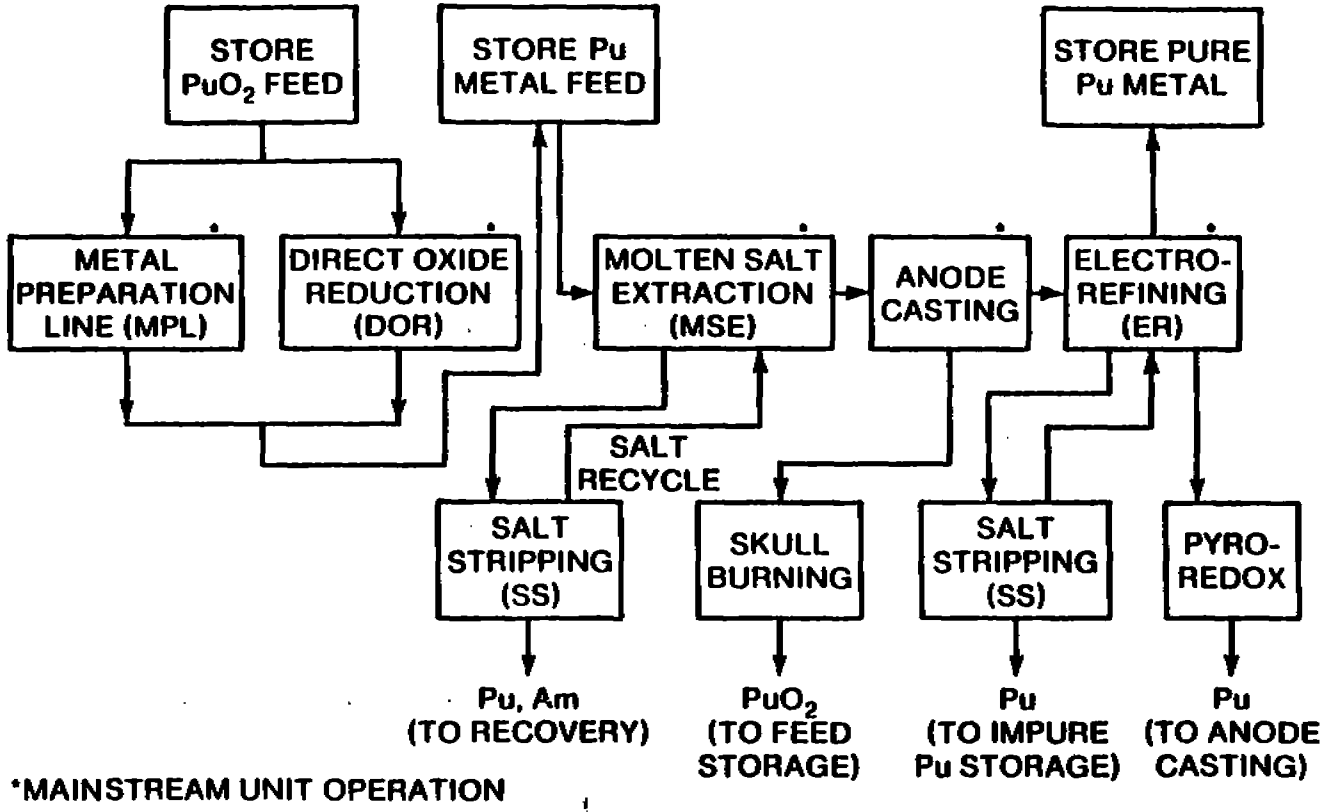



Fig. 14. Integrated pyrochemical processing system.

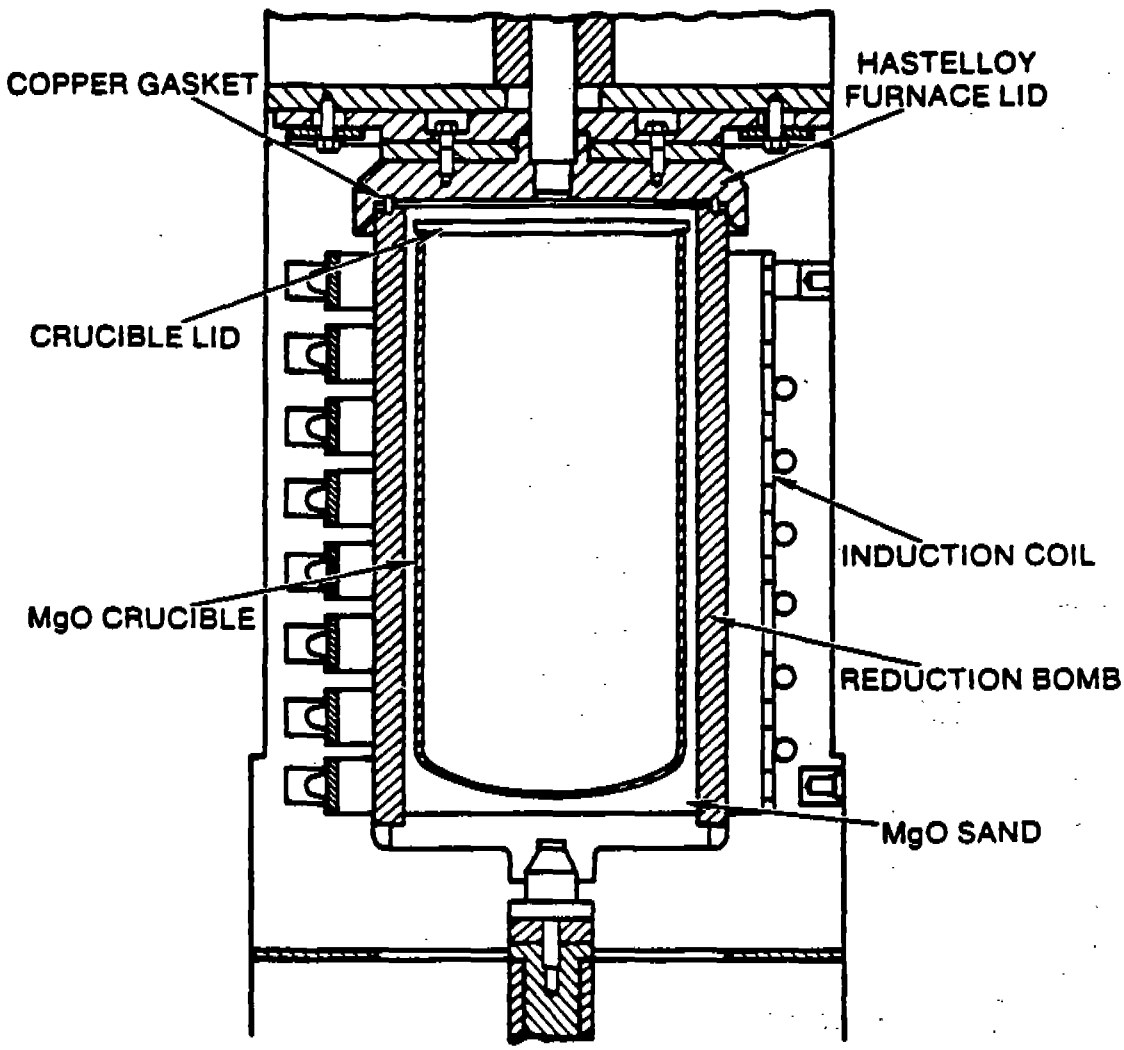



Fig. 15. Los Alamos $PuF_4$ reduction furnace.

bottom of the crucible and solidifies. After the equipment has cooled, technicians disassemble it and break the crucible to recover the metal button (which is mechanically separated from the slag).[63]

The waste streams are slag ($CaF_2$-$CaCl_2$), crucible, and magnesia sand. Aqueous processing recovers any plutonium in the slag or crucible, and the sand is reused. During fluorination, the off-gases are scrubbed with potassium hydroxide solution, which is tested for plutonium content and transferred to waste management when either it is exhausted chemically or its plutonium concentration reaches the discard limit.

Little or no purification occurs during the process, and the metal purity is similar to that of the feed material.[52] However, reagents introduce no impurities and, if sufficiently pure feed is used, the resulting metal is satisfactory for high-purity applications. Yields usually range from 97% to 99%.[14]

In a similar process at Savannah River, a mixture of 25 mol% $PuO_2$ and $PuF_4$ is the feed, and yields range from 95% to 99%.[64]

2. Direct Oxide Reduction (DOR). All oxide for the DOR process is calcined at 800°C, sampled, and transferred into the DOR processing area.[63] Technicians place up to 1 kg of oxide in a magnesia crucible with 5 kg of fused $CaCl_2$ and add a charge of calcium (50% calculated excess).[65] Figure 16 shows the equipment. The standard reaction vessel is vitrified magnesia, although some development work has investigated the use of tungsten or tantalum. For the magnesia reaction vessel, each reduction requires a new crucible, and holdup is minimized. The $CaCl_2$ salt can be replaced with a lower melting eutectic, $CaCl_2$ 26 mol% $CaF_2$, for the heat sink and solvent.[66] This replacement might reduce any side reaction of calcium with the magnesia crucible. In experiments at Los Alamos, investigators found no marked advantages with the eutectic and, in fact, high-melting salts apparently formed during eutectic preparation.

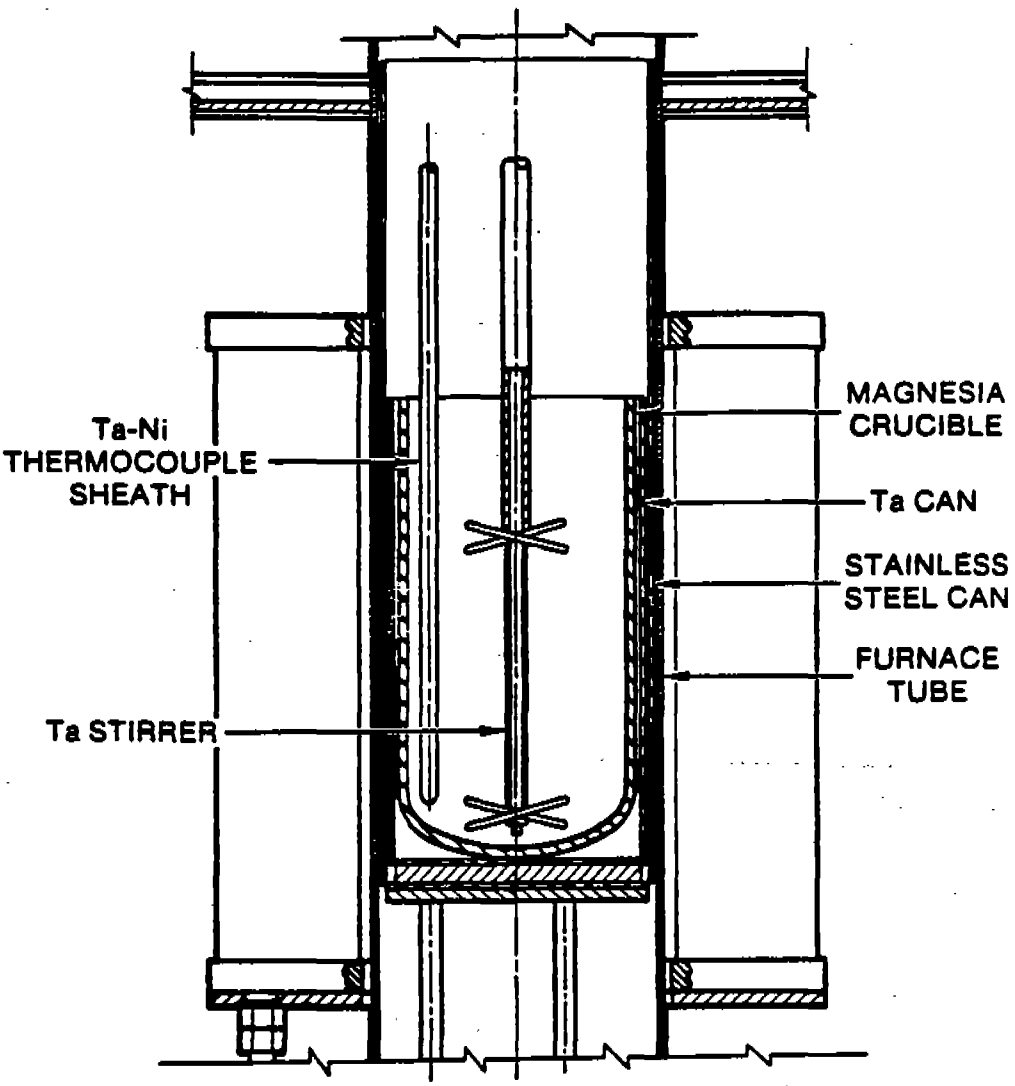



Fig. 16. DOR equipment.

Development work in this area continues at both Lawrence Livermore National Laboratory and Los Alamos National Laboratory.

The $CaCl_2$ is cast before use and contains no detectable water. However, the reduction transfers small amounts (parts per million [ppm]) of impurities from salt to the plutonium metal. The resulting metal is almost always more impure than the oxide from which it is formed. Efforts to produce high-purity metal by using purified reagents have not been successful, and facilities must further process metal formed by DOR to meet purity specifications.

Typically, the reaction begins at about 820°C with a temperature spike to 875°C. Reaction is complete within 15 min. The overall chemical reaction is

$$PuO_2 + 2\ Ca = Pu + 2\ CaO\ , \qquad (13)$$

and the free energy of formation ($\Delta F$) is estimated at -44.3 kcal at 1000°C.[55] The reaction proceeds to completion when excess calcium is present, sufficient $CaCl_2$ is available to dissolve the CaO that is produced, and rapid stirring is applied.

The reaction vessel cools until the products solidify. Almost all the plutonium forms a button at the bottom of the crucible. The salt immediately above the button contains a layer of metal shot, and the bulk of the salt solidifies above the metal. Technicians mechanically separate the button and recover the shot by reheating the shot-rich layer (usually with calcium present) above the melting point to consolidate the metal. Product yields are greater than 95%.[15] The metal phase contains significant impurities, as Table II shows. Both the spent salt and calcium are sufficiently low in plutonium to be discarded under present waste-management practices. However, the salt is by far the largest waste

TABLE II

REDUCTION OF "PURE" PLUTONIA TO METAL BY DOR

Concentration of Impurity (g Element/$10^6$ g of Sample)

| | | | Run 1 | | Run 2 | |
|---|---|---|---|---|---|---|
| Element | $CaCl_2$ | Ca | $PuO_2$ | Pu | $PuO_2$ | Pu |
| Li | 200 | <10 | <1 | 40 | <1 | <1 |
| Be | <1 | <5 | <1 | <1 | <1 | 50 |
| B | 90 | <5 | 2 | <1 | 3 | 50 |
| Na | 6,000 | <35 | 7 | 40 | 5 | 20 |
| Mg | 200 | 4,000 | <1 | 1 | < | 1,000 |
| Al | 30 | <10 | <5 | 60 | <5 | 100 |
| Si | 175 | <5 | < | 150 | <5 | 280 |
| K | 16,000 | <350 | 15 | <10 | 40 | 30 |
| Ca | - | - | 80 | 1,000 | 500 | 3,000 |
| Cr | 4 | <10 | <5 | <5 | <5 | 25 |
| Mn | <3 | 5 | 2 | 1 | <1 | 1 |
| Ni | 3 | 14 | <5 | 15 | <5 | 15 |
| Sr | 6,000 | 700 | <5 | 5 | <5 | <5 |
| Ag | <1 | <5 | <1 | 5 | <1 | 15 |
| Ta | <100 | <1,000 | <100 | <100 | <100 | <100 |
| Fe | 55 | <10 | 110 | 175 | 75 | 65 |
| Ga | <3 | <10 | 2 | 100 | 5 | 4 |
| U | - | <10 | 30 | 40 | 30 | 25 |
| C | - | 110 | - | 190 | 15 | 590 |
| Pu(wt%) | - | - | 87.80 | 99.66 | 88.20 | 99.64 |

generated during the integrated process and is a promising candidate for recycle.[65]

3. Molten Salt Extraction (MSE). The MSE process separates the more-reactive elements, such as americium, rare earths, alkali metals, and alkaline earth metals, from plutonium.[59,67,68] Technicians place a ternary salt, consisting of an oxidizing agent and a salt eutectic, in contact with the impure metal. This process is the first step at RFP in extracting americium from kilogram quantities of plutonium. Los Alamos employs the process only if the americium content is greater than 1000 ppm. Other processing sites may apply other criteria. The oxidizing agent is $MgCl_2$ contained in a NaCl/KCl eutectic. The major reactions are[69,70]

$$2\ Am + 3\ MgCl_2 = 2\ AmCl_3 + 3\ Mg\ , \qquad (14)$$

$$2\ Pu + 3\ MgCl_2 = 2\ PuCl_3 + 3\ Mg, \quad \text{and} \qquad (15)$$

$$Am + PuCl_3 = AmCl_3 + Pu\ . \qquad (16)$$

The americium and plutonium contents in the salt depend on the amount of oxidant added, the concentrations of the elements in the feed, the temperature, the number of contacting stages, and the mode of operation. Under the process conditions at Los Alamos, as much as 90% of the americium and 10% of the plutonium are transferred from the feed into the salt.[63] The process equipment is very similar to that used in DOR (Fig. 16), but a reusable tantalum vessel replaces the magnesia crucible. The batch size is 4.5 kg with a 12-h temperature cycle to 750°C. (The actual reaction time is only 30 min.) After the equipment has cooled to room temperature, technicians remove the fused salt and metal button from the crucible and separate them. Usually each feed button goes through two batch extractions.

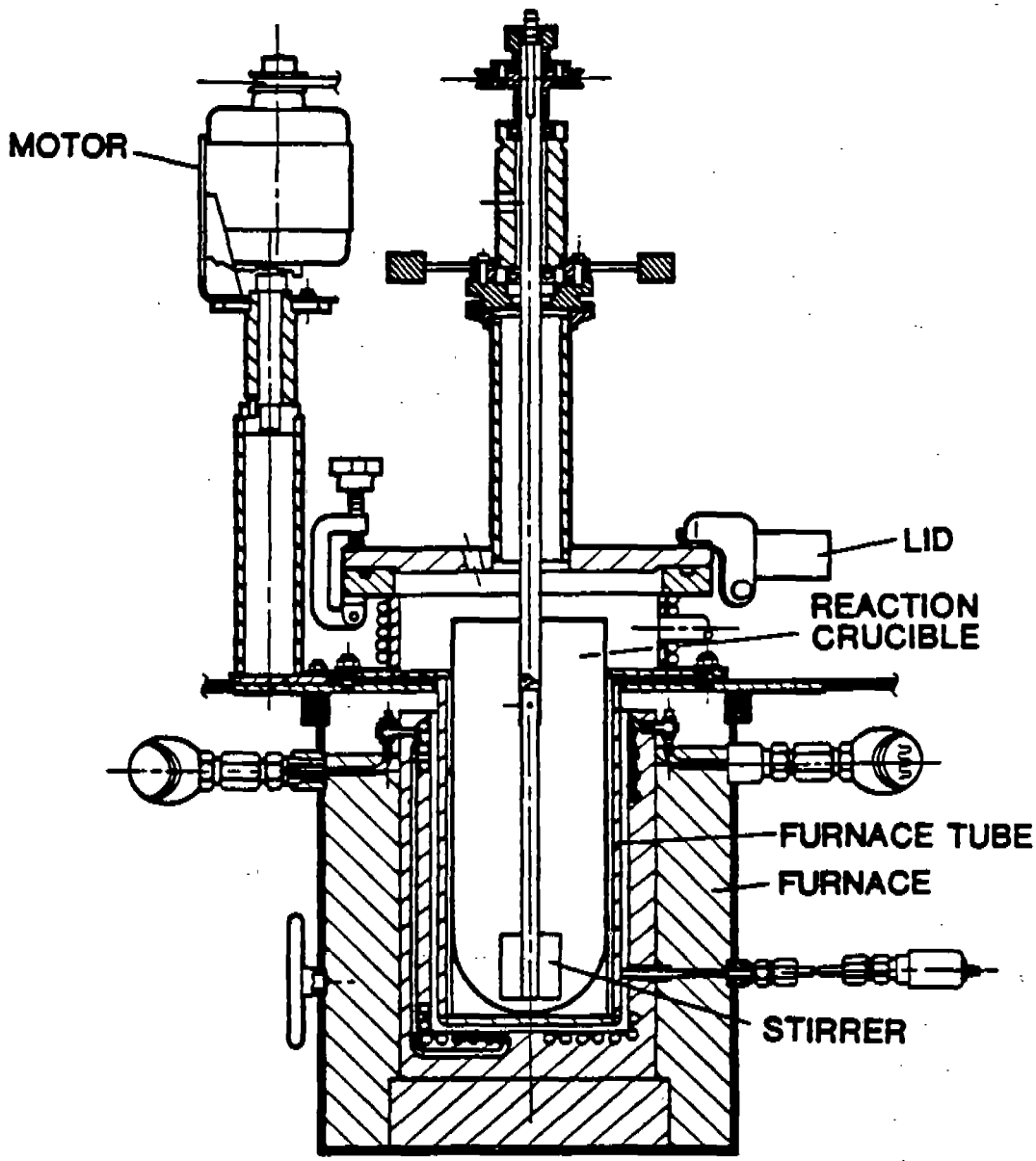



Fig. 17. RFP MSE equipment.

In the RFP procedure, workers load 2.2 kg of impure plutonium metal into a tantalum crucible with a NaCl/KCl eutectic containing $MgCl_2$ as a reducing agent.[71] Figure 17 shows the reaction cell. The salt moves through two extraction stages countercurrent to the flow of the metal in two batch operations.[67]

In both the Los Alamos and RFP processes, the final metal product is free of significant quantities of americium. Yields are satisfactory, reaching more than 95% in the two-stage countercurrent process. At present, Los Alamos recovers the salt residue by aqueous processing. RFP combines the plutonium with aluminum in a metal alloy and transfers it to the Savannah River Plant for aqueous reprocessing.[71] The high americium content in the spent salt is a potential radiation hazard that is presently minimized by using lead shielding and limiting operator exposure times. Studies of pyrochemical methods of recovery of both plutonium and americium from the spent salt have been proposed, and the possibilities are being examined.

4. Vacuum Melting and Casting. Technicians shape the impure metal button from DOR or MSE into a right circular cylinder 7 cm in diameter and 10 cm long to properly fit into the ER cell.[72] The addition of sufficient gallium ensures a critically safe geometry. Casting is accomplished by mixing about 6 kg of impure metal with gallium in a tantalum pour crucible and inductively heating the system to 800°C under vacuum. Figure 18 shows the apparatus. The metal and gallium mix upon melting and are bottom-poured from a tantalum crucible (Fig. 19) into a graphite mold.

Molten plutonium is very reactive, and the reaction

$$10\ Pu(l) + 3\ Ta_2O_5(s) \rightarrow 5\ Pu_2O_3(s) + 6\ Ta \qquad (17)$$

probably occurs during heating.[70] The oxide, however, forms a protective coating on the crucible walls and prevents further reaction.[73,74]

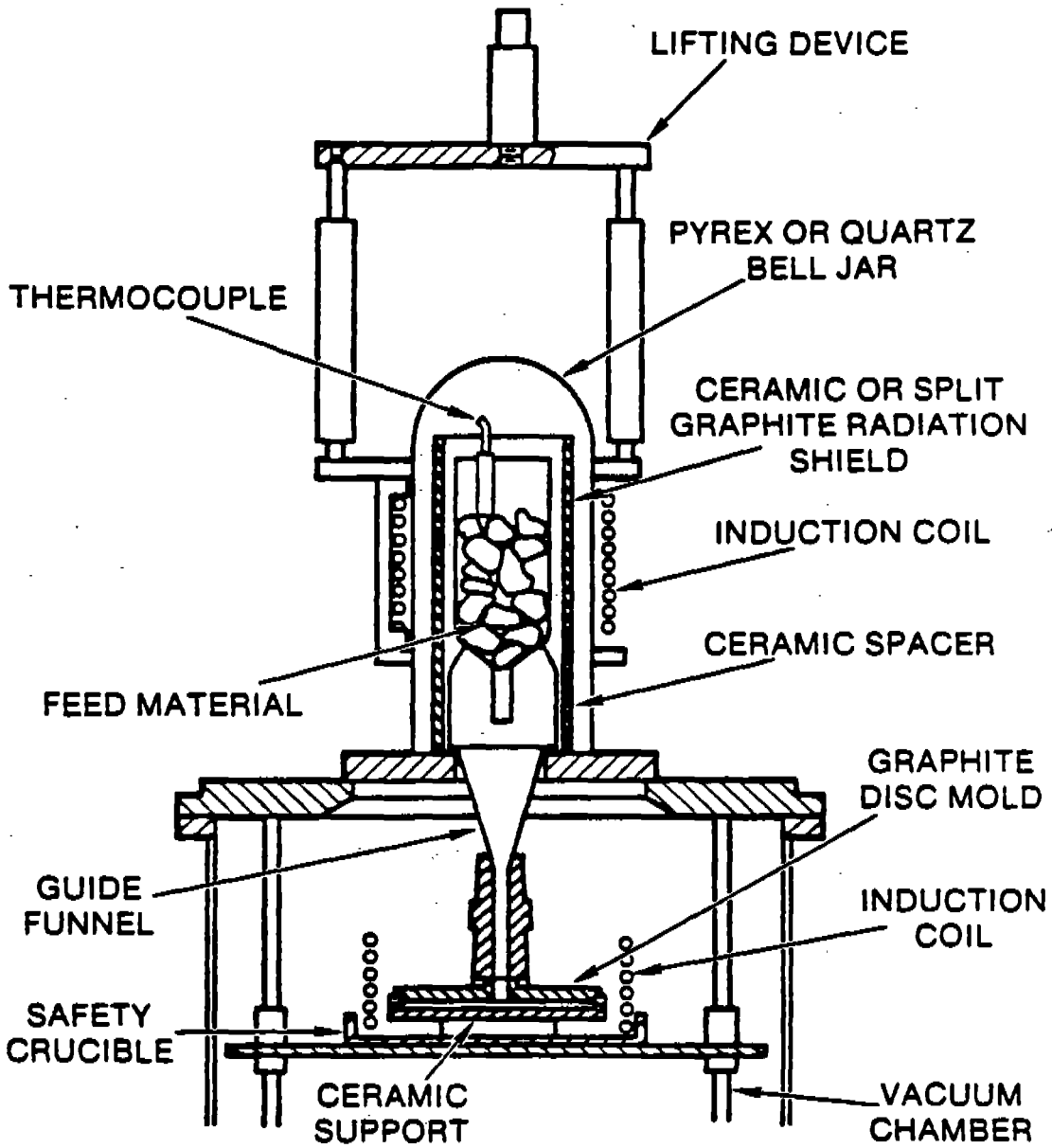



Fig. 18. Los Alamos vacuum casting equipment.

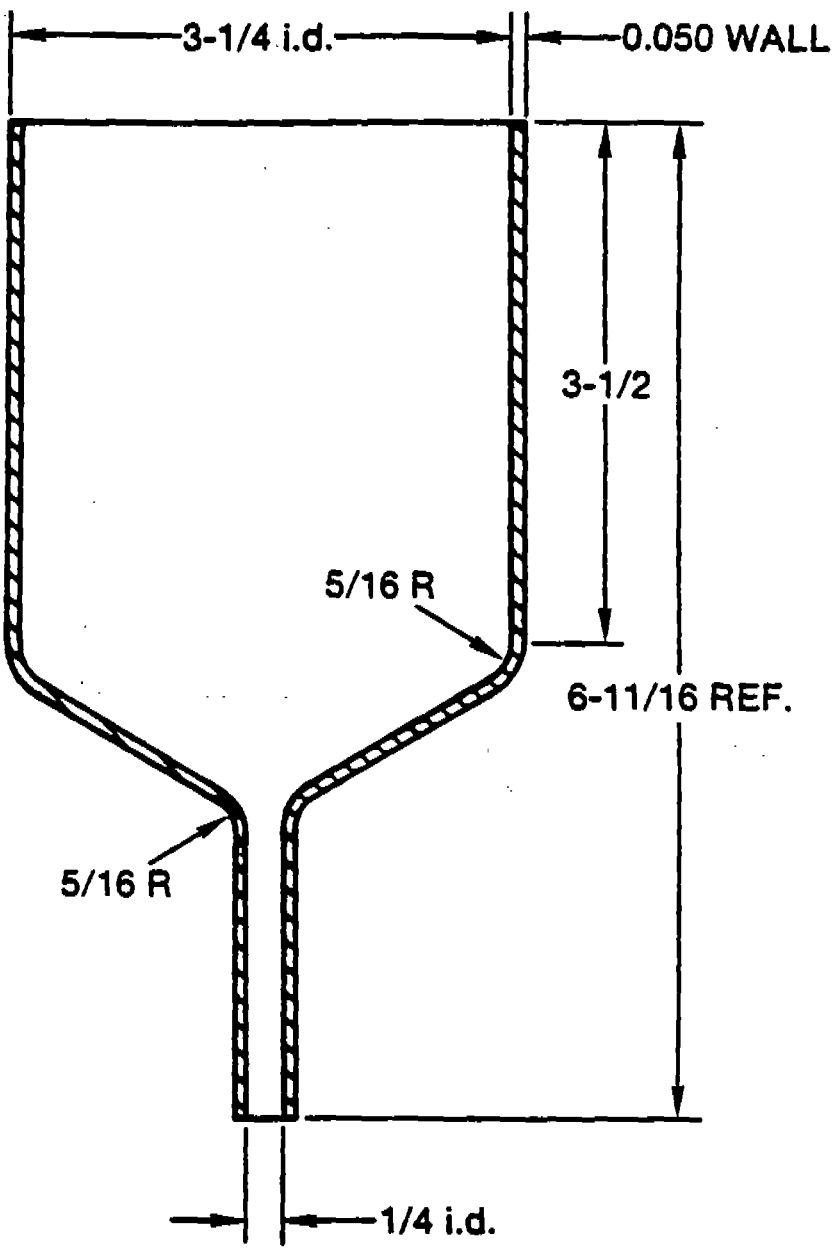



Fig. 19. Bottom-pour tantalum melt crucible.

Vacuum melting conditions may cause partial volitalization of metallic impurities such as sodium, calcium, and magnesium. Pouring releases more of the magnesium and calcium, which form a dark coating on the sides of the quartz envelope. Thorium, americium, alkali metals, and alkaline-earth and rare-earth metals tend to oxidize preferentially and concentrate in the casting residue (skull).[75] Insoluble impurities (oxides, carbides, and some metals) will float on the melt surface and generally remain in the crucible.[68]

Figure 20 shows a typical ingot. Yields are quite high, averaging over 90%. Impurity levels decrease during casting as shown in Table III, which summarizes high-purity casting feed. A casting residue always forms. It is burned in air, and the resulting oxide is rerouted either to DOR or to an aqueous process.

5. Electrorefining (ER). The major process for purifying impure plutonium at Los Alamos is ER. Liquid plutonium oxidizes from the anode into a molten-salt electrolyte. The plutonium ion is transported through the salt to the cathode, where it is reduced to metal. The reactors are

$$\text{anode} : \text{Pu(impure,l)} = \text{Pu}^{+3} + 3\ e^{-} , \tag{18}$$

$$\text{cathode:}\ \text{Pu}^{+3} + 3\ e^{-} = \text{Pu (pure,l)}, \text{ and} \tag{19}$$

$$\text{overall:}\ \text{Pu(impure,l)} = \text{Pu (pure,l)} . \tag{20}$$

The process produces extremely pure metal if the current is sufficiently low and if the process is terminated while plutonium is still the reacting species. Yields depend upon the purity of the feed metal; Los Alamos specifies the plutonium content of anode metal to be greater than 95% to ensure satisfactory results.

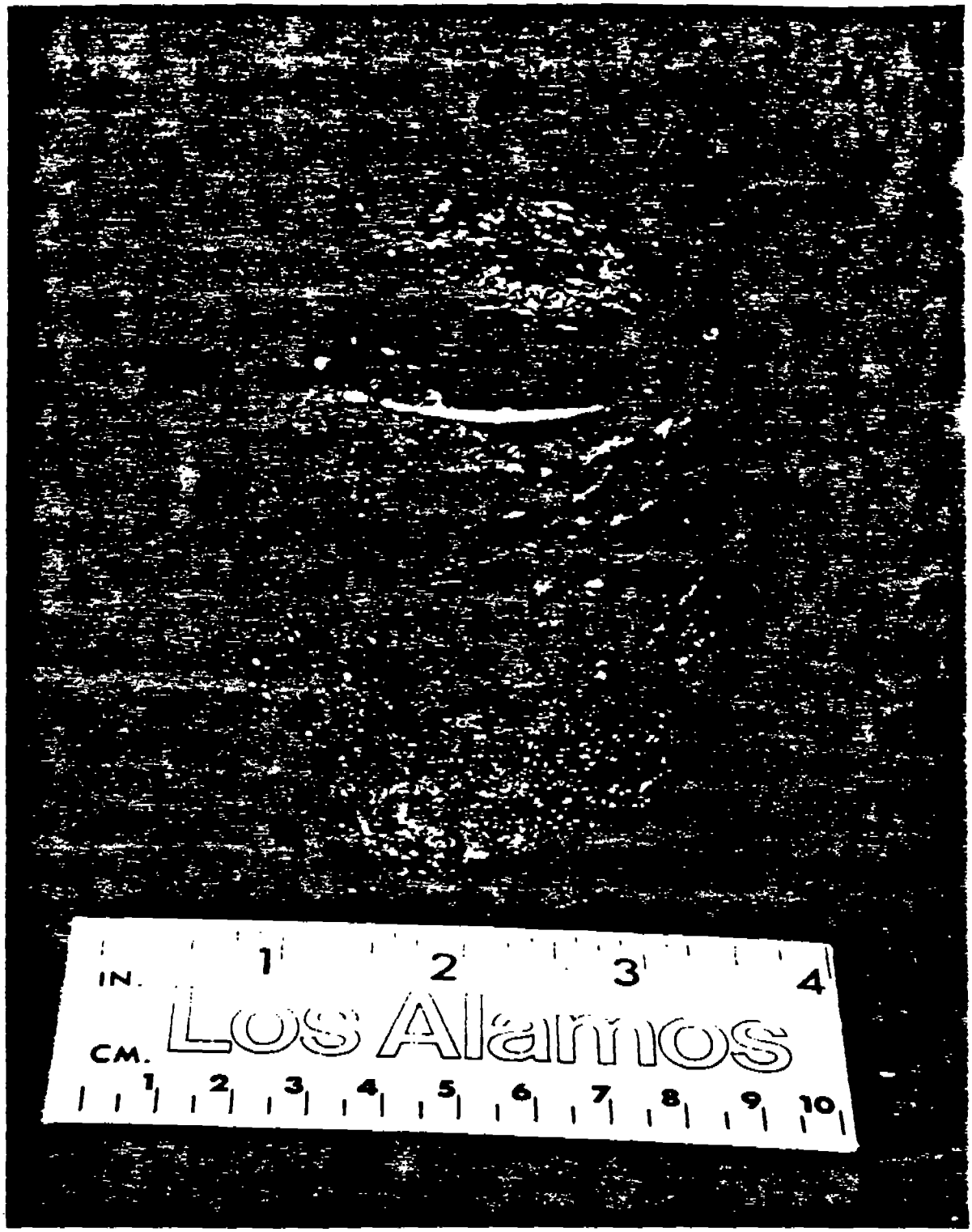



Fig. 20. Ingot from vacuum casting.

## TABLE III

### IMPURITY LEVELS IN HIGH-PURITY CASTING FEED AND CAST PARTS

| | Metal Feed, Parts per Million | | | Cast Part, Parts per Million | | |
|---|---|---|---|---|---|---|
| Element | High | Low | Most Frequent | High | Low | Most Frequent |
| Na | 5 | ≤1 | ≤2 | 1 | ≤1 | ≤1 |
| Ca | 10 | ≤2 | ≤3 | 10 | ≤1 | ≤1 |
| Mg | 8 | 2 | ≤5 | ≤5 | ≤2 | ≤2 |
| F | - | 2 | - | 5 | ≤2 | ≤2 |
| Al | 10 | ≤2 | ≤5 | 8 | ≤2 | 5 |
| Si | 15 | ≤5 | 8 | 10 | ≤1 | ≤5 |
| Pb | 2 | ≤0.5 | ≤1 | 2 | ≤0.5 | ≤0.5 |
| Cu | 2 | ≤0.5 | ≤1 | 5 | ≤1 | ≤1 |
| Sn | 2 | ≤1 | ≤1 | 2 | ≤0.5 | ≤0.5 |
| Cr | 2 | ≤1 | ≤1 | 2 | ≤1 | ≤1 |
| Mn | ≤1 | ≤0.5 | ≤0.5 | 1 | ≤0.5 | 0.5 |
| Zn | - | - | ≤10 | - | - | ≤5 |
| Zr | - | - | ≤10 | - | - | ≤0.1 |
| Mo | - | - | ≤0.5 | - | - | ≤0.5 |
| Th | 8 | ≤0.5 | 5 | - | - | ≤2 |
| U | 20 | 4 | 12 | 29 | 10 | 12 |
| Ta | 20 | ≤5 | 10 | 20 | ≤5 | 10 |
| W* | 80 | 50 | 65 | 90 | 40 | 65 |
| Ga | ≤2 | ≤0.2 | ≤0.5 | ≤2 | ≤0.2 | ≤0.5 |
| Ni | 5 | ≤0.5 | ≤0.5 | ≤5 | ≤0.5 | ≤5 |
| Fe | 20 | ≤2 | ≤5 | 20 | ≤2 | ≤5 |
| C | 50 | ≤10 | 20 | 40 | ≤10 | 10 |
| O | 40 | 10 | 20 | 40 | 10 | 15 |
| H | 35 | 5 | 10 | 20 | ≤5 | 10 |
| N | - | - | ≤10 | 6 | ≤1 | 5 |
| Am | (varies with feed) | | | | | |
| Pu | (weight difference) | | 99.985% | | | 99.985% |

Elements below detectable limits.

| | | | | | |
|---|---|---|---|---|---|
| Li | ≤0.005 ppm | Bi | ≤0.5 | Y | ≤0.1 |
| Be | ≤0.1 | K | ≤0.5 | Cs | ≤2 |
| B | ≤0.3 | Ti | ≤0.2 | Ba | ≤0.1 |
| Co | ≤0.5 | V | ≤0.5 | Hf | ≤0.5 |
| Cd | ≤0.5 | Rb | ≤0.5 | Re | ≤0.5 |
| La | ≤1 | Sr | ≤0.1 | | |

*Can be reduced to ≤2.5 ppm with more expensive TaC cathode.

Figures 21 and 22 show the Los Alamos ER reaction cell and equipment.[76] Two concentric magnesia crucibles joined at the base form the cell. In typical operations, technicians place 4-6 kg of impure plutonium metal in the inner crucible and add an equimolar mixture of NaCl/KCl containing 5 wt.% magnesium as an oxidant. This operation produces plutonium(III) in the electrolyte before a current is passed and assures the initial reduction of plutonium at the cathode. Workers assemble the cell in a stainless steel furnace tube, evacuated it, and back-fill it with argon. They then heat the cell to 740°C and lower the stirrer, anode, and cathode into the position shown in the figure. Direct current is passed through the cell and the solution is stirred until the plutonium is no longer the primary ion being formed at the anode. An increase in the static-cell potential, measured by a back emf sampling unit, indicates this event.[77] At a preset potential, the current automatically terminates and an operator withdraws the hardware from the melt. The operator turns off the heat, and the system cools to room temperature. The ceramic crucibles are broken to recover the salt, which is a primary residue, and the metal product. A technician mechanically separates the product ring, shown in Fig. 23, from the salt, samples it, and transfers it for future use.

The purity of typical product is greater than 99.95% plutonium.[78] Table IV gives the purities typically obtained for production runs. The elements less active than plutonium remain in the anode, along with a metal heel, to form the spent anode residue, which contains up to 10% of the feed metal. The residue is treated by pyroredox to recover the plutonium.

Figure 24 shows an alternative ER cell developed first at Argonne National Laboratory and later demonstrated at RFP.[71] Its design minimizes crucible breakage and cooling times in production runs.

The major residues in the process are the anode heel, the electrolyte, and metal trapped on the crucible, stirrer electrodes, and thermocouple well. These can be recovered by a number of aqueous and pyrochemical processes.[62,79-81]

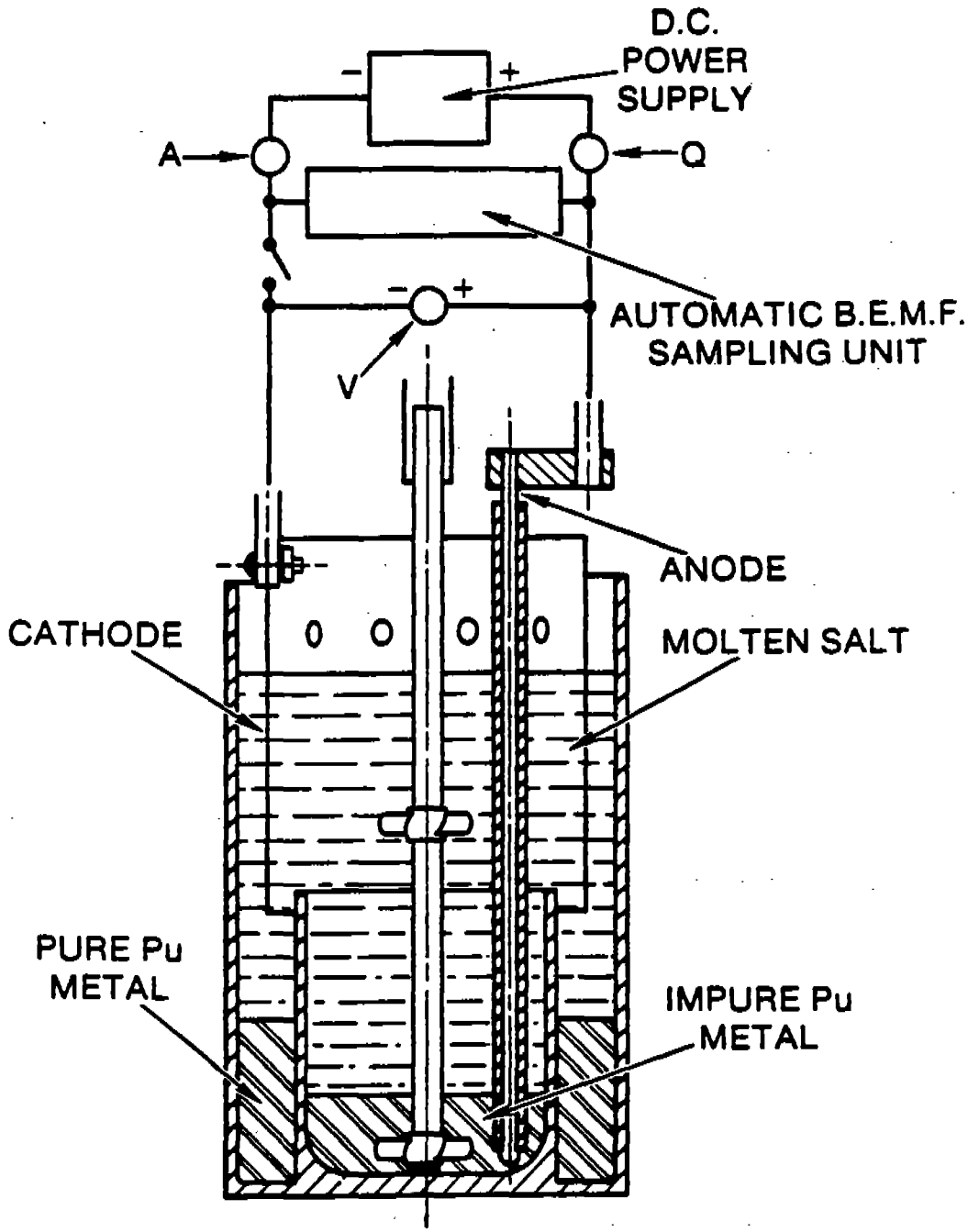



Fig. 21. Los Alamos ER cell.

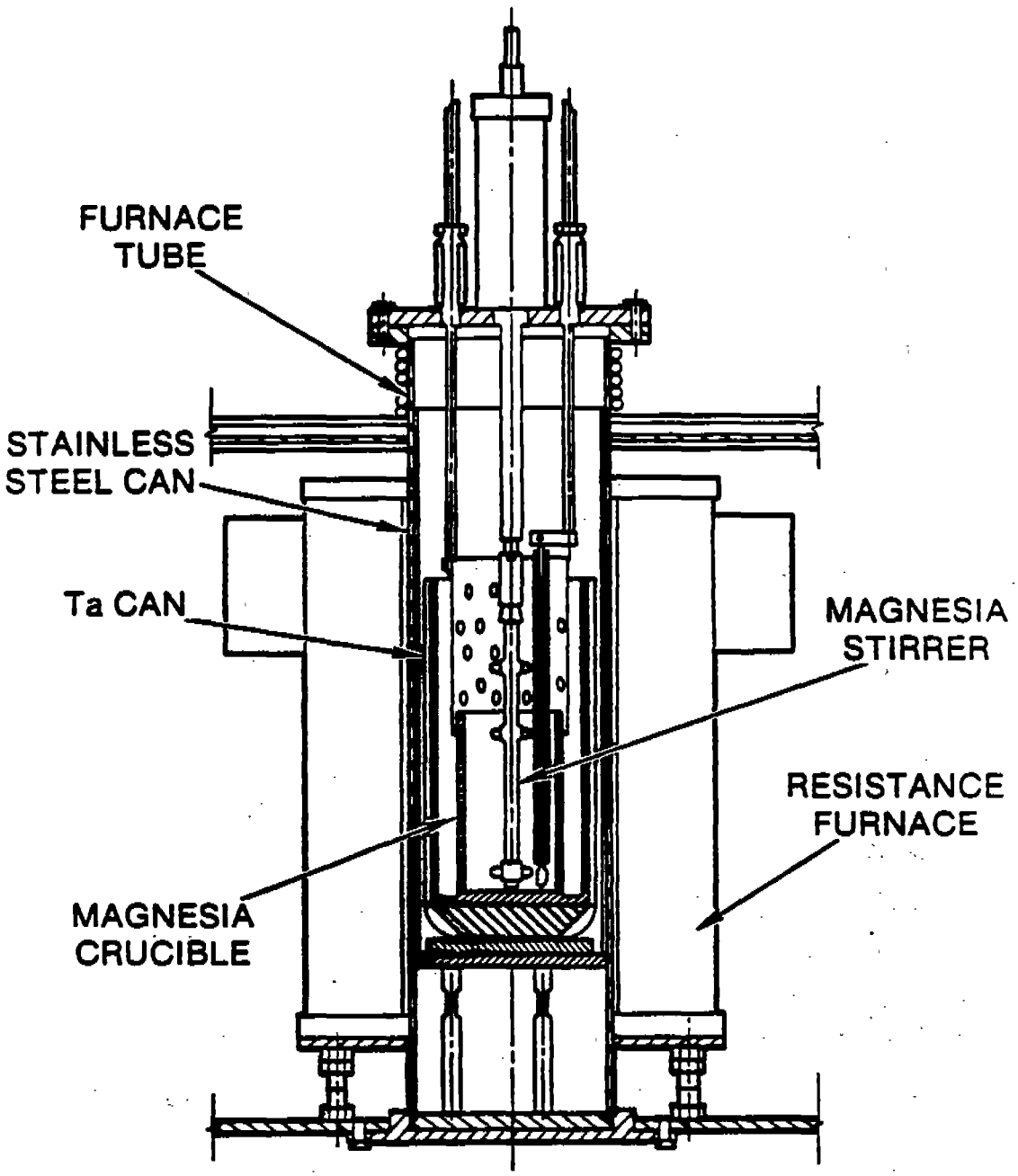



Fig. 22. ER equipment, 6-kg scale.



Fig. 23. Plutonium product ring from ER.

TABLE IV

BEHAVIOR OF IMPURITY ELEMENTS IN ER

| | Concentration (g Element/ $10^6$ g Pu) | | Location Where Element Is Concentrated |
|---|---|---|---|
| Element | Feed | Product | |
| Ir | 4,500 | 100 | --- |
| Ni | 1,000 | <0.5 | Anode |
| Cu | 500 | <1.5 | Anode |
| Ta | 5,000 | 80 | Anode |
| Pb | 2,000 | <0 | --- |
| Fe | 25,000 | 20 | Anode |
| Si | 320 | <5 | Anode |
| Cr | 340 | <5 | Anode |
| Ga | 10,000 | <25 | Anode |
| Zn | --- | --- | Anode |
| Mn | 70 | <2 | --- |
| Ti | 15,000 | 10 | --- |
| Al | 2,700 | <5 | Anode |
| U | 330 | <20 | Anode |
| Zr | 10,000 | 14 | --- |
| Th | 1,300 | 10 | Anode |
| Pu | --- | --- | --- |
| Ce | 527 | <25 | Electrolyte |
| Am | 850 | 82 | Electrolyte |

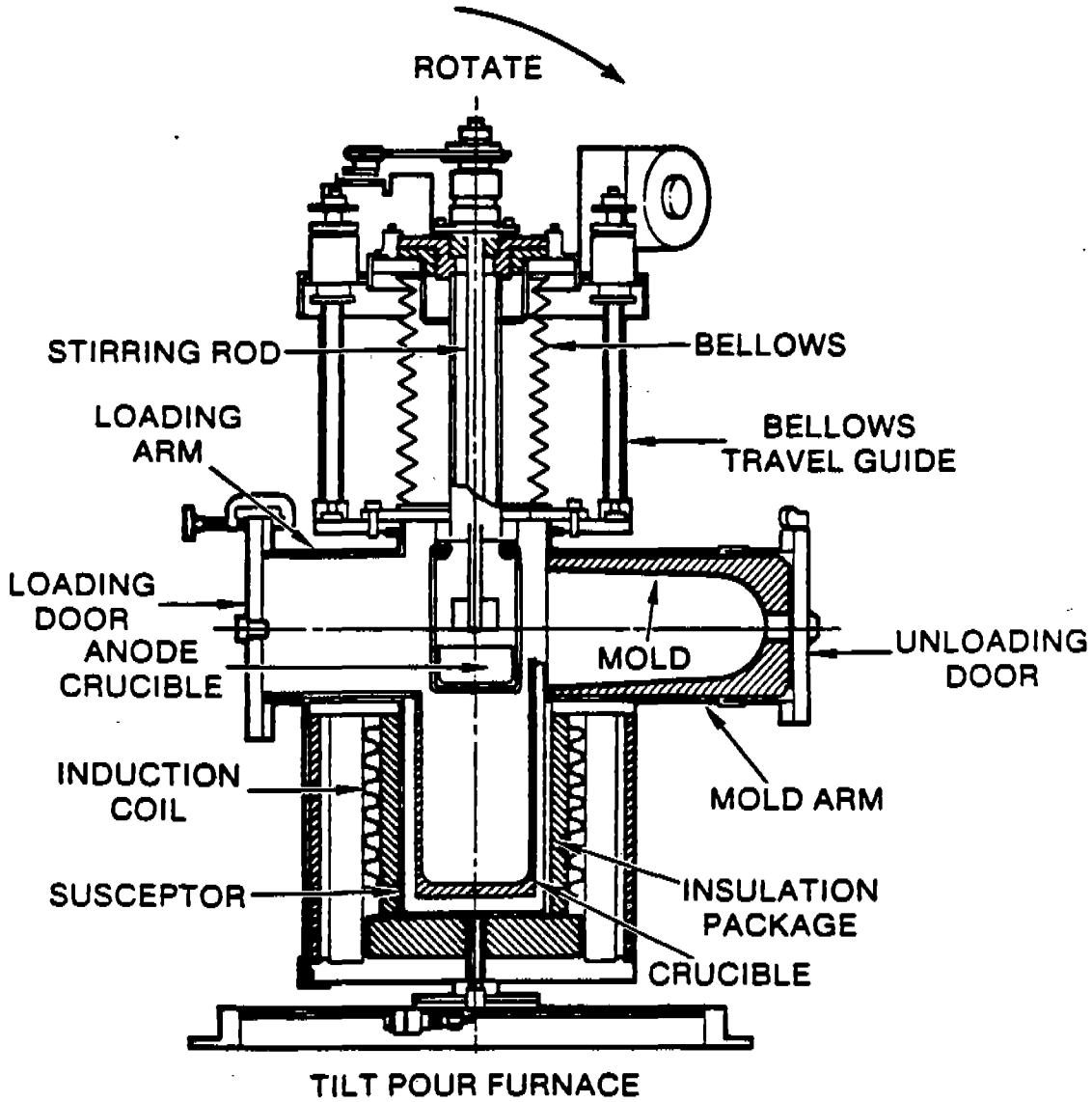



Fig. 24. Schematic of RFP's tilt-pour ER furnace.

In the pyroredox process, workers initially polish the spent anode with calcium to ensure that all the plutonium is present as metal.[62] They then oxidize the metal to plutonium(III) with $ZnCl_2$ dissolved in KCl. All elements more active than zinc will be oxidized into the salt phase. This process forms a zinc button that may be discarded. The technicians then mix the salt with a $Ca/CaCl_2$ salt to reduce plutonium and all elements less active than calcium. The reaction product is a salt phase above a two-phase button. The salt phase is mechanically separated and discarded. The bottom, denser metal phase is composed of plutonium and small quantities of calcium and zinc. The upper phase is typically 50% plutonium with the remainder being primarily zinc. Several buttons are allowed to coalesce at 850°C for 6 h to separate the ingots into a plutonium-rich lower phase suitable for ER and a less-pure upper phase that is recycled to the oxidation step.

Recovery operations treat the electrolyte salt from ER, which contains up to 8% of the feed plutonium and any elements more active than plutonium (such as americium), by salt-stripping to recover the plutonium. Operators add cacium to the salt in a DOR crucible and heat the mixture to 850°C, stir it, and allow it to cool. The metal product is recycled to ER. Aqueous methods for recovery leach crucible shards with HCl to recover plutonium. If plutonium from the residues is included in the calculation, recovery yields are quite high.

Since facilities first adopted ER in 1962, the process has produced large quantities of metal with greater than 99.96% purity. Once-through yields, particularly in conjunction with DOR and casting, are rather disappointing, and investigators are conducting additional research.[63]

## IV. WASTE MANAGEMENT

Solution processing technologies discussed in this report, as well as other processing technologies, produce both liquid and solid wastes that

must be disposed of in an acceptable manner. We will now discuss methods of dealing with these wastes.

A. Liquid Wastes

The evaporator process is the first step in the waste management stream for all solutions that can be discarded. Feed for this process consists of effluent (approximately 7M $HNO_3$) generated by the ion-exchange columns. This solution contains plutonium concentrations from several milligrams to 0.5 g/ℓ and is processed in one of two evaporators. An evaporator run usually concentrates 600 ℓ of solution to about 20 ℓ, designated bottom. The distillates from this process contain relatively low plutonium concentrations (usually below $7 \times 10^7$ (counts/min)/ℓ total alpha) and are discarded to a final waste-treatment facility. Technicians cool the bottoms, separate the salts by supernate filtration, and sample the filtrate for plutonium to ensure it may be discarded. If the sample results are acceptable, the filtrate (20 ℓ) is fixed in cement for disposal. The salts are also sampled for plutonium to establish criteria for discard. Following assay, workers place the salts in a PVC-lined drum and send them to a 10-yr retrievable storage. Another source of solutions is the oxalate filtrates, which are handled in the same manner as the effluents. A reduced distillation rate, however, compensates for the reactivity of the oxalate filtrate, which contains $NH_2OH \cdot HNO_3$.

Waste management is also responsible for all caustic solutions that are generated by the various head-end and purification sections. At present, facilities filter, sample, and assay these solutions to determine the need for further processing. If the filtrates meet the discard criterion ($\leq 5 \times 10^9$ (counts/min)/ℓ total alpha), the filtrates are transferred to the waste management facility.

A low-level-waste facility (Fig. 25) provides further treatment of the acid distillates and caustic solutions. The means of transfer is a gravity-flow stainless steel pipe encapsulated in PVC plastic. The wastes

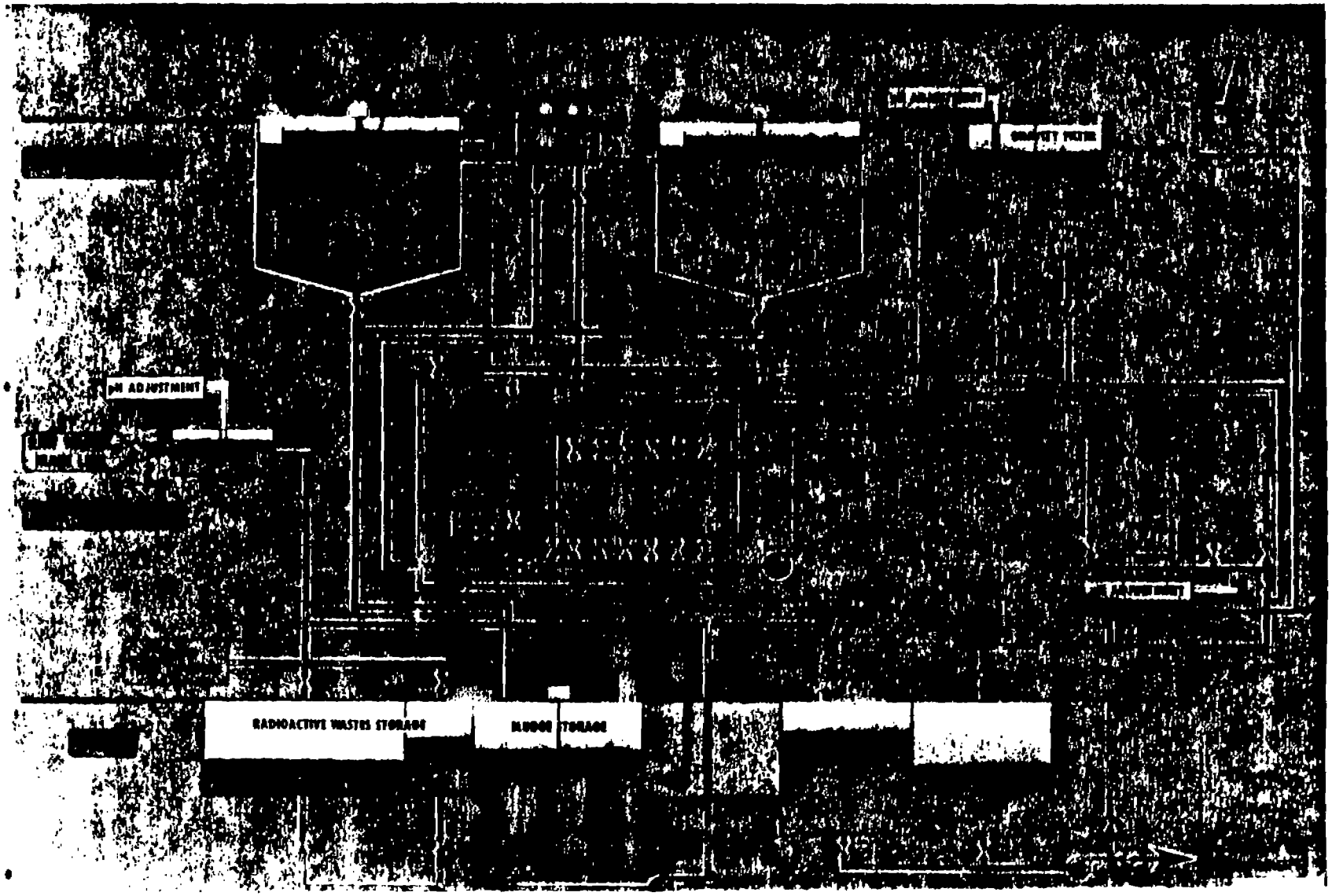



Fig. 25. Liquid Waste Treatment Facility TA-50 at Los Alamos National Laboratory.

collect in two 11,000-ℓ storage tanks located in a below-grade vault. The waste treatment at this facility includes the neutralization, chemical precipitation, settling, clarification, sand filtration, sludge collection, and solidification of sludges by addition of portland cement. Operators discard the effluent if the gross alpha activity is less than 4,000 d/m/ℓ; if it is not, the effluent is recycled through the plant. Development of the TRUEX process for $HNO_3$ systems has been concerned with the removal of plutonium and americium from Hanford TBP-based solvent-extraction raffinates. Experimental work by R. A. Leonard and associates[50] of Argonne National Laboratory has attained levels of <10 nCi/g (TRU elements). Extraction of 0.25M CMPO-0.75M TGP in $CCl_4$ produced a raffinate containing 2 nCi/g. Development of this potentially important and large-scale process continues.

## B. Solid Wastes

Plutonium-contaminated solid wastes can be divided into TRU waste, >100 nCi Pu/g, and low-level waste, <100 nCi Pu/g.[82]

The Waste Management Group retrievably stores solid TRU defense wastes above grade on asphalt pads and covers them with layers of wood, plastic sheet, and earth. Currently, operators must certify the defense wastes to meet the WAC for mandatory disposal at WIPP.[2] The WIPP facility is scheduled to receive its first waste shipments in 1989.

1. Process Residues. Immobilization of process residues in cement is a common method to ensure that solution and fine-particulate-containing waste will meet the WIPP WAC. Materials to be immobilized include solutions, sludges, organic liquids, processing residues, filter media, salts, ion-exchange resins, and nuclear materials such as americium oxide.

Often the immobilizing agent is portland cement mixed in a screw mixer, jet mixer, pug mill, or tumbling drum. The cement paste drops into a drum to set and cure. Several facilities use gypsum cement to immobilize

organic liquid waste that is premixed with water and an emulsifier. Los Alamos performs the mixing directly in a 55-gal. drum.

At Los Alamos, the chloride and evaporator bottoms solutions provide the water for the immobilization of the solid process residues with gypsum cement. Sodium hydroxide solutions (NaOH) neutralize the strongly acidic solutions into a pH range of 2-4. Technicians transfer the neutralized solution into a 55-gal. drum and add cement as the mixture is stirred with an air motor for a few minutes. Most solids are added near the end of the stirring. Americium oxide is stirred manually into the paste afterwards to prevent the spread of high-gamma-emitter material to the stirring equipment and the glove box. The system will employ in-drum stirring for several reasons:[83] (1) the operator can observe the mixture during stirring and control the time and rate of stirring to match the characteristics of the highly variable feed solutions; (2) if the operator judges it necessary to initiate the setting reaction, set-accelerator material can be added to the mix while stirring is continued; (3) the cleanup of mixing equipment is simpler (4); a flash set in the mixing equipment will not force a difficult cleanout of a frozen mixer; (5) finally, should the mix not set up, remixing can occur right in the drum.

Gypsum cement is the fixing agent of choice for the following reasons:[70] (1) it has a possible higher volume efficiency (70% vs 35% for portland cement); (2) it provides an optimal pH of 3-5 for setting (This setting requires less NaOH solution for neutralization; also, the acidic pH minimizes evaporator waste-solution release of ammonia that forms $NH_4NO_3$ particulates in the ventilation ducts and plugs the ventilation system filters.); (3) it demonstrates an ability to immobilize organic liquids when used with an emulsifier; and (4) it shows a tendency to reabsorb any water layer formed on the surface of the setting cement. (A common disadvantage for portland cement is the presence of free liquid in a drum after setting occurs.)

2. Combustibles and Noncombustibles. Solid residues not requiring immobilization consist of common combustibles and noncombustibles. Combustible wastes include paper, wood, rags, plastics, and graphite crucibles. Typical noncombustibles are metal valves, tubing, pipe, furnace tubes, tools, cans, glass, fiberglass, ceramics, and leaded dry-box gloves. These materials normally meet the WIPP WAC without further treatment, although additional processing may significantly reduce the volume of waste transported to WIPP.

There is a current plan to segregate and burn much of the combustible waste from the Los Alamos Plutonium Facility in the Waste Management Group's controlled air incinerator.[84] The resulting ash will be fixed in cement. To date, we have attempted only trial runs with lightly contaminated waste.

In addition bulky nonroutine waste items such as glove boxes will be cut up in the Waste Management Group's Size Reduction Facility if the items cannot be decontaminated to less than TRU levels.

Some of the solid wastes will probably require other types of processing to render them certifiable to WIPP. For example, salts and crucibles containing pyrophoric metals such as sodium or potassium will require roasting in air for conversion to oxides or treatment with lead chloride to form the chloride salts.[85]

Finally there are special-case wastes whose disposition has not yet been clarified. An example is HEPA filters. They can contain unacceptable quantities of particulate matter. The WAC Certification Committee is still evaluating whether the particles can be entirely released during transportation or in an accident. If the particles are mostly trapped, then the filters may be certified; if the particles can be mostly released, the filter media will be removed from the frame and fixed in cement.

## V. EMERGING TECHNOLOGIES

The handling of plutonium scrap and waste is labor intensive, particularly in processing secondary scrap materials that are generally lean in plutonium content and quite often contain contaminants that aggravate the scrap-handling problems. The following are some of the many challenges for evolving technologies:

- reduce secondary scrap generation,
- reduce waste generation including both the bulk weight and plutonium content,
- improve process and system yield,
- reduce personnel radiation exposure,
- become more cost effective, and
- improve accountability and safeguards.

The approaches taken to meet these challenges range from making subtle evolutionary changes to existing processes to making revolutionary approach changes to material processing. Probably the most significant efforts, in terms of overall long-term payoff, are those approaches aimed at stopping the generation of scrap and waste.

Automation and robotics will most certainly play an important role in defining the direction of new technology. But automation and robotics are not treatment technologies within themselves. They do represent outstanding tools to be used in improving our material handling, accountability, and safeguards, as well as in reducing the radiation exposure to personnel. Many researchers believe that automation and robotics will slowly become the main support activity for all process changes. Numerous projects aimed at automated handling are under way in facilities across the nation. As an example, in the plutonium-scrap processing facility at RFP in Colorado, a large stacker-retriever robot system is the primary means of accessing vault storage. Workers are installing a similar but much smaller stacker-retriever robot in a new vault at the plutonium facility at the Los Alamos National Laboratory.

Robots such as these can be coupled to computer systems and can thus become the heart of an accounting and inventory system. These functions can now take place with very high reliability and with little or no radiation exposure to personnel.

Vaults are not the only place where robots are demonstrating their usefulness. A new pick-and-place robot has been installed in the plutonium analytical laboratory at the Los Alamos National Laboratory. The robot works with the computer system to perform a variety of sample-preparation, dissolution, dilution, and data-compilation steps. Automation is beginning to move onto the working floor as well.[86,87] Automated NDA and bagout systems will replace the operator in performing these tedious, repetitive, and often high-exposure operations.

Computerization is rapidly becoming a second major new support activity appearing in the work place. The low price and compact nature of the new computers have made them highly desirable for data-compilation purposes. Indeed, voice-actuated data sheets preclude the need for personnel to punch the keyboard. Computers coupled with NDA evaluation equipment can also function as process-control systems. With the advent of more sophisticated processing techniques high-quality rapid-evaluation techniques are essential to avoid process upsets.

The third major evolutionary change that will become an essential tool in future technology is at-line or on-line analysis. Many of the new approaches concern NDA techniques. Gamma-ray counting with multichannel analyses can provide near-real-time analysis in continuous or semicontinuous systems. In processing steps such as solvent extraction, continuous dissolution, and ion exchange, extents of reaction are sometimes difficult to access. On-line NDA techniques will automatically determine column breakthrough. Destructive, wet chemistry techniques will begin to be integrated into the actual process operations to provide at-line process control. Techniques such as inductively coupled plasma spectroscopy can process a sample in a matter of minutes, thus providing impurity

information on a near-real-time basis. Coupling the results of the analysis with other automated aspects of process systems will provide enhanced process control.

A major aspect of technology improvement involves more than just modifications to existing processes. Opportunities to make significant changes in processing exist in the actual process chemistry and process-engineering areas. Researchers are presently investigating some of the following areas:

• Enhanced Dissolution. As noted earlier, recovery of plutonium from highly refractory plutonium oxide is a severe challenge to conventional aqueous processing. At Los Alamos, research has found that a new approach to the problem is the use of a superacid such as $HF/SbF_5$.[88] This reagent gives complete dissolution of refractory plutonium oxide in a practical time frame. Subsequent solvent distillation and recycle are an economical aspect of this experimental procedure. The fluoride residue is then amenable to either $PuF_6$ volatility techniques or to conventional procedures such as $HNO_3$-$Al(NO_3)_3$ dissolution and subsequent plutonium purification by solvent extraction or nitrate anion exchange. The superacid portion of the recovery procedure would add little to waste-stream volumes.

• Low-Temperature Fluorination. Recent work at Los Alamos has shown that a new fluorinating agent, FOOF, will produce $PuF_6$ at low temperatures.[20] FOOF can be generated from oxygen and fluorine mixtures by (1) ultraviolet photolysis, (2) microwave discharge, or (3) an even newer technique involving thermal dissociation of $F_2$. In a FOOF mixture, the two species identified to date are $O_2F_2$ and $O_2F$, the latter being a very reactive intermediate.[89] Although fluorine can produce the volatile compound $PuF_6$ as well, producing and delivering high concentrations of fluorine atoms to reactive sites is very difficult. Other potential applications for FOOF include new synthetic methods, surface passivation, and treatment and decontamination of plutonium-containing materials and equipment.

• Membrane Separation. A neglected area of aqueous materials processing has been thin-film membranes and their potential for metal ion separation.[90] Recent laboratory results have shown that, in principle, membrane techniques using practical equipment sizes can recover the actinide metal ions to well below 1 ppm.[91] Membrane development itself is starting to be a growth area for actinide separations involving (1) polymeric membrane development for metal ion separations, (2) modified concepts of supported liquid membranes, and (3) polymeric membranes containing covalently bonded, actinide-specific chelating agents. A major challenge for these endeavors will be the removal of plutonium and americium from acidic waste streams to the very low level required for discard to final waste processing. Currently, evaporation produces distillates with these low activity levels, but the concentrated residues may contain gram amounts of plutonium and americium that require immobilization in cement.

• Molten Salt/Molten Metal Redox Systems. Molten electrochemical techniques provide the capability to study and characterize complex chemical reactions in solution. In-depth application of many of these techniques to actinide chemistry in molten salts has yet to be completed, but the promise of a better understanding of electrode reactions in various molten-salt electrolytes may completely alter current actinide processing systems. In addition to improving the efficiency of plutonium purification by ER, intermediate purification and separation operations could benefit by proper application of electrolytic processes. Separation of impurities currently possible only through aqueous techniques could be completed in fewer steps, generating much less residue and achieving faster turnaround of product metal through electrochemical applications. Integration of electrochemical processing coupled with enhanced engineering automation will definitely play an important role in the future of actinide molten-salt processing and purification, as will computer monitoring and control.

• Integrated Reduction/Purification. Processing spent DOR salts, electrorefining liquid anodes, and generating and using plutonium trichloride ($PuCl_3$) are intended to lead to a system in which the oxide could be reduced to metal and electrorefined in the same equipment, the salt could be regenerated and reused, and the product metal could maintain the same high standards as our current electrorefined metal. Experts are investigating the use of $PuCl_3$ for the removal of americium to help maintain the purity of the extracted metal and for the potential of single-pass extraction of metals with very high americium content. The trichloride is also of interest for the introduction of the ionic plutonium species into electrolytic operations. Additional work is studying the use of reference electrodes in molten-salt systems to more fully understand and control the electrochemical processes occurring during the purification of plutonium and the subsequent recovery of pyrochemically generated residues. By combining the appropriate features of all of this work, researchers may be able to design and build a cell that has oxide as the feed and pure metal as the product and that generates a residue for discard at a fraction of the current residue-generation rate.

Regardless of where new technologies guide the processing of plutonium-bearing scrap and the handling of wastes, administrative issues will become a much more dominant driving force. These issues will most certainly involve aspects of environmental control, safeguards, material control and accountability, health and safety, and human reliability. These issues will predominately be politically motivated and implemented. The true challenge for both existing and emerging technologies will be to successfully address the administrative issues while simultaneously promoting safer, better, and more cost-effective processing.

## ACKNOWLEDGMENTS

From reading this chapter you will realize the historical significance of plutonium processing technology. The industry is very young compared with other inorganic processing industries. As a result, many of the original processing approaches are still in use today in some fashion. It is therefore necessary to recognize all of the original pioneers in the plutonium business for their contributions in establishing the technology base. In line with this acknowledgment, the authors apologize to all researchers whose specific work has not been cited here. The chapter was intended to highlight the status of plutonium processing and waste management. We encourage all readers to inquire further for in-depth processing information.

Finally, the authors would like to acknowledge Brian Thompson for editing and the staff of IS-12 for preparing all the illustrations. The authors would especially like to acknowledge Marion Harris for typing and coordinating the material.

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D009 - AK7

TWCP-QP-1.1-004,R.8/IC1
Effective Date: 12/20/01

TWCP-08526

# RECORDS SUBMITTAL

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TWCP-AK-2.1-011, R.0

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Category Number: (from page two): 07

**RECORD TITLE, SUBJECT, AND/OR KEYWORDS:**

Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47 (LA-UR-01-4964)

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Thanks,

scott

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# INTERIM CHANGE REQUEST

| ☑ TWCP ☐ WRR ☐ Other<br>If Other, please identify: _____ | IC Number: 1 |
|---|---|
| **Person Requesting this Interim Change:** June Fabryka-Martin | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, and TA-55-47 | **Document No./Revision:** TWCP-AK-2.1-006,R.~~1~~ 011 0 CSH 11/1/01 |
| **Effective Date of Current Document:** 09/20/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| Section 2.0 | Insert Note following the first bullet in Section 2.0:<br>NOTE: The primary sources of waste generator information presented in the AK Information Summary are:<br>• the "Los Alamos National Laboratory Transuranic Waste Database" maintained by the Facility Waste Operations (FWO) – Integrated Information Management (IIM) group for all TRU waste in storage at TA-54, in accordance with AP-SWO-006;<br>• the TA-55 Waste Management System (WMS) database described in QA-TP-WMS-000.001 and in Section 7.2 of the *TA-55 Transuranic Waste Interface Document* (TWID); and<br>• archived older versions of the TA-55 WMS database (TWCP-6988). | Respond to CBFO audit comments, by improving traceability to AK data sources. |
| Attachment 1 | Insert new references to AK Roadmap (see attached page) | |

**Date changes submitted:** 10/25/01 | **Desired effective date for changes:** 10/26/01

**INTERIM CHANGE APPROVAL**

| Document Preparer: John Musgrave | | Reviewer (if applicable): | |
|---|---|---|---|
| Signature: John Musgrave | Date: 10/25/01 | Signature: | Date: |
| Site Project QA Officer: Lawrence A. Soule | | LAAO (if implementing WAP requirements): | |
| Signature: L A Soule | Date: 10/25/01 | Signature: | Date: |
| ☑ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | | Do changes affect WAP data collection, data quality, or performance criteria?<br>☐ Yes ☑ No<br>If yes, date of CBFO approval: _____<br>(documentation attached) | |
| Site Project Mgr/Line Mgr: P Rogers | | | |
| Signature: Pamela Rogers | Date: 10/25/01 | | |
| USQ Screener (if applicable): NA | | | |
| Signature: Greg Burchett | Date: 10-29-01 | | |

**NOTE:** Changes can be designated on the document and attached to this form.

**Effective date for this interim change:** 11/5/01

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| AP-SWO-006, R.3.1 | A | Describes how the TRU Waste Storage Record (TWSR) is prepared, reviewed, submitted, and entered into a TRU waste database | *Review and completion of the TWSR* | Section 8.6 describes how waste generator information submitted on the TWSR, as well as other receipt and storage information, is entered into the LANL TRU Waste Database for TRU waste stored at TA-54. | Does not contain any data. No detailed discussion of changes made in this procedure since it was first issued in June 1994 as DOP-CST17G-003,R.0. The current procedure listed here was issued April 2001. |
| NMT7-AP-TA55-018, R3 | A | Contains waste generator information required by the LANL TRU Waste Certification Plan | *TA-55 Transuranic Waste Interface Document* (TWID) | Contains information on waste characterization, waste packaging configurations, and TRUCON codes for newly-generated TA-55 waste. Describes how waste generator information in the TA-55 Waste Management System (WMS) database is certified and maintained for waste generated at the TA-55 facility. Contains information on current and projected waste stream volumes. | Does not contain data on specific waste containers. Does not contain information for legacy waste generated prior to this document's approval. Periodically updated by TA-55. |
| QP-TP-WMS-000.001 | B | Compilation of TA-55 waste generator information, for individual waste containers. | TA-55 Waste Management System (WMS) | Certified and current database of waste container identifiers, waste codes (e.g., IDC, RSWD, EPA HWNs), assay results, packaging dates, waste material content and generating processes for TA-55 wastes. | Controlled access, continually being updated |
| TWCP-6988 | B | Compilation of TA-55 waste generator information, for individual waste containers. | *Archived generator's databases 95DRUM and 95ncdrum.* | Database of waste container identifiers, waste codes (e.g., IDC, RSWD, EPA HWNs), assay results, packaging dates, waste material content and generating processes for TA-55 wastes. | Archive of previous version of the TA-55 WMS; may not contain latest corrections. |

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47

**REPORT NUMBER:** TWCP-AK-2.1-011,R.0 (LA-UR-01-4964)

**WASTE GENERATED FROM WASTE STREAMS:** TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47

**EFFECTIVE DATE:** 09/20/01

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SITE PROJECT QA OFFICER — DATE

Andrew J. Montoya — 9-14-01
FACILITY REPRESENTATIVE — DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 09/20/01 | — | New report |
| IC1 | 11/5/01 | Section 2, Attachment 1 | Respond to CBFO audit comments, by improving treaceability to AK data sources. |

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**Attachments**

1 Acceptable Knowledge Roadmap (12 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Generalized Process Status Diagram for Pu-238 Processes (1 page)
4 Waste Generator Forms for TRU Waste (4 pages)
5 Chemical Waste Disposal Request Form (1 page)

## ACRONYMS

| | |
|---|---|
| $^{238}PuO_2$ | plutonium-238 oxide |
| AK | acceptable knowledge |
| CFR | *Code of Federal Regulations* |
| D | RCRA hazardous waste code for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction (process, not P/S code) |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste code for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| GPHS | General Purpose Heat Source |
| HEPA | high-efficiency particulate air |
| HWN | hazardous waste number |
| IDC | Item Description Code |
| K | RCRA hazardous waste code for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level waste |
| LWRHU | Lightweight Radioisotope Heater Unit |
| MDL | method detection limit |
| MEGAS | Multiple Energy Gamma Assay System |
| MT | material type |
| MWG | Milliwatt Generator |
| NDA | nondestructive assay |
| NIOSH | National Institute for Occupational Safety and Health |
| NMT | Nuclear Material Technology |
| PCB | polychorinated biphenyl |
| PF | Plutonium Facility |
| PPE | personal protective equipment |
| ppm | part per million |
| ppmv | part per million, on a volume basis |
| PRQL | program required quantitation limit |
| P/S [code] | process/status [code] |
| PWR | prohibited waste report |
| QA | quality assurance |
| QP | quality procedure |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |

| | |
|---|---|
| RSWD | Radioactive Solid Waste Disposal |
| RTR | real-time radiography |
| SME | subject matter expert |
| SRS | Savannah River Site |
| TA | technical area |
| TRU | transuranic |
| TRUCON | TRUPACT-II content |
| TRUPACT-II | Transuranic Waste Transporter-Model II |
| TWBIR | Transuranic Waste Baseline Inventory Report |
| TWCP | Transuranic Waste Characterization/Certification Project |
| $UCL_{90}$ | 90% Upper Concentration Limit |
| UCNI | Unclassified Controlled Nuclear Information |
| VE | visual examination |
| VOC | volatile organic compound |
| WAC | waste acceptance criteria |
| WIPP | Waste Isolation Pilot Plant |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WPRF | Waste Profile Request Form |
| WODF | Waste Origination and Disposition Form |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**NOTE:** This index indicates the main process AK summary report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | | EPA HWN listing for Pu-238 waste** | Current Status of P/S Code |
|---|---|---|---|---|---|
| **P/S codes cited in this report that may generate Pu-238 waste** | | | | | |
| ASP | Aqueous Scrap Processing | Plutonium-238 Operations | 3.5.1, Att. 4 | — | Active |
| C1 | Pu-238 Heat Source Calorimetry | Plutonium-238 Operations | 3.5.2 | — | Active |
| GPHS | General Purpose Heat Source Fabrication | Plutonium-238 Operations | 3.5.2, Att. 4 | — | Active |
| MTL | Metallography | Plutonium-238 Operations | 3.5.3, Att. 4 | — | Active |
| P1 | Routine Pu-238 Heat Source Production | Plutonium-238 Operations | 3.5.2, Att. 4 | — | Active |
| PPD | Plutonium Pellet Dissolution | Special Processing | 3.5.11, Att. 4 | — | Inactive since 1998 |
| R8 | Routine Pu-238 Solidification | Plutonium-238 Operations | 3.5.6, Att. 4 | D006, D008, D009, D011 (apply only to hydroxide and oxide cake waste) | Active |
| R8 | Recovery of Pu-238 from Sucrose Solutions | Plutonium-238 Operations | 3.5.7, Att. 4 | — | Inactive since 1988 |
| RCI | Recovery of Pu-238 from Contaminated Iridium | Plutonium-238 Operations | 3.5.5, Att. 4 | — | Inactive since 1992 |
| SCP | Routine Pu-238 Scrap Processing | Plutonium-238 Operations | 3.5.4, Att. 4 | — | Active |
| TDC | Thermal Decomposition of Cellulose Items | Nitrate Operations | 3.5.1, Att. 4 | D005, D006, D007, D008, D011 | Active |
| WD | Welding and Decontamination for GPHS | Plutonium-238 Operations | | — | Active |
| WS | Pu-238 Direct Oxide Reduction | Plutonium-238 Operations | 3.5.8, Att. 4 | D005 (applies only to salt | Active |

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | | EPA HWN listing for Pu-238 waste** | Current Status of P/S Code |
|---|---|---|---|---|---|
| | | | | waste) | |
| **P/S codes cited in this report that do not generate Pu-238 waste** | | | | | |
| ED | Cascade Dissolver | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 | Active |
| ITF ITF4 | Impact Test Facility | Metal Operation Processes | 3.5.2, Att. 4 | — | Active |
| MPD | Cascade Dissolver | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 | Inactive since 1996 |
| OR | Direct Oxide Reduction | Pyrochemical Processes | 3.5.2, Att. 4 | — | Active |
| SC | Cascade Dissolver, G437 | Nitrate Operations | 3.5.2, Att. 4 | D005, D006, D007, D008, D011 | Active |
| SP | Scrap Dissolution, G438 | Nitrate Operations | 3.5.2, Att. 4 | D007 | Active |

* Process AK summary reports: Metal Operation Processes (TWCP-AK-2.1-003), Nitrate Operations (TWCP-AK-2.1-005), Plutonium-238 Operations (this report), and Special Processing (TWCP-AK-2.1-007)

** Any debris waste containing lead (e.g., leaded gloves) is discarded as mixed TRU waste to which EPA HWN D008 is applicable.

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-43

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-43, Non-mixed Combustible/Noncombustible Debris Waste Containing Plutonium-238 |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5000, Debris Waste |
| **TWBIR:** | LA-T004, LA-T005 |
| **TRUCON Codes:** | LA116A, LA116B, LA116C, LA116D, LA116E, LA116H, LA117D, LA117E, LA118C, LA119B |
| **Maximum Layers of Packaging:** | 5 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1993—1998 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 166 containers (35 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

**Waste-generating process:**

The overall goal of the Pu-238 processes is to produce heat sources for various applications. Limited recovery of plutonium from metal, metal alloys, scrap, and residues is also part of the Pu-238 processing.

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; plutonium scrap; pyrochemical salts; crucible pieces; ash; and analytical laboratory solutions.

**Waste Material Parameter List (including packaging)**

| | |
|---|---|
| *Waste materials*: | Cellulosics, plastics, rubber, inorganic matrices, iron-based metals and alloys, other inorganic materials |
| *Packaging materials*: | Steel, plastics |

**Waste Stream Description**

Combustible/noncombustible debris including paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated during Pu-238 activities. Plastic-based waste includes, but may not be limited to: tape, polyethylene and vinyl; gloves; plastic vials, polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; plexiglass; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to: rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain HEPA filters, noncombustible glass and metallic debris. Some of this waste was packaged in small metal cans before being placed in 55-gallon drums.

**RCRA Characterization:**

No HWNs apply to containers in waste stream TA-55-43.

**Radionuclide Content**

These waste streams contain plutonium material type (MT)-83, with an initial isotopic composition of plutonium with about 83 percent Pu-238. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Thorium-232 and neptunium-237 are present in the feed material. Other secondary radionuclides which may occasionally be present in very low concentrations as contaminants from other TA-55 activities in the area are americium-243, cesium-137, uranium-238, and thorium-230.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* (TWCP-PLAN-0.2.7-001,R.5)

*Process Acceptable Knowledge Summary Report for Pu-238 Operations at TA-55* (TWCP-AK-2.1-009)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-44

**Waste Stream Number and Title:** TA-55-44, Mixed Combustible/Noncombustible Debris Waste Containing Plutonium-238

**Summary Category Group:** S5000

**Waste Matrix Code and Description:** S5000, Debris Waste

**TWBIR:** LA-W001

**TRUCON Codes:** LA115B, LA116B, LA116C, LA116D, LA116E, LA116F, LA116H, LA118A, LA118C, LA119A, LA119B, LA119D, LA123B, LA123C, LA123F

**Maximum Layers of Packaging:** 5

**Site:** LANL

**Waste-Generating Facility:** TA-55, Plutonium Facility (building PF-4), all wings

**Time Period of Generation:** 1978—1998

**Defense Waste Status:** Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility.

**Waste Stream Volume (as stored):** 952 containers (188 $m^3$)

**Waste Stream Volume (after repackaging):** Not yet determined

### Facility Mission

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

### Waste-generating Process

The overall goal of the Pu-238 processes is to produce heat sources for various applications. Limited recovery of plutonium from metal, metal alloys, scrap, and residues is also part of the Pu-238 processing.

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; plutonium scrap; pyrochemical salts; crucible pieces; ash; and analytical laboratory solutions.

**Waste Material Parameter List (including packaging)**

| | |
|---|---|
| *Waste materials*: | Cellulosics, plastics, rubber, inorganic matrices, iron-based metals and alloys, other inorganic materials |
| *Packaging materials*: | Steel, plastics |

**Waste Stream Description**

Combustible/noncombustible debris including paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated during Pu-238 activities. Plastic-based waste includes, but may not be limited to: tape, polyethylene and vinyl; gloves; plastic vials, polystyrene; Tygon tubing; polyvinyl chloride plastic; Teflon products; plexiglass; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to: rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain noncombustible glass and metallic debris. Some of this waste was packaged in small metal cans before being placed in 55-gallon drums. This waste stream may contain lead items, or items from P/S codes R8, PPD, and TDC (which may be mixed waste items).

**RCRA Characterization:**

EPA Hazardous Waste Numbers (HWN): D005, D006, D007, D008, D011

**Radionuclide Content**

These waste streams contain plutonium material type (MT)-83, with an initial isotopic composition of plutonium with about 83 percent Pu-238. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Thorium-232 and neptunium-237 are present in the feed material. Other secondary radionuclides which may occasionally be present in very low concentrations as contaminants from other TA-55 activities in the area are americium-243, cesium-137, uranium-238, and thorium-230.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* (TWCP-PLAN-0.2.7-001,R.5)

*Process Acceptable Knowledge Summary Report for Pu-238 Operations at TA-55* (TWCP-AK-2.1-009)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-45

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-45, Nonmixed Metallic Waste Containing Plutonium-238 |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5100, Inorganic Debris Waste |
| **TWBIR:** | LA-T005 |
| **TRUCON Codes:** | LA117B, LA117C, LA117E, LA117G |
| **Maximum Layers of Packaging:** | 4 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1993—1998 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 86 containers (18 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

**Waste-generating Process**

The overall goal of the Pu-238 processes is to produce heat sources for various applications. Limited recovery of plutonium from metal, metal alloys, scrap, and residues is also part of the Pu-238 processing.

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; plutonium scrap; pyrochemical salts; crucible pieces; ash; and analytical laboratory solutions.

**Waste Material Parameter List (including packaging)**

| | |
|---|---|
| *Waste materials*: | Metal scrap items, cellulosics, rubber, plastics |
| *Packaging materials*: | Steel, plastics |

**Waste Stream Description**

Metal waste generated from facility and equipment operations and maintenance. This includes metal scrap, small tools, small equipment items, motors, pumps, and process equipment. Only a small fraction of plastic (used as packaging and not in direct contact with the waste material) is present in this waste stream. Most of this waste was packaged in small metal cans before being placed in 55-gallon drums.

**RCRA Characterization:**

No HWNs apply to containers in waste stream TA-55-45.

**Radionuclide Content**

These waste streams contain plutonium material type (MT)-83, with an initial isotopic composition of plutonium with about 83 percent Pu-238. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Thorium-232 and neptunium-237 are present in the feed material. Other secondary radionuclides which may occasionally be present in very low concentrations as contaminants from other TA-55 activities in the area are americium-243, cesium-137, uranium-238, and thorium-230.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* (TWCP-PLAN-0.2.7-001,R.5)

*Process Acceptable Knowledge Summary Report for Pu-238 Operations at TA-55* (TWCP-AK-2.1-009)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-46

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-46, Mixed Metallic Waste Containing Plutonium-238 and Lead Items |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5100, Inorganic Debris Waste |
| **TWBIR:** | LA-W005 |
| **TRUCON Codes:** | LA117C, LA117E |
| **Maximum Layers of Packaging:** | 4 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1978—1998 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 167 containers (32 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

**Waste-generating Process**

The overall goal of the Pu-238 processes is to produce heat sources for various applications. Limited recovery of plutonium from metal, metal alloys, scrap, and residues is also part of the Pu-238 processing.

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; plutonium scrap; pyrochemical salts; crucible pieces; ash; and analytical laboratory solutions.

**Waste Material Parameter List (including packaging)**

| | |
|---|---|
| *Waste materials*: | Metal scrap items, cellulosics, rubber, plastics |
| *Packaging materials*: | Steel, plastics |

**Waste Stream Description**

Metal waste generated from facility and equipment operations and maintenance. This includes metal scrap, small tools, small equipment items, motors, pumps, and process equipment. Only a small fraction of plastic (used as packaging and not in direct contact with the waste material) is present in this waste stream. Most of this waste was packaged in small metal cans before being placed in 55-gallon drums. This waste stream may contain lead items.

**RCRA Characterization**

TA-55-46 is conservatively assigned the following EPA Hazardous Waste Numbers (HWN).

- D005, D006, D007, D008, D011

**Radionuclide Content**

These waste streams contain plutonium material type (MT)-83, with an initial isotopic composition of plutonium of about 83 percent Pu-238. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Thorium-232 and neptunium-237 are present in the feed material. Other secondary radionuclides which may occasionally be present in very low concentrations as contaminants from other TA-55 activities in the area are americium-243, cesium-137, uranium-238, and thorium-230.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* (TWCP-PLAN-0.2.7-001,R.5)

*Process Acceptable Knowledge Summary Report for Pu-238 Operations at TA-55* (TWCP-AK-2.1-009)

## ACCEPTABLE KNOWLEDGE SUMMARY FOR TA-55-47

| | |
|---|---|
| **Waste Stream Number and Title:** | TA-55-47, TRU HEPA Filter Waste Containing Plutonium-238 |
| **Summary Category Group:** | S5000 |
| **Waste Matrix Code and Description:** | S5410, Composite Filter Debris Waste |
| **TWBIR:** | LA-T005 |
| **TRUCON Codes:** | LA119B |
| **Maximum Layers of Packaging:** | 1 |
| **Site:** | LANL |
| **Waste-Generating Facility:** | TA-55, Plutonium Facility (building PF-4), all wings |
| **Time Period of Generation:** | 1993—1998 |
| **Defense Waste Status:** | Defense-related TRU waste. There is no historical record or evidence of spent nuclear fuel or high-level waste ever having been handled at the facility. |
| **Waste Stream Volume (as stored):** | 14 containers (2.9 $m^3$) |
| **Waste Stream Volume (after repackaging):** | Not yet determined |

**Facility Mission**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and were not segregated based on funding source until August 27, 1998.

**Waste-generating Process**

The overall goal of the Pu-238 processes is to produce heat sources for various applications. Limited recovery of plutonium from metal, metal alloys, scrap, and residues is also part of the Pu-238 processing.

**Process Feed**

Plutonium metal or metal alloys; plutonium oxides and hydroxide cakes; plutonium scrap; pyrochemical salts; crucible pieces; ash; and analytical laboratory solutions.

**Waste Material Parameter List (including packaging)**

| | |
|---|---|
| *Waste materials*: | Iron-based metals and alloys, cellulose, plastic |
| *Packaging materials*: | Steel, plastics |

**Waste Stream Description**

High-efficiency particulate air (HEPA) filters generated from facility and equipment operations and maintenance.

**RCRA Characterization:**

No HWNs apply to containers in waste stream TA-55-47

**Radionuclide Content**

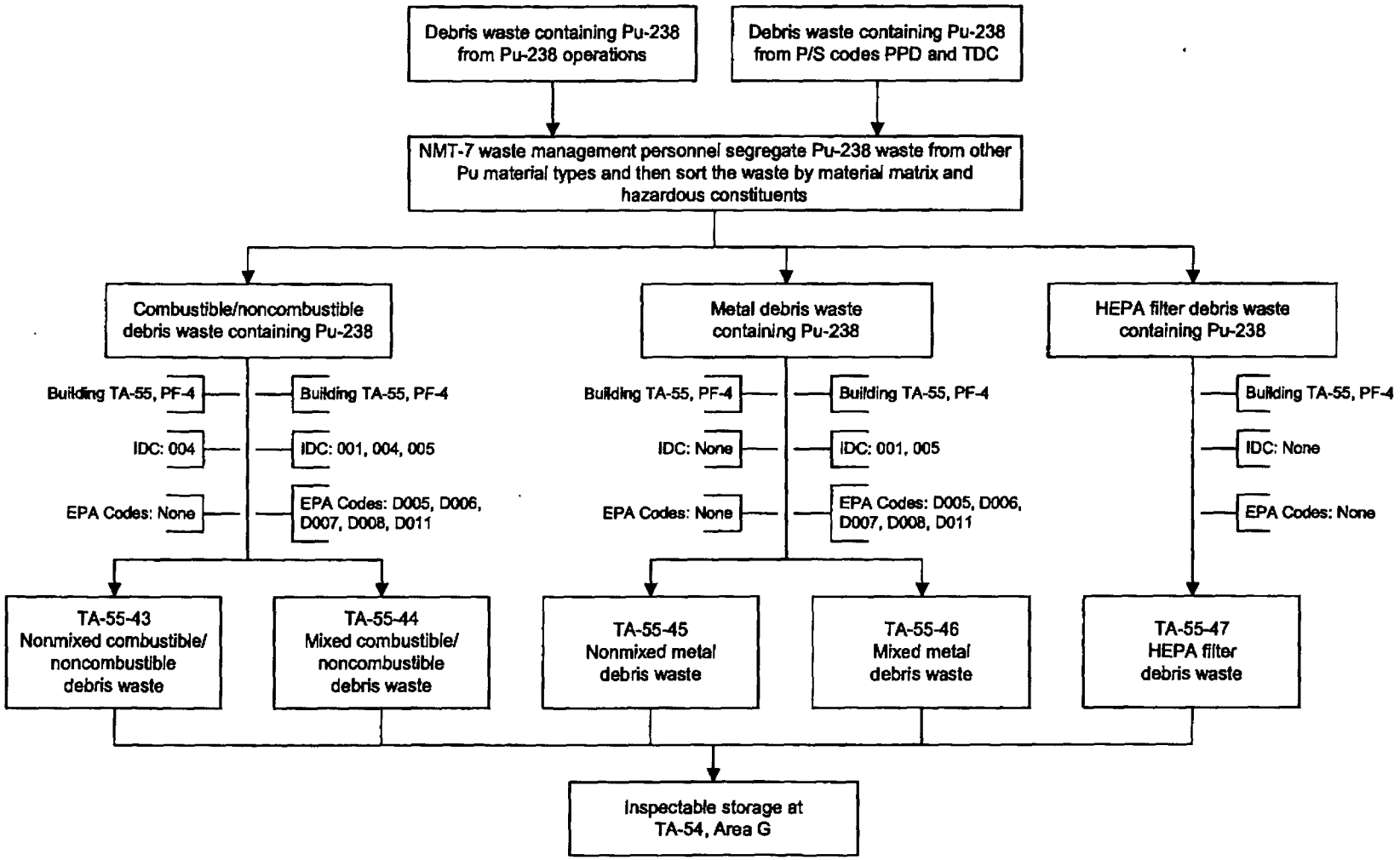
These waste streams contain plutonium material type (MT)-83, with an initial isotopic composition of plutonium with about 83 percent Pu-238. Americium-241, neptunium-237, and uranium-234 may be present at detectable concentrations as decay products of their plutonium precursors. Thorium-232 and neptunium-237 are present in the feed material. Other secondary radionuclides which may occasionally be present in very low concentrations as contaminants from other TA-55 activities in the area are americium-243, cesium-137, uranium-238, and thorium-230.

**Primary References for Documentation of Acceptable Knowledge**

*Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* (TWCP-PLAN-0.2.7-001,R.5)

*Process Acceptable Knowledge Summary Report for Pu-238 Operations at TA-55* (TWCP-AK-2.1-009)

## WASTE GENERATION SUMMARY DIAGRAM



# ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR WASTE STREAMS TA-55-43, TA-55-44, TA-55-45, TA-55-46, and TA-55-47

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization, and defines AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste*. Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK information and provides guidelines on how AK should be obtained and documented.

This AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize AK information about characteristics of the wastes generated by the Plutonium Facility at Technical Area (TA) 55, one of the TRU waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides technical support for assignment of specific waste containers to the waste streams covered by this report.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to waste streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, and TA-55-47 (also referred to as the Pu-238 debris waste streams) covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* (TWCP-PLAN-0.2.7-001,R.5) (AK Information Summary) that includes information regarding all LANL TRU waste streams

  **NOTE:** The primary sources of waste generator information presented in the AK Information Summary are:

  - The "Los Alamos National Laboratory Transuranic Waste Database" maintained by the Facility Waste Operations (FWO)-Integrated Information Management (IIM) group for all TRU waste in storage at TA-54, in accordance with AP-SWO-006
  - The TA-55 Waste Management System (WMS) database described in QA-TP-WMS-000.001 and in Section 7.2 of the *TA-55 Transuranic Waste Interface Document* (TWID)
  - Archived older versions of the TA-55 WMS database (TWCP-6988)

- Review of documents related to the waste generation and waste management activities at TA-55 as documented in the Acceptable Knowledge Roadmap (Attachment 1)

- Interviews with personnel involved with waste generation and waste management at TA-55 as documented in the process AK report listed in the Acceptable Knowledge Roadmap (Attachment 1)

- Review of process AK reports for TA-55 processes (as discussed below)

- Analysis of processes generating waste, as discussed in the process AK reports and in this report

The Transuranic Waste Characterization/Certification Project (TWCP) Records Management/Document Control (RMDC) Center contains copies of the documents that are referenced in this summary report. Unclassified Controlled Nuclear Information (UCNI) are reported in records, rather than included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This AK waste stream summary report is based on detailed process information compiled in *Process Acceptable Knowledge Summary Report for Plutonium-238 Operations at TA-55* (TWCP-AK-2.1-009). This particular process AK report contains information on 11 individual processes that have each been assigned a unique identifier called a process/status (P/S) code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generator records. However, as described in section 3.2, TA-55 TRU waste items have always been segregated and packaged into waste containers based on the physical form and material type content of the waste, without regard to process of origin (i.e., P/S code). In order to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number), separate AK reports have been prepared for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in the process AK report.

## 3.0 DESCRIPTION OF THE WASTE STREAM

### 3.1 Facility and Mission

The TA-55 Plutonium Facility processed Pu-238 into heat sources from Pu-238 feedstock supplied by Savannah River Site (SRS). Waste streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47 were generated at the TA-55 Plutonium Facility as a result of these heat source fabrication activities. The Pu-238 fabrication activities were strictly segregated from all other Pu-processing activities at TA-55 because cross-contamination of materials would adversely affect the quality and usability of the end products (TWCP-1037). The heat source

fabrication activities included both defense missions (the Milliwatt Generator Program, TWCP-1045) and nondefense applications such as the space program. However, waste also was produced from "special process" and research-related activities. These wastes were not segregated until 1998, but rather were commingled in the final waste containers to such an extent that segregation is not possible on the basis of waste generating process or glovebox location (TWCP-887). For this reason the waste streams are defense related. The waste was also co-mingled with room trash related to these same operations (both defense and non-defense), which was initially boxed as low-level waste but was returned for discard in drums as TRU waste when on-site radioassay results showed it exceeded the low-level waste threshold value (TWCP-816). In addition, all the fuels possess approximately the same weight percent Pu-238, so there is no distinguishing isotopic signature among the fuels of the various projects.

TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47 waste streams were generated in the TA-55 Plutonium Facility (Building PF-4). A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

## 3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process of origin. Relevant details of these planning and implementation documents are summarized in this section, to provide background information to support the process used by TWCP to assign TA-55 waste containers to specific waste streams. Waste stream assignment is made on the basis of waste generator information compiled in the TWCP waste container data base, which comprises the bulk of the AK Information Summary. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, which are key factors in the evaluation of the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents in that drum.

### 3.2.1 Waste Packaging at TA-55

Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged by this team. Materials are considered waste only when they have been received and processed by the waste

management team. Waste segregation schemes used by this team have evolved since operations began at the Plutonium Facility in 1978.

In 1978, the standard operating procedure for waste management at TA-55 stated the guiding philosophy of minimizing the amount of waste generated and minimizing the plutonium content of that waste (TWCP-3943). Discard limits for plutonium in various types of waste matrices were established by the waste-generating group, and approved by the LANL division office and the DOE Albuquerque Operations Office. Personnel were requested to sort potentially recyclable TRU waste items (i.e., those containing potentially recoverable amounts of plutonium) into classes such as rubber, plastics, rags, non-Pu metals, glass, oils, cans, sweepings, etc. These materials were then assayed. Based upon its plutonium level relative to the DL, material was either sent to recovery operations or to "20-year" retrievable storage. All liquids, including oils, were required to be sent to recovery operations for processing. Liquids were explicitly prohibited from any container of solid waste materials.

In 1984, a lab-wide TRU Waste Certification Plan was adopted for newly generated TRU waste (TWCP-697). Each LANL waste generator was required to develop an attachment to this plan to define the details of the waste certification functions and controls that applied to their specific processes and waste streams. TA-55 prepared an attachment in March 1987 for contact-handled combustible and noncombustible solid waste (TWCP-701), defined as follows:

- Combustible waste forms included materials that could be reduced to an ash if desired but that did not require further processing to meet the WIPP WAC (TWCP-701). (This definition is still current.) Subcategories included plastic-base, cellulose-base and miscellaneous (graphite and graphite crucibles). It was acceptable for the combustible waste stream to include some unspecified "small" fraction of noncombustible solids such as scrap metals.

- Noncombustible waste forms included materials that could not be reduced to ash but that did meet the WIPP WAC without further processing (TWCP-701). The two subcategories were metals and non-metals. The non-metal wastes included glass, fiberglass heating mantles, porcelain crucibles, ceramic furnace tube inserts, and leaded glovebox gloves. It was acceptable for the noncombustible waste stream to include some unspecified "small" fraction of combustible solids, and that could be contained in plastics. For WIPP purposes, any waste forms that were chemically compatible and that met the WAC, could be combined into a single waste container.

In 1995, a new TRU Waste Certification Plan was adopted, including a new attachment that formalizes how the TA-55 waste management team currently segregates newly generated wastes into waste streams (TWCP-700). Waste materials are segregated:

- by radioisotope, to meet nondestructive assay (NDA) and gas generation requirements
- by material matrix, to meet NDA and TRUCON requirements
- by hazardous constituents, to meet RCRA and Department of Transportation (DOT) requirements

Combustible waste forms include plastic base and cellulose base (TRUCON code 116), but graphite waste was moved to the noncombustible category. Noncombustible debris waste forms are broken down to a finer level of classification than had previously been used:

- metals (TRUCON code 117)
- glass (TRUCON code 118)
- HEPA filters (TRUCON code 119)
- leaded gloves (TRUCON code 123)
- salts (TRUCON code 124)
- graphite (TRUCON code 115)

In addition, each major waste form includes provisions for small quantities of unspecified waste with similar properties. This provision is necessary to allow for infrequently encountered waste items.

### 3.2.2 Waste Stream Delineation for TA-55

From the beginning of operations at TA-55, the physical description of each waste item generated was documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for waste items was sometimes also documented on this form. Starting in 1987, the TA-55 Plutonium Facility began its current system of tracking waste items both by the process from which they originated as well as by their material content. Waste items are labeled with an item identification (ID) code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item (although recording of P/S codes was inconsistent until about 1990). In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each ID code and record its matrix material. This form was signed by the waste packager and approved by

quality assurance personnel. Both the WODF and DWLS for each TRU waste drum have been maintained as hard copy records by the generator. For waste stream TA-55-19, example copies of these container records (for combustible debris) are included in Attachment 4. Note that this waste container (LA00000055683) contains waste items generated by three different P/S codes (CXL, ED, and SC), each with its own completed WODF.

Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

Waste stream delineation was performed using waste generator information (such as the WODF and DWLS) that has been compiled in an electronic database that is part of the AK Information Summary. Because waste items from several different P/S codes were combined into each waste drum, a special sort on the P/S code of each waste item in a drum was necessary to determine if the drum contained all non-mixed items, some or all mixed-waste items, or a special case item. If the P/S code information was missing for any item in a waste drum (as was the case for many older wastes), that drum was conservatively assigned to the mixed-waste stream.

### 3.2.3 Waste Container Labeling

The net effect of the waste packaging system used at TA-55 is that several HWNs are conservatively assigned to individual waste streams for the purposes of WIPP disposal, because the WIPP WAP requires HWN assignment on a waste stream rather than a waste container basis. For the purposes of generator and on-site storage, however, LANL labels waste on a container by container basis. Thus, the hazardous labels on containers in storage at LANL should not be expected to correspond to the HWNs assigned to the waste stream through this AK summary report. Hazardous labels are updated to meet WIPP disposal requirements just before loading waste containers into the Transuranic Package Transporter-Model II (TRUPACT-II) for shipping to the WIPP.

3.3 Waste Physical Form and Content Description

The TA-55-43 and TA-55-44 waste streams are defined as combustible/ noncombustible debris waste (AK Information Summary, Appendix D), with TA-55-44 being a mixed waste stream and TA-55-43 its non-mixed counterpart. The waste includes paper, rags, plastic, rubber, and plastic-based and cellulose-based waste generated during Pu-238 activities. Plastic-based waste includes, but may not be limited to: tape, polyethylene and vinyl; gloves; plastic vials, polystyrene; tygon tubing; polyvinyl chloride plastic; Teflon products; plexiglass; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to: rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials. The waste may also contain HEPA filters and noncombustible glass and metallic debris. Some of this waste was packaged in small metal cans before being placed in 55-gallon drums.

The TA-55-45 and TA-55-46 waste streams are defined as metallic waste (AK Information Summary, Appendix D), with TA-55-46 being a mixed waste stream and TA-55-45 its non-mixed counterpart. The waste includes small tools, cans, small equipment, motors, pumps, process equipment, gloveboxes, ventilation ductwork, and pipes. The waste may also contain a small fraction of combustible solids (paper, rubber, plastics) (AK Information Summary, Appendix D).

The TA-55-47 waste stream consists of HEPA filters (AK Information Summary, Appendix D).

3.4 Waste Volume and Time Period of Waste Generation

The information in Table 1 is from the AK Information Summary (TWCP-PLAN-0.2.7-001, R.5, Table 3-1). These values will change as the AK Information Summary is continually updated and as new waste information is obtained.

**Table 1. Pu-238 Debris Waste Stream Volumes and Years Generated**

| Waste Stream | Waste Stream Volume | Years Generated |
|---|---|---|
| TA-55-43 | 166 containers (35 $m^3$) | 1993 to 1998 |
| TA-55-44 | 952 containers (188 $m^3$) | 1978 to 1998 |
| TA-55-45 | 86 containers (18 $m^3$) | 1993 to 1998 |
| TA-55-46 | 167 containers (32 $m^3$) | 1978 to 1998 |
| TA-55-47 | 14 containers (2.9 $m^3$) | 1993 to 1998 |

Source: AK Information Summary, R.5, Table 3-1

## 3.5 Waste Generation Process

### 3.5.1 Overview

The Pu-238 debris waste streams were generated from Pu-238 operations used in TA-55 processes to fabricate heat sources.

The manufacturing and research operations performed at TA-55 in the recovery of plutonium results in the production of plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical (TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scrap generated from operations at various LANL facilities and other DOE sites and from commercial radioactive sources. These recovery operations, along with associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Plutonium processing facilities generate contaminated debris waste that includes:

- paper, rags, plastic, rubber, and plastic-based and cellulose-based waste. Plastic-based waste includes, but may not be limited to: tape, polyethylene and vinyl; gloves; plastic vials, polystyrene; tygon tubing; polyvinyl chloride plastic; Teflon products; plexiglass; and dry box gloves (unleaded neoprene base). Cellulose-based waste includes, but may not be limited to: rags, wood, paper, and cardboard; laboratory coats and overalls; booties and cotton gloves, and similar materials.

- small tools, cans, small equipment, motors, pumps, process equipment, gloveboxes, ventilation ductwork, and pipes.

- HEPA filters.

### 3.5.2 Process Flow Diagrams

Detailed information about the TA-55 Pu-238 processes is compiled in *Process Acceptable Knowledge Summary Report for Plutonium-238 Operations at TA-55* (TWCP-AK-2.1-009). A generalized flow diagram for Pu-238 processes relevant to this AK search is presented as Attachment 3. The full block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

The following subsections describe the processes that generated waste assigned to the TA-55-43, TA-55-44, TA-55-45, TA-55-46, and TA-55-47 waste streams. The potential for RCRA-regulated constituents to be

present due to feed materials or chemical use in these processes is summarized in Section 3.6. The applicability of EPA HWNs as a result of this potential is specified in Section 8.

Pu-238 processing operations involve several separate and different processes. The processes and P/S codes applicable to these operations are listed below.

- Aqueous Scrap Processing (P/S code ASP)
- General Purpose Heat Source Fabrication (P/S code GPHS)
- Metallography (P/S code MTL)
- Routine Pu-238 Heat Source Production (P/S code P1)
- Routine Pu-238 Waste Solidification (P/S code R8)
- Recovery of Pu-238 from Sucrose Solutions (P/S code R8)
- Recovery of Pu-238 from Contaminated Iridium (P/S code RCI)
- Routine Pu-238 Scrap Processing (P/S code SCP)
- Pu-238 Direct Oxide Reduction (P/S code WS)

### 3.5.3 Aqueous Scrap Processing (P/S code ASP)

P/S code ASP is a new activity that covers work involved in the purification of solid Pu-238 oxide ($^{238}PuO_2$) in a nitric acid stream, similar to the recovery activities already established for Pu-239 as part of TA-55 nitrate operations (e.g., P/S codes ED, MPD, SC and SP described in TWCP-AK-2.1-005). A flow chart showing the Pu-238 Aqueous Scrap Recovery Process (P/S code ASP) is included as Attachment 5 in the process AK report for Pu-238 operations.

During comminution, the Pu-238 solid is ground to a particle size < 5 μm, after which all or a portion of the ground material is put into a dissolution vessel. The Pu-238 solid is dissolved in a mixture of refluxing concentrated nitric acid and hydrofluoric acid. The Pu-238-rich solution is filtered through a 5-μm Teflon membrane, which is then stored in a stainless steel can. A portion of the filtrate may be processed through ion exchange, or the entire filtrate may be treated for oxalate precipitation.

Oxalate precipitation involves pH adjustment of the filtrate with nitric acid. Urea is added to scavenge nitrite that could interfere with further chemical pretreatment. Hydroxylamine nitrate is added to adjust the valence of the plutonium to (III). Oxalic acid is added to form a Pu-oxalate precipitate. The precipitate is filtered, and calcination converts the Pu-238 oxalate to $^{238}PuO_2$ product. The solid product is cooled, weighed, and stored.

The Pu-238 filtrate destined for ion exchange may undergo an aluminum nitrate treatment in which the filtrate is added to aluminum nitrate dissolved in dilute nitric acid, followed by filtration to collect any formed solids. (Typically, the aluminum nitrate treatment is not performed.) The filtrate then undergoes pretreatment involving urea, sodium nitrite, and ferrous salt prior to ion exchange. The Pu-rich eluate is collected and undergoes oxalate precipitation as described above. The Pu-lean effluent, which contains impurity metal ions as well as aluminum from the aluminum nitrate treatment, is adjusted to a basic pH with sodium hydroxide. The majority of the impurity ions—along with any residual Pu-23—precipitate as metal hydroxides.

The hydroxide precipitate is calcined and then stored, and the hydroxide filtrate is sampled to determine the radioactivity level. The hydroxide filtrates are transferred to P/S code R8, which is the residue solidification process. In this process, any soluble Pu-238 is recovered with ferric nitrate and sodium hydroxide, and the filtrate resulting from the solidification process is sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50 through the caustic waste line. Pu-238 in the hydroxide filtrates can also be recovered by an ultrafiltration/polymer filtration (UF/PF) process.

The $^{238}PuO_2$ product is sent to P/S code P1. The hydroxide cakes are stored either in the vault or in the glovebox line.

3.5.4 Heat Source Fabrication (P/S codes GPHS and P1)

The routine Pu-238 heat source production process involves fuel fabrication, pellet production, and scrap/process residues processing. Each of these processes constitutes a separate operation, using different materials and generating different types of waste; therefore, they are addressed individually below. Debris waste containing lead (e.g., gloves) may be generated by any of the heat source production processes. This waste is segregated from non-lead debris waste and disposed of as RCRA-regulated TRU waste.

The first step in each of the processes is $^{16}O$ isotopic exchange that occurs at 775 °C. In GPHS and LWRHU processing, oxygen isotopic exchange is followed by heating to 1000 °C to release the alpha-decay product helium from the $PuO_2$ crystal structure. The MWG processing scheme later seasons the granules at 1600 °C while GPHS and LWRHU season a portion at 1600 °C and a second portion at 1100 °C. The latter two processes ultimately hot press the pellets at 1530 °C and later heat treat the pellets at 1000 °C and finally at 1527 °C. By contrast, the MWG process mixes the $PuO_2$ with powdered yttrium metal and heats it at 1350 °C to form a sub-stoichiometric plutonium oxide. These

temperatures are so high as to ensure that any organic material that might have been present in the initial feedstock would not survive in the fuel.

Fuel Fabrication

The feed material for the fuel fabrication is $^{238}PuO_2$ from SRS. The SRS has been directly or indirectly the source of all feed material for fuel fabrication. This material goes through the physical processes of weighing, splitting, ball milling, slugging and screening, and granule seasoning. No solvents or metals are introduced to the process; therefore, the waste generated will not be regulated by the EPA under RCRA. All waste generated from the fuel fabrication process is nonmixed waste.

Pellet Production

The feed material for the pellet production process consists of $^{238}PuO_2$ from fuel fabrication. This material undergoes the physical processes of screening and weighing, die loading, hot pressing, sintering, and dimensioning. The product is sent to the vault and any residues are sent to the scrap/process residues processing. No solvents or metals are introduced to this process; therefore, any waste generated is not RCRA-regulated and is considered nonmixed TRU debris waste.

Scrap and Process Residues Processing

The scrap and process residues processing operation receives materials from the vault and various other processes, such as fuel fabrication, pellet production, calorimetry, and metallography. This is a physical process consisting of weighing, sorting, segregating, and loading into a shipping container. The product from this process either goes to the vault or feeds into the calorimetry operation. No solvents or metals are introduced into this process. Therefore, the waste generated is nonmixed TRU debris contaminated with Pu-238.

3.5.5 Metallography (P/S code MTL)

The metallography process receives its feed material ($^{238}PuO_2$) from P/S code P1 processes. The metallography process is a physical process involving cutting, mounting, grinding, polishing, and photography. The process may also include etching.

The feed material consists of $^{238}PuO_2$ fuel samples recovered from encapsulated heat sources, impacted heat sources, fuel pellets, or other sources. This process is predominately a physical process, generating

only Pu-238-contaminated debris waste. However, chemicals are used to mount and etch the $^{238}PuO_2$.

The waste generated from the metallography process includes aluminum tape, grinding papers and polishing cloths, aqueous abrasive slurries, acid etching solution, and aqueous washing/cleaning solutions. All of these wastes are nonmixed, Pu-238-contaminated wastes. The grinding papers and polishing cloths are dried and disposed of as debris waste, as is the aluminum tape. The aqueous abrasive slurries, which are not RCRA-regulated, are feed material for the Pu-238 waste solidification process (P/S code R8). Any etching solution remaining on the $^{238}PuO_2$ sample is rinsed off using distilled water and is collected with the aqueous wash solutions. These solutions, which are not RCRA-regulated, are also sent to the waste solidification process (P/S code R8). Any excess etching solution, which is a corrosive liquid, would not be contaminated with Pu-238 and, therefore, would not be TRU waste.

The metallography process may generate debris waste containing lead (e.g., gloves). This waste is segregated from non-lead debris waste and disposed of as RCRA-regulated TRU waste.

3.5.6 Scrap Processing (P/S code SCP)

The scrap processing operation received its feed material ($^{238}PuO_2$) from calorimetry operations (P/S code C1), heat source operations (P/S codes P1 and GPHS), and the vault. The feed material did not contain any hazardous constituents. It was a physical process that involved opening, weighing, sorting, and segregating the $^{238}PuO_2$ that arrived in an EP-60 shipping container. The $^{238}PuO_2$ was then loaded into a shipping container and sent to the calorimetry process then to the vault.

No solvents or metals were introduced into the process; therefore, the only waste generated is solid debris waste. Any debris waste containing lead (e.g., gloves) was segregated from non-lead debris waste and disposed of as RCRA-regulated TRU waste. The types of materials in the debris waste include cheesecloth pads and metal tools and equipment.

3.5.7 Recovery of $^{238}PuO_2$ from Contaminated Iridium (P/S code RCI)

The process was the recovery of $^{238}PuO_2$ from contaminated iridium (Ir). The feed material for this process came from metal items in the Ir inventory in TA-55, Building PF-4, or TA-3, CMR Building. This process used both molten magnesium chloride and electrochemical dissolution to remove the Pu-238 from the Ir.

The waste generated from the recovery process includes solid, non-hazardous, TRU debris waste, such as magnesium chloride salt, magnesium oxide crucibles, tantalum and stainless steel cans, and routine laboratory trash. Any debris waste containing lead (e.g., gloves) was segregated from non-lead debris waste and disposed of as RCRA-regulated TRU waste. The spent electrolyte solution, which was acidic and contaminated with small amounts of Ir and Pu-238, and the water wash were sent to the Pu-238 solidification process (P/S code R8).

3.5.8 Routine $^{238}$Pu Waste Solidification (P/S code R8)

The process of solidifying Pu-238 in waste solutions began in 1978 and is still active. Feed material for this process comes from analytical operations (CHM-1, CLS-1), Pu-238 heat source fabrication operations, metallography operations, and Pu-238 decontamination operations. The feed solutions are strongly acidic, contain heavy metals, and have Pu-238 concentrations that are many orders of magnitude above the discard limit for radioactive waste solutions. The solidification process uses sodium hydroxide, ferric nitrate, and phenolphthalein (1%) in ethanol to precipitate Pu-238.

The analytical techniques for Pu-238 solutions do not require organic solvents and heavy metals to be introduced into the solutions. In addition, the Pu-238 solutions returning from analytical chemistry are analyzed for heavy metals (totals) in a random fashion along with routine analyses for pH (or acid concentration) and radioactivity. Thus, from 1992 – 1997, 68 analyses were performed on 49 solutions returning from CLS-1, as follows: four for arsenic (As), three for barium (Ba), four for cadmium (Cd), 24 for chromium (Cr), three for lead (Pb), six for mercury (Hg), five for selenium (Se), and 19 for silver (Ag). None of the analytical results for total metals exceeded the RCRA regulatory level for the toxicity characteristic for the metals (based on the 20:1 factor). Two of the results for Hg were inconclusive due to insufficient sensitivity in the analysis.

The hydroxide ferroflocculation process might concentrate the heavy metals from the analytical solutions sufficiently to put them above the regulatory level for toxicity in the hydroxide cakes. Based on the concentration of metals in the feed waste stream (CLS-1 solutions) and the chemistry involved in the solidification process, the arsenic, barium, chromium, and selenium remain in the filtrate. The cadmium (Cd), lead (Pb), mercury (Hg), and silver (Ag) co-precipitate with the hydroxide cakes. Since May 1991, the filtrate from this process has been analyzed for metals and all results have been below the RCRA regulatory limits. Without analytical data on the hydroxide cakes, the RCRA codes for Cd

(D006), Pb (D008), Hg (D009), and Ag (D011) must be applied to the hydroxide cakes (but not to the debris waste).

The solid debris waste generated from this process is disposed as TRU solid, non-mixed waste. It is not assigned any EPA hazardous waste numbers. Any laboratory debris waste containing lead (e.g., gloves) is segregated from non-lead debris waste and is disposed of as RCRA-regulated TRU waste.

3.5.9 Recovery of Pu-238 from Sucrose Solutions (P/S code R8)

The recovery of Pu-238 from sucrose solutions comprised feed material that consisted of a 35% sucrose solution composed of sodium pyrophosphate, water, and sucrose. Sucrose solutions were used as a dispersive medium in particle size analysis of $^{238}PuO_2$; therefore, the feed solutions contained $^{238}PuO_2$.

This was a physical process. No solvents were introduced during the process or as feed material. The wastes generated from this process consist of a calcined residue of sucrose and solid debris waste. The debris waste may contain stainless steel, ceramic, glassware, tygon tubing, and filter paper. All of the waste generated is solid TRU waste. Any laboratory debris waste containing lead (e.g., gloves) is segregated from non-lead debris waste and is disposed of as RCRA-regulated TRU waste.

3.5.10 Pu-238 Direct Oxide Reduction (P/S code WS)

P/S code WS is a new activity that uses Direct Oxide Reduction (DOR) process described for P/S code OR in TWCP-AK-2.1-006. In this process, $PuO_2$ and calcium metal are reacted in molten calcium chloride to produce plutonium metal. The reaction is conducted in a magnesium oxide crucible at 820°C to 875°C. Any arsenic, mercury or selenium present in the impure plutonium oxide would be driven off due to their volatility at this high temperature (TWCP-1258). The reaction proceeds to completion when excess calcium is present and when sufficient calcium chloride is available to dissolve the calcium oxide product.

After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide. All DOR salts are exposed to air to oxidize any pyrophoric metals that might be present. The salt is then either routed through aqueous recovery operations (P/S code ASP) to recover the plutonium, or discarded as waste along with the remaining calcium metal (which has been converted to calcium oxide) and magnesium oxide crucible pieces.

3.6 Material Inputs to the Waste Generation Process

Material inputs to the waste generation processes derive from four general sources: (a) feed materials, (b) associated nuclear material types, (c) chemical use, and (d) ancillary material inputs such as those related to the use of laboratory equipment and materials and glovebox maintenance activities.

3.6.1 Feed Materials Identification

The feed materials for processes that generate Pu-238 debris waste consist of the general types of materials listed in Table 2. These feed materials are obtained either from the storage vault, as process outputs from various P/S codes, or from sources outside TA-55, including other DOE facilities.

**Table 2. Typical Process Feed Materials for Pu-238 Operations**

| Feed Material | RCRA-Regulated Substances | P/S Codes in Pu-238 Operations |
|---|---|---|
| Pu oxide | Pure $^{238}$Pu oxide produced, separated and purified at SRS. SRS information indicates that no RCRA substances are present in this material (TWCP-1044) | GPHS, MTL, P1, SCP, WS |
| Intermediate Pu-238 products in purification processes (Pu oxalates, oxides, hydroxides) | Hydroxide cakes may contain Cd (D006), Pb (D008), Hg (D009), and Ag (D011). The other products typically do not contain RCRA substances | ASP |
| Analytical laboratory solutions | Analytical laboratory solutions are potentially contaminated with Cd (D006), Pb (D008), Hg, (D009), and Ag (D011). | R8 |
| Crucible pieces (tantalum, magnesium oxide) | Typically pure, no RCRA substances present | ASP |
| Iridium metal | Typically pure, no RCRA substances present | RCI |
| Other matrices contaminated with Pu-238 above the discard limit (e.g., ash, salts, equipment) | Purity determined on a case-by-case basis | ASP, R8 |

3.6.2 Radionuclide Content Identification

The primary Pu material type input for Pu-238 processes at TA-55 is MT-83. The designation *material type* (e.g., MT-83) is used within the

DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 3 indicates the isotopic composition of Pu-238 material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The purpose of such bounding calculations is to provide a basis for identifying significant enrichment or depletion of one radionuclide versus another, based on radioassays of individual waste containers (see Section 14.3). The results of these calculations are tabulated in the last three columns of Table 3. The calculations assume that (a) none of these isotopes were

**Table 3. Average Isotopic Content of Plutonium Material Type MT-83**

| | Plutonium Isotope (Wt. %) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| Material Type (MT) | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT-83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

TA-55 processes are not expected to alter the Pu isotopic ratios of the feed material. The material type used in the process generating each waste item was documented on the WODF and DWLS (examples shown in Attachment 4). However, other radionuclides are present in most of the process wastes from decay of a Pu precursor or as a contaminant in the feed material. Table 4 lists analyses of actinide impurities in several $^{238}PuO_2$ fuel lots as received from SRS for LWRHU production.

- Np-237, the decay product of Am-241 (half-life, 458 yr), is expected to be present in minor amounts in most debris waste from processes at TA-55. It was present in the oxide fuel lots listed in Table 4, at concentrations up to 2 x $10^{-3}$ (relative to Pu).

- U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life and very low levels of Pu-239 in MT-83.

- U-234 is present as a decay product of Pu-238 (half-life, 87.74 years) (Table 3). It was present in the oxide fuel lots listed in Table 4, at concentrations up to 1 x $10^{-3}$ (relative to Pu).

- Th-232 was also present as a contaminant in the oxide fuel lots (Table 4).

**Table 4. Actinide Impurities in $PuO_2$ Fuel Lots for the Cassini Program**

| Isotope | Los Alamos Fuel Lot (μg/g Pu) | | | | |
|---|---|---|---|---|---|
| | **272** | **274** | **275** | **285** | **286** |
| $^{232}Th$ | 1700 | 1800 | 2300 | 2190 | 1845 |
| $^{234}U$ | 300 | 190 | 1070 | 720 | 615 |
| $^{236}Pu$ | <1 | <1 | <1 | <1 | <1 |
| $^{237}Np$ | 1030 | 1060 | 1460 | 1500 | 1545 |
| $^{241}Am$ | 46 | 49 | 71 | 29 | 36 |

Source: TWCP-1030

In general no correlation is expected to be seen among the different radioelements: Th, Pu, Np, U, or Am. The differences in valence states and chemical affinities among these elements are expected to result in substantial fractionation during several TA-55 and SRS processes, including ion exchange, solvent extraction, hydroxide precipitation, and dissolution.

Secondary radionuclides are also present in the waste due to processing of feed materials other than Pu-238 (TWCP-882), e.g., thermal decomposition of cellulosic debris under P/S code TDC, which is conducted in the same general vicinity as the Pu-238 operations. This activity is a potential source of local contamination for additional Am-241, Np-237, U-234, and Th-232, as well as for Am-243, Th-230, U-235, and U-238.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The assay results are summarized in Section 14.3.

3.6.3 Chemical Content Identification

Chemical contents of Pu-238 process inputs and outputs were compiled from chemical lists contained in procedures reviewed during the process AK search and from subject matter expert (SME) input. The Pu-238 process AK report contain detailed assessments of these chemical inputs and of the applicability of EPA HWNs (TWCP-AK-2.1-009). This section summarizes the chemical inputs in the following categories:

- Acids and bases
- Gases and cryogenic fluids
- Metals
- Inorganic chemicals
- Organic chemicals

3.6.1.1 *Acids and bases.* Acids used in the TA-55 Pu-238 processes are hydrobromic acid, hydrochloric acid, hydrofluoric acid, nitric acid, and oxalic acid. Sodium hydroxide is the only base used in Pu-238 processes. No EPA HWNs are applicable to the use of these chemicals in the TA-55 Pu-238 processes for the following reasons:

- D001 (oxidizer), D002 (corrosivity), and D003 (reactivity) do not apply to the solid debris waste because there are no free liquids in this waste.

- Hydrofluoric acid is listed in Appendix VIII of 40 CFR Part 261, for its corrosive and toxic characteristics, with EPA HWN U134. However, the HWN is not applicable to the manner in which this chemical was used in the processes covered by this report.

- None of the acids or bases are F, K or P-listed chemicals.

3.6.3.2 *Gases and cryogenic fluids.* Argon is the only gas used in the TA-55 Pu-238 processes and is not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation. No cryogenic fluids are used.

3.6.3.3 *Metals.* Iridium and yttrium are used in the TA-55 Pu-238 processes but are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII of that regulation.

3.6.1.2 *Inorganic chemicals.* The following inorganic chemicals used in the TA-55 Pu-238 processes are not identified as having

hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: aluminum oxide, diamond, ferric nitrate, magnesium chloride, magnesium oxide, silicon carbide, and sodium pyrophosphate.

3.6.1.3 *Organic chemicals.* The following organic chemicals used in the TA-55 Pu-238 processes are not identified as having hazardous characteristics in 40 CFR Part 261, including Appendix VIII in that regulation: Duco Cement, epoxy mounting resin, ethylene glycol, Fantastik, ion exchange resins, phenophthalein, sucrose, and UCAR C-34 cement.

Ethanol is identified in Appendix VIII of 40 CFR Part 261 as having hazardous characteristics (flammability). However, no HWN applies to the use of this chemical in Pu-238 processes because there are no free liquids in solid TRU waste streams.

## 4.0 DIVISION OF THE WASTE STREAM INTO LOTS

Waste containers in a waste stream are characterized as a campaign, in which the targeted group of waste containers to be characterized is selected based on criteria such as availability of the waste containers, waste loading level, availability of waste generator records, and hazardous waste numbers. Hence, the waste streams produced through Pu-238 activities at TA-55 will be divided into sub-streams based on TWCP characterization and certification schedule of activities.

## 5.0 CORRELATIONS BETWEEN WASTE STREAMS

The Pu-238 wastes generated from TA-55 between 1979 and the present were all generated as part of the same heat-source fabrication processes, which were physically separated from other TA-55 activities that processed Pu-239 material types. Waste streams TA-55-43 through TA-55-47 are closely related to each other but are not related to other waste generation activities at TA-55 involving Pu-239 processing.

## 6.0 ASSIGNMENT OF WASTE MATRIX CODES

Table 5 lists the waste matrix codes (WMC) assigned to each of the Pu-238 debris waste streams based on waste generation practices described in the TA-55 Waste Management Procedure, 1996 (TWCP-351), description of past segregation practices (TWCP-701, Section 2.1, page 4 of 43), and the process AK report for Pu-238 operations at TA-55 (TWCP-AK-2.1-009). The table also lists additional waste-related codes that apply to the waste streams, based on definitions and information in the *Transuranic Waste Baseline Inventory Report* (TWBIR), the TRUPACT-II Content (TRUCON) Code (DOE/WIPP-89-004/Rev.12), Radioactive Solid Waste Disposal (RSWD), and Item Description Code (IDC).

**Table 5. Assignment of Waste Codes to Pu-238 Debris Waste Streams**

| Waste Stream | TA-55-43 | TA-55-44 | TA-55-45 | TA-55-46 | TA-55-47 |
|---|---|---|---|---|---|
| **Waste Description** | Combustible/ noncombustible debris | Combustible/ noncombustible debris | Metal debris | Metal debris | HEPA filters |
| **WMC** | S5000 | S5000 | S5100 | S5100 | S5410 |
| **TWBIR** | LA-T004<br>LA-T005 | LA-W001 | LA-T005 | LA-W005 | LA-T005 |
| **TRUCON codes** | LA116<br>LA117<br>LA118<br>LA119 | LA115<br>LA116<br>LA118<br>LA119<br>LA123 | LA117 | LA117 | LA119 |
| **RSWD** | None listed | A10, A14, A15, A16, A17, A18, A19, A30, A52, A55, A60, A61, A95 | None listed | A30, A31, A51, A52, A61 | None listed |
| **IDC** | 004 | 001, 004, 005 | None listed | 001, 005 | None listed |

Source: AK Information Summary, R.5

## 7.0 ASSIGNMENT OF WASTE MATERIAL PARAMETER CODES

Table 6 lists the waste material parameter (WMP) codes assigned to each of the Pu-238 debris waste streams based on waste generation practices described in the TA-55 Waste Management Procedures (see Section 3.2), the process AK report for Pu-238 operations at TA-55 (TWCP-AK-2.1-009), a review of waste items listed for individual containers in TWCP-5086, and waste-generator information compiled in the AK Information Summary.

## 8.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

### 8.1 F, K, and P Listings

RCRA-regulated F-listed, K-listed and P-listed materials are not present in the feed materials and are not introduced as a part of Pu-238 operations. Therefore, there are no F-listed, K-listed or P-listed constituents in solid TRU waste generated by Pu-238 operations.

**Table 6. WMP Codes Applicable to Pu-238 Debris Waste Streams**

| WMP | TA-55-43 | TA-55-44 | TA-55-45 | TA-55-46 | TA-55-47 |
|---|---|---|---|---|---|
| Iron-based Metals/Alloys (IM) | Major | Major | Major | Major | Major |
| Aluminum-based Metals/Alloys (AM) | — | — | Minor | — | — |
| Other Metals (OM) | — | Minor | — | Minor | Minor |
| Cellulosics (C) | Major | Major | — | — | Minor |
| Rubber (R) | Minor | Minor | — | — | — |
| Plastics (waste) (PW) | Major | Major | Minor | Minor | Minor |
| Organic Matrix (OR) | — | — | — | — | — |
| Inorganic Matrix (IN) | Minor | Minor | — | — | Major |
| Soils/Gravel (S) | Minor | Minor | — | — | — |
| Other Inorganic Materials (OI) | Major | Major | Minor | Minor | Major |
| Steel (packaging) (ST) | Minor | Major | Major | Major | Major |
| Plastics (packaging) (PP) | Minor | Minor | Minor | Minor | Minor |

— None or negligible

8.2 Toxicity Listings

No D001 (ignitable), D002 (corrosive), or D003 (reactive) listings apply to solid TRU waste from Pu-238 operations because no free liquids are present.

D005 (barium), D006 (cadmium), D007 (chromium), D008 (lead), and D011 (silver) are assigned to waste streams TA-55-44 and TA-55-46 due to the presence of waste from P/S code TDC, which sometimes processes Pu-238 items.

D006 (cadmium), D007 (chromium), D008 (lead), D009 (mercury) and D011 (silver) are assigned to debris waste from P/S code R8 (waste solidification) due to the potential for hydroxide cake material to be present in the debris waste.

D008 (lead) is assigned to waste streams TA-55-44 and TA-55-46 because any waste container of Pu-238 debris that contains lead (e.g., gloves, aprons, shielding) will be assigned to one of these two waste streams.

Sampling and analysis of waste material from waste stream TA-55-43 has confirmed that this waste stream does not contain RCRA-regulated toxic metals above regulatory limits (TWCP-1698). The results support AK information that the feed material supplied by SRS is high purity, and that no RCRA-regulated metals are added to the Pu-238 materials during processing at TA-55.

## 9.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." The waste streams covered by this AK report have no listings for corrosivity, reactivity, or ignitability. Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests (see Attachment 5), introduced in June 1980, included check boxes that the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments for TA-55 (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF (see Attachment 4, pp. 4 and 5) documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in waste, explosives were altogether prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. In case of a misfire or unconsumed explosives, a procedure is in place at TA-55 to ensure that explosives do not enter the waste stream (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

Controls have also been in place to ensure the exclusion of ignitable constituents. D001 does not apply to wastes in these waste streams for the following reasons:

- Solutions are sent to the RLWTF if they are below the DL for plutonium.
- If above the DL, the solutions are sent to aqueous processes as part of chloride or nitrate operations. Aqueous recovery steps include dissolution of any solid plutonium in hydrochloric or nitric acid, followed by plutonium recovery by ion exchange. The solutions are then below the DL and are either sent to the RLWTF or to the evaporator.
- Rags that are above the DL for plutonium are thermally decomposed, which destroys any organic component.
- Rags that are below the DL for plutonium are discarded as combustible debris, but headspace gas analyses support the contention that any organic solvents that may be present are below the limits established by the WIPP WAC (Section 14.4).
- Finally, 100 percent of the drums are subjected to headspace gas analysis, and drums showing over 500 ppm total flammable VOCs are prohibited from being shipped to the WIPP. (This limit is quite conservative. For comparison, the explosive limit for acetone by itself is 25,000 ppm.)

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed onto vermiculite and discarded in an appropriate waste stream and containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report (PWR) in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 10.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Controls are in place to ensure chemical compatibility for the waste contents and the TRUPACT-II shipping containers. Section 9.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

For waste that has been generated after the implementation of the 1987 Certification Plan, Generator Attachments, waste generators signed a statement on the WODF for each waste item specifying that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Prior to the installation of the Impact Test Facility in the early 1990s, explosives were prohibited

from TA-55. In addition, waste management inspectors performed visual inspection of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement.

Chemical compatibility analyses were performed for TRUCON codes 115 (graphite waste), 116 (combustible waste), 117 (metal waste), 118 (glass waste), 119 (filter waste), 123 (leaded rubber and metal waste), and 125 (mixed combustible/noncombustible waste), which indicated that all chemicals and the waste matrix were compatible at levels less than or equal to trace amounts (DOE/WIPP-89-004).

## 11.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed, or the container is tagged as non-compliant by filing a PWR in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

The effectiveness of administrative and procedural controls on the prohibition of pyrophorics in TRU waste has been verified through testing. For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the RFETS (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Chemical Waste Disposal Requests dated as early as June 1980 included boxes that were required to be checked if the waste contained pyrophoric, flammable, corrosive, or explosive materials (see Attachment 5, Chemical Waste Disposal Request).

In addition, for wastes generated after the implementation of the 1987 Certification Plan, Generator Attachments, associated waste packaging procedures, and quality assurance systems, the waste generator has signed a statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The TA-55 Attachment to the Certification Plan describes how these restrictions were verified by waste management personnel (TWCP-701, Sections 3.8.5 through 3.8.7).

## 12.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the Pu-238 operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in lists of process inputs documented in the TA-55 process AK reports.

- All transformers known to contain PCBs have been tracked from initiation of operations of TA-55 in 1978. When any transformer oil is drained, the oil is handled by a subcontractor who is wholly responsible for its disposal; this oil does not enter the LANL disposal operations (TWCP-3568/N-82).

- Ballast in fluorescent light fixtures could contain PCBs, but at TA-55 these light fixtures are outside the gloveboxes and hence would not enter the TRU waste stream.

- Oil-filled capacitors are not known to have been used in TA-55 gloveboxes.

In addition, if the possibility exists for the waste to contain PCBs, RTR operators are required to check for indications of PCB-containing materials or PCB-contaminated materials. If there is reason to suspect that an item may contain PCBs (based on AK, operator training, or previous operator experience), then the operator submits a PWR and places a hold tag on the waste container (Section 6.6.6 and Table 3 in TWCP-DTP-1.2-008).

## 13.0 DETERMINATION OF THE MAXIMUM NUMBER OF CONFINEMENT LAYERS PERMITTED FOR WASTE PACKAGING

Pu-238 debris waste is primarily generated from operations performed in gloveboxes. The waste is placed directly into bag-out bags (also called inner bags) through an opening in the glovebox where the bag is attached, and the bag is then closed and detached from the glovebox. Pu-238 debris waste may also be generated from "hot jobs" outside of the glovebox, such as valve changes, or from decontamination of spills or other releases. In these cases, the waste is placed directly into one (or possibly more) inner bags at the work area.

Waste drum packaging procedures for Pu-238 debris waste streams have gone through several changes since the beginning of operations at TA-55. TRUCON code assignments made by the waste generator are compiled in the AK Information Summary. However, in the absence of this information, TRUCON Codes will be assigned to the waste container in accordance with the default packaging configurations and associated TRUCON codes shown in Table 7, that reflect the packaging protocols in effect during different periods of time at TA-55 (TWCP-816) and that are consistent with characterization data obtained by RTR (Section 14.1).

**Table 7. Maximum Layers of Confinement to be Used for Pu-238 Debris Waste Streams in the Absence of More Specific Waste Characterization Data**

| Waste Stream | Default Layers of Confinement, based on WMC* | | | | | |
|---|---|---|---|---|---|---|
| | 01/78 – 12/97 | | | 01/98 – present | | |
| TA-55-43 | S5000 | LA125F | 5 layers, 2-DTT, 3-TT | S5000 | LA116E | 1 layer, 1-TT-F |
| TA-55-44 | S5100 | LA117H | 5 layers, 2-DTT, 3-TT | S5100 | LA117C | 1 layer, 1-TT-F |
| | S5110 | LA117H | 5 layers, 2-DTT, 3-TT | S5110 | LA117C | 1 layer, 1-TT-F |
| | S5120 | LA118E | 5 layers, 2-DTT, 3-TT | S5120 | LA118B | 1 layer, 1-TT-F |
| | S5300 | LA116H | 5 layers, 2-DTT, 3-TT | S5300 | LA116E | 1 layer, 1-TT-F |
| | S5311 | LA123G | 5 layers, 2-DTT, 3-TT | S5311 | LA123C | 1 layer, 1-TT-F |
| | S5410 | LA119E | 5 layers, 2-DTT, 3-TT | S5410 | LA119B | 1 layer, 1-TT-F |
| TA-55-45 TA-55-46 | S5100 | LA117H | 5 layers, 2-DTT, 3-TT | S5100 | LA117C | 1 layer, 1-TT-F |
| | S5110 | LA117H | 5 layers, 2-DTT, 3-TT | S5110 | LA117C | 1 layer, 1-TT-F |
| | S5120 | LA118E | 5 layers, 2-DTT, 3-TT | S5120 | LA118B | 1 layer, 1-TT-F |
| TA-55-47 | S5410 | LA119E | 5 layers, 2-DTT, 3-TT | S5410 | LA119B | 1 layer, 1-TT-F |

* Layers of confinement for these TRUCON Codes are defined in DOE/WIPP-89-004
DTT—drum liner bag closed by twist and tape
TT—inner bag closed by twist and tape
TT-F—filtered inner bag closed by twist and tape

## 14.0 CONFIRMATION OF AK INFORMATION FOR WASTE STREAM

Characterization data acquired by WAP-compliant activities provide a means to confirm AK information. Radiography, radioassay, and headspace gas analysis are conducted on all retrievably stored containers of debris waste, and VE has been conducted on over 60 containers of debris waste. Relevant aspects of the data produced by these activities are summarized in the sections below, focusing on the extent to which the data confirm AK information.

### 14.1 Radiography Data

Radiography data are examined to confirm AK information about WMC assignments, layers of packaging, absence of prohibited items, and relative

volumes or weights of waste matrix parameters for a waste stream. Thus far, 114 containers, which comprise slightly less than 8 percent of the 1474 containers in these five waste streams (based on AK Information Summary, R.4), have undergone RTR, with the data contained in WIPP-compliant batch data reports. The following observations are made from an examination of the data summarized in Table 8:

**Table 8. RTR Data for Pu-238 Debris Waste Streams**

| Waste stream | TA-55-43 | TA-55-44 | TA-55-45 | TA-55-46 | TA-55-47 |
|---|---|---|---|---|---|
| Number of containers in waste stream | 189 | 974 | 120 | 174 | 17 |
| Number of containers with RTR data | 53 | 14 | 35 | 11 | 1 |
| Waste stream (AK) WMC | S5000 | S5000 | S5100 | S5100 | S5410 |
| RTR WMC | | | | | |
| S5000 | 5 | --- | --- | --- | --- |
| S5100 | --- | 1 | --- | 1 | --- |
| S5110 | 1 | --- | 35 | 10 | --- |
| S5300 | 47 | 13 | --- | --- | --- |
| S5410 | --- | --- | --- | --- | 1 |
| Average % weight | | | | | |
| Combustible | 91 | 61 | 7 | 8 | 61 |
| Noncombustible | 9 | 39 | 93 | 92 | 39 |
| • Metal | 7 | 25 | 91 | 84 | 39 |
| RTR PWR | | | | | |
| • Sealed containers > 4 liters | 2 | 9 | 7 | 7 | --- |
| • Pressurized containers | 1 | --- | 1 | --- | --- |
| • Free liquid | 1 | --- | --- | --- | --- |
| • Heavy object | --- | --- | --- | 1 | --- |
| Number of packaging layers (excluding containers with RTR PWRs) | | | | | |
| No layers | 4 | --- | --- | --- | --- |
| Less than or equal to 1 | 3 | 1 | --- | --- | --- |
| Less than or equal to 2 | 18 | 2 | 9 | --- | 1 |
| Less than or equal to 3 | 23 | 2 | 14 | 1 | --- |
| Less than or equal to 4 | --- | --- | 4 | --- | --- |
| Less than or equal to 5 | --- | --- | --- | 1 | --- |
| Less than or equal to 6 | --- | --- | --- | --- | --- |
| Indeterminate | 1 | --- | --- | 1 | --- |
| Subtotal | 49 | 5 | 27 | 3 | 1 |

Data from RTR batch data reports: LA00-RTR-001 (TWCP-4079), LA00-RTR-002 (TWCP-4459), LA00-RTR-018 (TWCP-4469), LA00-RTR-019 (TWCP-TBD), LA00-RTR-025 (TWCP-4457), LA00-RTR-026 (TWCP-4574), LA00-RTR-028 (TWCP-4577), LA01-RTR-001 (TWCP-4545), LA01-RTR-003 (TWCP-4572), LA01-RTR-004 (TWCP-5061), LA01-RTR-005 (TWCP-TBD), LA01-RTR-006 (TWCP-TBD), LA01-RTR-011 (TWCP-5784), LA01-RTR-012 (TWCP-5111), LA01-RTR-013 (TWCP-5147), LA01-RTR-014 (TWCP-5087), LA01-RTR-015 (TWCP-5252), LA01-RTR-016 (TWCP-5088), LA01-RTR-017 (TWCP-5155), LA01-RTR-018 (TWCP-5119), LA01-RTR-020 (TWCP-5117), LA01-RTR-021 (TWCP-5838), LA01-RTR-023 (TWCP-5267), LA01-RTR-025 (TWCP-5265), LA01-RTR-026 (TWCP-5335), LA01-RTR-032 (TWCP-5842), LA01-RTR-036 (TWCP-5846), LA01-RTR-038 (TWCP-5848), LA01-RTR-043 (TWCP-5853), LA01-RTR-047 (TWCP-6007), LA01-RTR-056 (TWCP-6011); AK Information Summary, R.4

- positive confirmation of AK WMC for all drums

- identification of prohibited waste items in 29 drums, representing 25% of the 114 drums examined, for the following reasons: sealed containers > 4 liters (25 drums), pressurized container (2 drums), free liquid (one drum), and heavy object inadequately braced (1 drum). All of these drums were assigned PWRs and require repackaging to remediate the prohibited waste item.

- confirmed the presence of 3 or fewer packaging layers for all but one drum of debris waste in waste streams TA-55-43 and TA-55-44 (excluding drums with PWRs). The number of plastic layers for this single drum was indeterminate due to the large amount of plastic packaging material present.

- confirmed the presence of 5 or fewer packaging layers for all but one drum of metal debris waste in waste streams TA-55-45 and TA-55-46 (excluding drums with PWRs). RTR data for the number of plastic layers in one drum were indeterminate.

14.2 Visual Examination Data

VE data are used to confirm AK information on waste stream descriptions, WMC, the absence of prohibited items, the number and type of confining layers, and the relative volumes and weights of waste matrix parameters. As of August 13, 2001, AK packaging and WMC information had been evaluated by VE for 52 debris waste containers in waste streams TA-55-19 and TA-55-20, in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). VE results are summarized in the AK Summary Report for those waste streams (TWCP-AK-2.1-008), from which the following observations are made:

- VE confirmed the AK WMC (S5300) for all of the examined drums.

- The maximum number of confining layers observed by VE was five (for one drum), consistent with AK information indicating that the number of layers is six or less for debris waste (TWCP-816).

- No closed liners were found by VE, which confirmed AK and RTR information.

- For some of the drums, the number of confinement layers observed during VE was greater than the number of layers associated with the TRUCON code assigned for these drums by the waste generator. The default AK value indicated by Table 7 of TWCP-AK-2.1-008,R.0 was also less conservative than the VE findings. (The inconsistency was addressed in TWCP-AK-2.1-008,R.1.)

A conservative conclusion is that these discrepancies indicate that TRUCON code assignments by the waste generator must be viewed with caution, at least with

respect to waste containers packaged in 1997 when TA-55 personnel were transitioning from one packaging procedure to another.

14.3 Radioassay Data

Radioassay data are examined to confirm AK information on Pu material type and mass, the presence of other radionuclides contributing to the total activity in each drum, and evidence for fractionation of other actinides (e.g., uranium, americium) relative to Pu during material processing. Isotopic data have been obtained for drums created in 1998 when 28 parent drums containing Pu-23 debris waste were repackaged into 132 drums in order to meet wattage limits. Tables 9 and 10 summarize information relevant to these evaluations for the Pu-238 debris waste drums that have undergone isotopic analysis and radioassay.

Data in Tables 9 and 10 confirm the following AK information:

- The dominant isotope in 27 of the 28 parent drums is Pu-238. Pu-239 is dominant in one parent drum (55631), but isotopic analysis indicates that this drum contains a mixture of Pu-238 and Pu-239 material types.
- The material type is MT-83 for 27 of the 28 parent drums. The average measured percentage of Pu-238 is 77.5, showing a slight decrease (due to radioactive decay) from the initial value of 83.89 reported by AK. One drum (55631) appears to have a mixture of Pu-238 and Pu-239 material types.
- All the repackaged drums for which assay data have been reported qualify as TRU waste.
- The measured assay value for total Pu is within two standard deviations of that reported by the waste generator for all drums with complete assay results.
- Np-237 is present at low levels in 27 of the 28 parent drums, at levels similar to those reported in Table 3 (section 3.6.2). Am-243, the decay product of Pu-243, is present in 8 drums. Both of these nuclides are commonly present at low levels in TRU waste from TA-55.
- U-234, the decay product of Pu-238, is present at detectable levels in half of the parent drums. Its concentration (relative to total Pu) ranges from 0.01 to 8. One-third of the samples are above 0.3, the value expected if ingrowth from Pu-238 were its only source.
- Th-232 is present in 3 of the parent drums, consistent with data presented in Table 3.
- No U-233, U-235, or U-236 was detected, confirming AK information that these uranium isotopes are not expected to be detectable in Pu-238 process waste.

**Table 9. Pu Isotopic Data for Pu-238 Debris Wastes**

| Waste Stream | Parent Drum | No. of Repackaged Drums | Average Composition of Repackaged Drums (wt %) Pu-238 | Pu-239 | Pu-240 | Pu-241 | Pu-242 | Total Measured Pu, g | Total Pu Reported by Waste Generator (± 1 stnd dev) |
|---|---|---|---|---|---|---|---|---|---|
| TA-55-43 | 55400 | 7 | 80.6 | 16.6 | NR | 0.20 | 0.40 | 2.13 | 2.85 ± 0.53 |
| | 55431 | 5 | 79.8 | 17.4 | NR | 0.24 | 0.37 | 1.81 | 1.55 ± 0.89 |
| | 55437 | 9 | 79.9 | 17.2 | NR | 0.23 | 0.31 | 2.28 * | 3.13 ± 0.21 |
| | 55439 | 3 | 81.9 | 15.8 | NR | 0.25 | 0.35 | 0.52 * | 0.65 ± 0.10 |
| | 55476 | 2 ⊥ | 81.7 | 15.9 | NR | 0.26 | 0.39 | 0.44 * | 0.74 ± 0.55 |
| | 55558 | 1 | 78.8 | 19.2 | NR | 0.25 | 0.24 | 0.27 | 0.77 ± 0.33 |
| | 55615 | 5 | 81.3 | 16.4 | NR | 0.21 | 0.22 | 2.35 | 2.38 ± 0.19 |
| | 55631 | 2 | 23.6 | 67.6 | NR | 0.37 | 0.07 | -- * | 0.25 ± 0.37 |
| | 55683 | 7 | 79.6 | 18.1 | NR | 0.23 | 0.18 | 2.57 | 2.69 ± 0.80 |
| | 56091 | 6 | 79.6 | 17.5 | NR | 0.23 | 0.49 | 2.53 | 2.39 ± 0.12 |
| | 56283 | 3 | 79.4 | 17.8 | NR | 0.23 | 0.22 | 1.04 | 1.04 ± 0.13 |
| | 57706 | 1 | 73.7 | 22.8 | NR | 0.17 | 0.26 | 0.26 | 0.18 ± 0.06 |
| TA-55-44 | 52686 | 2 | 71.8 | 23.6 | NR | 0.18 | 0.29 | 0.19 | 0.23 ± 0.09 |
| | 55403 | 3 | 79.4 | 17.6 | NR | 0.21 | 0.42 | 0.62 | 1.19 ± 0.50 |
| | 55451 | 5 | 82.4 | 15.2 | NR | 0.21 | 0.35 | 1.29 | 2.32 ± 0.68 |
| | 55452 | 4 | 79.3 | 17.3 | NR | 0.21 | 0.53 | 0.89 * | 1.25 ± 0.59 |
| | 55625 | 6 | 81.5 | 16.1 | NR | 0.20 | 0.20 | 2.13 | 2.36 ± 0.16 |
| | 55663 | 5 | 73.9 | 22.8 | NR | 0.22 | 0.21 | 0.53 * | 1.46 ± 0.16 |
| | 55668 | 4 | 82.8 | 15.1 | NR | 0.19 | 0.18 | 1.13 * | 2.26 ± 0.15 |
| | 55836 | 2 | 79.2 | 17.9 | NR | 0.22 | 0.23 | 0.31 | 0.42 ± 0.17 |
| | 56000 | 1 | 78.3 | 18.8 | NR | 0.23 | 0.23 | -- * | 0.29 ± 0.08 |
| | 56090 | 9 ⊥ | 82.1 | 15.9 | NR | 0.21 | 0.16 | 1.91 * | 3.46 ± 0.07 |
| | 56397 | 4 ⊥ | 71.9 | 25.1 | NR | 0.20 | 0.19 | -- * | 1.74 ± 0.07 |
| TA-55-47 | 55605 | 7 | 82.9 | 14.3 | NR | 0.19 | 0.38 | 2.27 | 0.14 ± 1.60 |
| | 55695 | 9 ⊥ | 80.4 | 16.7 | NR | 0.21 | 0.32 | 1.57 * | 1.30 ± 0.53 |
| | 55696 | 4 | 82.4 | 15.2 | NR | 0.23 | 0.33 | 0.56 * | 2.25 ± 1.22 |
| | 55938 | 12 | 81.0 | 16.7 | NR | 0.21 | 0.20 | 2.90 * | 0.15 ± 1.70 |
| | 56053 | 4 | 79.8 | 18.4 | NR | 0.22 | 0.16 | 0.88 | 0.53 ± 0.41 |
| Total | 28 | 132 | — | — | — | — | — | 33.4 * | 40 grams |
| Average | — | — | 77.5 | 19.6 | NR | 2.4 | 0.2 | — | — |

⊥ Isotopic averages exclude one or more repackaged drums for which isotopic data have not yet been reported.

* Total measured mass of Pu excludes one or more repackaged drums for which assay data have not yet been reported.

NR Not reported because values were below the minimum detection level for Pu-240

Data from FRAM batch data reports: LA98-3.1.4-002 (TWCP-2001), LA98-FRAM-002 (TWCP-2003), LA98-FRAM-003 (TWCP-2116), LA98-FRAM-004 (TWCP-2005), LA98-FRAM-005 (TWCP-2257), LA98-FRAM-006 (TWCP-2256), LA98-FRAM-007 (TWCP-2631), LA98-FRAM-008 (TWCP-2708), LA00-FRAM-002 (TWCP-5571), LA01-FRAM-020 (TWCP-6067), LA01-FRAM-021 (TWCP-TBD), LA01-FRAM-025 (TWCP-TBD)

Data from radioassay batch data reports: LA98-PAN-001 (TWCP-2002), LA98-PAN-002 (TWCP-2004), LA98-PAN-003 (TWCP-2158), LA98-PAN-004 (TWCP-2240), LA98-PAN-005 (TWCP-2456), LA98-TGS-001 (TWCP-1725), LA98-TGS-002 (TWCP-2713), LA98-TGS-003 (TWCP-2732), LA99-PAN-001 (TWCP-2630), LA00-HENC-002 (TWCP-6069), LA01-HENC-017 (TWCP-TBD)

Data from AK Information Summary, R.4, Appendix H

**Table 10. Secondary Radionuclides Detected in Pu-238 Debris Wastes***

| Waste Stream | Parent Drum | Am241 | Am243 | Np237 | Ac227 | Cs137 | U234 | U238 | Th230 | Th232 |
|---|---|---|---|---|---|---|---|---|---|---|
| TA-55-43 | 55400 | | | X | | | X | | | |
| | 55431 | | | X | | | X | | | X |
| | 55437 | | | X | | | X | | | |
| | 55439 | | | X | | | X | | | |
| | 55476 | | | | | | | | | |
| | 55558 | | | X | | | | | | |
| | 55615 | | | X | | | | | | |
| | 55631 | X | | X | | X | | | | |
| | 55683 | | | X | | | X | | | |
| | 56091 | | X | X | | | X | | | |
| | 56283 | | | X | | | X | | | |
| | 57706 | | X | X | X | X | | X | | |
| TA-55-44 | 52686 | | | X | | | | | | |
| | 55403 | | | X | | | | | | |
| | 55451 | | | X | | | X | | | |
| | 55452 | X | X | X | | X | X | | | |
| | 55625 | | | X | | | X | | | |
| | 55663 | | X | X | | X | | | | |
| | 55668 | | X | X | | | | | | |
| | 56000 | | | X | | | | X | | |
| | 56090 | | X | X | | | X | | | |
| | 56397 | X | X | X | | | X | X | X | |
| TA-55-47 | 55605 | | | X | | | X | X | | |
| | 55695 | | X | X | | | | | | |
| | 55696 | | | X | | | X | X | | X |
| | 55938 | | | X | | | | | | |
| | 56053 | | | X | | | | X | | X |
| Total | 28 | 3 | 8 | 27 | 1 | 4 | 14 | 6 | 1 | 3 |

Data from FRAM batch data reports: LA98-3.1.4-002 (TWCP-2001), LA98-FRAM-002 (TWCP-2003), LA98-FRAM-003 (TWCP-2116), LA98-FRAM-004 (TWCP-2005), LA98-FRAM-005 (TWCP-2257), LA98-FRAM-006 (TWCP-2256), LA98-FRAM-007 (TWCP-2631), LA98-FRAM-008 (TWCP-2708), LA00-FRAM-002 (TWCP-5571), LA01-FRAM-020 (TWCP-6067), LA01-FRAM-021 (TWCP-TBD), LA01-FRAM-025 (TWCP-TBD)

* A radionuclide was considered to be present if it was detected with an uncertainty less than 21.5% (TWCP-2130).

- Ac-227, Am-241, Cs-137, Th-230, and U-238 were detected in 1 to 6 of the parent drums.

14.4 Headspace Gas Data

Headspace gas data are examined to confirm AK information about the presence or absence of hazardous constituents in a given waste stream, and the assignment of each drum to the appropriate mixed or nonmixed waste stream. Table 11 summarizes VOC target analyte concentrations and total flammability for

headspace gas samples from 31 containers assigned to waste streams TA-55-43, TA-55-44, and TA-55-47. (No approved WAP-compliant data are yet available for drums from waste streams TA-55-45 or TA-55-46.) These data confirm the following AK information:

- Five VOCs were detected above the minimum detection limit (MDL) in one or more of these 3 waste streams—toluene, acetone, butanol, methanol, and methyl ethyl ketone. Because these chemicals are present as solvents used in the manufacturing of plastics, their presence in headspace gases in drums without any other known source of these VOCs is attributed to (1) off-gassing of constituents in the tape and plastic bags used to package waste items, and (2) radiolytic degradation of the plastic, rubber, tape, Tygon, and similar items in the waste (Attachment C in TWCP-2102).
- All Upper Concentration Limit ($UCL_{90}$) values were below their program required quantitation limits (PRQL).
- Acetone was the only target analyte detected (in one drum) above its PRQL.
- No Tentatively Identified Compounds (TICs) were detected.
- All drums were below the WIPP WAC limits for flammability. No methane was detected in any of the drums, and hydrogen concentrations were lower by more than an order of magnitude than the WAC limit of 5 percent.

## 15.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 260—Hazardous Waste Management System: General
- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, Segregation of hazardous materials
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Records Management* (TWCP-QP-1.1-004)
- *Transuranic Package Transporter (TRUPACT)-II Content Codes* (DOE/WIPP-89-004)
- *Transuranic Waste Baseline Inventory Report* (CAO-94-1005) *(TWBIR)*
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA-530-R-94-024)
- *Waste Analysis Plan, to the Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088, Attachment B)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

**Table 11. Headspace Gas Data (ppmv) for Target Analytes and Total Flammability in Pu-238 Debris Waste Streams**

| ANALYTE | MDL | TA-55-43 (10 drums) | | | TA-55-44 (15 drums) | | | TA-55-47 (6 drums) | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Mean | $UCL_{90}$* | Maximum | Mean | $UCL_{90}$* | Maximum | Mean | $UCL_{90}$* | Maximum |
| Benzene | 10 | 0.8 | 0.8 | — | 0.8 | 0.8 | — | 0.8 | 0.8 | — |
| Bromoform | 10 | 1.5 | 1.5 | — | 1.5 | 1.5 | — | 1.5 | 1.5 | — |
| Carbon Tetrachloride | 10 | 1.2 | 1.2 | — | 1.2 | 1.2 | — | 1.2 | 1.2 | — |
| Chlorobenzene | 10 | 2.0 | 2.0 | — | 2.0 | 2.0 | — | 2.0 | 2.0 | — |
| Chloroform | 10 | 1.3 | 1.3 | — | 1.3 | 1.3 | — | 1.3 | 1.3 | — |
| 1,1-Dichloroethane | 10 | 1.3 | 1.3 | — | 1.3 | 1.3 | — | 1.3 | 1.3 | — |
| 1,2-Dichloroethane | 10 | 1.1 | 1.1 | — | 1.1 | 1.1 | — | 1.1 | 1.1 | — |
| 1,1-Dichloroethene | 10 | 1.0 | 1.0 | — | 1.0 | 1.0 | — | 1.0 | 1.0 | — |
| Cis-1,2-Dichloroethylene | 10 | 1.6 | 1.6 | — | 1.6 | 1.6 | — | 1.6 | 1.6 | — |
| Ethyl Benzene | 10 | 2.0 | 2.0 | — | 2.0 | 2.0 | — | 2.0 | 2.0 | — |
| Ethyl Ether | 10 | 1.0 | 1.0 | — | 1.0 | 1.0 | — | 1.0 | 1.0 | — |
| Methylene Chloride | 10 | 0.6 | 0.6 | — | 0.6 | 0.6 | — | 0.6 | 0.6 | — |
| 1,1,2,2-Tetrachloroethane | 10 | 2.1 | 2.1 | — | 2.1 | 2.1 | — | 2.1 | 2.1 | — |
| Tetrachloroethene | 10 | 1.6 | 1.6 | — | 1.6 | 1.6 | — | 1.6 | 1.6 | — |
| Toluene | 10 | 1.8 | 1.8 | 4 | 2.2 | 2.8 | 4 | 2.1 | 2.1 | 5 |
| 1,1,2-Trichloro 1,2,2-trifluoroethane (Freon-113) | 10 | 1.1 | 1.1 | — | 1.1 | 1.1 | — | 1.1 | 1.1 | — |
| 1,1,1-Trichloroethane | 10 | 1.3 | 1.3 | — | 1.3 | 1.3 | — | 1.3 | 1.3 | — |
| Trichloroethene | 10 | 1.2 | 1.2 | — | 1.2 | 1.2 | — | 1.2 | 1.2 | — |
| m-Xylene and p-xylene | 10 | 3.1 | 3.1 | — | 3.1 | 3.1 | — | 3.1 | 3.1 | — |
| o-Xylene | 10 | 1.9 | 1.9 | — | 1.9 | 1.9 | — | 1.9 | 1.9 | — |
| Acetone | 100 | 20.9 | 47.8 | 56 | 36.3 | 52.5 | 130 | 16.8 | 16.8 | — |
| Butanol | 100 | 15.7 | 15.7 | 44 | 13.9 | 23.3 | 29 | 12.5 | 12.5 | — |
| Methanol | 100 | 14.5 | 14.5 | 39 | 15.2 | 36.7 | 48 | 11.8 | 11.8 | — |
| Methyl ethyl ketone | 100 | 18.7 | 18.7 | — | 18.9 | 18.9 | 22 | 18.7 | 18.7 | — |
| Methyl isobutyl ketone | 100 | 12.4 | 12.4 | — | 12.4 | 12.4 | — | 12.4 | 12.4 | — |
| Total Flammability* | 500 | 104 ± 32 | | 194 | 119 ± 43 | | 248 | 94.2 ± 1.4 | | 97.1 |

Source: TWCP-6357, 6358, 6359; VOC target analyte list for debris waste from WIPP WAP, Table B3-2.

— analyte not detected; ppmv, part per million by volume; MDL, Method Detection Limit; PRQL, Program Required Quantitation Limit; UCL90, 90% Upper Concentration Limit

— Not applicable

* For analytes below the MDL, $UCL_{90}$ and total flammability concentrations are calculated by assuming concentrations were one-half of the MDL values, as described in the UCL90 records package for each waste stream

# ACCEPTABLE KNOWLEDGE ROADMAP

Waste Streams: TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47.

Copies of these documents are in the TWCP RMDC Center. Refer to *Records Management* (TWCP-QP-1.1-004) for information on requesting copies.

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| AP-SWO-006,R.3.1 | A | Describes how the TRU Waste Storage Record (TWSR) is prepared, reviewed, submitted, and entered into a TRU waste database | *Review and completion of TWSR* | Section 8.6 describes how waste generator information submitted on the TWSR, as well as other receipt and storage information, is entered into the LANL TRU Waste Database for TRU waste stored at TA-54. | None |
| NMT7-AP-TA55-018,R3 | A | Contains waste generator information required by the LANL TRU Waste Certification Plan | *TA-55 Transuranic Waste Interface Document (TWID)* | Contains information on waste characterization, waste packaging configurations, and TRUCON codes for newly-generated TA-55 waste. Describes how waste generator information in the TA-55 Waste Management System (WMS) database is certified and maintained for waste generated at the TA-55 facility. Contains information on current and projected waste stream volumes. | Document does not give information about RCRA constituents introduced or present in the processes |
| QP-TP-WMS-000.001 | B | Compilation of TA-55 waste generator information, for individual waste containers. | TA-55 Waste Management System (WMS) | Certified and current database of waste container identifiers, waste codes (e.g., IDC, RSWD, EPA HWNs), assay results, packaging dates, waste material content and generating processes for TA-55 wastes. | Overview document – Generator Attachments provide more detailed information. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-351 | B | Procedure for waste management practices at TA-55 | TA-55 document 539-GEN-R02. | Document describes TA-55 waste management practices for solid and liquid wastes | None |
| TWCP-352 | B | Description of plutonium recovery processes | *Wastes from Plutonium Conversion and Scrap Recovery Operations,* LA-11069-MS, March 1988. | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983. | Los Alamos Certification Plan, 1983 | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document – Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1955,* TRUWM-TA55-CPA-03, R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *Generator Attachment* to the *Certification Plan* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Provides an explanation of why some waste containers may be packaged with 6 layers of confinement | No Direct way to differentiate between and 6 layers of packaging |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by P/S code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-1030 | C | Waste characterization (P/S LWRHU) | LANL Report number LA-13143-MS pp. 5-6, 7-8, 17-18. | Summarized analytical results of as-received and partially processed Pu-238 materials used in the Cassini LWRHU process. | Materials in these waste streams generally would have been produced as the result of processing many of the lots. |
| TWCP-1037 | D | $^{238}$Pu fabrication process description ; waste characterization | Written information obtained from a TA-55 waste management expert | Detailed information of all facets of Pu-238 fabrication activities supports conclusion that these waste streams are non-mixed. | References to documents providing additional information are not provided in the memo, but have been added to the AK Summary Report. |
| TWCP-1044 | D | Waste characterization | SRS Memo NMS-EHB-970073, March 12, 1997 | Describes the SRS process for producing the Pu-238 that was used at TA-55 and presents analyses for metals in the Cassini material. | No flow diagram included. |
| TWCP-1698 | C | Analytical results for Pu-238 debris waste in drums assigned to TA-55-43, lot no. 1 | Report: Sampling and Analysis Project Validates Acceptable Knowledge on TA-55-43, Lot No. 1 (sent to New Mexico Environment Department) | Confirms absence of non-radioactive hazardous chemicals in TA-55-43 | Data were obtained prior to issuance of the WAP |
| TWCP-1725 | A | Radioassay data for drums from Pu-238 waste streams | LA98-TGS-001 | Radioassay data | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-2001 | A | Isotopic data for drums from Pu-238 waste streams | LA98-3.4.1-002 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-2002 | A | Radioassay data for drums from Pu-238 waste streams | LA98-PAN-001 | Radioassay data | None |
| TWCP-2003 | A | Isotopic data for drums from Pu-238 waste streams | LA98-FRAM-002 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-2004 | A | Radioassay data for drums from Pu-238 waste streams | LA98-PAN-002 | Radioassay data | None |
| TWCP-2005 | A | Isotopic data for drums from Pu-238 waste streams | LA98-FRAM-004 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-2102 | B | Presence of VOCs in headspace gas resulting from off-gassing and radiolytic degradation of plastics | Waste Determination Report for Waste Stream TA-55-43 Lot No. 01, Report LA-UR-98-3610, by Rogers et al. | Reviews published literature and presents data and calculations supporting that VOCs are present in headspace gas of TRU waste containers as a result of off-gassing and radiolytic degradation of plastics | None |
| TWCP-2116 | A | Isotopic data for drums from Pu-238 waste streams | LA98-FRAM-003 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-2130 | D | Estimate of the minimum detection limit for Am-243, Np-237, Pa-231, and Th-232 for FRAM analyses | Criteria for reporting Am-243, Np-237, Pa-231, and Th-232 on mobile PAN radioassay data sheets | If the error in the peak area for the isotopes Am-243, Np-237, Pa-231, and Th-232 is greater than 21.5% in the FRAM report, then that isotope is considered to be below the minimum detectable activity. | Memo refers specifically to PAN radioassay data, but the same reasoning is applied to TGS and HENC assay data as well, and to all radionuclides detectable by FRAM. |
| TWCP-2158 | A | Radioassay data for drums from Pu-238 waste streams | LA98-PAN-003 | Radioassay data | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-2240 | A | Radioassay data for drums from Pu-238 waste streams | LA98-PAN-004 | Radioassay data | None |
| TWCP-2256 | A | Isotopic data for drums from Pu-238 waste streams | LA98-FRAM-006 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-2257 | A | Isotopic data for drums from Pu-238 waste streams | LA98-FRAM-005 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-2456 | A | Radioassay data for drums from Pu-238 waste streams | LA98-PAN-005 | Radioassay data | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests are on residues rather than waste that is lower in Pu content; hence, they are conservative. |
| TWCP-2630 | A | Radioassay data for drums from Pu-238 waste streams | LA99-PAN-001 | Radioassay data | None |
| TWCP-2631 | A | Isotopic data for drums from Pu-238 waste streams | LA98-FRAM-007 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-2708 | A | Isotopic data for drums from Pu-238 waste streams | LA98-FRAM-008 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-2713 | A | Radioassay data for drums from Pu-238 waste streams | LA98-TGS-002 | Radioassay data | None |
| TWCP-2732 | A | Radioassay data for drums from Pu-238 waste streams | LA98-TGS-003 | Radioassay data | None |
| TWCP-3568/N-82 (UCNI) | C | Clarification of specific processes within the nitrate operations at TA-55 | Jim Foxx, SME, response to comments received on the draft Acceptable Knowledge Summary Report for TA-55 Nitrate Operations, 2/25/00 | Resolutions to the questions and issues raised by Pam Rogers during her review of the Acceptable Knowledge Summary Report for TA-55 Nitrate Operations, 2/25/00 | Information is based on SME knowledge. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of gases. | Information is based on SME knowledge. |
| TWCP-4166 | D | Answers to questions on disposal of spray cans used in gloveboxes | Interview with Jim Foxx, 10/17/00 | Answers to questions on disposal of spray cans used in gloveboxes. | Information is based on SME knowledge. |
| TWCP-4457 | A | RTR data for drums from Pu-238 waste streams | LA00-RTR-025 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-4459 | A | RTR data for drums from Pu-238 waste streams | LA00-RTR-002 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-4469 | A | RTR data for drums from Pu-238 waste streams | LA00-RTR-018 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4545 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-001 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-4572 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-003 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-4573 | A | RTR data for drums from Pu-238 waste streams | LA00-RTR-026 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-4577 | A | RTR data for drums from Pu-238 waste streams | LA00-RTR-028 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-4835 | A | RTR data for drums from Pu-238 waste streams | LA00-RTR-001 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5086 | B | P/S Codes for TA-55 Waste items, listed by drum | P/S codes for waste items in individual drums are either from the TA-55 Waste Management System or from the certified data base | P/S Codes for drums that underwent VE | Only some drums are included |
| TWCP-5087 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-014 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5088 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-016 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5110 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-004 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5111 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-012 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5117 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-020 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5119 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-018 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5147 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-013 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5155 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-017 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5163 | B | Waste generator records for 5 drums of TA-55 combustible debris waste packaged in 1985-86 | Radioactive Solid Waste Disposal (RSWD) Records | Lists P/S codes (embedded in waste item identifiers) for drums S855627, S862004, S862274, S862456, and S862286. | From noncertified TRU waste data base |
| TWCP-5252 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-015 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5265 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-025 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5267 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-023 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5335 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-026 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5571 | A | Isotopic data for drums from Pu-238 waste streams | LA00-FRAM-002 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5784 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-011 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5838 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-021 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5842 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-032 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5846 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-036 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5848 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-038 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-5853 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-043 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-6007 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-047 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |
| TWCP-6011 | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-056 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-6067 | A | Isotopic data for drums from Pu-238 waste streams | LA01-FRAM-020 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | None |
| TWCP-6069 | A | Radioassay data for drums from Pu-238 waste streams | LA00-HENC-002 | Radioassay data | None |
| TWCP-6357 | A | UCL90 calculations for headspace gas concentrations in drums from waste stream TA-55-44 | UCL90 Calculations for TA-55-44 | UCL90 calculations for headspace gas concentrations in drums from waste stream TA-55-44, based on waste stream assignment of drums in the AK Information Summary, R.5 | None |
| TWCP-6358 | A | UCL90 calculations for headspace gas concentrations in drums from waste stream TA-55-43 | UCL90 Calculations for TA-55-43 | UCL90 calculations for headspace gas concentrations in drums from waste stream TA-55-44, based on waste stream assignment of drums in the AK Information Summary, R.5 | None |
| TWCP-6359 | A | UCL90 calculations for headspace gas concentrations in drums from waste stream TA-55-47 | UCL90 Calculations for TA-55-47 | UCL90 calculations for headspace gas concentrations in drums from waste stream TA-55-44, based on waste stream assignment of drums in the AK Information Summary, R.5 | None |
| | | | | | |
| TWCP-TBD | A | Radioassay data for drums from Pu-238 waste streams | LA01-HENC-017 | Radioassay data | Has not yet completed Project-level review |
| TWCP-TBD | A | RTR data for drums from Pu-238 waste streams | LA00-RTR-019 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Awaiting review and approval from CBFO for review of pre-WAP RTR video |
| TWCP-TBD | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-005 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Awaiting review and approval from CBFO for review of pre-WAP RTR video |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

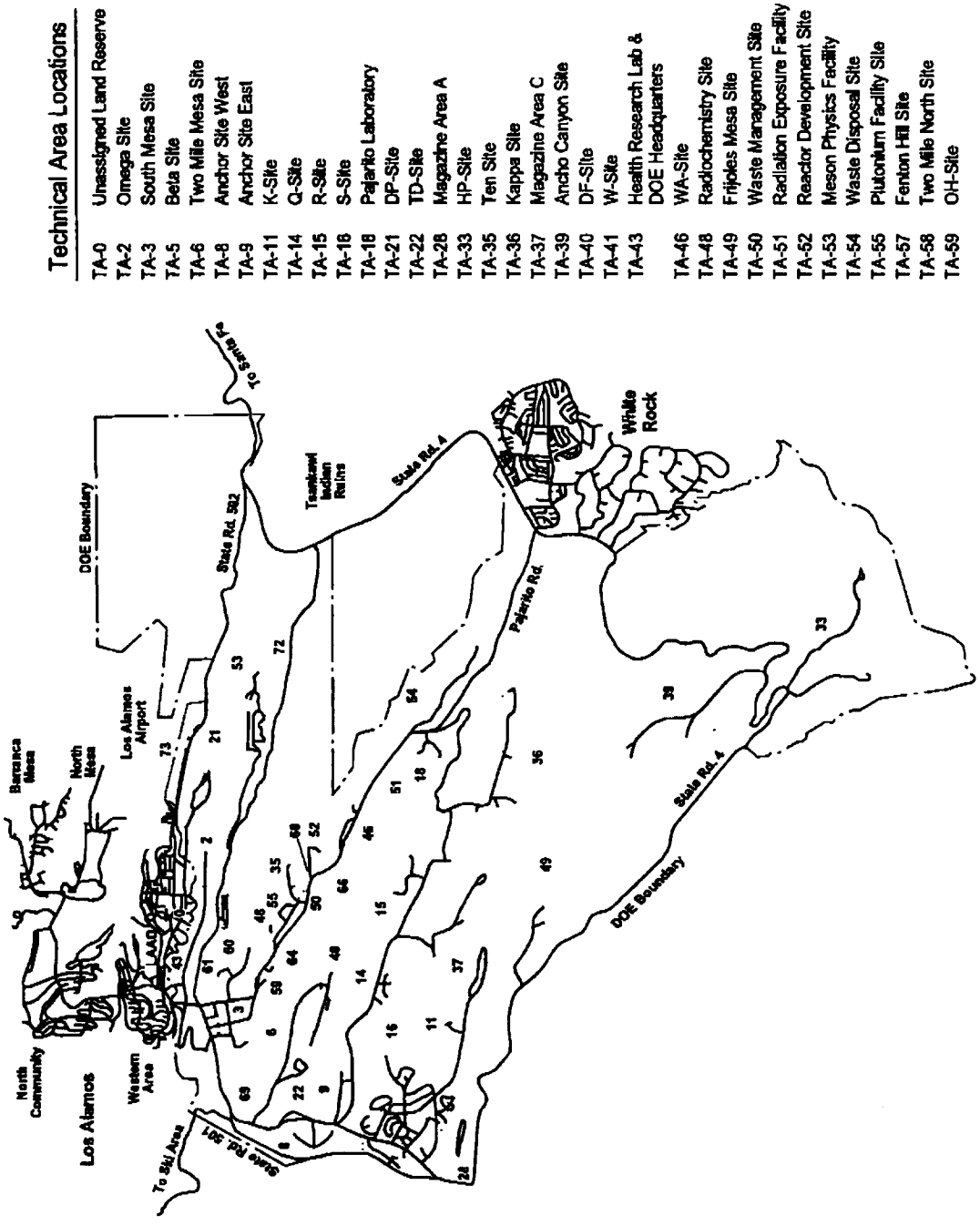
| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-TBD | A | RTR data for drums from Pu-238 waste streams | LA01-RTR-006 | RTR data on prohibited items, WMC, packaging layers, and estimated volumes and weights of waste material parameters in drum | Awaiting review and approval from CBFO for review of pre-WAP RTR video |
| TWCP-TBD | A | Isotopic data for drums from Pu-238 waste streams | LA01-FRAM-021 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | Has not yet completed Project-level review |
| TWCP-TBD | A | Isotopic data for drums from Pu-238 waste streams | LA01-FRAM-025 | Concentrations of Pu isotopes and secondary radionuclides, relative to total Pu | Has not yet completed Project-level review |
| TWCP-AK-2.1-003,R.2 | B | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Metal Operations at TA-55* | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-005,R.2 | B | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* | Detailed information on each P/S code for nitrate operations at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Special Processing Operations at TA-55* | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-AK-2.1-008,R.2/IC1 | A | Results of VE conducted as quality control check on RTR for Summary Category Group S5000 (debris waste) | *Acceptable Knowledge Summary Report for Waste Streams TA-55-19 and TA-55-20* | Section 14.2 summarizes results of VE conducted on drums of combustible debris waste from waste streams TA-55-19 and TA-55-20 (WMC S5300), in order to establish site-specific miscertification rate for Summary Category Group S5000 (debris) | Results may not be representative of Pu-238 debris waste |
| TWCP-AK-2.1-009,R.2 | B | Generators interview and TWCP AK references | *Process Acceptable Knowledge Summary Report for Plutonium-238 Operations at TA-55* | Detailed information on each P/S code for plutonium-238 operations at TA-55 | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-PLAN-0.2.7-001,R.4 | C | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK references based on generator's original data | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | Analysis of RTR, FRAM and radioassay data in Sections 14.1 and 14.3 was based on assignment of drums in the AK Information Summary, R.4. This analysis was not redone when the Summary was updated to R.5 because the changes were minor for the Pu238 waste streams. | Out-of-date. R.5 was issued shortly after this AK waste stream report started its review cycle. Used R.5 to update all of this AK report with the exception of Sections 14.1 (RTR data) and 14.3 (radioassay data). |
| TWCP-PLAN-0.2.7-001,R.5 | C | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK references based on generator's original data | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | Detailed information on each waste drum and waste stream. Used throughout this report, except for analysis of RTR, FRAM, and radioassay data in Sections 14.1 and 14.3. | Reliability and completeness of waste generator data is highly variable; this information summary is continually being revised and updated |

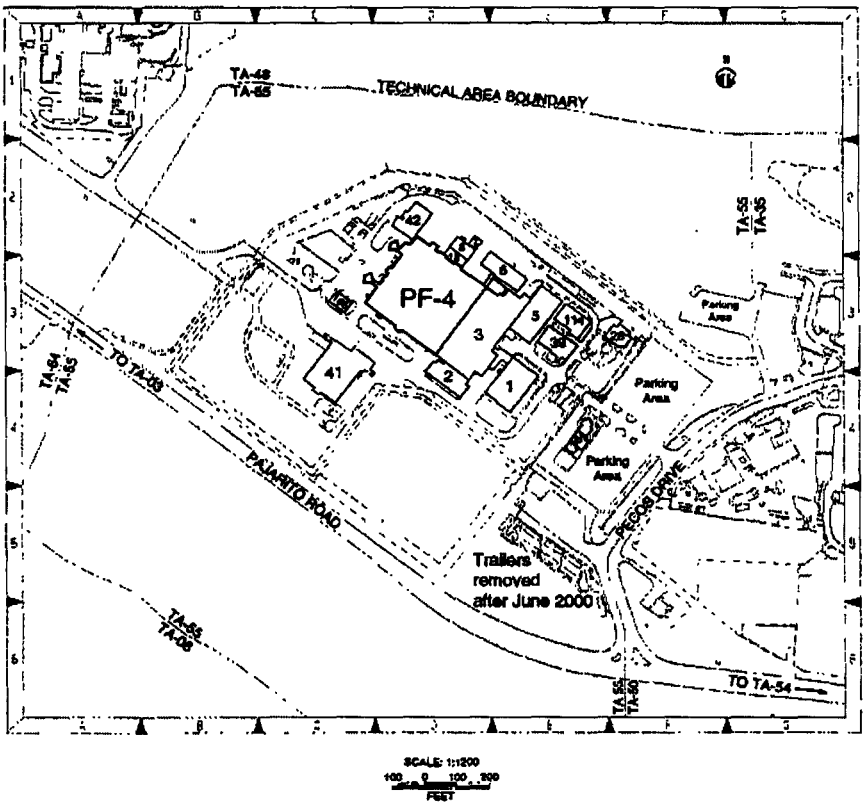
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# MAP OF LANL

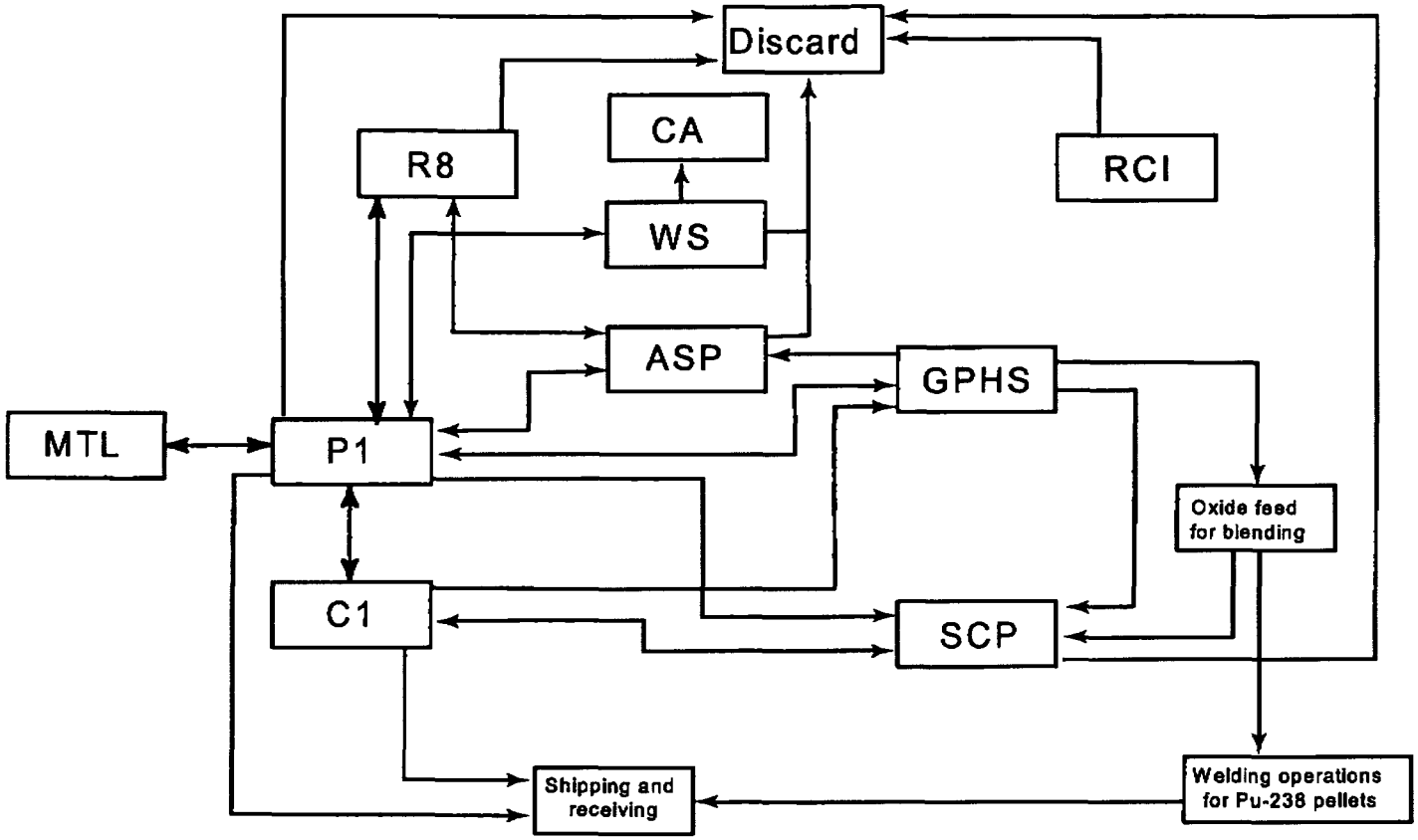

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Los Alamos Airport
Barranca Mesa
North Mesa
North Community
Los Alamos
Western Area
To Ski Area
State Rd. 501
DOE Boundary
State Rd. 4

## MAP OF TA-55

**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.



**GENERALIZED PROCESS STATUS DIAGRAM FOR PU-238 PROCESSES**



# WASTE GENERATOR FORMS FOR TRU WASTE

**Los Alamos** NATIONAL LABORATORY

# TRU WASTE STORAGE RECORD

LA00000055683

## 1. GENERATOR'S PRE-USE VISUAL INSPECTION

| | | | |
|---|---|---|---|
| Drum Lot Code: UNI-A-AH-1-2524 | Inspected Items | | |
| Year of Manufacture: 1994 | ☑ Ring, Bolt, and Nut | ☑ Chime | ☑ Dents |
| Box Serial Number: 101A | ☑ Lid and Gasket | ☐ Gouges | ☑ Paint |
| This container has been visually inspected according to approved procedures and has been found to be free of damage that would make it unsuitable for TRU waste packaging. | Printed Name: J. [illegible] | Date: 1-24-95 | |
| | Signature: | | |

## 2. GENERATOR'S PACKAGE INFORMATION

| | | | |
|---|---|---|---|
| Group: TMT-7 | Technical Area: TA-55 | Building: PF-4 | Program Code: RBR3000 |
| Normal: ☑ Yes ☐ No | | | |
| Additional Information: TID # B22206 | | | |
| 2 - 5M Bags folded not taped | | | |
| by Swipe Survey was NOA Lab 139 3758 | | | |

RADIONUCLIDE CONTENT

Material Type: ☑ Yes ☐ No — 813

| Nuclide | Amount | | Uncertainty | | Ci-Curie Mi-Gram |
|---|---|---|---|---|---|
| Pu-238 | 3.91217 | E-11 | 1.11618 | E-11 | C |
| Pu-239 | 2.21719 | E+2 | 6.71719 | E+3 | C |
| Pu-240 | 1.11515 | E+2 | 3.41315 | E+3 | C |
| Pu-241 | 9.61411 | E+1 | 2.81617 | E+1 | C |
| Pu-242 | 9.41412 | E+6 | 2.81098 | E+6 | C |
| | | E | | E | |
| | | E | | E | |
| | | E | | E | |

| CODE | CONTAINER | INTERNAL SHIELDING | Thickness (in.) |
|---|---|---|---|
| 01 | ☑ Steel Drum (55 gal.) | ☑ None | |
| 02 | ☐ Standard Waste Box | Type | |
| 03 | ☐ Other (Call TWCO) | | |
| 04 | ☐ RH Canister | | |

Waste Profile Request Number: 81715 P1

Carbon Filter ID: 01 LA 13 14 1314 02

Process Batch Code: NIA

| | |
|---|---|
| Gross Weight (lb.) | 18.519 E+1 |
| Organic Material Wt. (lb.) | 1.418 E+1 |
| Organic Material Volume (%) | 10.10 |
| TRUCON Code | 16.1A |
| Date Closed (MMDDYY) | 011595 |

NONRADIOACTIVE HAZARDOUS MATERIALS

| Name | EPA Code | Quantity (g) |
|---|---|---|
| None | | |

The data in this section were collected, and the waste described herein was packaged and labeled according to approved procedures.

Printed Name: [illegible] Signature: [illegible] Date: 1-26-95

## 3. GENERATOR SITE HEALTH PHYSICS INFORMATION

| | | | | |
|---|---|---|---|---|
| Gamma Dose Rate (mrem/h) | 12.0 E+0 | Survey Meter Model: RO2C | Property Number: 2641 | Calibration Void Date: 4/5/95 |
| Neutron Dose Rate (mrem/h) | 1.0 E+0 | Survey Meter Model: NR-4 | Property Number: 5207 | Calibration Void Date: 4/20/95 |
| Total Dose Rate (mrem/h) | 13.0 E+0 | The data in this section were collected according to approved procedures. | | |
| Alpha Contamination (dpm/100cm²) | 0.0 E+0 | Printed Name: [illegible] | | Date: 02/08/95 |
| Beta-Gamma Cont. (dpm/100cm²) | 0.0 E+0 | Signature: [illegible] | | |

## 4. CST-7 REVIEW/AUTHORIZATION

| | | |
|---|---|---|
| The data package for this waste has been reviewed by CST-7. The generator is authorized to arrange transportation to TA-54 by AR 10-6. | Printed Name: [illegible] | Date: 2/1/95 |
| | Signature: [illegible] | |

# DISCARDABLE WASTE LOG SHEET

Effective Date 08/01/94
Page 1 of 1 Pages

LA000000556953 — WASTE PACKAGE SERIAL NUMBER
☐ N-Comb ☑ Comb ☑ Pu-238

Two Drum Liners Installed: ☐
Assay Instrument Type: NEUTRON GAMMA ☐ ☑

Install/Tighten Carbon Filter(s): N/A
Tighten Locknut or Box Plugs: N/A

NK waste: N
Lead shielding: N
1/8 Inch Drum Liner: N

CONTAINER: ☑ Open ☐ In-Line

TID# B222206
Date TIDed 1-25-95

| ITEM NO | ITEM ID | PKG WT Kg | MATRIX (MATERIAL) | HT | SNM GRAMS | UNCRT +/- GRAMS | ITEM SNM g + 2X UNCERT | SNM+2X UNCERT. running total | CERTIFIED PERCENTILE | REMARKS (Wt in kg) ORGANICS Vt% | ORGANICS WT. | HAZARDOUS MATERIALS | OTHER REMARKS | AUTH. PG/LN | DATE mm/dd/yy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | PLS-221 | 1.29 | Plastic | 53 | 0.44 | 0.03 | 0.50 | 0.50 | | | 0.78 | None Container 1 kg | | 9/3 | 1-25-95 |
| 1 | PLS-218 | 1.65 | Plastic | 83 | 0.25 | 0.04 | 0.33 | 0.83 | | | 1.14 | None Container 0.5 l | | 9/3 | 1-25-95 |
| 2 | PLS-186 | 1.18 | Plastic | 83 | 1.04 | 0.61 | 2.26 | 3.09 | | | 0.67 | None Container 0.5 l | | 9/3 | 1-25-95 |
| 3 | PLS-224 | 1.08 | Plastic | 53 | 0.22 | 0.02 | 0.26 | 3.35 | | | 0.57 | None Container 0.5 l | | 9/3 | 1-25-95 |
| 4 | PLS-202 | 1.83 | Plastic | 83 | 0.31 | 0.04 | 0.39 | 3.74 | | | 1.32 | None Container 0.5 l | | 9/3 | 1-25-95 |
| 5 | PLS-216 | 1.85 | Plastic | 83 | 0.31 | 0.02 | 0.35 | 4.09 | | | 1.34 | None Container 0.5 l | | 9/3 | 1-25-95 |
| 6 | PLS-192 | 1.40 | Plastic | 83 | 0.12 | 0.04 | 0.20 | 4.29 | | | 0.89 | None Container 0.5 l | | 9/3 | 1-25-95 |
| 7 | | | | | | | | | | | | | | | |
| 8 | | | | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | |

TOTAL Pkg wt Kg: 10.28
X 2.2046 = Pkg wt Lbs(#): 22.66
+CRUM/BX TARE #: 63.48
= CALC GROSS #: 86.14
SCALE GROSS #: 85.94

NMT-2 Gross wt. Check Initials: [illegible]
Actability Check Init.: [illegible]

| | | | | | | |
|---|---|---|---|---|---|---|
| 83 | 2.69 | 0.80 | | | TOTALS | 100 | 6.71 | Haz-Mat | None | |

Organics wt (kg) x 2.2046 = wt (lbs): 14.79
QA Pkg Approval: [illegible] 2-27-95

NMT-4 Assay Value 2.382 +/- 0.116
Instrument ID 605 Pass
Date 1-30-95 2/24/95
NMT-4 Sign. [illegible]

This container's waste was packaged and the NMT-2 data on the DWLS and the CWSR were collected according to process/area defined in the Los Alamos Certification Plan and the appropriate attachment(s).

NMT-2 signature [illegible]

TRUPACT-TASS-DR-02, R00

Page 1 of
Effective Date: 07/12/9

518317

# WASTE ORIGINATION AND DISPOSITION FORM (solid waste)

**SECTION I** To be completed by waste generator operator

DATE 6/8/94

ITEM ID PLS-202 MATRIX Plastic MTs 83 1 $Pu^{240}/U^{235}$

| AMOUNT OF WASTE (kg) | | |
|---|---|---|
| gross | tare | net |
| 1.53 | 0.51 | 1.02 |

ROOM NUMBER/PHONE 204 / 7-2370

EXTRA BAG STUBS # 0 #PKGS(BAGS) 1

BAG SIZES: 11LB ____ 14LB ~ 26LB ____

HAZARDOUS/PROHIBITED MATERIALS (LIST) None

LEAD SHIELDING (DESCRIBE,kg) none

SAFE TO OPEN OUTER CAN: YES [>] NO [ ]

I certify that this item contains no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix, except as listed above. Current SOPs were followed in the origination of this item and I believe it will meet current approved discard limits.

Operator's name printed and signature Supervisor's name(printed) & P/S

**SECTION II** To be completed by NMT-2 Waste Management Inspector(s)

[ ] for [ ] NOT [\] Certified Cement Certifiable

Inspector's signature 6-28-94 Date

WM OBSERVATIONS: Hold Item Bag + Can Filtered (1.83 Kg Pkg wt)

PASSES WIRE TIE RESTRICTIONS: YES ____ NO ____

INSPECTORS INITIALS ____ # PKGS 1

gm Pu / kg net, or # units = 0.31 / 1.02 = 0.30

EDL VALUE 5.60 UNITS g/kg

ITM MEETS EDL [✓] YES [ ] NO

Inspector Initials

Waste Package Serial Number: LA 0 0 0 0 0 0 5 5 6 8 3

**SECTION III** To be completed by NMT-4 MDA Lab

MEASUREMENT CODE G05

Pu(g) 0.3050 +/- 0.0446

( ) ____ +/- ____

NAME (printed)

SIGNATURE

28JUN94 DATE

COMMENTS

HEALTH-SAFETY-ENVIRONMENT FORM

LOS ALAMOS SCIENTIFIC LABORATORY

DATE

# CHEMICAL WASTE DISPOSAL REQUEST

REQUESTED BY _____ PHONE _____

GROUP _____ LOCATION: TA-_____ BLDG._____ AREA/WING _____ ROOM_____

WASTE VOLUME ($ft^3$) _____

NUMBER OF CONTAINERS (SIZE/TYPE) _____

WASTE FORM (check as appropriate):

☐ SOLID ☐ LIQUID ☐ GAS

COMMON NAMES OF CHEMICALS: _____

POTENTIAL HAZARDS (check as appropriate):

CORROSIVES ☐ Acids ____strong ____mild ____weak

☐ Bases ____strong ____mild ____weak

☐ FLAMMABLE ☐ TOXIC ☐ OTHER:

☐ EXPLOSIVE ☐ CARCINOGEN

☐ PYROPHORIC ☐ INFECTIOUS

☐ OIL ☐ UNKNOWN

CAN MATERIALS REACT VIOLENTLY WHEN EXPOSED TO:

AIR _____ WATER _____ OTHER CHEMICALS _____

If yes, give details: _____

OTHER USEFUL INFORMATION: _____

(TO BE COMPLETED BY H-7)

DISPOSAL RECORD

AREA _____ PIT/SHAFT _____ DATE _____ BY _____

MAIL THIS FORM TO WASTE MANAGEMENT, H-7, MS-[illegible]

6/80

H&ES 7-5A

# TWCP/WRR
# Document Modification/Review Cycle

☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-011,R.0/IC1 New Rev/IC: R0/IC1

Preparer: John Musgrave

Document Title:
Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☒ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☒ Forms have been marked as SAMPLE
- ☒ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ● Closed Date to DC: 11/5/2001 Signed Initials: [signature]

Date Received: 11/6/01

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 11/5/01
- ☑ Master Index Updated - Date: 11/5/01
- ☑ N/A Archive old revision (Record)

- ☑ Capture Document: ✓ Word __ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- ☑ N/A Add: Controlled Document Original Signatures on File at the RMDC
- ☑ Security Set for: ✓ Read Only
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date ✓ LAUR ✓ Title ✓ Link ✓ Test
- ☑ On-line test: ✓ Open Doc N/A Password
- ☑ Electronic Notification: ✓ Sent ✓ Printed
- ☑ N/A CAO: __ Electronic Copy __ Printed

11/5/01

If pages are separated match to Document: TWCP-AK-2.1-011,R.0/IC1

# TWCP/WRR
# Document Modification/Review Cycle

Status: ○ Open ● Closed ☐ Revision ☒ Interim Change

Date Received: 11/1/2001

Current Rev/IC: R0

Document ID: TWCP-AK-2.1-011,R.0/IC1

Rev/IC: R0/IC1

Document Title:

Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47

Preparer: John Musgrave Date to DP Team: 11/5/2001

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

☒ IC - Not Applicable

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

# TWCP/WRR
# Document Modification/Review Cycle

☒ IC - Not Applicable

Reviewer Comments Incorporated:
Redline/DRR Given to Preparer:
Reconciled Comments Returned:
Modifications Made to Document:
Preparer Review of Modifications:
Signed/Release for Final Signature:

Comments:

☒ IC - Not Applicable

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: For Training Distribution
Cc: fabi@lanl.gov
Bcc:
Attached:

The following is a revised report.

**Effective Date: 115/01**

**TWCP-AK-2.1-011,R.0/IC1** - Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47 (LA-UR-01-4964)

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

*Patricia G. Patton*

**Los Alamos National Laboratory**
**E-ET**
**Records Management / Document Control**
**( RMDC )**
**TA-0**
**557 Oppenheimer Building 764**
**Phone: (505) 667-2071**
**Email: pgp@lanl.gov**

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LOS ALAMOS
NATIONAL LABORATORY - TWCP RMDC

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## TWCP-AK-2.1-011,R.0/IC1

**Effective Date** 11-5-2001 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47 (LA-UR-01-4964)

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC ✓ | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
| ☐ RAMROD | | | | | |
| ☐ RANT | | | | | |
| ☐ DECON | | | | | |
| ☒ QA ✓ | | | | | |

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Signature: _____ Date: 11/5/01

AK-2.1-011, R0/IC1

X-Sender: 092080@eet-mail.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.0.1
Date: Tue, 22 Jan 2002 09:59:28 -0700
To: Shannan Baker <shannan@lanl.gov>, pgp@lanl.gov
From: marji gavett <gavett@lanl.gov>
Subject: Re: Fwd: Re: TWCP-PLAN-0.2.7-001,R.5
Cc: pzr@lanl.gov, souza@lanl.gov, lindahl@lanl.gov
X-RCPT-TO: <114654@eet-mail.lanl.gov>

Thank you Shannan.

At 09:41 AM 1/22/02 -0700, Shannan Baker wrote:
> In speaking with S-7, Dan Gerth, he said that we should get new LAUR numbers even though it is an IC, it is still a change to the document. Anything that may go outside the Lab, even though minor editorial changes have been made, a new number is required.
>
> Thanks,
> Shannan

At 08:00 AM 1/22/2002 -0700, marji gavett wrote:
> I agree; however, it might be worth following up with classification....
>
> At 08:45 AM 1/18/02 -0700, Shannan Baker wrote:
> > Marji & Patricia,
> >
> > I think that we should get an LAUR number on this, just to cover all bases. It only takes a few days to get something through classification. However, this is just my opinion...
> >
> > Shannan
> >
> > X-Sender: 084120@eet-mail.lanl.gov
> > X-Mailer: QUALCOMM Windows Eudora Version 5.0
> > Date: Thu, 17 Jan 2002 16:42:44 -0700
> > To: Patricia G Patton <pgp@lanl.gov>
> > From: "Pamela Z. Rogers" <pzr@lanl.gov>
> > Subject: Re: TWCP-PLAN-0.2.7-001,R.5
> > Cc: gavett@lanl.gov, shannan Baker <shannan@lanl.gov>
> > X-RCPT-TO: <115883@eet-mail.lanl.gov>
> >
> > Pat - I reviewed IC1 to AK-2.1-011, R0 and found that it consists only of references added to the report. Since the body of the references is not classified or UCNI, the titles can not be. Therefore I see little value added in having this small change force the report through reclassification.
> >
> > However, I'm not the final word on this. I'm copying Marji and Shannan in case they have gotten further updates or clarification on this issue. If not, we should probably call S division and ask about this kind of situation.
> >
> > Thanks for checking!

# TWCP/WRR
# Document Modification/Review Cycle

☐ Revision
☐ Interim Change

Document ID: TWCP-AK-2.1-011 New Rev/IC: 0

Preparer: John Musgrave

Document Title:
Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 9/19/2001 Signed Initials: JM

Date Received: 9/20/01

- ☑ Verify Signatures
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- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 9/20/01
- ☑ Master Index Updated - Date: 9/20/01
- ☑ N/A Archive old revision (Record)

- ☑ Capture Document: __ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☐ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- ☑ N/A Add: Controlled Document Original Signatures on File at the RMDC
- ☑ N/A Security Set for: ____ Read Only
- ☑ Web Page TOC: __ No/Rev ✓ Effective Date 9/20/01 ✓ N/A LAUR ✓ Title ✓ Link __ Test
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- ☑ Electronic Notification: ✓ Sent ✓ Printed
- ☑ N/A CAO: __ Electronic Copy __ Printed

Date Finished: 9/20/01 Signature: [illegible]

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# TWCP/WRR
# Document Modification/Review Cycle

Status: ○ Open ◉ Closed ☐ Revision ☐ Interim Change

Date Received: 9/19/2001

Current Rev/IC: -

Document ID: TWCP-AK-2.1-011

Rev/IC: 0

Document Title:

Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47

Preparer: John Musgrave Date to DP Team: 9/19/2001

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

Work was done over a period of several months

☐ IC - Not Applicable

| Reviewer | Name | Sent Out | Returned | Comments |
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Comments:

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# TWCP/WRR
# Document Modification/Review Cycle

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| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

☐ IC - Not Applicable

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
| J. Musgrave | Technical | 9/4/2001 | 9/4/2001 | Document Preparer |
| J. Fabryka-Martin | Technical | 9/4/2001 | 9/4/2001 | Independent Technical Reviewer/Editor |
| P. Rogers | SPM | 9/17/2001 | 9/17/2001 | Site Project Manager |
| M. Gavett | QA | 9/17/2001 | 9/18/2001 | Site Project QA Officer |
| A. Montoya | Fac Mgr | 9/4/2001 | 9/14/2001 | Facility Representative |
| | | | | |
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Comments:

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
| Classification | | 9/14/2001 | 9/19/2001 | LA-UR-01-4964 |
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Comments

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: For Training Distribution
Cc: fabi@lanl.gov
Bcc:
Attached:

The following is a revised procedure.

**Effective Date: 9/20/01**

**TWCP-AK-2.1-011,R.0** - Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47 (LA-UR-01-4964)

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

***Patricia G. Patton***

**Los Alamos National Laboratory**
**E-ET**
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**TA-0**
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TWCP-AK-2.1-011,R.0

**Effective Date** 9-20-2001 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46, TA-55-47

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC ✓ | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
| ☐ RAMROD | | | | | |
| ☐ RANT | | | | | |
| ☐ DECON | | | | | |
| ☒ QA ✓ | | | | | |

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To be signed by the Controlled Document Recipient or their designee.

Signature: _____ Date: 9/20/01

**Los Alamos**
NATIONAL LABORATORY

# TRU WASTE STORAGE RECORD

LA00000056636

## 1. GENERATOR'S PRE-USE VISUAL INSPECTION

| Purchase Order # | Inspected Items | | |
|---|---|---|---|
| *This container has been visually inspected according to approved procedures and has been found to be free of damage that would make it unacceptable for TRU waste packaging.* | ☒ Ring, Bolt, and Nut | ☒ Chime | ☒ Dents |
| | ☒ Lid and Gasket | ☒ Gouges | ☒ Paint |
| Name TRUJILLO MICHAEL C | Znumber 096605 | | Date JUL 30 1997 |

## 2. GENERATOR'S PACKAGE INFORMATION

| Group NMT-7 | Technical Area 55 | Building PF-4 | Program Code 8J0700 KF14 1000 0000 | ☐ Off-Normal |
|---|---|---|---|---|

Additional Information TID 826672

| CONTAINER | LINER |
|---|---|
| ☒ Steel Drum (55 gal.) | ☒ None |
| ☐ Steel Drum (85 gal.) | ☐ 90 mil liner |
| ☐ Standard Waste Box | ☐ 125 mil liner |
| ☐ RH Canister | INTERNAL SHIELDING |
| ☐ Other (Call TWCO) | ☒ None |
| ☐ Overpack | Type / Thickness (in.) |
| Carbon Filter ID 01 1576 / 02 | |

RADIONUCLIDE CONTENT

| Nuclide | Amount | Uncertainty | C = Curie M = Gram |
|---|---|---|---|
| PU-238 | 6.007E-3 | 5.138E-4 | M |
| PU-239 | 5.633E+1 | 4.816E+0 | M |
| PU-240 | 3.604E+0 | 3.082E-1 | M |
| PU-241 | 1.201E-1 | 1.027E-2 | M |
| PU-242 | 1.201E-2 | 1.027E-3 | M |
| AM-241 | 9.551E-2 | 8.166E-3 | M |

| | |
|---|---|
| Waste Profile Request Number | 20309 |
| Process Batch Code | NA ☐ PDP Program Tracking No: |
| Gross Weight (lb.) | 1.12E+2 |
| Net Weight (lb.) | 4.88E+1 |
| Shipping Category | 3003400280 |
| LANL Waste Stream ID | TA-55-3 |
| TRUCON Code | 116C |
| Date Closed (MMDDYY) | AUG 4 1997 |

NONRADIOACTIVE HAZARDOUS MATERIALS

| Name | EPA Code | Quantity (g) |
|---|---|---|
| None | | |
| | | |
| | | |

Obliterate names

Accumulation Start Date (MMDDYY)

*The data in this section were collected, and the waste described herein was packaged and labeled according to approved procedures.*

Name VIGIL ROBERT A | Znumber 091564 | Date AUG 11 1997

## 3. GENERATOR SITE HEALTH PHYSICS INFORMATION

| | | | | | |
|---|---|---|---|---|---|
| Gamma Dose Rate (mrem/h) (contact) | 8.0E+1 | Survey Date AUG 6 1997 | Survey Instrument RO20 | Property Number 006487 | Calibration Due Date SEP 13 1997 |
| Neutron Dose Rate (mrem/h) (contact) | 1.3E+0 | Survey Date AUG 6 1997 | Survey Instrument PNR-4 | Property Number 004906 | Calibration Due Date OCT 2 1997 |
| Total Dose Rate (mrem/h) (contact) | 8.1E+1 | | | | |
| otal Dose Rate (mrem/h) (1 meter) | 8.8E+0 | *The data in this section were collected according to approved procedures.* | | | |
| Alpha Contamination (dpm/100cm$^2$) (max) | 0.0E+0 | Name CHAVEZ RONALD | | | |
| Beta-Gamma Cont. (dpm/100cm$^2$) (max) | 0.0E+0 | Znumber 112026 | | Date AUG 11 1997 | |



Modifications to Computer Generated Data Invalidate this Form

replace w/ LA000000 55683

Los Alamos
NATIONAL LABORATORY

DISCARDABLE WASTE
LOG SHEET

LA000000056636

| Item ID | Matrix | Pkg Wt (lbs) | Qty | Volume (ft³) | MT | SNM/Rad Uncertainty | Pu/Section/Lin Cft Mass |
|---|---|---|---|---|---|---|---|
| CONCRETE | Combustibles | 8.03 | | | S2 | 0.031 0.124 | 0.4 |
| PLSBOX | Plastic | 8.02 | | | S1 | 10.215 1.005 | 0.17 |
| PLSSCZB | Plastic | 11.95 | | | S2 | 49.824 5.025 | 0.17 |

| MT | Total SNM | Total Uncert |
|---|---|---|
| S2 | 49.879 | 6.214 |

| | |
|---|---|
| Total Pkg Wt (lbs) | 48.72 |
| Drum Tare (lbs) | 62.50 |
| Calc Gross Wt (lbs) | 111.50 |
| Mass Gross Wt (lbs) | 111.00 |

Printed AUG 29 97 11:36:46 by BUSTAMANTE J M

# TRU Waste Origination & Disposition Information

| | | | | | |
|---|---|---|---|---|---|
| Item ID: COMCXL5 | Source: Combustibles | | | | Date: JUL 30 1997 |
| Quantity: 1 | Gross Wt (kg): 5.72 | Tare Wt: | Net Wt (kg): 5.72 | Volume (ft³): | Process Status: CXL |
| Custodian: ORTEGA JOSE D | | | Facility: 108039 | Room: 420 | Phone: 7-2575 |
| Waste Process: Solid Waste Processing | | Assay: NDA Laboratory | Container Info: | | Drum ID: LA00000056636 |

| | | | | | |
|---|---|---|---|---|---|
| Beryllium | NO | Explosives | NO | PCB's | |
| Compressed Gases | NO | Free Liquids | NO | Particulates | NO |
| Corrosive | NO | Hazardous | | Pyrophorics | NO |

Comments: Trash from hot job.

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 0.031 | 0.134 | G05. | 4.30 | 0.010 | JUL 31 1997 | GUTIERREZ DARLENE D |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| JUL 30 1997 | CHAVEZ RONALD G | CERTIFIED | |
| AUG 4 1997 | VIGIL ROBERT A | PACKED | LA00000056636 |

Printed AUG 28 97 11:38:44 by BUSTAMANTE J M

# TRU Waste Origination & Disposition Information

| | | | | | |
|---|---|---|---|---|---|
| PLSED3 | Plastic | | | | JUL 30 1997 |
| Quantity: | Gross Wt (kg): 3.18 | Tare Wt: | Net Wt (kg): 3.18 | Volume (l): | Process Status: ED |
| Generator: ROMERO JOE C | | | Facility: 109702 | Room: 401 | Phone: 7-2572 |
| Waste Program: Solid Waste Processing | | Facility: NDA Laboratory | Classification: | | Drum Id: LA00000056636 |

| | | | | | |
|---|---|---|---|---|---|
| Beryllium | NO | Explosives | NO | PCB's | |
| Compressed Gases | NO | Free Liquids | NO | Particulates | NO |
| Corrosive | NO | Hazardous | | Pyrophorics | NO |

Job Desc: PLASTICS FOR DISCARD

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 10.215 | 1.055 | G05 | 16.00 | 3.210 | JUL 31 1997 | GUTIERREZ DARLENE D |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| JUL 30 1997 | CHAVEZ RONALD G | CERTIFIED | |
| AUG 4 1997 | VIGIL ROBERT A | PACKED | LA00000056636 |

Printed AUG 28 97 11:38:44 by BUSTAMANTE J M

# TRU Waste Origination & Disposition Information

| Item# | Matrix | | | | Date |
|---|---|---|---|---|---|
| PLSSC28 | Plastic | | | | JUL 30 1997 |
| Quantity / Gross Wt (kg) | Tare Wt | Net Wt (kg) | Volume (l) | | Present Status |
| 8.70 | | 8.70 | | | SC |
| Generator | | | Building | Room | Phone |
| LUJAN JOE E | | | 083188 | 420 | 7-2575 |
| Waste Process | | Assay | Container Info | | Drum# |
| Solid Waste Processing | | NDA Laboratory | | | LA00000056636 |

| | | | | | |
|---|---|---|---|---|---|
| Beryllium | NO | Explosives | NO | PCB's | |
| Compressed Gases | NO | Free Liquids | NO | Particulates | NO |
| Corrosive | NO | Hazardous | | Pyrophorics | NO |

Comments

## Assay Information

| Isotope | MT | SNM (g) | Uncert (g) | Mcode | Limit | SNM (g)/unit | Date | By |
|---|---|---|---|---|---|---|---|---|
| PU-239 | 52 | 49.824 | 5.025 | G05 | 16.00 | 5.730 | JUL 31 1997 | GUTIERREZ DARLENE D |

## Justification Memos

| Memo ID |
|---|
| NONE |

## Hazardous Materials

| EPA Code | Material | Wt (g) |
|---|---|---|
| NONE | | |

## History

| Date | Name | Event | Comments |
|---|---|---|---|
| JUL 3 1997 | CHAVEZ RONALD G | CERTIFIED | |
| AUG 4 1997 | VIGIL ROBERT A | PACKED | LA00000056636 |

Printed AUG 29 97 11:38:45 by BUSTAMANTE J M

**Los Alamos**
NATIONAL LABORATORY

# TRU WASTE STORAGE RECORD

LA0000055683

## 1. GENERATOR'S PRE-USE VISUAL INSPECTION

| | | | |
|---|---|---|---|
| Drum Lot Code: UN [illegible] T-2594 | Inspected Items | | |
| Year of Manufacture: 1914 | ☑ Ring, Bolt, and Nut | ☑ Chime | ☑ Dents |
| Box Serial Number: NA | ☑ Lid and Gasket | ☐ Gouges | ☑ Paint |
| *This container has been visually inspected according to approved procedures and has been found to be free of damage that would make it unsuitable for TRU waste packaging.* | Printed Name | Date 1-24-95 | |
| | Signature | | |

## 2. GENERATOR'S PACKAGE INFORMATION

| | | | | |
|---|---|---|---|---|
| Group: NMT-7 | Technical Area: TA-55 | Building: PF-4 | Program Code: RBR3000 | Normal: ☑ Yes ☐ No |
| Additional Information: TID # B22206 | | | | |
| 2-SWL Bags Folded not taped | | | | |
| Swipe Survey was NOA Lvl 39 3798 | | | | |

| CODE | CONTAINER | INTERNAL SHIELDING | |
|---|---|---|---|
| 01 | ☑ Steel Drum (55 gal.) | ☑ None | |
| 02 | ☐ Standard Waste Box | Type | Thickness (in.) |
| 03 | ☐ Other (Call TWCO) | | |
| 04 | ☐ RH Canister | | |

| | |
|---|---|
| Waste Profile Request Number | 18715 |
| Carbon Filter ID 01 | LA 13 14 1314 02 |
| Process Batch Code | NA |
| Gross Weight (lb.) | 18.519 E+1 |
| Organic Material Wt. (lb.) | 1.418 E+1 |
| Organic Material Volume (%) | 1010 |
| TRUCON Code | 1116A |
| Date Closed (MMDDYY) | 011595 |

**RADIONUCLIDE CONTENT**

Material Type: ☒ Yes ☐ No — 83

| Nuclide | Amount | Uncertainty | C=Curie M=Gram |
|---|---|---|---|
| PU238 | 3.9217 E-1 | 1.1618 E-1 | C |
| PU239 | 2.2179 E+2 | 6.7179 E+3 | C |
| PU240 | 1.1515 E+2 | 3.4315 E+3 | C |
| PU241 | 9.6141 E+1 | 2.8617 E+1 | C |
| PU242 | 9.4142 E+1 | 2.8108 E+1 | C |

**NONRADIOACTIVE HAZARDOUS MATERIALS**

| Name | EPA Code | Quantity (g) |
|---|---|---|
| None | | |

*The data in this section were collected, and the waste described herein was packaged and labeled according to approved procedures.*

| Printed Name | Signature | Date |
|---|---|---|
| | | 1-26-95 |

## 3. GENERATOR SITE HEALTH PHYSICS INFORMATION

| | | | |
|---|---|---|---|
| Gamma Dose Rate (mrem/h) | 12.0 E+1 | Survey Meter Model: RO32 | Property Number: 2641 | Calibration Void Date: 4/31/95 |
| Neutron Dose Rate (mrem/h) | 1.0 E+1 | Survey Meter Model: PNR-4 | Property Number: 5807 | Calibration Void Date: 4/30/95 |
| Total Dose Rate (mrem/h) | 13.0 E+1 | *The data in this section were collected according to approved procedures.* | | |
| Alpha Contamination (dpm/100cm²) | 0.0 E+0 | Printed Name | | Date: 02/08/95 |
| Beta-Gamma Cont. (dpm/100cm²) | 0.0 E+0 | Signature | | |

## 4. CST-7 REVIEW/AUTHORIZATION

| | | |
|---|---|---|
| *The data package for this waste has been reviewed by CST-7. The generator is authorized to arrange transportation to TA-54 by AR 10-5.* | Printed Name | Date 3/1/95 |
| | Signature | |

# DISCARDABLE WASTE LOG SHEET

Effective Date 08/01/94

Page 1 of 1 Pages

LA000000055683 — WASTE PACKAGE SERIAL NUMBER

N-Comb ☐ Comb ☑ Pu-238 ☑

Two Drum Liners Installed: 1111

Install/Tighten Carbon Filter(s): 1111

Tighten Locknut or Box Plugs: 1111

RH waste: N

Lead shielding: N

1/8 Inch Drum Liner: N

CONTAINER: Open ☑ In-Line ☐

Assay Instrument Type: NEUTRON ☐ GAMMA ☑

TID# B22206

Date TIDed 1-25-95

| ITEM NO | ITEM ID | PKG WT Kg | MATRIX (MATERIAL) | MT | SNM GRAMS | UNCRT +/- GRAMS | ITEM SNM g + 2X UNCERT | SNMg+2x UNCERT. running total | CERTIFIED PERSONNEL | REMARKS (Wt in kg) ORGANICS V% | ORGANICS WT. | HAZARDOUS MATERIALS | OTHER REMARKS | AUTH. PG/LN | DATE mm/dd/yy |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 0 | PLS-221 | 1.29 | Plastic | 83 | 0.44 | 0.03 | 0.50 | 0.50 | | | 0.78 | None Container 0.51 kg | | 9/3 | 1-25-95 |
| 1 | PLS-218 | 1.65 | Plastic | 83 | 0.25 | 0.04 | 0.33 | 0.83 | | | 1.14 | None Container 0.51 | | 9/3 | 1-25-95 |
| 2 | PLS-186 | 1.18 | Plastic | 83 | 1.04 | 0.61 | 2.26 | 3.09 | | | 0.67 | None container 0.51 | | 9/3 | 1-25-95 |
| 3 | PLS-224 | 1.08 | Plastic | 83 | 0.22 | 0.02 | 0.26 | 3.35 | | | 0.57 | None Container 0.51 | | 9/3 | 1-25-95 |
| 4 | PLS-202 | 1.83 | Plastic | 83 | 0.31 | 0.04 | 0.39 | 3.74 | | | 1.32 | None Container 0.51 | | 9/3 | 1-25-95 |
| 5 | PLS-216 | 1.85 | Plastic | 83 | 0.31 | 0.02 | 0.35 | 4.09 | | | 1.34 | None Container 0.51 | | 9/3 | 1-25-95 |
| 6 | PLS-192 | 1.40 | Plastic | 83 | 0.12 | 0.04 | 0.20 | 4.29 | | | 0.89 | None Container 0.51 | | 9/3 | 1-25-95 |
| 7 | | | | | | | | | | | | | | | |
| 8 | | | - | | | | | | | | | | | | |
| 9 | | | | | | | | | | | | | | | |

| | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| TOTAL Pkg wt Kg X 2.2046 = Pkg wt Lbs(#) | 10.28 / 22.66 | NMT-2 Gross wt. Check Initials | 83 | 2.69 | 0.80 | ☒ | | TOTALS | 110 | 6.71 | Haz-Mat | None | |
| +DRUM/BX TARE # | 63.48 | | | | | | | Organics wt (kg) x 2.2046 = wt (lbs) | 14.79 | | NMT-4 Assay Value | 2.382 +/- 0.116 | |
| = CALC GROSS # | 86.14 | Acntability Check Init. | | | | | | QA Pkg Approval | | | Instrument ID | GPS Pass | |
| SCALE GROSS # | 85.94 | | | | | | | M.C. May 2-24-95 | | | Date | 1-30-95 2/24/95 | |
| | | | | | | | | | | | NMT-4 Sign. | | |

This container's waste was packaged and the NMT-2 data on the DWLS and the CWSR were collected according to procedures defined in the Los Alamos Certification Plan and the appropriate attachment(s).

NMT-2 Signature

518317

# WASTE ORIGINATION AND DISPOSITION FORM (solid waste)

**SECTION I** To be completed by waste generator operator

DATE 6/8/94

ITEM ID PLS-202 MATRIX Plastic MTs 83 / _____ $Pu^{240}/U^{235}$ _____

| AMOUNT OF WASTE (kg) | | |
|---|---|---|
| gross | tare | net |
| 1.53 | 0.51 | 1.02 |

ROOM NUMBER/PHONE 204 / 7-2370

EXTRA BAG STUBS # 0 #PKGS(BAGS) 1

BAG SIZES: 11LB____ 14LB✓ 26LB____

HAZARDOUS/PROHIBITED MATERIALS (LIST) None

LEAD SHIELDING (DESCRIBE,kg) None

SAFE TO OPEN OUTER CAN: YES ☒ NO ☐

I certify that this item contains no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix, except as listed above. Current SOPs were followed in the origination of this item and I believe it will meet current approved discard limits.

Operator's name printed and signature Supervisor's name(printed) & P/S

**SECTION II** To be completed by NMT-2 Waste Management Inspector(s)

☐ Certified for ☐ Cement NOT ☒ Certifiable

Inspector's signature 6-28-94 Date

WM OBSERVATIONS: Hold Item Bag & Can Filtered (1.83 Kg Pkg wt)

PASSES WIRE TIE RESTRICTIONS: YES ✓ NO____

INSPECTORS INITIALS ✓ # PKGS 1

$\frac{\text{gm Pu}}{\text{kg net, or } \# \text{ units}} = \frac{0.31}{1.02} = 0.30$

| EDL VALUE | ITM MEETS EDL | |
|---|---|---|
| 5.60 | ☒ YES ☐ NO | Inspector initials |
| UNITS g/kg | | |

Waste Package Serial Number: LA 0 0 0 0 0 0 5 5 6 8 3

**SECTION III** To be completed by NMT-4 NDA Lab

MEASUREMENT CODE G05

NAME (printed) _____

Pu(g) 0.3050 +/- 0.0446

SIGNATURE _____ 28JUN94 DATE

( ) _____ +/- _____

COMMENTS _____

HEALTH-SAFETY-ENVIRONMENT FORM

LOS ALAMOS SCIENTIFIC LABORATORY

DATE

# CHEMICAL WASTE DISPOSAL REQUEST

REQUESTED BY _____ PHONE _____

GROUP _____ LOCATION: TA-_____ BLDG. _____ AREA/WING _____ ROOM _____

WASTE VOLUME ($ft^3$) _____

NUMBER OF CONTAINERS (SIZE/TYPE) _____

WASTE FORM (check as appropriate):

☐ SOLID ☐ LIQUID ☐ GAS

COMMON NAMES OF CHEMICALS: _____

POTENTIAL HAZARDS (check as appropriate):

CORROSIVES ☐ Acids _____strong _____mild _____weak

☐ Bases _____strong _____mild _____weak

☐ FLAMMABLE ☐ TOXIC ☐ OTHER: _____

☐ EXPLOSIVE ☐ CARCINOGEN _____

☐ PYROPHORIC ☐ INFECTIOUS _____

☐ OIL ☐ UNKNOWN _____

CAN MATERIALS REACT VIOLENTLY WHEN EXPOSED TO:

AIR _____ WATER _____ OTHER CHEMICALS _____

If yes, give details: _____

OTHER USEFUL INFORMATION: _____

(TO BE COMPLETED BY H-7)

DISPOSAL RECORD

AREA _____ PIT/SHAFT _____ DATE _____ BY _____

MAIL THIS FORM TO WASTE MANAGEMENT, H-7, MS-~~B248~~ 571

6/80 HSE&E 7-EA

QP-00-004,R.0
Effective Date: 06/18/03

TWCP-15414

# RECORDS SUBMITTAL

**INSTRUCTIONS:** This form is prepared by the record source when submitting individual records, batch data reports, or a records package to the RMDC Center. For records packages, a Table of Contents (TOC) must also be submitted. Each record submitted requires a complete form.

**MANDATORY:** X To the best of my knowledge, the record(s) have no radioactive contamination.

Signature: _____

**RECORD TYPE:**

X Project 2010 ☐ Facility (RRES)

☐ Other: _____ ☐ UCNI ☐ Proprietary

**RECORD SOURCE:**

Submittal Date: 7/25/03 Z No.: 109592 Name/Org: PATRICIA PATTON – RRES-CE

Originator: JOHN MUSGRAVE Organization: NMT

**TYPE OF RECORD/ACTION TO BE TAKEN**

X Individual Record ☐ Batch Data Report ☐ Records Package (+ TOC)

X New ☐ Revision* ☐ Addition* ☐ Supersedes*

*Record Barcode Number: _____ *Review Cycle (if applicable): ☐ Yes ☐ No ☐ NA

**RECORD ID NUMBER**: (e.g., memo symbol number, procedure (include revision), deficiency number, batch data report number, unique record identifier if applicable):

TWCP-AK-2.1-005, R.2

Record Date: 5/17/01 Physical Page Count: 180 X Single Sided ☐ Double Sided

Category Number: (from page two): 07

**RECORD TITLE, SUBJECT, AND/OR KEYWORDS:**

TWCP-AK-2.1-005, R.2/IC1 Process AK Report for Nitrate Operations at TA-55 (INCLUDES INTERIM CHANGE 1) - LA-UR-01-2555 – LA-UR-02-1715

**RECORD CENTER USE ONLY**

☑ Accepted Date: 7-25-03 ☐ Return Date: _____

Signature: _____ Resubmitted: _____

RIDs Type: LT

Scan Date: _____ By _____ QC Date: _____ By _____

X-Sender: chsmith@norris-mail.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.1
Date: Thu, 24 Jul 2003 10:37:16 -0600
To: pgp@lanl.gov
From: Cathy Smith <chsmith@lanl.gov>
Subject: Please retire Process AK Reports
Cc: sgw@lanl.gov
X-Scanned-By: MIMEDefang 2.35

Hi Patsy,

As we discussed yesterday, here is the list of Process AK Reports that we would like to retire as controlled documents and submit as records to RMDC. Could you let Betty Humphrey and myself know when you have the record IDs - we need to update the references in the main AKIS document.

Thanks a million!

Cheers, Cathy

The following can be turned into Records, to be referenced in our AKIS or AK Summaries...

1. TWCP-AK-2.1-002, R.2/IC1 Process AK Report for Chloride Operations at TA-55

2. TWCP-AK-2.1-003, R.2/IC1 Process AK Report for Metal Operations Processes at TA-55

3. TWCP-AK-2.1-004, R.2/IC2 Process AK Report for Miscellaneous Operations at TA-55

4. TWCP-AK-2.1-005, R.2/IC1 Process AK Report for Nitrate Operations at TA-55

5. TWCP-AK-2.1-006, R.2/IC1 Process AK Report for Pyrochemical Processes at TA-55

6. TWCP-AK-2.1-007, R.2/IC1 Process AK Report for Special Processing at TA-55

7. TWCP-AK-2.1-009, R.0/IC1 Process AK Report for Pu-238 Operations at TA-55

8. TWCP-AK-2.1-013, R.0 AK Report for NG Waste from Nitrate Operations at TA-55

9. TWCP-AK-2.1-014,R.0 AK Report for NG Waste from Miscellaneous Operations at TA-55

10. TWCP-AK-2.1-016,R.0 AK Report for NG Waste from Special Processing Operations at TA-55

11. TWCP-AK-2.1-017,R.0 AK Report for NG Waste from Metal/Pyrochemical Operations at TA-55

---

*"The simplest questions are the hardest to answer."*
*Northrop Frye*

Catherine H. Smith
***Project 2010***
RRES-CE Certification Group
Risk Reduction & Environmental Stewardship Division
Phone: 667-0113 Page: 664-7104

**INTERIM CHANGE REQUEST**

LA-UR-02-1715

| ☑ TWCP ☐ WRR ☐ Other<br>**If Other, please identify:** | **IC Number:** 1 |
|---|---|
| **Person Requesting this Interim Change**: Sandy Wander | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Process Acceptable Knowledge Report for Nitrate Operations at TA-55 | **Document No./Revision:** TWCP-AK-2.1-005,R.2 (LA-UR-02-1715) |
| **Effective Date of Current Document:** 05/17/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| Title Page, p.1 | Delete "Summary" from title to read:<br>"Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55" | Clarification |
| Global | Change all occurrences of "Sampling Plan" to "AK Information Summary" | Document title change |
| Note and 3rd column heading / pp. vi and ix | Delete "summary" from "NOTE" at top if page vi and from "*" note at bottom of page ix<br>Change 3rd column heading on pages vi–ix to read:"Process AK Report*"<br>Delete entire 4th column | Clarification |
| Notes and 3rd column heading / pp. vi and ix | Delete "summary" from "NOTE" at top of page vi and from "*" note at bottom of page viii<br>Delete the word "summary" in third column heading | Clarification |
| Page xi, second paragraph, last sentence | Add "Cm-244" to Radioisotope content of the waste listing between Pa-231 and Cs-137 | TWCP-5165 indicates possibility of Cm-244 in waste. Added at request of NDA operations leader. |
| Page xi, bullet list | Add as Bullet 3: "D004, D010: P/S code HRA prior to 1984"<br>Bullet 4: Add "except NR" between "P/S codes" and "in nitrate operations"<br>Bullet 5: Delete "MB", add "CD, DS, HCD, HD, LR, RCM, RFX, RR"<br>Bullet 9: Add "RB, RBJ, SP"<br>Bullet 10: Add "AO, RCM, RFX"<br>Bullet 17: Add "AL, ATL, ED, MPD, SC | Per SME, codes applicable prior to 1984 to P/S code due to possible usage.<br>NR code never activated, per SME<br>Per SME, MB used high purity Ba at <TCLP levels. Additional codes added per SME, HWN should be same as other P/S codes in that category.<br>Update report to make text and listings agree, per SME<br>Update report to make text and listings agree, per SME<br>Per SME, P/S codes should carry same HWNs as other is category. |

| | | |
|---|---|---|
| Global search and replace | From all references to "process AK summary report," delete "summary" to read "process AK report"<br>From all titles that previously read "Process Acceptable Knowledge Summary Report, " delete "Summary" to read "Process Acceptable Knowledge Report" | Clarification |
| 3.5.6.19/p. 29 | In second paragraph, change first sentence to read ". . . process, **but** ~~and~~ are ~~not~~ introduced with the feed materials **consisting of ash and miscellaneous materials contaminated with D006, D007, D008, D009, and D011**." Delete second sentence. | Correction of AK information |
| Table 1, p. 44 | Column 1, row 1 (Miscellaneous materials): Delete "sand, slag" and "crucibles"<br>Column 3, row 1 (Miscellaneous materials): Delete "CR" | Per SME, sand, slag, and crucibles would not be contaminated with these RCRA heavy metals.<br>Per SME, this P/S code would not be associated with these HWNs. |
| Section 4.2, pp. 50, 51 | Add "D009" to AL, ATL, MPD, and SC<br>Insert "AO" to list (after AL) and "D006, D007, D008, D009, D011"<br>To CD, add "D005"<br>To DS, add "D005" and "D009"<br>To HCD, add "D005"<br>To HD, add "D005"<br>To LR, add "D005"<br>Insert "RCM" to list (after RC) and add "D005, D006, D007, D008, D009, D011"<br>Insert RFX to list (after REM) and add "D005, D006, D007, D008, D009, D011"<br>To SP, add "D006" and "D008" | Per SME , P/S codes have possible contamination of D009 due to feed materials.<br>Update report to make text and listings agree, per SME |
| Attach. 3, p. 1 of 10 | Add "D009" to timelines AL and ATL<br>Add "D006, D007, D009, D011" [from 6/86 through 12/88] to timeline AO. | Timeline updated due to addition of code per SME<br>Timeline updated due to addition of codes per SME. |
| Attach. 3, p. 2 of 10 | For timeline CF, replace "(See Notes 4 and 6)" with "(See Note 4)" | Note did not apply when reviewed. |
| Attach. 3, p. 3 of 10 | Add "D005" to DS timeline<br>Add "D009" to ED timeline | Timeline updated due to addition of code per SME<br>Timeline updated due to addition of code per SME |
| Attach. 3, p. 4 of 10 | Add "D005" to HD/CD/HCD timeline. Remove Note 15 | Timeline updated due to addition of code per SME. Note 15 was typo error. |

| | | |
|---|---|---|
| Attach. 3, p. 5 of 10 | Add "D005" to LR timeline | Timeline updated due to addition of code per SME |
| | Add "D009" to MPD timeline | Timeline updated due to addition of code per SME |
| | Delete "D005" and "D008" from MB timeline | P/S code never activated. |
| Attach. 3, p. 7 of 10 | Add "D006, D007" to RB/RBJ timeline from 1/28/87-3/6/92 and 4/15/94-8/15/99 | Timeline updated due to addition of code per SME. Report updated to be consistent with AK information in text. |
| | Add "D005, D006, D007, D009, D011" to RCM and RFX timelines | Timeline updated due to addition of code per SME |
| | Add "D005" to RR timeline | Timeline updated due to addition of code per SME |
| | Add "D009" to SC timeline | Timeline updated due to addition of code per SME |
| | Add "D006" to SP timeline | Timeline updated due to addition of code per SME |
| Attach. 4, pp. 1–3, 6–10, 12–14 | Add "*D008" to the "EPA Codes" column for all rows and insert the following note at the end of the table: "*D008 due to leaded gloves" | Table updated with "*" to reflect leaded gloves. |
| | All additions are to "EPA Codes" column. All references are to "P/S Code" column.<br>AL: Add "D009"<br>AO: Add "D006, D007, D009, D011"<br>ATL: Add "D009"<br>CD: Add "D005"<br>DS: Add "D005"<br>ED: Add "D009"<br>HCD: Add "D005"<br>HD: Add "D005"<br>HRA: Add "D004, D005, D010"<br>LR: Add "D005, *D008"<br>MB: Delete "D007, D008, D009"<br>MPD: Add "D009"<br>RB: Add "D006, D007, D008"<br>RBJ: Add "D006, D007, D008"<br>RC: *D008<br>RCM: Add "D005, D006, D007, D008, D009, D011"<br>RFX: Add "D005, D006, D007, D008, D009, D011"<br>RO: Add "*D008"<br>RR: Add "D005"<br>SC: Add "D009"<br>SP: Add "D006"<br>TDC: Add "*D008" | Table updated to reflect additional information from SMEs. |

| | | |
|---|---|---|
| Attach. 6, pp. 1, 2 | Add new Attachment 6 and update "Contents" page to reflect addition<br>Add following paragraph to end of Section 2.0:<br>"When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6)." | New TWCP-QP-1.1-021 requirement |

| | |
|---|---|
| **Date changes submitted**: 02/25/02 | **Desired effective date for changes**: |

**INTERIM CHANGE APPROVAL**

| | | | |
|---|---|---|---|
| Document Preparer: S Wander | | Reviewer (if applicable): Facility Rep | |
| Signature: Sandy Wander | Date: 3/19/02 | Signature: Wayne A. Pringle | Date: 3/20/02 |
| Site Project QA Officer: M A Gavett | | LAAO (if implementing WAP requirements): N/A | |
| Signature: M A Gavett | Date: 3/21/02 | Signature: | Date: |
| ☑ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | | Do changes affect WAP data collection, data quality, or performance criteria? | |
| Site Project Mgr/Line Mgr: P Rogers | | ☐ Yes ☑ No<br>If yes, date of CBFO approval: _____ (documentation attached) | |
| Signature: Pamela Rogers | Date: 3/19/02 | | |
| USQ Screener (if applicable): NA | | | |
| Signature: | Date: 3.25.02 | | |

**NOTE:** Changes can be designated on the document and attached to this form.

**Effective date for this interim change:** 3/21/02

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge ~~Summary~~ Report for Nitrate Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-005,R.2 (LA-UR-01-2555)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

**EFFECTIVE DATE:** 05/17/01

**NEXT REVIEW DATE:** 05/17/03

**DOCUMENT PREPARER:**

Lotus Musgrave — NAME — 5/7/01 — DATE

**APPROVALS:**

June Fabryka-Martin — INDEPENDENT TECHNICAL REVIEWER/EDITOR — 5/7/01 — DATE

Mavis R-Lo — SITE PROJECT MANAGER — 5/12/01 — DATE

Sandy Wander — WASTE CERTIFICATION OFFICIAL — 5/14/01 — DATE

SITE PROJECT QA OFFICER — 5/14/01 — DATE

Cheryl L. Foxx — FACILITY REPRESENTATIVE — 5/7/01 — DATE

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 06/23/00 | — | New report (TWCP-03940) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | 05/17/01 | All | Respond to CBFO review comments and update to include new AK information |
| 2/IC1 | 03/21/02 | All | Clarification to procedure and SME updates |

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1 Acceptable Knowledge Roadmap (21 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Timeline for Nitrate Operations (10 pages)
4 Process Inputs and Outputs (15 pages)
5 Generalized Process Status Diagram for Nitrate Processes (1 page)
6 Decision/Discrepancies Resolution Documentation (2 pages)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| AK Information Summary | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001) |
| CFR | *Code of Federal Regulations* |
| CLS | Chemistry and Laser Science [Division]—former name of C Division |
| CSMO | Central Scrap Management Office |
| D | RCRA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DTP | detailed technical procedure |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FFTF | Fast Flux Test Facility |
| HEPA | high efficiency particulate air |
| HWN | [EPA] hazardous waste number |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level [radioactive] waste |
| MSE | molten salt extraction |
| MT | material type |
| N | Nitrate [designator for individual documents in nitrate operations reports in Attachment 1, Acceptable Knowledge Roadmap] |
| OSWER | Office of Solid Waste and Emergency Response [EPA] |
| P | RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| P/S [code] | process status [code] |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| SME | subject matter expert |
| SOP | safe/standard operating procedure |
| TA | technical area |

| | |
|---|---|
| TOPO | trioctyl phosphate oxide |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization/Certification Project |
| UCNI | Unclassified Controlled Nuclear Information |
| WAC | waste acceptance criteria |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WIPP | Waste Isolation Pilot Plant |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request Form |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**NOTE:** This index indicates the main process AK report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| AL | Ash Leach | Nitrate Operations |
| AO | Americium Processing Calcination | Nitrate Operations |
| AP | Americium Purification | Nitrate Operations |
| AS | Anode Heel Dissolution | Nitrate Operations |
| AT | Ash Testing | Nitrate Operations |
| ATL | Advanced Test Line for actinide separation (RD&D) | Nitrate Operations |
| BAC | Bacterial Decomposition of Cellulose Items | Nitrate Operations |
| BF | Unknown name for this P/S code | Nitrate Operations |
| BL | Blending | Nitrate Operations |
| BM | Burning Metal | Nitrate Operations |
| BU | Button Burning | Nitrate Operations |
| CC | Calcination | Nitrate Operations |
| CD | Hydroxide Cake Dissolution | Nitrate Operations |
| CF | Cement Fixation | Nitrate Operations |
| CH | Characterization | Nitrate Operations |
| CK | RD&D Volatile Fluoride Pu Recovery | Miscellaneous Operations |
| CL | Crucible Processing | Chloride Operations |
| CN | C-N-O Analysis | Metal Operation Processes |
| COD | Chlorinated Oxide Dissolution | Nitrate Operations |
| COL | Chlorinated oxide leach | Nitrate Operations |
| CPOD | Catalyzed Electrochemical Plutonium Oxide Dissolver | Nitrate Operations |
| CR | Crushing and Pulverizing | Nitrate Operations |
| CS | Chloride Solutions | Chloride Operations |
| CX | Chloride Anion Exchange | Chloride Operations |
| DF | DS Furnace and Oxide Preparation | Nitrate Operations |
| DP | Dry Processing | Nitrate Operations |
| DS | Ion Exchange | Nitrate Operations |

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| ED | Cascade Dissolver | Nitrate Operations |
| ETD | Experimental Thermal Decomposition | Nitrate Operations |
| EV | Evaporator | Nitrate Operations |
| FA | Americium Processing | Nitrate Operations |
| FC | Canning | Nitrate Operations |
| FX | Cement to Drum | Nitrate Operations |
| GMS | Open Gradient Magnetic Separation | Nitrate Operations |
| HC | Calcination | Nitrate Operations |
| HCD | Hydroxide Cake Dissolution | Nitrate Operations |
| HD | Hydroxide Cake Dissolution | Nitrate Operations |
| HGMS | High Gradient Magnetic Separation | Nitrate Operations |
| HP | Cement Fixation | Nitrate Operations |
| HRA | Hanford Reservation Materials | Nitrate Operations |
| IA | Impure Americium Holding for Discard | Nitrate Operations |
| IB | Matrix Study of Pyrochemical Salts | Miscellaneous Operations |
| IS | Incinerator | Nitrate Operations |
| LC | Uranium/plutonium Processing | Nitrate Operations |
| LG1 | Noncombustible Leach | Nitrate Operations |
| LG2 | Hydroxide Cake Dissolution | Nitrate Operations |
| LR | Ion Exchange | Nitrate Operations |
| MAG | Magnetic Separation | Nitrate Operations |
| MAS | RD&D Experimental Processes | Nitrate Operations |
| MB | Nitric Dissolution of Molten Salts | Chloride Operations<br>Nitrate Operations |
| MELL | Mediated Electro-Oxidation of LLW | Nitrate Operations |
| MF | Metals Furnace | Nitrate Operations |
| ML | Non Pu Metal Leach | Nitrate Operations |
| MPD | Cascade Dissolver | Nitrate Operations |
| NC | Noncombustible Leach | Nitrate Operations |
| NL | Noncombustible Leach | Nitrate Operations |
| NR | Nitrate Recovery | Nitrate Operations |

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| OD | Oxide Dissolution | Nitrate Operations |
| OH | Hydroxide Precipitation | Nitrate Operations |
| OY | Oxalate Precipitation | Nitrate Operations |
| PA | Passivation | Nitrate Operations |
| PAF | Passivation Furnaces | Nitrate Operations |
| PR | Peroxide Precipitation | Nitrate Operations |
| PS | Peroxide Precipitation of MSE Salts | Nitrate Operations |
| PT | Plutonium Thorium Separation | Nitrate Operations |
| PTS | RD&D Pretreatment Study | Nitrate Operations |
| RB | Roasting and Blending | Nitrate Operations |
| RBJ | Roasting & Blending Jr | Nitrate Operations |
| RC | Rotary Calciner | Nitrate Operations |
| RCM | Rich Column Material Ion Exchange | Nitrate Operations |
| RFX | Ion Exchange | Nitrate Operations |
| RO | Oil Recovery | Nitrate Operations |
| RR | Ion Exchange | Nitrate Operations |
| SC | Cascade Dissolver, G437 | Nitrate Operations |
| SE | Solvent Extraction | Chloride Operations |
| SO | Super Oxidizer, FOOF Program | Miscellaneous Operations |
| SP | Scrap Dissolution, G438 | Nitrate Operations |
| SSD | Special Scrap Dissolution | Nitrate Operations |
| SX | Americium Processing Silicon Removal | Nitrate Operations |
| TDC | Thermal Decomposition of Cellulose Items R&D | Nitrate Operations |
| UPS | Uranium/plutonium Separation | Nitrate Operations |
| US | Uranium Separation for Solid Solution Feed | Nitrate Operations |
| US2 | Uranium Separation for Non-solid Solution Feed | Nitrate Operations |
| VC | Variable CSMO Scrap Dissolution | Nitrate Operations |
| VP1 | CSMO Scrap Dissolution | Nitrate Operations |
| VP2 | Polycube Processing | Nitrate Operations |

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| VP3 | Hydroxide Precipitation | Nitrate Operations |
| VUL | Vessel Unloading | Nitrate Operations |
| ZD | Scrap Oxide Dissolution | Nitrate Operations |

* Process AK reports: Chloride Operations (TWCP-AK-2.1-002,R.2), Metal Operations (TWCP-AK-2.1-003,R.2), Miscellaneous Operations (TWCP-AK-2.1-004,R.2), and Nitrate Operations (this report)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Nitrate Operations

**P/S codes**: AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed debris; waste immobilized in cement

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, as well as associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from nitrate operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

Process wastes from nitrate operations are generated in Building PF-4, Rooms 208, 401, 409, 420, and 434, of the TA-55 Plutonium Facility. Plutonium operations included reclaiming plutonium from scrap and residues produced from numerous feed sources.

**Description of the process waste (physical form and typical content description):**

Waste from nitrate operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, and glass debris; and waste immobilized in cement.

***Summary Category Group:*** S3000, S5000

***Waste Matrix Codes:*** S3000, S3100, S3200, S5100, S5300, S5400

**Description of the waste-generating process:**

The overall goal of the nitrate operations is to recover plutonium from metal, metal alloys, scrap, and residues and produce a purified plutonium oxide product or feedstock for conversion to

metal. Processes include pretreatment, dissolution, purification, evaporation, and cement fixation.

**Process feed:**

Plutonium metal or metal alloys, oxides and hydroxide cakes; pyrochemical salts; crucible pieces; anode heels; ash; analytical laboratory solutions; and residues from other DOE facilities.

**Radioisotopic content of the waste:**

Variety of plutonium material types with different well-defined isotopic compositions. Am-241, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium, or plutonium and uranium, so that the waste will usually be enriched in Am-241 or U-234, but may also be depleted in some cases. Pa-231, Cm-244, and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- F002 and F003: P/S codes CF and HP
- No K or P codes
- D004, D010: P/S code HRA prior to 1984
- D008: all P/S codes except NR in nitrate operations for the generation of leaded gloves
- D005: P/S codes COL, CD, DS, HCD, HD, LR, RCM, RFX, RR
- D005, D006, D007, D008, D011: P/S codes AL, AT, ATL, ED, ETD, IS, MPD, PTS, RC, SC, TDC
- D005, D006, D007, D008, D009, D011: P/S code HRA
- D005, D008: P/S code VUL
- D006, D007, D008: P/S codes OD, RB, RBJ, SP, SSD
- D006, D007, D008, D009, D011: P/S codes AO, CD, DS, EV, FX, HCD, HD, HGMS, IA, LG2, LR, MELL, OH, RCM, RFX, RR
- D006, D007, D008, D011: P/S codes AS, BF, BU
- D006, D008: P/S codes LG1, ML, NC, NL, VC
- D006, D008, D040: P/S code RO
- D007: P/S codes PT, SP
- D007, D008 , D009, D011, D019, D021, D022, D039: P/S codes CF, HP
- D007, D009: P/S codes AP, MB
- D009: P/S codes AL, ATL, ED, MPD, SC, VP1, VP3
- D011: P/S code CPOD

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR NITRATE OPERATIONS AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes that generated TRU waste in the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for several waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to TA-55 waste streams resulting from nitrate operations covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001,R.5) (AK Information Summary) that includes information regarding all TRU waste streams

- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to nitrate operations is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record Nos. TWCP-3548, TWCP-3566, TWCP-3567, and TWCP-3568. Individual documents in these records have been assigned a separate identifier, N-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

present in the process wastes, based on subject matter expert (SME) interviews and any relevant data

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Unclassified Controlled Nuclear Information (UCNI) is contained in these records, and will not be included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK report is part of a set of closely related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six operational areas. The multiple processes in each area are described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005) (this report)
- *Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, nitrate operations include over 80 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6).

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in nitrate operations, and identify the resulting wastes as well as outputs that are sent to other operations, such as pyrochemical operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Most processes in nitrate operations were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (DLs) (TWCP-816).

### 3.2 Basis, Rationale, and Assumption Used to Delineate the Waste Streams

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the AK Information Summary. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, to evaluate the most appropriate waste

summary group, waste matrix code, and potential for the presence of hazardous constituents. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

3.3 Waste Physical Form and Content Description

Wastes generated during nitrate operations are primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. General debris waste categories from nitrate operations include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles
- Metal debris (for example, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from nitrate operations. The cemented waste includes cemented organics and cemented inorganics, including emulsified oils.

3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1979, when nitrate operations first began at TA-55, to the present. Process wastes from nitrate operations have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding EPA HWNs are shown graphically in Attachment 3, Time Lines.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

3.5 Waste Generation Processes

The following subsections describe the generation of waste by nitrate operations, as well as product and waste outputs to other processes or operations.

Manufacturing and research operations performed at TA-55 in the production of plutonium also generate plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery and manufacturing operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55. Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352 and TWCP-886).

This report addresses the aqueous nitrate-based recovery processes. The primary feed source for the nitrate recovery operations is plutonium residues from other recovery operations (e.g., chloride or pyrochemical), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities (TWCP-3548/N-1). The overall goal of the nitrate recovery operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The nitrate recovery operations can be divided into the following process steps:

- Pretreatment
- Dissolution
- Purification, including conversion to oxide
- Cement fixation

Each of these process categories is described below. The timeframe and EPA HWNs associated with each P/S code are shown on the timelines included as Attachment 3; the dates can be correlated to the dates on the procedures listed in Attachment 1. Attachment 4 contains a complete listing of P/S codes for nitrate operations, their descriptions, feed materials, chemical inputs, outputs and applicable EPA HWNs. A simplified process flow diagram for nitrate operations is found in Attachment 5.

3.5.1 Pretreatment (P/S codes BL, BM, BU, CR, DP, ETD, GMS, HGMS, IS, MAG, MAS, MF, OH, OY, PA, PAF, PTS, RC, RO, TDC, VP2, VUL)

Pretreatment primarily includes physical processes used to prepare scrap and residues for the next step, dissolution (TWCP-3548/N-1). Pretreatment may have included any or all of the following processes: calcination (RC), caustic leaching, chemical separation (hydroxide or oxalate precipitation), crushing and pulverizing (CR), distillation, filtering of liquids or oils, incineration (IS), magnetic separation (GMS, MAG, MAS, HGMS), passivation (PA, PAF), scraping, and sorting (TWCP-3548/N-1 through N-18). As materials are received from various operations within TA-55, they are sorted and sent to other pretreatment processes or directly to dissolution depending on the

physical nature of the scrap or residue and on the amount and type of plutonium associated with the material. Loose plutonium may be brushed off of a scrap item and then the item sent to dissolution. Chunks of plutonium-bearing residue (e.g., sand, slag, crucibles) are sent for crushing and pulverizing (CR). Magnetic plutonium-bearing materials are sorted using magnetic separation (GMS, MAG, MAS, HGMS) into either lean or rich plutonium-bearing residues (TWCP-3548/N-1 and N-2). The lean plutonium-bearing residues are sent to cement fixation (CF) if plutonium concentrations are below the DL (TWCP-3548/N-1 and N-2). Finely divided plutonium in sweepings or powder form is sent directly to dissolution. Lapping or grinding oils are filtered if necessary, and the liquid portion is sent to P/S code CF for immobilization in cement, or to P/S code RO for absorption on vermiculite, if plutonium concentrations are below the DL (TWCP-3548/N-10 and N-15). If there are a significant quantity of filtered solids, they are calcined and sent to dissolution (TWCP-3568/N-82).

Thermal pretreatment processes have also been used to prepare plutonium-bearing materials for dissolution (TWCP-3548/N-1). Passivation (PA, PAF) converts pyrophoric plutonium metal and other reactive metals to a stable oxide prior to dissolution. These materials were heated in a tube furnace to approximately 600 °C (PA, PAF) (TWCP-3548/N-7 and N-11). Cellulose materials contaminated with plutonium (e.g., cheesecloth, wood, paper, cardboard) have been incinerated (IS) or thermally decomposed (TDC) (TWCP 3548/N-1, N-5, N-6, N-7, N-11, and N-12). Ash from the incinerator was sent to a calciner (P/S code RC) to remove any residual organic materials and to ensure complete oxidation prior to dissolution. Thermal decomposition of cellulose (P/S code TDC) is performed in an argon atmosphere and the vapors and particulate matter are trapped in a caustic scrubber (TWCP 3548/N-6 and N-12, TWCP 3568/N-82). The caustic solution generated by the scrubber is sent to the TA-50-1 RLWTF after meeting the TA-50-1 waste acceptance criteria (WAC) (TWCP-3548/N-12). The wash water is filtered and sent to purification if plutonium concentrations are above the DL, or to the TA-50-1 RLWTF if it meets the TA-50-1 WAC. The rags are disposed as debris waste or thermally decomposed (TDC) (TWCP 3548/N-4, TWCP 3568/N-76). The ash from the thermally decomposed rags was rotary calcined (RC) before it was sent to dissolution (TWCP 3568/N-79). The burning of plutonium metal (BM), anode heels, and oxides was used to prepare these materials for either dissolution or storage in the vault (TWCP 3548/N-13 and N-14). Distillation was used to recover plutonium from polystyrene cubes (VP2) (TWCP 3548/N-18).

A caustic (hydroxide) leach process has been used to pretreat electro-refining furnace scrapings from the Rocky Flats Plant, and other residues

high in chlorides. Chlorides were removed using sodium hydroxide and the treated residues were then dissolved in nitric and hydrofluoric acid (TWCP 3566/N-26, N-26A, and N-30E). In this case, the caustic solution would be sent to the TA-50-1 RLWTF if it met the TA-50-1 WAC, and the filtered solids would continue through the dissolution process.

In overview, particulate solids from the pretreatment step are sent to dissolution if plutonium concentrations are above the DL and to cement fixation (CF) if concentrations are below the DL (TWCP-3548/N-1 through N-18). Liquids are sent to purification if plutonium concentrations are above the DL and to the RLWTF if they meet the TA-50-1 WAC (TWCP-3548/N-1 through N-18). Chemicals used in the pretreatment steps are listed in Table 5 in Section 3.6.3. Chemicals used in these steps that are covered by 40 *Code of Federal Regulations* (CFR) Part 261, including Appendix VIII of those regulations, are (1) hydrofluoric, nitric, oxalic, and sulfuric acid, (2) potassium and sodium hydroxide, (3) hydrogen peroxide (an oxidizer), and (4) trichloroethylene. EPA HWNs D001 and D002 do not apply to the solid wastes despite the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes. Trichloroethylene was only used in 1979 in P/S code RO, as a diluent for filtering oils (not used for solvent properties [TWCP-3548/N-10 and N-18]). Thus, the EPA HWN D040, but not F002, applies to waste generated under P/S code RO during 1979.

Additional EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the feed materials (see Table 1 in Section 3.6) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (section 4.2). Leaded gloves and other lead-containing items were discarded as described in section 3.6.1.

**NOTE:** For some of these P/S codes, no formal procedures could be found and the necessary information was extracted from process flow diagrams and SME input. More detailed descriptions of such P/S codes that are included in this pretreatment section are provided in section 3.5.6, as follows: P/S codes BL, BU, DP, ETD, HGMS, MF, PA, PTS, RC, RO, and VP2.

3.5.2 Dissolution (P/S codes AL, AS, AT, ATL, BAC, CD, COD, COL, CPOD, ED, HCD, HD, LC, LG1, LG2, MB, MELL, ML, MPD, NC, NL, NR, OD, PS, PT, SC, SP, SSD, UPS, US, US2, VC, VP1, ZD)

Dissolution is comprised of numerous processes that generate a plutonium-nitrate solution for feed to a purification process (TWCP-

3548/N-1, TWCP-3568/N-79). The main chemicals used in dissolution are nitric acid and calcium fluoride and/or hydrofluoric acid, which together form a standard leach solution. Additionally, other chemicals are used for particular dissolution processes. Depending on the particular process involved, dissolution takes place in pots or in cascade systems. Debris waste items may be wiped with a cloth soaked in a nitric acid/calcium fluoride solution to recover surface contamination of plutonium. The cloths are dunked in water a few times and wrung out (TWCP-3568/N-82). The solutions from the cloths are collected and filtered. The solids from the solutions are recycled through the dissolution process if plutonium concentrations are above the DL, or sent to cement fixation or disposed as debris waste if concentrations are below the DL (TWCP-3548/N-1, TWCP-3568/N-79). The plutonium-bearing solutions were sent to purification. The cloths are reused if they are not falling apart; otherwise, they are discarded as solid waste or sent to incineration (IS), depending on the nuclear material content (TWCP-3568/N-82).

Plutonium on the surface of metal and noncombustible debris waste items is also recovered by leaching or dipping the waste item into the standard leach solution (ML, NC) (TWCP-3548/N-1, TWCP-3566/N-22, N-29, N-30, and N-31, TWCP-3568/N-79). Plutonium-bearing solutions are sent to purification, while the leached items below the DL are discarded. Lead-containing waste items (e.g., leaded gloves) below the DL are segregated, packaged separately, and assigned the EPA HWN D008 (TWCP-3567/N-39). Other leached metal items containing RCRA-regulated heavy metals are also segregated from metal debris that is not RCRA-regulated and are assigned the appropriate EPA HWNs (e.g. D006 for cadmium) (TWCP-3568/N-84).

From the late 1970s to the present, many plutonium-bearing materials are dissolved in a standard leach solution of nitric and hydrofluoric acid after appropriate pretreatment or preparation (TWCP-3566/N-30A through N-30F, TWCP-3568/N-79). These materials include alloys, anodes, carbides, casting skulls, electrorefining residues, metals, and plutonium oxide. After dissolution, solids are discarded if below the DL or recycled if above the DL, while solutions are sent to purification. These solutions contain dissolved heavy metals (e.g., lead, cadmium, mercury, or chromium) below the regulatory levels (TWCP-3568/N-82). These metals may be concentrated to above the regulatory levels in the purification step (as a hydroxide cake) or in the evaporator step, as addressed later in this report.

Starting in 1990, plutonium oxide was also dissolved using an electrochemical process that incorporated the chemicals found in the standard leach solution as well as ferric ammonium sulfate, potassium

thiocyanate, and silver nitrate (CPOD) (TWCP-3548/N-1 and TWCP-3566/N-21). The electrochemical cell used in this process relied on silver acting as a catalyst for the dissolution of plutonium. Waste from this process was considered suspect hazardous for the presence of silver and was assigned the EPA HWN D011. This process was replaced in 1994 by a similar electrochemical process (P/S code MELL) that used cobalt nitrate or cerium nitrate in place of silver nitrate to reduce the generation of hazardous and mixed waste at TA-55 (TWCP-3548/N-1 and TWCP-3566/N-33).

Two dissolution processes were designed to remove excess silica from either solid residues during dissolution or from plutonium-bearing solutions after dissolution (TWCP-3567/N-34 and N-35). In both these processes, silica was removed from solutions prior to sending them to purification. One process involved the following steps: adjusting the acidity of the feed solution using nitric acid; distilling to concentrate the solution; oxidizing the plutonium to a valence state of +4 with hydrogen peroxide; heating the solution until the excess hydrogen peroxide is destroyed; and filtering the solution to remove the silica solids (TWCP-3567/N-34). The solution from this process went to anion exchange purification process. The second silica-removal process used a hydrofluorinator with a potassium hydroxide scrubber solution (TWCP-3567/N-35). The solution from this process was sent to the TA-50-1 RLWTF via the caustic waste line if the plutonium content was below the DL or to the lean residue ion exchange (LR) purification process if the content was above the DL. The filtered silica solids from both processes were re-dissolved if plutonium concentrations were above the DL or disposed to cement fixation (CF) if concentrations were below the DL.

Uranium-plutonium oxide mixtures were leached using nitric acid to preferentially dissolve the uranium (UPS) (TWCP-3566/N-19). Aluminum nitrate was added to the solution to complex any fluoride ion that might be present. The uranium-bearing filtrate was disposed to cement fixation (CF). The plutonium-bearing solids were sent to dissolution (ED, MPD, or SP) and then to either an anion-exchange process or the oxalate-precipitation process (OY) for purification.

A caustic (hydroxide) leach process has been used to pretreat electro-refining furnace scrapings from the Rocky Flats Plant and other residues high in chlorides. Chlorides were removed using sodium hydroxide, and the treated residues were then dissolved in nitric and hydrofluoric acid (TWCP-3566/N-26, N-26A, and N-30E). The filtered solids continued through the dissolution process. If the plutonium content in the solution was above the DL, the solution was refiltered (TWCP-3566/N-26). If the

plutonium content was below the DL, the caustic solution was disposed to the TA-50-1 RLWTF (TWCP-3566/N-26A).

Several dissolution processes involved the use of cascading dissolvers or dissolution pots (AL, AT, ED, MPD, OD, SC, SP) (TWCP-3548/N-1). The choice of dissolution equipment is based on the concentration of plutonium present in the feed material and the physical form of the feed material. Feed materials include ash, glovebox sweepings, ground slag or crucibles, oxides, residues, salts, and sand (TWCP-3566/N-23, N-24, N-25, and N-28; TWCP-3567/N-36, N-37, and N-37A).

For P/S code OD, the feed materials came from P/S codes PAF, IB, RB, and RBJ (TWCP-3568/N-81). The possible impurities in the feed materials consisted of cadmium, chromium, and/or lead. These metals would be contained in the filtrate, which was sent to the ion exchange processes for further purification. The debris waste generated from this process is not expected to contain cadmium, chromium, or lead above the regulatory limits because the dissolution involved strong acids (any soluble metals should be in the filtrate). However, without analytical data or other acceptable information confirming that the concentrations of these hazardous constituents are below the regulatory levels, the applicable EPA HWNs (D006, D007, and D008) are assigned pending additional information (TWCP-3568/N-83).

Cascading dissolvers consist of a series of heated columns into which the standard leach solution is introduced along with aluminum nitrate in some instances. Air is bubbled through the columns to promote mixing of the solutions and to keep particles in suspension. Solution from the first column overflows to the second column and so on (TWCP-3548/N-1; TWCP-3566/N-23, N-24, N-24A, and N-25; TWCP-3567/N-36). After dissolution in the dissolvers, the solutions are filtered and then sent to purification. The filtered solids are sent to other dissolution processes if plutonium concentrations are above the DL, or to cement fixation (CF) or disposed as debris waste if concentrations are below the DL.

Another feed material for the nitrate operations is hydroxide filtrate cakes from the chloride operations (TWCP-3548/N-1). This material is dissolved using the standard leach solution, which is then filtered (CD, HCD, HD) (TWCP-3566/N-32). Aluminum nitrate is added to the solution and the solution is re-filtered. The filtrate is sent to purification. Filtered solids are re-dissolved if plutonium concentrations are above the DL, or disposed to cement fixation (CF) if concentrations are below the DL. From 1985 to 1994, the hydroxide cakes from the chloride operations contained cadmium, chromium, lead, mercury, and silver (TWCP-3567/N-39 and N-40). After 1994, silver is not present in the cakes. The debris waste generated from the dissolution of hydroxide

cakes from the chloride operations is not expected to contain the listed metals above the regulatory limit. However, without analytical data or other acceptable information confirming that the concentrations of these hazardous constituents are below the regulatory levels, the applicable D-codes (D006, D007, D008, D009, and D011) are assigned pending additional information (TWCP-3568/N-83).

In overview, filtered solids from the dissolution step are re-dissolved until plutonium concentrations are below the DL, then sent to cement fixation (CF); debris items are disposed after the plutonium contamination is removed from the surface by leaching; plutonium-bearing solutions are sent on to purification or to the metal preparation line (P/S code MP) (TWCP-3548/N-1; TWCP-3566/N-21 through N-33; TWCP-3567/N-34 through N-36).

Chemicals used in the dissolution steps are listed in Table 5 in Section 3.6.3. Chemicals used in these steps that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are (1) ascorbic, formic, hydrochloric, hydrofluoric, nitric, oxalic, and sulfuric acid; (2) potassium and sodium hydroxide, (3) hydrogen peroxide (an oxidizer), and (4) mercuric and silver nitrate (TWCP-3566/N-21, N-22, N-23, N-24, N-25, N-28, N-29, N-30B, N-30C, N-30D, N-30E, N-30F, N-31, N-32, and N-33; TWCP-3567/N-34, N-35, N-36, N-37, and N-37A; TWCP-3568/N-81). EPA HWNs D001 and D002 do not apply to the solid wastes despite the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes. Mercuric nitrate was used as a catalyst in P/S code VP1, which is accordingly assigned the EPA HWN for mercury, D009. Silver nitrate was used in P/S code AT and CPOD, which are therefore assigned the EPA HWN for silver, D011.

Additional EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the material feed (see Table 1 in Section 3.6) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (discussed in section 4.2). For example, RCRA-regulated hazardous constituents introduced to the nitrate operation at the dissolution step from hydroxide filtrate cakes include cadmium, chromium, lead, mercury, and silver (TWCP-3567/N-39, N-40). Leaded gloves were discarded as described in section 3.6.1.

**NOTE:** For some of these P/S codes, no formal procedures could be found and the necessary information was extracted from process flow diagrams and SME input. More detailed descriptions of such P/S codes that are included in this dissolution section are provided in section 3.5.6, as

follows: P/S codes AS, BAC, COD, COL, LC, LG1, LG2, MB, NL, NR, PS, PT, SSD, US, US2, VC, VP1, and ZD.

3.5.3 Purification and Oxide Conversion (P/S codes AO, AP, CC, CH, DF, DS, FA, FC, HC, LR, OH, OY, PR, RB, RBJ, RCM, RFX, RR, SX, and VP3)

A peroxide precipitation process (PR) was used to achieve excellent separation of plutonium from the cationic impurities calcium, chromium, magnesium, cesium, cobalt, and aluminum, as well as americium (TWCP-3567/N-52). Peroxide was added to the oxide dissolution filtrate feed material to convert the plutonium to valence state (+4). Additional peroxide resulted in the precipitation of $Pu_2O_7$. The resulting peroxide filter cake was dissolved in nitric acid and the solution was sent to oxalate precipitation (OY). The filtrate solution from the peroxide precipitation was sent to hydroxide precipitation (OH), also known as the peroxide kill process.

Plutonium-bearing solutions generated in the dissolution step are directed to purification for plutonium recovery (TWCP-3548/N-1). Purification consists of both ion exchange and precipitation processes. There are three primary ion exchange processes based on the concentration of plutonium in solution: rich feed (RCM), dissolver solutions (DS), and lean residue (LR). After ion exchange, plutonium-bearing solutions are directed to oxide precipitation and then to an oxidation process. The oxidation process generates plutonium oxide, a stable form of plutonium suitable for storage or further processing into plutonium metal.

The ion exchange processes use resin-filled columns to collect plutonium (P/S codes DS, RCM, LR, RR, RFX) (TWCP-3548/N-1; TWCP-3567/N-41, N-42, N-43, N-44, N-46, N-47, and N-53). The pH of incoming solutions is adjusted with nitric acid and the plutonium is stabilized by changing the plutonium valence state to (+4) using hydrogen peroxide. Other chemicals used to adjust acidity or to "condition" incoming solutions to address the presence of fluoride, silica, metal impurities, or plutonium (+6) include: aluminum nitrate, ferrous ammonium sulfate, hydrogen peroxide, sodium hydroxide, sodium nitrite, sulfuric acid, and urea. Certain intermediate solutions used to condition the ion exchange feed, especially caustic solutions used to "kill" the peroxide, are filtered and then sent to the TA-50-1 RLWTF if they meet the TA-50-1 WAC.

If solutions high in americium are "conditioned" with hydrogen peroxide, an americium hydroxide precipitate forms when the solutions are dripped into sodium hydroxide to "kill" the peroxide (TWCP-3567/N-55). This precipitate is dissolved using nitric acid, sent

through an ion exchange column, and then sent on to the oxalate precipitation process to recover the americium and convert it to americium oxide (P/S codes AO, AP, FA, and SX).

Plutonium (+4) binds to the resin while impurities such as americium, uranium, and other metals flow through the columns (TWCP-3548/N-1; TWCP-3567/N-41, N-42, N-43, N-44, N-46, and N-47). The plutonium remains on the resin in the (+4) valence state until an eluting agent (hydroxylamine nitrate or 0.35-1.0 M nitric acid) is flowed through the columns. This releases purified plutonium in solution for further processing (i.e., precipitation and oxidation). The plutonium-poor solutions or effluents from the ion exchange columns are sent to the evaporator (EV) for re-concentration. Ion exchange resins are reconditioned using nitric acid; spent ion exchange resins are periodically sent to cement fixation (CF) for disposal.

After ion exchange, plutonium-bearing solutions are sent on to a precipitation process (P/S codes OY and OH) to convert the plutonium solution to plutonium oxide (TWCP-3548/N-1; TWCP-3567/N-41, N-42, N-43, N-47, N-48, N-50, N-51, N-51A, and N-53; TWCP-3568/N-79). This process involves the addition of oxalic acid to form a plutonium oxalate precipitate. The precipitate is then filtered out of the solution, washed, dried, and converted to an oxide using calcination, heat lamps, or hot plates. The plutonium solutions are either sent to the evaporator (EV) for volume reduction or, for a short time, were treated with hydroxide precipitation.

Hydroxide cakes from the chloride operations, which started in 1985 (TWCP-3567/N-40), are introduced to the nitrate operations in the dissolution step (TWCP-3567/N-39). The outputs from the dissolution of chloride operations hydroxide cakes are sent to P/S code LR or DS. Therefore, RCRA-regulated hazardous constituents associated with the feed materials from the chloride operations may carry through to P/S codes DS and LR (TWCP-3567/N-38). The hazardous metal constituents contained in hydroxide cakes from 1982 (based on the start of the chloride operations) until 1994, include cadmium, chromium, lead, mercury, and silver (TWCP-3567/N-40). Beginning in 1994, only cadmium, chromium, lead, and mercury are expected to be present. These metals may be present above the regulatory limits in the waste streams generated by P/S codes DS and LR. Therefore, the EPA HWNs D006, D007, D008, D009, and D011 are assigned to the waste from 1982 to 1994; and D006, D007, D008, and D009 are assigned from 1994 forward.

In overview, plutonium oxide from the purification step is transferred to the vault for storage or to the metal preparation line; solutions are sent to

the evaporator for re-concentration and then returned to ion exchange or sent to P/S codes CF or HP for immobilization in cement. The distillates are sent to the RLWTF if they meet the TA-50 WAC. Spent ion exchange resins are sent to cement fixation (CF) (TWCP-3567/N-41 through N-53).

Chemicals used in the dissolution steps are listed in Table 5 in Section 3.6.3. Chemicals used in these steps that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are (1) hydrofluoric, nitric, and oxalic acid; (2) sodium hydroxide, and (3) hydrogen peroxide (an oxidizer)(TWCP-3567/N-41 through N-47, N-50, N-51, N-53, N-54, and N-55; TWCP-3568/N-81). EPA HWNs D001 and D002 do not apply to the solid wastes despite the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes.

However, EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the material feed (see Table 1 in Section 3.6) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (discussed in section 4.2). For example, RCRA-regulated hazardous constituents introduced to P/S codes DS and LR with the hydroxide filtrate cakes include cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). Similarly, plutonium oxide from the vault may have been roasted and blended in P/S codes RB and RBJ to provide a more homogeneous feed for the metal preparation line (P/S code MP); these oxides may have contained cadmium (D006), chromium (D007), and lead (D008) (TWCP-3567/N-56, N-57, N-57A, and N-57B). Leaded gloves were discarded as described in section 3.6.1.

**NOTE:** For some of these P/S codes, no formal procedures could be found and the necessary information was extracted from process flow diagrams and SME input. More detailed descriptions of such P/S codes that are included in this purification section are provided in section 3.5.6, as follows: P/S codes AO, AP, CC, CH, DF, FA, FC, HC, and VP3.

3.5.4 Evaporator (P/S code EV)

Plutonium-poor ion exchange effluents and oxalate precipitation filtrates are sent to the evaporators to re-concentrate plutonium, if possible, and reduce the volume of disposed waste (TWCP-3548/N-1, TWCP-3568/ N-61 through N-65). General facility maintenance solutions (e.g., wet vacuum water, mop water, chiller water) are also sent to the evaporator if they do not meet the TA-50-1 WAC (TWCP-3568/N-76). The wet

vacuum water and chilled circulating water are contaminated with nitric acid, hydrochloric acid, or caustic solutions having the same characteristics as those sent to the TA-50-1 RLWTF, only richer in nuclear material content (e.g., diluted processing solutions) (TWCP-3568/N-82). The mop water is taken back into the evaporator only if it has a significant nuclear material content, which means that it originated in the processing solutions before escaping the confines of the glovebox system. There has never been an indication that spilled materials included a solvent.

Plutonium-poor solutions are collected in storage tanks and sent to the evaporators in batches of up to 600 liters (TWCP-3548/N-1; TWCP-3568/N-61 through N-65). These solution batches are then concentrated to approximately 25-liter volumes called "bottoms." As the bottoms cool, salts precipitate out and settle on the bottom of cooling trays. After cooling, the bottoms are sent back to ion exchange if plutonium concentrations are above the DL or to cement fixation (CF) if concentrations are below the DL. Attempts are made to re-dissolve settled salts, but if this is not possible, the bottoms are filtered and the salts are sent to dissolution if plutonium concentrations are above the DL or disposed as uncemented (debris) waste or sent to cement fixation (CF) if concentrations are below the DL. Nitric acid is used in the evaporator process to wash nitrate salts having a plutonium concentration above the DL. Except for approximately one year in 1990/1991, no other chemicals are used in the evaporator step in addition to those found in the ion exchange effluents and oxalate precipitation filtrates waste (TWCP-3548/N-1; TWCP-3558/N-61 through N-65). In the 1990/1991 timeframe, formic acid was added to the evaporator as an experiment to decrease the nitric acid concentration (by converting nitrate to nitrogen oxides) (TWCP-3568/N-76).

Chemicals used in the evaporator that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are nitric and formic acid. However, EPA HWNs D001 and D002 do not apply to the solid wastes from the evaporator because there is no free liquid in these wastes.

However, EPA HWNs apply to waste from P/S code EV as a result of the presence of regulated chemicals in the evaporator feed material. Hydroxide cakes from chloride operations, which started in 1982 (TWCP-3567/N-40), are introduced to nitrate operations in the dissolution step (TWCP-3567/N-39). Therefore, RCRA-regulated hazardous constituents associated with the feed materials from chloride operations may carry through from dissolution to P/S codes DS and LR to the evaporator (TWCP-3567/N-38). The hazardous constituents contained in the hydroxide cakes from 1982 (based on the start of the chloride operations) until 1994 include cadmium (D006), chromium

(D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). After 1994, only cadmium, chromium, lead, and mercury are expected to be present. Analysis of evaporator bottoms at TA-55 and statistical evaluation of analytical results using control charts have also shown that chromium, lead and mercury are above regulatory limits in this waste (TWCP-3568/N-66).

3.5.5 Cement Fixation (P/S codes CF, HP, IA)

In the cement fixation step, various wastes with plutonium concentrations below the DL from nitrate and other operations at TA-55 are collected and immobilized in cement for interim and long-term storage (TWCP-3548/N-1; TWCP-3568/N-67 through N-74). Cement fixation has been carried out in 55-gallon drums under P/S code CF, and in one-gallon cans under P/S code HP (TWCP-3568/N-72).

The cement fixation process came into existence in 1980 under what became P/S code HP. The following information was provided by a SME (TWCP-3568/N-81) because documented procedures for this process could not be identified. Wastes sent to P/S code HP for disposal in one-gallon cans included: americium oxide; calcium chloride salts from direct oxide reduction, pyroredox, and salt stripping; chloride solutions; evaporator bottoms; filter aid; glovebox sweepings; graphite powder; high efficiency particulate air (HEPA) filter media; high-fired ash; leached ash residues; leached particulate solids (e.g., sand, slag, crucible parts); passivated uranium carbide; plutonium/thorium fluoride filter cakes; plutonium/thorium hydroxide filter cakes; pump oils; silica solids; spent ion exchange resins; trioctyl phosphine oxide and iodine in kerosene; uranium oxide; and uranium solutions (TWCP-3568/N-72).

Since 1981, the primary feed to this process was the evaporator bottoms solution. Evaporator bottoms were treated by hydroxide precipitation and filtered. The cakes would dry only very slowly so the wet cakes were rolled in plastic bags with Portland cement powder or were stirred in one-gallon cans with Portland cement to make them set. In 1981, hydroxide precipitation was discontinued and the neutralized bottoms solutions were stirred directly with Portland cement powder in one-gallon cans. In January 1983, Gypsum (calcium sulfate) cement powder (also known as Envirostone cement) replaced the Portland cement powder. The evaporator bottoms solution was adjusted to a pH of about 3 for Gypsum cement or to a basic pH (7-10) for Portland cement. The cement powder was then mixed into the solution. Any particulate matter was added during the stirring operations.

Waste oil/organic solutions set up in cement were restricted to TRU vacuum pump oils and mixtures of trioctyl phosphine oxide (TOPO) and iodine dissolved in kerosene. Some of the miscellaneous solutions sent

for cement fixation included analytical chemistry solution residues that contained RCRA-regulated organics or heavy metals. Oils and organic liquids are emulsified by the addition of a surfactant before they are mixed with the neutralized evaporator bottom solutions (TWCP-3568/N-74). The miscellaneous solutions were treated in a manner much like the evaporator bottoms solution.

The discard of impure americium oxide from P/S code AO (section 3.5.6.1) was mostly accomplished by stirring it into a one-gallon can of evaporator bottom cement paste (up to 140 g americium/can). When all cement was being stirred in one-gallon cans, the americium-containing can was placed in the center of the middle layer of cans in a drum to provide maximum shielding. When storage of the impure americium hydroxide cakes in P/S code AO became a radiation exposure problem, a significant portion of the stored material was placed in P/S code IA until the material could be immobilized in cement for disposal. P/S code IA was active from April 1986 to December 1988. It did not involve any type of processing and, therefore, did not generate any waste.

In July 1988, the cementation process was changed from stirring the cement in one-gallon cans to stirring cement monoliths in 55-gallon drums attached to the glovebox (under P/S code CF). Although P/S code HP is still open, it has not been used since July 1988.

**NOTE:** The strategy proposed for shielding americium-containing cans, after the operation converted to 55-gallon drum monoliths, was to push the one-gallon americium-containing can down into the wet cement paste in the drum. However, the SME did not believe that it was ever attempted.

P/S code CF began in August 1988 and continues to the present time. Wastes collected for disposal in 55-gallon drums include aqueous and organic liquids from analytical chemistry; evaporator bottoms and evaporator salts; fine particulate materials, such as salts filtered from solutions, leached filter paper residues, and ash; oils, organic petroleum-based liquids, and spent ion exchange resins. As was the case for P/S code HP, the primary feed to this process has been the evaporator bottoms solutions. In 1996, the cementation process again converted from Gypsum cement powder (last used in June 1996) back to Portland cement powder (reuse began in July 1996).

Chemicals used in the cement fixation step under P/S codes CF and HP include: cement accelerator, Gypsum cement, nitric acid (pH adjustment), organic liquid emulsifier (which acts as a surfactant), Portland cement, silicon defoamer, sodium citrate retarder, and sodium hydroxide (pH adjustment) (TWCP-3568/N-69, N-71, N-72, N-74).

Phthalate buffer solution for pH 4 and phosphate buffer solution for pH 7 were used in P/S code CF only. EPA HWNs D001 and D002 do not apply to the solid wastes from cement fixation as a result of these chemicals because there is no free liquid in these wastes.

Although RCRA-regulated organics and metals were not used in either of the two cement fixation processes, regulated chemicals were present in the materials sent to be immobilized in cement. Therefore, the waste streams generated by these processes may contain RCRA-regulated solvents and metals above the regulatory limits.

- Analysis of evaporator bottoms at TA-55 between 1994 and 1998 and statistical evaluation of analytical results using control charts have also shown that chromium (D007), lead (D008) and mercury (D009) are above the regulatory limit for this waste (TWCP-3568/N-66).

- Hydroxide cakes from the chloride operations, which started in 1982 (TWCP-3567/N-40), are introduced to the nitrate operations in the dissolution step (TWCP-3567/N-39). Therefore, RCRA-regulated hazardous constituents associated with the feed materials from the chloride operations as well as those derived from other nitrate dissolution processes may carry through to cement fixation (TWCP-3567/N-38). The hazardous constituents contained in the hydroxide cakes from chloride operations include cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). The use of silver in chloride operations ended at the end of 1993. After 1993, heavy metal analyses have been conducted on the solutions, with chromium, lead, cadmium, and mercury being detected at levels above the regulatory levels at times.

- Gypsum cement was found to leach heavy metals above regulatory levels, but the Portland cement does not (N-66/TWCP-3568). Thus, the chromium, lead and mercury are no longer considered hazardous after 1995. In addition, arsenic, barium, cadmium, selenium and silver concentrations were all below the regulatory threshold limits for these metals.

- The presence of RCRA constituents in waste analytical chemistry solutions was noted in the data packages beginning in 1990. The RCRA-regulated organic chemicals found in these solutions included carbon tetrachloride (D019), n-butanol (F003), acetone (F003), methanol (F003), tetrachloroethylene (D039, F003), xylene (F003), methylene chloride (F002), chloroform (D022), and chlorobenzene (D021).

Based on this information, the following EPA HWNs apply to P/S codes CF and HP (until cessation of this process in August 1988):

- P/S codes CF and HP. Applicable EPA HWNs for organic chemicals are F002, F003, D019 (carbon tetrachloride); D021 (chlorobenzene), D022 (chloroform); and D039 (tetrachloroethylene).

- P/S code HP (from 1980 to December 1982): Applicable EPA HWNs for heavy metals for waste immobilized in Portland cement are D007 (chromium), D008 (lead), and D009 (mercury).

- P/S codes HP (from January 1983 to July 1988) and CF (from August 1988 to July 1996): Applicable EPA HWNs for heavy metals for waste immobilized in Gypsum cement are D007 (chromium), D008 (lead), D009 (mercury), and D011 (silver, until its use ended in 1992).

- P/S code CF (from July 1996 to the present time): Applicable EPA HWNs for heavy metals for waste immobilized in Portland cement are D007 (chromium), D008 (lead), and D009 (mercury). However, immobilization with Portland cement is an approved treatment and the final waste form is no longer hazardous.

Because P/S code IA simply held excess americium hydroxide cakes from P/S code AO, the EPA HWNs applicable to P/S code AO also apply to P/S code IA. These EPA HWNs are D007, D008, D009, and D011.

### 3.5.6 Additional P/S codes

Other P/S codes included in the Nitrate Operations, for which no procedures were found during this AK documentation review, are described in this section. The information for these P/S codes was derived from process flow diagrams and SME input (TWCP-3568/N-77 and N-81). The timeframe and EPA HWNs associated with each P/S code are shown on the timelines included as Attachment 3. The inputs, outputs, and applicable EPA HWNs are provided in Attachment 4.

#### 3.5.6.1 Americium Processing Calcination (AO)

This process was active from 1979 to 1984 and from 1986 to 1988 and went through three variations. The process was inactive from 1984 to 1986. From 1979 to 1984, this process received high purity americium oxalate cakes from P/S code FA. These cakes were calcined in a furnace resulting in a pure americium oxide product, which went to the vault and eventually most of this supply was sent to Oak Ridge

National Laboratory for distribution to manufacturers to be used for smoke detectors, well logging, and anti-static brushes. Beginning in February 1986 until about 1987, this process received oxalate cakes from P/S code PS. This impure americium oxalate was calcined to the oxide and sent to the vault as a reserve that could be converted to high purity oxide if a need arose. Finally, from April 1986 to December 1988, impure americium hydroxide cakes were received from chloride ion exchange processing of molten salt extraction salts. Those cakes were calcined and stored in P/S code AO and IA until they were ready for disposal by cement fixation (CF).

RCRA-regulated organic solvents were not used in any variation of this process and were not present in the feed materials; therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. RCRA-regulated metals also were not used in this process and were not introduced by the feed materials from P/S codes FA and PS; therefore, there would not be any RCRA-regulated metals in the waste streams generated from 1979 to June 1986. The presence of RCRA-regulated metals in the chloride operations, however, could carry over into this process. Therefore, waste generated from June 1986 to December 1988 may contain concentrations of cadmium, chromium, lead, mercury, and silver above the regulatory level (TWCP-3567/N-39 and N-40), resulting in EPA HWNs D006, D007, D008, D009, and D011 being assigned. The waste stream generated by this process consisted of the usual glovebox waste items.

3.5.6.2 Americium Purification (AP)

This process was performed from 1979 to June 1986, with a period of inactivity from 1984 to early 1986. The nitric acid concentration in americium solutions from P/S code SX was adjusted to 7 molar and passed through an ion exchange column. The plutonium (+4) would bind to the ion exchange resin and the americium (+3) would pass through the column, resulting in a purified americium solution. At the conclusion of the run, the plutonium was eluted off the column by washing the column with 1 molar nitric acid, and the plutonium solution collected separately. The plutonium solution was then sent to one of the plutonium ion exchange columns for recovery of the plutonium.

RCRA-regulated organic solvents and metals were not used in this process and were not present in the feed material from P/S code SX; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. Chemicals, such as hydroxylamine nitrate, were used to adjust the valence of the plutonium. The waste stream generated by this process consisted of the usual glovebox waste items, such as glass vessels, HEPA filters, and rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.3 Anode Heel Dissolution (AS)

This process was performed from 1980 to November 1988. The plutonium oxide generated as the result of burning anode heels in P/S code BU was dissolved in a nitric acid/hydrofluoric acid mixture or in calcium fluoride, and filtered to remove the nondissolving residues. These residues were dried and collected and sent after assay to P/S code SP for more rigorous dissolution. The filtrate was sent to the rich residue ion exchange column (RR) for purification.

Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium (D006), chromium (D007), lead (D008), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.4 Bacterial Decomposition of Cellulose Items (BAC)

This process was performed from mid-1995 to mid-1996 and was an alternative to thermal decomposition. The process involved the decomposition of cellulose rags using a living organism to digest the cellulose to glucose and other byproducts. Cheesecloth rags, bacteria, and water were added to a flask and allowed to sit while the bacteria digested the rags. The resulting solution was sent to the lean residue ion exchange (LR).

RCRA-regulated organics and metals were not used in this process and were not introduced by the feed materials;

therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process.

3.5.6.5 P/S code BF

Activities under this P/S code were nearly identical to those under P/S code BU because the feed was also anode heel metal. Heels were burned under P/S code BF between September 1985 and November 1986 came from the electrorefining step (P/S codes ER or SS) at TA-55. Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium (D006), chromium (D007), lead (D008), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.6 Blending (BL)

This process was performed from 1979 to May 1988. Various lots of plutonium oxide in the vault or in-house P/S codes were fed into this process. Each container of oxide was weighed, opened, and screened to remove oversized material. The oversized material was ground with a mortar and pestle and rescreened. The individual contents were combined and blended in a V-blender to make a homogeneous lot of feed oxide that was sent as feed to the roasting and blending process (RB).

This is a physical process in which no additional materials or chemicals are used. RCRA-regulated organic solvents and metals were not used in the process and were not introduced with the feed material; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. The waste generated consisted of typical glovebox waste items, such as HEPA filters, glass, ceramic boats and plates, cleaning rags, brushes, metal containers and equipment, and plastics. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.7 Button Burning (BU)

This process was performed from approximately 1979 to 1986. Metal buttons were received from offsite DOE facilities (usually Hanford, but possibly Rocky Flats as well). The metal buttons were burned in a furnace at about 600°C. The oxide produced from six buttons was combined and blended to make up a uniform feed lot for the anode heel dissolution process (AS).

Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium (D006), chromium (D007), lead (D008), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.8 Calcination (CC)

This process was performed from 1979 to November 1988. Plutonium oxalate cakes from the oxalate precipitation process (OY) were calcined by heating in air in a furnace to form pure plutonium oxide. The oxide became feed for the oxide reduction process.

This was a physical process, not involving any chemical reagents. RCRA-regulated organic compounds and metals were not used in this process and were not introduced by the feed materials. The oxalate cakes were of high purity. Therefore, the waste generated from this process would not contain any RCRA-regulated organic compounds or metals. The waste generated from this process consists of the usual glovebox waste items plus metal tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.9 Characterization (CH)

This process was performed from 1979 to February 1989 and received samples of blended lots of oxide from the blending process (BL). Portions of the samples were weighed out for four analyses to demonstrate that the oxide powders met the acceptance criteria for preparation of driver fuel for the Fast

Flux Test Facility (FFTF). The Loss on Ignition Analysis involved heating the powder and measuring the weight loss from driving off adsorbed water and gases. The Surface Area Analysis involved absorption of nitrogen gas on the oxide at liquid nitrogen temperature. The Particle Size Analysis measured the settling rate of oxide particles dispersed in a viscous, water-soluble liquid using the absorption of X-rays by the particles. The slurry was discarded to cement fixation (HP). Finally, some of the powder was pressed into pellets and sintered at 160 degrees C before measuring and weighing them for density. The pellets and oxide residues were packaged separately and sent to the vault as archives and eventually recycled. Oxide powders from other sources were also partially characterized many times. The process was used to make water-dampened plutonium oxide pucks for a criticality experiment and to test the reactivity of calcium nodules from pyrochemical operations.

RCRA-regulated organics and metals were not used in this process and were not introduced by the feed materials. The oxide samples were high-purity materials. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals. The waste generated by this process included the usual glovebox waste of HEPA filters, window glass and glass containers, metal containers and tools, brushes, and cleaning rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.10 Chlorinated Oxide Dissolution (COD)

This process was performed from August 31, 1988 to July 1991. The front-end of this process looked identical to the chlorinated oxide leach process (COL). Chloride pyrochemical salts were dissolved in sodium hydroxide solution and filtered. The filtrate was discarded into the caustic waste line to the TA-50-1 RLWTF or immobilized in cement (CF). The dried plutonium oxide cake was dissolved in a nitric acid-hydrofluoric acid mixture as part of this process, or sent to a cascade dissolver (ED). The solution from the acid dissolution step was filtered and the solids were returned to the dissolution step. The solution volume was reduced by distillation. The distillate was processed in one of the ion exchange columns. The concentrated solution was re-filtered and all of the filter residues were sent to a cascade dissolver (ED) or to the filter residues dissolution process

(SP). The filtrate was sent to one of the ion exchange columns for recovery.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials. The pyrochemical salts should be of high purity. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals.

3.5.6.11 Chlorinated Oxide Leach (COL)

This process was performed from June 13, 1989 to June 1991. Chlorinated oxides or plutonium oxide contained in chloride-based pyrochemical salts from Rocky Flats were subjected to leaching with sodium hydroxide. The chloride salts would dissolve in the solution that would then be filtered. If the filtrate met the TA-50-1 WAC, it would be sent into the process caustic waste line at the TA-50-1 RLWTF. If not, it would be sent to cement fixation (CF). The cake containing the plutonium oxide would be dried and sent to the cascade dissolver (ED) or to chlorinated oxide dissolution (COD).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. RCRA-regulated metals also were not used in this process. However, the Rocky Flats salts that fed this process would contain any barium present in their electrorefining salts. Barium is not expected to be present above the regulatory limits in the waste generated by this process; however, without analytical results or other acceptable information to support this, the EPA HWN for barium (D005) is assigned to the liquid waste sent to cement fixation (CF) (TWCP-3568/N-83). The waste generated by this process consists of the usual glovebox waste, such as glassware, plastic filter boats and tubing, and rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.12 DS Furnace and Oxide Prep (DF)

This process was performed from 1979 to April 1990. The wet plutonium oxalate cake from the ion exchange process (DS) was placed in a metal can and heated in air in a furnace to dry the cake and then decompose the oxalate to an oxide product. The oxide product was returned to the ion exchange process (DS) prior to being sent to the vault.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials. The oxalate cakes were of high-purity. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals. The waste generated by this process consists of the usual glovebox waste items plus metal tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.13 Dry Processing (DP)

This process was performed from 1979 to December 1985 and was the front-end treatment of polycubes, which were blocks of polystyrene with plutonium oxide embedded in them (TWCP-4100). The Hanford polycubes were skinned to remove the uncontaminated surface and perhaps some of the oxide embedded beneath the surface. If the skins met the DL, they would be discarded as plastic waste. If not, the skins would be sent to polycube processing (VP2) along with the bulk of the cube material. In preparation for that treatment, the cubes would be crushed and milled into small fragments.

This is a physical process. RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals. The waste generated by this process consists of the usual glovebox waste items plus plastic, metal tools and equipment, rags, and brushes.

3.5.6.14 Experimental Thermal Decomposition (ETD)

This process has been performed from June 4, 1996 to the present. Combustible residues from various P/S codes are heated in a furnace under argon until the organic matrix is volatilized and decomposed, and a carbon-rich residue containing plutonium oxide and impurities remain. This residue is then sent to a rotary calciner (RC) to remove the carbon.

RCRA-regulated organics and metals are not used in this process. Organics may be introduced with the feed materials depending upon the P/S codes from which the materials come; however, any solvents are dissipated during the heating process. The feed materials may initially contain low levels of RCRA-regulated metals, but the thermal decomposition process drives off most of the mass, thereby

concentrating the non-volatile heavy metals. Therefore, the waste generated from this process may contain RCRA-regulated metals (but no organics). The waste generated by this process consists of the usual glovebox waste items plus metal tools, containers, and equipment; rags; brushes; and a water scrub solution from scrubbing the off-gas.

3.5.6.15 Americium Processing (FA)

This process was performed from 1979 to 1984. The 7 molar nitric acid solution from the americium purification process (AP) was distilled to reduce volume, and the acidity was adjusted to a low concentration of approximately one molar prior to oxalate precipitation in P/S code AO. The oxalate filtrate was sent to one of the hydroxide precipitation processes, such as P/S code VP3.

RCRA-regulated organics and metals were not used in this process. RCRA-regulated organics also were not introduced with the feed materials. Therefore, the waste generated from this process would not contain any RCRA-regulated solvents. Any RCRA-regulated metals present as impurities in the feed materials would be contained in the oxalate filtrate sent to a hydroxide precipitation process. However, the process description for P/S code AP does not indicate the presence of metals above the regulatory limit. The waste generated by this process consists of glass vessels, sintered glass frits, HEPA filters, rags, and other glovebox waste discarded as TRU solid waste. Because this is predominantly americium, waste materials were always discarded. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.16 Canning (FC)

This process has been run from 1979 to the present. Plutonium oxide coming out of the blending process (BL) for storage in the vault is weighed into a food pack can (approximately 1 kg of oxide per can) and a lid is placed on the can in the canning operation. The can is wiped down with a water-dampened rag and passed out into a hand-held plastic bag in a hood. The plastic bag is sealed with vinyl tape and the unit is canned into a second larger food pack can that is entirely uncontaminated, for storage.

This is a physical process. RCRA-regulated organics and metals are not used in this process and are not introduced with the feed materials. The feed material is high-purity

plutonium oxide. Therefore, the waste generated by this process would not contain any RCRA-regulated solvents or metals. The waste generated by this process includes typical glovebox waste, such as HEPA filters and glass windows, as well as rags and stainless steel tools, cans, and equipment. Any wastewater generated by this process is sent to the ion exchange processes. Leaded gloves were disposed of as described in Section 3.6.1 until 1992, when this waste began to be segregated and disposed of as RCRA-regulated waste.

3.5.6.17 Cement to Drum (FX)

This process was performed from 1980 to July 1988. During the time that all cement was stirred in a one-gallon can (HP), the cans were initially bagged out a few cans at a time in a polyvinyl chloride (PVC) plastic bag and placed in a drum as they could best be fitted in. Eventually, a drum-out port was dedicated to this purpose. A 26-lb bag attached to a glovebox would be allowed to fit down into a drum. The one-gallon can would be stacked inside the bag in the drum, seven cans to a layer with five layers, for a total of 35 cans contained inside one bagout bag. No processing of materials was performed in this process.

This is a packaging process. RCRA-regulated organics and metals were not used in this process. Any applicable RCRA codes based on the feed materials are assigned to the cement fixation (CF and HP). The waste generated by this process was the usual glovebox waste, including large amounts of plastic. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.18 Calcination (HC)

This process was performed from 1979 to August 1989. Plutonium oxalate cakes from P/S code OY were first calcined in air up to 700 degrees C. Water vapor was then passed through the cakes as it was heated to 850–900 degrees C to remove any fluoride impurity from the oxide. This prevented fluoride-catalyzed low temperature sintering in the oxide product.

RCRA-regulated organics and metals are not used in this process and are not introduced with the feed materials. The feed materials (oxalate cakes) are of high purity. Therefore, the waste generated by this process would not contain any RCRA-regulated solvents or metals. This process generates

the usual glovebox waste, plus metal tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.19 High Gradient Magnetic Separation (HGMS)

This process has been performed from May 10, 1994 to the present. This P/S code is very similar to P/S codes GMS, MAG, and MAS. In this process, a steel mesh placed in a magnetic field becomes a magnetic attractor for plutonium particles of less than 50 microns. The particles are removed from slurries of soil and clays in water. This method reduces the quantity of soil that must be treated to remove the plutonium. The soil is first screened to separate the particles that are larger than 53 microns and cannot be separated in this process. The less than 53-micron fraction is slurried in water and passed around the magnet. The lean fraction is discarded as waste in cement fixation (CF) or sent to storage if the plutonium concentration is above the DL. The plutonium-rich fraction is stored until can be taken into a dissolution process. The slurry is filtered and the water is reused.

RCRA-regulated organics and metals are not used in this process but are introduced with the feed materials consisting of ash and miscellaneous materials contaminated with D006, D007, D008, D009, and D011. The waste generated by this process includes the usual glovebox waste plus metal screens and tools, rags, brushes, and containers.

3.5.6.20 Hanford Reservation Materials (HRA)

HRA refers to process residues sent from Hanford Reservation to TA-55 for plutonium recovery (TWCP-5371). This material was sent through nitrate operations but waste from processing it was tracked by the source code (HRA) instead of the P/S code in which the waste was generated. To be conservative, all EPA HWNs that are applicable to P/S codes in nitrate operations (other than the cementation processes CF and HP) are also applied to wastes from HRA. These EPA HWNs are D005, D006, D007, D008, D009, and D011.

**NOTE:** Because this code is not a process, there is no timeline associated with it in Attachment 3.

3.5.6.21 Impure Americium Holding for Discard (IA)

This P/S code was active from April 1986 to December 1988. When storage of the impure americium hydroxide cakes in P/S code AO became a radiation exposure problem, a significant portion of the stored material was placed in P/S code IA until the material could be fixed in cement for disposal. This P/S code did not involve any type of processing and, therefore, did not generate any waste.

Because this P/S code simply held excess americium hydroxide cakes from P/S code AO, the EPA HWNs applicable to P/S code AO apply to P/S code IA. These EPA HWNs include D006, D007, D008, D009, and D011.

3.5.6.22 Uranium/Plutonium Processing Nitrate Hydrofluoric Dissolution (LC)

This process was active from August 12, 1985 to August 1987. Plutonium oxides from P/S codes US (later renamed US1) and US2 were dissolved in nitric acid and hydrofluoric acid, concentrated by distillation, and filtered. The distillate solution was sent to P/S code EV. Any filter residues were calcined and recycled into the dissolution process. The uranium-plutonium solution was subjected to an oxalate precipitation with oxalic acid or sodium oxalate to precipitate the plutonium. The slurry was filtered and the plutonium oxalate was sent to a calcination process. The uranium nitrate solution was cemented in P/S code HP.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste, plus glassware, heating mantles, plastic filter boats, filter paper, rags, brushes, and metal tools and equipment.

3.5.6.23 Non Combustible Leach (LG1)

This process was active from October 1982 to December 1985. Metal, glass, and plastic from most PF-4 processes were leached with nitric acid to remove plutonium surface contamination from those matrices. The solution mixture was filtered to separate insoluble residues, which were dried and discarded as solid TRU waste. The plutonium nitrate-containing filtrate was sent to P/S code LR for

purification. This filtrate may have contained chromium, cadmium, and/or lead that was leached out from the stainless steel, shielding, or other metal feed materials (TWCP-3568/N-84).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials (TWCP-3568/N-81). Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. The metal feed materials generally consisted of steel, stainless steel, aluminum, and copper. Any RCRA-regulated metals leached from these feed materials would be in the filtrate sent to P/S code LR. However, the leached materials may still contain concentrations of cadmium and/or lead that may leach out above the regulatory limit, resulting in the debris waste requiring the applicable EPA HWNs (D006, D008) (TWCP-3568/N-84). The chromium in stainless steel does not leach out above the regulatory limit. This process generated the usual glovebox waste, plus metal, glass, plastic, plastic filter boats, filter papers, glassware, rags, and brushes (TWCP-3568/N-81).

3.5.6.24 Hydroxide Cake Dissolution (LG2)

This process was active from October 1982 to December 1985. Hydroxide cakes from P/S codes CS and VP3 were dissolved in nitric acid and the solution was filtered. Any residue or filter cake was sent back to the dissolution step. The filtrate containing the plutonium nitrate was sent to P/S code LR for purification.

RCRA-regulated metals and organics were not used in this process; however, during the 1985 time period, certain metals could have been introduced with P/S code CS (from chloride operations), and mercury could have been introduced with the P/S code VP3 feed material. These metals would be found in the nitric acid filtrate, which fed into P/S code LR. Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. However, there may have been cadmium (D006), chromium (D007), mercury (D009), or silver (D011) in the feed material from 1984 through December 1985. This process generated the usual glovebox waste, plus glassware, metal tools and equipment, plastic filter boats, filter papers, rags, and brushes.

3.5.6.25 Nitric Dissolution of Molten Salts (MB)

This process was active from February 1986 to January 1987 and included both a hydrochloric acid dissolution path and a nitric acid dissolution path. The hydrochloric acid path began with refluxing the molten salt extraction (MSE) salts in hydrochloric acid and filtering the material. The solid residues were sent back into the dissolution process. The plutonium solution was sent to P/S code SE for purification. The distillate from the condenser tube was neutralized if it would meet the process caustic waste WAC for the TA-50-1 RLWTF. If it would not meet the WAC, the material was sent to either P/S code CS or CX. In the nitric acid dissolution, the nitric acid refluxed solution was filtered and sent to P/S code PS. The solid residues were recycled back into dissolution. The distillate from the condenser tube was recycled if there was low plutonium content, but was sent to P/S code LR if the plutonium content was high.

RCRA-regulated organics and metals were not used in this process and organics were not introduced with the feed material.

3.5.6.26 Metals Furnace (MF)

This process was active from May 23, 1986 to February 1989. Plutonium metal items were roasted in air at a carefully controlled temperature. After the metal was completely converted to plutonium oxide, the materials were divided into one-kg lots and canned for storage in the vault to await blending.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials. The metal items feed materials were of reasonable purity. Therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated typical glovebox waste, plus metal tools, containers, plastic bags, metal equipment, ceramic boats, rags, and brushes.

3.5.6.27 Non Combustible Leach (NL)

This process was active from 1979 to February 1989 and is very similar to P/S code LG1. Surface contaminated metal, glass, and plastic were subjected to nitric acid leaching and filtration. The filter residues were dried and discarded if they

met the DL. Otherwise, the residues were recycled back into the leaching step. The bulk matrix materials leached were assayed to see if they met the DL for disposal. If not, they were recycled into the leaching step. The filtrate containing the plutonium nitrate was sent to P/S LR for purification. This filtrate may have contained chromium, cadmium, and/or lead from stainless steel, shielding, and other metal feed materials (TWCP-3568/N-84).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. The metal feed materials may have consisted of steel, stainless steel, aluminum, and copper. Any RCRA-regulated metals leached from these feed materials would be in the filtrate sent to P/S code LR. However, the leached metals may still contain concentrations of cadmium and/or lead above the regulatory limit, resulting in the debris waste requiring the applicable EPA HWNs (D006, D008) (TWCP-3568/N-84). The chromium in stainless steel does not leach out above the regulatory limit. This process generated the usual glovebox waste, plus glassware, metal tools and equipment, plastic filter boats, filter papers, rags, and brushes, as well as the metal, glass, and plastic matrices being leached (TWCP-3568/N-81).

3.5.6.28 Nitrate Recovery (NR)

The processes under P/S codes ED, HCD, MPD, and RFX were combined into this one P/S code; however, this P/S code was never activated. Therefore, waste was never generated under this P/S code.

3.5.6.29 Passivation (PA)

This process was active from 1979 to January 1990. Glovebox sweepings, oxides that may contain unoxidized plutonium metal, carbides, and nitrides that can be very reactive in an oxidizing acid are burned in a tube furnace in air to passivate the material and moderate its reactivity. It can then be sent to a dissolution process such as P/S SP or OD.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the typical glovebox waste, plus metal

tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.30 Peroxide Precipitation of MSE Salts (PS)

This P/S code was active from February 1986 to January 1987. Plutonium-containing nitric acid solutions from P/S code MB were filtered, diluted, stirred, and sampled for nuclear material content and to verify that the proper concentrations of materials existed in the solutions. The plutonium in the solution was precipitated out using hydrogen peroxide. The precipitate was filtered to separate it from the solution. The peroxide cake was redissolved in nitric acid and sent to P/S code SO. The americium-rich filtrate was dripped into sodium hydroxide solution to destroy the peroxide. The hydroxide slurry was acidified with nitric acid and an oxalate precipitation performed on the solution. The americium oxalate was separated as a cake by filtration and the cakes were sent to P/S code AO. The filtrate was sent to P/S code LR for recovery of plutonium.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. RCRA-regulated metals were not used in this process; however, if barium was present in the MSE salt feed material, it would be present in the americium oxalate filtrate that was sent to P/S code LR. According to the SME, however, it is very unlikely that barium was present in the feed material. Therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste materials, plus plastic filter boats, glassware, metal stirrers and column end caps. This waste was disposed as solid TRU waste.

3.5.6.31 Plutonium/Thorium Separation (PT)

This process was active from 1979 to December 1985. Initially, plutonium/thorium oxides were dissolved in nitric and hydrofluoric acid (TWCP-3567/N-54). Sodium chromate and lanthanum nitrate were added to this solution. Thorium was removed from solution through formation of a thorium fluoride precipitate. After filtering out this precipitate, the plutonium and chromium were reduced to the (+3) valence state in solution using hydroxylamine nitrate and then sent to oxalate precipitation to recover the plutonium. Chromium in solution was sent to the evaporator (EV). Because of the

chromium, the waste solution from this activity is assigned the EPA HWN D007.

Later, the process changed to separate plutonium from thorium and americium using technologies similar to those used for ion exchange (TWCP-3567/N-54, N-55). Plutonium/thorium oxide residues were dissolved in nitric acid and passed through a nitrate-based ion exchange column to separate the two actinides. The column effluent containing thorium was subjected to a hydroxide precipitation and filtration. The filtrate was discarded into the process caustic waste line to the TA-50-1 RLWTF. The residue from filtration was calcined and discarded as a solid waste. The plutonium-containing ion exchange eluate was also subjected to a hydroxide precipitation and filtration. Because the plutonium cake is still contaminated with thorium, the slurry was redissolved in nitric acid and passed through a chloride ion exchange column. The thorium effluent underwent a hydroxide precipitation and filtration. The thorium residue is calcined and discarded. The filtrate is discarded into the process caustic waste line to the TA-50-1 RLWTF. The plutonium-bearing hydrochloride eluate undergoes hydroxide precipitation and filtration. The filtrate is discarded into the process caustic waste line to the TA-50-1 RLWTF. The plutonium hydroxide cake is dissolved again in nitric acid and sent to P/S code RR for recovery.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents in the waste streams generated by this process. Chromium (D007) could be present due to the use of a chromate salt in the process from 1979 until December 1985. This process generated the typical glovebox waste streams, plus glassware; metal tools, equipment, and containers; plastic filter boats; filter papers; rags; and brushes.

3.5.6.32 RD&D Pretreatment Study (PTS)

This process was active from January 4, 1990 to February 1992. A variety of residue matrices were pulled into P/S code PTS to be characterized for impurities, state of division, and even pretreatment (milling, grinding, etc.) to achieve a desired state for use in fluoride volatility studies in P/S code CK. Most of the effort was expended on ash from LANL and Rocky Flats.

RCRA-regulated organics and metals were not used in this process, but the ash feed would have been high in heavy metals such that this P/S code would generate waste potentially contaminated with non-volatile heavy metals: barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic, mercury and selenium would not be present because they would have been volatilized. This process generated the typical glovebox waste streams, plus metal tools, containers, and equipment; plastic bags; ceramic furnace elements; ceramic boats; rags; and brushes.

3.5.6.33 Rotary Calciner (RC)

This process has been active from 1985 to the present. Ash from P/S codes IS and TDC and other carbon-containing ash and graphite crucibles are calcined in an oxygen or air stream. This removes organic carbon. The calcined ash is blended and sent to recovery. This process is also used to calcine uranium oxides before uranium separation.

RCRA-regulated organics and metals were not used in this process, but the ash feed would have been high in heavy metals such that this P/S code would generate waste potentially contaminated with non-volatile heavy metals: barium (D005), cadmium (D006), chromium (D007), lead (D008), and silver (D011). Arsenic, mercury and selenium would not be present because they would have been volatilized. This process generated the typical glovebox waste streams, plus metal tools, containers, and equipment; plastic bags; ceramic furnace elements; ceramic boats; rags; and brushes.

3.5.6.34 Oil Recovery (RO)

This process was active from 1979 to March 1989. Vacuum pump oils and other contaminated organics from various PF-4 operations were analyzed for nuclear material content. If they met the DL for plutonium, they were mixed with vermiculite and packaged in a drum for disposal. If the oils or organics contained plutonium above the DL, they were filtered through a glass frit so as to meet the DL. Any plutonium residue caught in the filter was to be sent to recovery operations.

Once in 1979, trichloroethylene (D040) was used as a diluent to reduce the viscosity of vacuum pump oil so that the oil

could be filtered through a glass frit. Otherwise, RCRA-regulated chemicals were not used in this code or present in the feed materials. Therefore, other than EPA HWN D040 in 1979, there would not be any RCRA-regulated solvents in the waste generated by this process.

RCRA-regulated metals were not used in this process. However, metal particles from the wear of vacuum pumps, such as lead, cadmium, and steel, could be in the oil; however, the metals are not soluble. The oils contain less than three percent of solids. Lead is the typical heavy metal in vacuum pump oils, while cadmium is found in hydraulic oils. The chromium from the steel is present in the oils in concentrations below the regulatory limit, based on analyses of similar low-level radioactive waste oils. These metal particles remain with the oil when it is absorbed on vermiculite. In the absence of analytical data or other acceptable information confirming that the concentrations of lead and cadmium are below the regulatory levels, the applicable EPA HWNs D006 and D008 are assigned pending additional information (TWCP-3568/N-83).

This process also generated the typical glovebox waste, plus glassware; metal tools, equipment, and containers; plastic bags and tubing; rags; and brushes.

3.5.6.35 Special Scrap Dissolution (SSD)

This process was active from March 10, 1988 to February 1991. Miscellaneous oxide scrap items were combined, dissolved in nitric acid/hydrofluoric acid, and filtered. The filter residues were dried on a hot plate and assayed. If the residues met the DL for plutonium, they were discarded as solid waste. If the plutonium concentration in the residues did not meet the DL, the materials were recycled back into the dissolution/filtering process. The plutonium nitrate-containing filtrate was sent to one of the ion exchange columns for purification.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials; therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. RCRA-regulated metals were not used in this process; the presence of heavy metals in the feed materials depends on the source of the feed materials. The feed materials could have contained cadmium, chromium, and/or lead as impurities. These metals would be

contained in the filtrate, which was sent to the ion exchange processes for further purification. The debris waste generated from this process is not expected to contain cadmium, chromium, or lead above the regulatory limits because the dissolution involved strong acids (any soluble metals should be in the filtrate). However, without analytical data or other acceptable information confirming that the concentrations of these hazardous constituents are below the regulatory levels, the applicable EPA HWNs D006, D007, and D008 are assigned pending additional information (TWCP-3568/N-83). This process generated the typical glovebox waste, plus glassware; metal containers, tools, and equipment; plastic filter boats; filter papers; rags; and brushes.

3.5.6.36 Americium Processing Silicon Removal (SX)

This process was active from 1979 through 1984. The americium-containing hydroxide cakes from the peroxide kill process (initially P/S code PR, but later P/S code OH) were redissolved in nitric acid and the solution concentrated through distillation to precipitate a gel of silica. The silica gel was separated by filtration, air dried, and discarded as solid waste at first and later immobilized in cement. The americium-containing filtrate was sent to P/S code AP.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the following TRU solid waste: glass vessels, heating mantles, HEPA filters, and other glovebox waste, and rags. Because this process involved predominantly americium-containing feed material, waste materials were always discarded

3.5.6.37 Uranium Separation for Solid Solution Feed (US)

This process was active from January 25, 1984 to January 1986. Calcined solid solutions (consisting of uranium or plutonium oxide from P/S code RC) were dissolved in concentrated nitric acid, followed by oxalate precipitation of plutonium oxalate, and filtration. The uranium-bearing filtrate was partially neutralized, immobilized in cement (HP), and discarded. The plutonium oxalate cake was dried on a hot plate and calcined to the oxide. The oxide was again heated in concentrated nitric acid with the remaining uranium impurity dissolving. The resulting solution went to cement

fixation (HP). The insoluble plutonium oxide was separated by filtration, calcined, and sent to P/S code LC (for dissolution) or RR (for purification).

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials, which were of high purity; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste, plus glassware, metal tools and equipment, plastic filter boats, filter papers, rags, and brushes.

3.5.6.38 Uranium Separation for Non-Solid Solutions (US2)

This process was active from January 25, 1984 to January 1986. The uranium in mixed plutonium-uranium oxide was dissolved in 5 molar nitric acid and filtered. The uranium solution was fixed in cement (HP) and discarded as waste. The solid plutonium oxide separated by filtration was dried on a hot plate and sent to P/S code LC (for dissolution) or RR (for recovery).

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste streams, plus glassware, heating mantles or hot plates, metal tools and equipment, plastic filter boats, filter papers, rags, and brushes.

3.5.6.39 Variable CSMO Scrap Dissolution (VC)

This process was active from April 1986 to December 1989 and is identical to P/S code SSD. Miscellaneous oxide scrap items were combined, dissolved in nitric acid/hydrofluoric acid, and filtered. The filter residues were dried on a hot plate and assayed. If the residues met the DL for plutonium, they were discarded as solid waste. If the plutonium concentration in the residues did not meet the DL, the materials were recycled back into the dissolution/filtering process. The plutonium nitrate-containing filtrate was sent to one of the ion exchange columns for purification. This filtrate may have contained chromium, cadmium, and/or lead from stainless steel, shielding, or other metal scrap items (TWCP-3568/N-84).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. The oxide feed materials have usually been through a heating process that would volatilize/decompose any organics. Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. The presence of heavy metals in the feed materials depends on the source of the feed materials. Any RCRA-regulated metals leached from these feed materials would be in the filtrate sent to ion exchange. However, the leached residues may still contain concentrations of cadmium and/or lead above the regulatory limit, resulting in the debris waste requiring the applicable EPA HWNs D006 and D008 (TWCP-3568/N-84). Any chromium in scrap metal does not leach out above the regulatory limit. This process generated the typical glovebox waste, plus glassware; metal containers, tools, and equipment; plastic filter boats; filter papers; rags; and brushes (TWCP-3568/N-81).

3.5.6.40 CSMO Scrap Dissolution (VP1)

This process was active from September 26, 1985 to April 1986. Plutonium-aluminum alloy from Hanford was dissolved in nitric acid using mercuric nitrate as a catalyst. If the item was pyrophoric, it was first calcined in P/S code PA. The quantity of mercuric nitrate was quite small because it was present as a catalyst. Filtration separated the solution of plutonium from aluminum metal pieces and a sludgy salt of aluminum nitrate. The metal pieces were picked out of the salt, which was discarded into cement. If the metal was discardable, it went to metallic waste. Plutonium-rich metal went back into dissolution. The plutonium solution was subjected to oxalate precipitation using oxalic acid or sodium oxalate, and filtered to form a cake that would be calcined to the oxide. The oxalate filtrate went to P/S code VP3. This process was modified to perform dissolution of the aluminum in sodium hydroxide after the first month because of the difficulty in controlling the reactivity of this system. The undissolved plutonium oxide could be separated by filtration and sent to one of the dissolution processes.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. RCRA-regulated metals were not introduced with the feed materials. However, in the first month of operation of this process (September 1985 to October 1985) mercuric nitrate was used in a very

small quantity as a catalyst in the dissolution step. The mercury would be found in the oxalate filtrate and, therefore, also introduced into P/S code VP3 during this time period. EPA HWN D009 (mercury) applies to waste generated under P/S codes VP1 and VP3 during the latter part of 1985. This process generated the usual glovebox waste streams, plus glassware, heating mantles, metal tools and equipment, rags, and brushes.

3.5.6.41 Polycube Processing (VP2)

This process was active from 1979 to April 1986. The skins and fragments of polycubes from P/S code DP were placed in a furnace and the polystyrene was decomposed to form volatile breakdown products in the form of oils, which were sent to Room 425 for absorption on vermiculite (eventually P/S code RO). The dry oxide residue was stored in the vault or sent to the dissolution processes.

RCRA-regulated organics and metals were not used in this process and were not introduced as feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated glovebox waste, plus furnaces and furnace elements, metal containers and tools, vacuum pump oil, rags, and brushes.

3.5.6.42 Hydroxide Precipitation (VP3)

This process was active from 1979 to April 1986. In the early years of TA-55, the oxalate filtrates from P/S codes LR, RR, LC, SO, and VP1 were brought to P/S code VP3 to perform a hydroxide precipitation and filtration to separate out the plutonium hydroxide cake. The hydroxide cake went to P/S code LG2 for dissolution. The filtrate was discarded through the process caustic waste line to the TA-50-1 RLWTF. The oxalate filtrates from P/S code LC went to P/S code EV after June 1, 1984.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents in the waste streams generated by this process. RCRA-regulated metals were not used in this process; however, mercury (D009) would have entered the process with the feed material from P/S code VP1 (from September 26, 1985 to October 31, 1985). The mercury would have precipitated in the hydroxide

cake. If the hydroxide cake contained plutonium below the DL, the mercury would accompany it to cement fixation (CF); therefore, this waste stream would be RCRA-regulated. If the hydroxide cake could not be discarded, it was sent to dissolution (P/S code LG2). This process generated the usual glovebox waste, plus plastic filter boats, filter papers, glassware, metal tools and equipment, rags, and brushes.

3.5.6.43 Scrap Oxide Dissolution (ZD)

This process was active from September 25, 1984 to November 1988. Scrap oxide from the vault and impure oxide from P/S code CL were dissolved in nitric acid and hydrofluoric acid, and filtered. The residues were collected into 900-gram batches and recycled through the process before being sent to the vault as intractable. The filtrates were sent to P/S code LR or RR ion exchange column for purification of the plutonium.

RCRA-regulated organics were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. RCRA-regulated metals were not used in this process; however, heavy metals are possible in the feed materials. These metals would end up in the filtrate that ultimately goes to the evaporator (EV). This process generated the typical glovebox waste streams, plus glassware; metal tools, containers, and equipment; plastic bags and filter boats; filter papers; rags; and brushes.

3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for nitrate operations at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for nitrate operations consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites. Although Pu is usually the radioactive element of interest in the feed materials, in some cases the feed material consisted of other radioactive elements, as indicated by Table 2.

**Table 1. Process Feed Materials for Nitrate Operations**

| Feed Materials | Potential Presence of RCRA-Regulated Substances* | P/S Codes in Nitrate Operations |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• CLS-1 solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (Cl-25/TWCP-3547). | CF, HP (if solutions contained Pu >DL) |
| Anode heels | Typically contaminated with RCRA-regulated heavy metals Cd, Cr, Pb and Ag (D006, D007, D008, D011). Heavy metals As, Hg, and Se are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | AS, BU, NC |
| Ash from P/S codes ETD and TDC; or from other DOE sites such as Hanford | Usually suspect contaminated with Ba, Cd, Cr, Pb, and Ag (D005, D006, D007, D008, D011). As, Hg, and Se may also be present although these metals are volatilized at high temperatures if present in the oxide and chloride forms. | AL, AT, ATL, ED, HGMS, HRA, IS, MPD, PTS, RC, SC |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | MAS, SC |
| Disassembled weapons components | High-purity Pu and U material types, no RCRA substances present | BM, RB, RBJ |
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity; may or may not contain RCRA substances | MAS |
| Hydroxide cakes | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | CD, HCD, HD, LG2 |

| Feed Materials | Potential Presence of RCRA-Regulated Substances* | P/S Codes in Nitrate Operations |
|---|---|---|
| Miscellaneous materials contaminated with Pu (e.g. tools, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters, Hanford [Hanford materials]) | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | ATL, BAC, CPOD, ED, ETD, GMS, HGMS, HRA, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD |
| MSE salts | Typically fairly pure, suspect contaminated with barium (D005) | MB, PS |
| Pu metal or metal alloy, Hanford (Hanford materials) | High purity, no RCRA-regulated substances, unless noted otherwise | ATL, BM, BU, MF, PAF, VP1 |
| Pu oxalates | High purity, no RCRA-regulated substances, unless noted otherwise | CC, DF, HC |
| Pu oxides, Hanford (Hanford materials) | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008)<br>High purity oxides and material from Hanford from P/S codes CA and MA, and from the vault; no RCRA substances | ATL, BL, CH, CPOD, DP, ED, FC, HRA, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2 |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than Ba are present | COD, COL, MB |

* The information in this column is highly generalized. Applicability of specific EPA HWNs to a process as a result of the feed material must be determined on a case-by-case basis because the presence and fate of contaminants is time and function dependent.

**Table 2. P/S Codes with Radionuclides Other Than Pu in Feed Materials**

| P/S code in nitrate operations | Radionuclide in feed material |
|---|---|
| AO, AP, FA, PR | Am-241 |
| ATL | Np-237 |
| CF | Am-341, U, Th-232 |
| HP, IA, OH, SX | Am-241 |
| LC, RC, UPS, US | U |
| PT | Th-232 |

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

3.6.1 Physical Form Identification

Solid waste from nitrate operations primarily consists of metal and debris waste, as well as cemented waste discarded under P/S codes CF or HP. Debris waste contains glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Lead-containing debris items are segregated and packaged separately (TWCP-3567/N-39). Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste were incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), is used to list each item number and record its matrix material. This form is signed by the waste packager, and then reviewed and approved by quality assurance (QA) personnel. Example forms for one drum of waste generated can be viewed in record TWCP-2513.

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for nitrate operations at TA-55 are listed in Table 3. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Please note that Table 3 indicates the isotopic composition of the material types at the time the waste was characterized.

The MT provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. These bounding calculations provide a basis for identifying enrichment or depletion of one

radionuclide versus another based on radioassays of individual waste containers. The results of these calculations are also tabulated in Table 3. The calculations assume that (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old at that time (TWCP-698).

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in Am-241 or U-234 depending on whether the source of contamination is the process product or the process residues (TWCP-882). Table 4 indicates some P/S codes in which enrichment of radioelements other than Pu are expected to be greater than usual.

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from nitrate operations at TA-55, with exceptions as noted in Tables 2 and 4. In addition, Pa-231 and Cs-137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations (TWCP-5164, TWCP-5165).

In general, uranium and its isotopes are expected to be present only at trace levels, if at all. U-238 would only be present if uranium was the feed material (e.g., as has been the case for P/S codes LC, RC, UPS, US, and sometimes CF; Table 2). U-235 in growth from the decay of Pu-239 half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. Uranium-234 would be present in MT 83 as a decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total Pu would be about 0.14. No U-236 is present.

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data are used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). This AK report will be updated to incorporate the results of these comparisons.

### 3.6.3 Chemical Content Identification

Chemical inputs to nitrate operation processes are listed in Table 5. The use of strong acids, bases, or oxidizers does not result in RCRA listings

## Table 3. Average Isotopic Content of Plutonium Material Types and Enrichments

| Material Type (MT) | Plutonium Isotope (Wt.%) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

[a] These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.
Source: TWCP-698

## Table 4. Secondary Radionuclides in Process Wastes

| P/S code | Secondary radionuclide in process waste |
|---|---|
| AO | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1985—1987, impure $AmO_2$ for disposal) |
| AP | Am-241 (1979—1984, Am-241 production) |
| ATL | Np-237 (1993—1994, NDA standards material) |
| CD, HCD, HD | Am-241 (1992—present) |
| CF, ED, EV, RB, RFX | Np-237 as decay product in MSE (1992—present) |
| EV | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1992—present) |
| FA | Am-241 (1979—1984, Am-241 production) |
| HP | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1985—1987, impure $AmO_2$ for disposal)<br>Am-241 (1992—present) |
| IS | Cm-244 (March 1987—April 1987) |
| LR, PR | Am-241 (1979—1984, Am-241 production) |
| PS | Am-241 (1985—1987, impure $AmO_2$ for disposal) |
| PT | Th-232 (1980—1985) |

Source: TWCP-882

## Table 5. Chemical Inputs to Processes Described in This Report

| Chemical Input | P/S Codes in Which RCRA-Listed Chemicals Are Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| **Gases** | | |
| Argon gas<br>Nitrogen gas | | |
| **Acids** | | |
| Ascorbic acid<br>Formic acid<br>Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Oxalic acid<br>Sulfuric acid | | D002 does not apply to the TRU solid waste because there are no free liquids in this waste |
| **Bases** | | |
| Potassium hydroxide<br>Sodium hydroxide | | D002 does not apply to the TRU solid waste because there are no free liquids in this waste |
| **Inorganic Chemicals** | | |
| Aluminum nitrate | | |
| Calcium fluoride | | |
| Calcium nitrate | | |
| Cerium nitrate | | |
| Cobalt nitrate | | |
| Ferric ammonium sulfate hydrate | | |
| Ferric nitrate | | |
| Ferrous ammonium sulfate | | D003 does not apply to the TRU solid waste because there are no free liquids in this waste. |
| Ferrous sulfamate | | |
| Gypsum cement | | |
| Hydrogen peroxide | | |
| Hydroxylamine nitrate | | |
| Lanthanum nitrate | | |
| Magnesium oxide | | |
| Mercuric nitrate | VP1 | D009. Used as catalyst in P/S code VP1; hydroxide cake produced in VP1 is processed in P/S code VP3 |
| Portland cement | | |
| Potassium fluoride hydrate | | |
| Potassium thiocyanate | | |
| Silver nitrate | AT, CPOD | D011, used as catalyst from 1990 to 1994 in CPOD. D011 does not apply to P/S code AT because it was used in a cold lab and did not become part of any TRU waste. |
| Sodium chloride | | |
| Sodium chromate | PT | D007, used in separation of Th from Pu/Am |
| Sodium nitrite | | |
| Sodium oxalate | | |
| **Metals** | | |
| Platinum | | |
| Stainless steel | | |
| Titanium | | |

| Chemical Input | P/S Codes in Which RCRA-Listed Chemicals Are Used | Comments on Applicability of RCRA HWNs (if any) |
|---|---|---|
| **Organic Chemicals** | | |
| Acetone | OH, OY | F003 if used as a solvent |
| Diethyl oxalate | | |
| Ethanol | | |
| Formamide | | |
| Ion exchange resin | | |
| Oil (engine) | | |
| Organic liquid emulsifier | | |
| Phenolphthalein | | |
| Phosphate buffer solution | | |
| Phthalate buffer solution | | |
| Polyoxyethylene-20-Sorbitan laurate (surfactant) | | |
| Silicon adhesive | | |
| Silicon defoamer (General Electric AF9020, Silicon Antifoam Emulsion) | | |
| Sodium citrate retarder | | |
| Trichloroethylene | RO | D040 applies to P/S code RO; used once in 1979 as diluent for oils |
| Urea | | |
| Vacuum grease | | |

for solid debris waste from these processes because of the absence of free liquids in this waste.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

The assignment of EPA HWNs to process wastes from nitrate operations is summarized below, as well as on the process timelines in Attachment 3, and the table of process inputs and outputs in Attachment 4. These assignments are based on the possible presence of RCRA chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

### 4.1 F, K, and P Listings

F002 and F003 apply to waste discarded under P/S codes CF and HP. Some of the solutions sent to these P/S codes for immobilization in cement contain the following organic chemicals:

- F002: methylene chloride
- F003: acetone, butyl alcohol (n-butanol), methanol, tetrachloroethylene, and xylene.

No K or P listings apply to solid wastes generated from any of the P/S codes in this report because no K-listed or P-listed chemicals were present in the feed materials, chemicals or equipment used in these processes.

### 4.2 Toxicity Listings

D008 (lead) applies to all P/S codes due to the potential to generate leaded gloves. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, leaded gloves were segregated and discarded in the metal debris waste stream. Since May 1992, leaded gloves have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166). Lead-containing debris waste is segregated and packaged separately from other debris waste (TWCP-3567/N-39); these wastes also are assigned D008.

Waste from most P/S codes in nitrate operations carry several EPA HWNs due to the presence of metals with toxicity characteristics in the feed materials. P/S codes covered by this report carry the following codes for heavy metals:

| | |
|---|---|
| AL | D005, D006, D007, D008, D009, D011 |
| AO | D006, D007, D008, D009, D011 |
| AP | D007, D009 |
| AS | D006, D007, D008, D011 |
| AT | D005, D006, D007, D008, D011 |

| | |
|---|---|
| ATL | D005, D006, D007, D008, D009, D011 |
| BF | D006, D007, D008, D011 |
| BU | D006, D007, D008, D011 |
| CD | D005, D006, D007, D008, D009, D011 |
| CF | D007, D008, D009, D011, D019, D021, D022, D039 |
| COL | D005 |
| CPOD | D011 |
| DS | D005, D006, D007, D008, D009, D011 |
| ED | D005, D006, D007, D008, D009, D011 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |
| FX | D006, D007, D008, D009, D011 |
| HCD | D005, D006, D007, D008, D009, D011 |
| HD | D005, D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| HRA | D005, D006, D007, D008, D009, D011 |
| IA | D006, D007, D008, D009, D011 |
| IS | D005, D006, D007, D008, D011 |
| LG1 | D006, D008 |
| LG2 | D006, D007, D008, D009, D011 |
| LR | D005, D006, D007, D008, D009, D011 |
| MB | D007, D008, and D009 (in accordance with discussion in TWCP-AK-2.1-002,R.2, section 3.6.2) |
| MELL | D006, D007, D008, D009, D011 |
| ML | D006, D008 |
| MPD | D005, D006, D007, D008, D009, D011 |
| NC | D006, D008 |
| NL | D006, D008 |
| OD | D006, D007, D008 |
| OH | D006, D007, D008, D009, D011 |
| PT | D007 |
| PTS | D005, D006, D007, D008, D011 |
| RC | D005, D006, D007, D008, D011 |
| RCM | D005, D006, D007, D008, D009, D011 |
| RFX | D005, D006, D007, D008, D009, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SC | D005, D006, D007, D008, D009, D011 |
| SP | D006, D007, D008 |

| | |
|---|---|
| SSD | D006, D007, D008 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1 | D009 |
| VP3 | D009 |
| VUL | D005, D008 |

D001 (ignitable), D002 (corrosive) or D003 (reactive) do not apply to the solid wastes from nitrate operations because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 5.0).

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes that the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual verification of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), in use since 1991, includes a statement that must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) re-emphasizing the prohibition on liquids in the waste, and the continuation of waste management inspection.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data are used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage are evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166) and were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; and venting was confirmed by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, (3) and no sparking. Experimental results on the reactivity of LANL direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed, or the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 5.0 and 6.0.

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the nitrate operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 5, and Attachment 4. In the cement fixation process (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from initiation of operations of TA-55 in 1978. When any transformer oil is drained, the oil is handled by a subcontractor who is wholly responsible for its disposal; this oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),*

and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*

- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Records Management* (TWCP-QP-1.1-004)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) (WIPP WAC)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

## ACCEPTABLE KNOWLEDGE ROADMAP

Waste from P/S Codes AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

Copies of these documents are in the TWCP RMDC Center. Refer to *Records Management* (TWCP-QP-1.1-004) for information on obtaining copies of these documents

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | Wastes from Plutonium Conversion and Scrap Recovery Operations, LA-11069, March 1988 | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | Budget information may not be acceptable. |
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-701 | C | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Waste was co-mingled with room trash, and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level DLs. | None |
| TWCP-882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from Jim Foxx | Lists additional radionuclides and metals potentially in waste, subdivided by process status code. Covers time period from 1978 to present. | Best information available, but it is based on worker recollection because other records are not available. |
| TWCP-886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Fixx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-887 | D | Co-mingling of Defense and Non-Defense TRU Waste | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997 | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests were conducted on residues rather than on waste. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-2513 | A | Example of Generator Reports for Drum 54856 | TA-55 Records Management Center | Example of generator records including WPRF #07045 and WODF form showing the waste generator certification statement. | Older forms are often hard to read. |
| Cl-25/ TWCP-3547 (UCNI) | D | Answers to questions about chloride processes | Interview with Jim Foxx, 9/23/99 | Answers to questions on Chloride processes; CLS-1 solvent list | None |
| TWCP-3548/ N-1 (UCNI) | B | General description of the overall Nitrate recovery process. | *TA-55 Final Safety Analysis Report* (07/13/95) | Each step of the nitrate recovery process is described. This includes pretreatment, dissolution, purification, oxidation, and evaporation. | It provides mostly a current (as of 1995) description of the process. It alludes to past practices in places. |
| **Nitrate Pretreatment Procedures** | | | | | |
| TWCP-3548/ N-2 (UCNI) | C | P/S diagram; process diagram; process description (P/S GMS, MAG, MAS) | Magnetic Separation Research and Development; Magnetic Separation, 460-REC-R00 through R01, 1/30/89 through 11/2/92 | Describes magnetic separation processes for lean and rich residues. Lean residues <EDL are sent to cement fixation. | None |
| TWCP-3548/ N-3 (UCNI) | C | Process description | Standard Operating Procedure for Handling Process Generated Residues at TA-55, 503-GEN-R00, 2/28/78 | Procedure for residue handling, including liquid residues sent to recovery, not specified if nitrate or chloride processing. | None |
| TWCP-3548/ N-4 (UCNI) | C | Process description | Standard Operating Procedure for the Packaging of Rags for Recovery, 504-GEN-R00, 2/25/78 | Describes rinsing of nitrated rags in water. Water sent to ion exchange. | None |
| TWCP-3548/ N-5 (UCNI) | C | Chemical list; process description (P/S IS based on description) | Incinerator, 422-REC-R00 through R04, 3/1/78 through 1/15/87 | Describes incinerator process and disposition of ash. | P/S code IS assigned based on title and description |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3548/ N-6 (UCNI) | C | P/S Diagram; process description (P/S TDC) | Thermal Decomposition of Cellulose Items, 402-REC-R00, no date | Describes thermal decomposition of rags in an inert atmosphere and also how nitrated rags were soaked in water and the water sent to ion exchange. | No date is available for this procedure. |
| TWCP-3548/ N-7 (UCNI) | C | Process diagram; chemical list; process description (P/S PAF) | Oxidation of Pu Metal and Alloys Prior to Dissolution; Oxidation of Pu Metal and Alloys; Passivation Furnaces, 429-REC-R00 through R05, 3/1/78 through 12/12/95 | Describes passivation furnace process. | None |
| TWCP-3548/ N-8 (UCNI) | C | Process description | Procedure for Burning of (Pu, U) Carbides; Burning Plutonium and/or Uranium Carbides and Nitrides, 428-REC-R00 through R02, 3/1/78 through 12/8/86 | Pu and U nitrides or carbides are burned to remove pyrophorics. | None |
| TWCP-3548/ N-9 (UCNI) | C | P/S diagram, chemical list, process description (P/S VUL) | Vessel Handling and Unloading, 494-REC-R00, R01, R02, and R04, 11/15/91 through 3/12/93 | | R04 is marked as "Draft" with no approval signatures or date. |
| TWCP-3548/ N-10 (UCNI) | C | Chemical list; process description | Procedure for Disposal of Oils Containing Recoverable Amounts of Pu in the Form of (U, Pu) Carbides, 431-REC-R00, 1/26/78; 431-REC-R01, no date | Oils are filtered for Pu recovery. Oils <EDL are absorbed on vermiculite for disposal. Filtered solids are sent to dissolution. | None |
| TWCP-3548/ N-11 (UCNI) | C | Process description | Passivation, 431-REC-R00, 12/19/86 | Passivation of Pu bearing materials to remove pyrophorics (Ca, Mg metal). | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3548/ N-12 (UCNI) | C | P/S Diagram; chemical list; process description (P/S TDC) | Thermal Decomposition of Cellulose Items, 498-REC-R00 and R02, 6/2/95 and 8/15/97 | Thermal decomposition of rags in inert atmosphere. Off gases removed with caustic scrubber. Caustic is filtered and sent to RLWTF if <EDL. | None |
| TWCP-3548/ N-13 (UCNI) | C | Process description | Anode Heel Burning; Burning Metal, 434-REC-R00 through R01, 2/6/87 through 1/30/89 | Oxidation of the metal heel from electrorefining and preparation of oxide as feed for aqueous recovery. | None |
| TWCP-3548/ N-14 (UCNI) | C | P/S diagram; process description (P/S BM) | Plutonium Metal Burning; The Burning and Brushing of Plutonium Metal; 433-NMT7, R03; 433-REC-R00 through R03, 9/6/90; 5/13/94 through 8/15/97 | Removal of friable plutonium oxide from metal and calcination of the metal. | None |
| TWCP-3548/ N-15 (UCNI) | C | Process description | Processing Lapping Oil and Similar Organics, 435-REC-R00, 3/1/78; 435-REC-R01, no date | Oils are filtered for Pu recovery. Oils <EDL are absorbed on vermiculite for disposal. Filtered solids are sent to dissolution. | None |
| TWCP-3548/ N-16 (UCNI) | C | Process description | Evaluation of Pu (VI) Reduction by Nitrous Oxide, 493-REC-R00, no date | Experimental procedure to use nitrous oxide to reduce Pu (VI) to Pu (IV). | Procedure has no approval signatures or date. Assume this procedure was never implemented. |
| TWCP-3548/ N-17 (UCNI) | C | P/S diagram; chemical list; process description (P/S CR) | Crushing and Pulverizing, 435-REC-R00 through R05, 2/18/87 through 8/25/97 | Crushing and pulverizing residues to approximately 20 mesh for dissolution in nitric acid. | None |
| TWCP-3548/ N-18 (UCNI) | C | Diagram (not P/S); chemical list; process description | Polystyrene Cube Processing, 437-REC-R00 through R02, 1/19/83 through 10/22/84 | Plutonium and depleted uranium is recovered from polystyrene plastic using crushing followed by distillation. | None |

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|---|---|---|---|---|---|
| **Nitrate Dissolution Procedures** | | | | | |
| TWCP-3566/ N-19 (UCNI) | C | P/S diagram; chemical list; process description (P/S UPS) | Preferential Dissolution of Uranium Oxides from a Uranium-Plutonium Oxide Mixture, 445-REC-R00 through R03, 3/14/84 through 4/15/92 | Calcined residues containing depleted uranium and plutonium are dissolved in nitric acid. The uranium is contained in the filtrate and wash solutions, which are discarded to cement fixation. The insoluble plutonium oxide is then recovered by ion exchange or oxalate precipitation. | None |
| TWCP-3566/ N-20 (UCNI) | C | P/S diagram; chemical list; process description (P/S ATL) | Advanced Testing Line for Actinide Separations (ATLAS) Unit Operations, 491-REC-R00 through R03; 12/23/91 through 8/25/97 | The ATLAS unit was a design and development, pilot plant operation that encompassed all steps of the $NO_3$ operations. | None |
| TWCP-3566/ N-21 (UCNI) | C | P/S diagram; chemical list; process description (P/S CPOD) | Catalyzed Electrochemical Plutonium Oxide Dissolver (CEPOD), 490-REC-R00 through R01; 10/10/90 through 10/13/92 | Electrochemical dissolution of Pu residues. Silver nitrate was used as a catalyst. | None |
| TWCP-3566/ N-22 (UCNI) | C | Chemical list; process description | Recovery of Contaminated Platinum, 430-REC-R00, 3/1/78 | Recovery of Pu from platinum boats using nitric/hydrofluoric acid. | None |
| TWCP-3566/ N-23 (UCNI) | C | P/S diagram; chemical list; process description (P/S ED) | Casting Crucible Dissolution, 425-REC-R00 and R01, 1/26/78; Four-Inch Cascading Airlift Dissolvers, 425-REC-R00 through R07, 2/18/87 through 8/15/97 | Casting crucible dissolution for plutonium recovery.<br>Dissolution of Pu residues and finely divided materials using the 4" cascading dissolvers. | None |

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| TWCP-3566/ N-24 (UCNI) | C | P/S diagram; chemical list; process description (P/S SC) | Slag and Crucible Dissolution Procedure; 424-REC-R00, 1/26/78<br>Dissolution of Sand, Slag, and Crucible in 6-inch Cascade Dissolvers; Six-Inch Cascade Dissolvers, 424-REC-R00 and R03 through R08, 5/18/88 through 8/26/97 | Slag and crucible dissolution for plutonium recovery.<br>Later revisions addressed recovery of Pu from residues of sand, slag, and crucible using a 6" cascade dissolver system. | None |
| TWCP-3566/ N-24A (UCNI) | C | Process description | Pneumatic Salt Crusher, 444-REC-R00, 1/29/90 | Salt crusher is used to prepare feed materials for the six-inch cascading dissolver. No chemicals used. | None |
| TWCP-3566/ N-25 (UCNI) | C | P/S diagram; chemical list; process description (P/S MPD) | Multipurpose Cascade Dissolver System, 489-REC-R00 through R01, 10/04/91 through 9/27/94 | Operation of multipurpose cascade dissolver system for processing impure Pu bearing feeds. | None |
| TWCP-3566/ N-26 (UCNI) | C | Process diagram (not P/S); process description | Alkaline Leach of Chloride Contaminated Plutonium Oxides, 450-REC-R00, 08/21/89 | Chloride contaminated Pu oxides are leached using 0.5 M sodium hydroxide to remove chloride contamination. | None |
| TWCP-3566/ N-26A (UCNI) | C | Process description | Dissolution of High Salt and/or Chloride Contaminated Plutonium Dioxide, 448-REC-R00, 1/6/88 | Recovery of plutonium from chlorinated oxide received from Rocky Flats. | This is a hand written, temporary? procedure. It may have been a proposed procedure that was never implemented. No final version of this procedure was found. |
| TWCP-3566/ N-27 (UCNI) | C | Process description | Distillation of Am IX Column Effluents to Reduce Acidity and Volume, 470-REC-R01, 08/27/84 | Distillation of Am ion exchange column effluents to reduce acidity and volume. | None |

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| TWCP-3566/ N-28 (UCNI) | C | Diagram (not P/S); chemical list; process description, (P/S AL based on description) | Ash Leaching, 423-REC-R00 through R05, 1/26/78 through 9/14/90 | Recovery of Pu from on-site and off-site ash by leaching with nitric acid and calcium fluoride. | P/S code of AL assigned based on title and description. |
| TWCP-3566/ N-29 (UCNI) | C | Diagram (not P/S); chemical list; process description (P/S ML based on description) | Leaching of Contaminated Metals in Nitric Acid, 431-REC-R00 and R01, 10/18/90 through 1/27/94 | Recovery of Pu from non-Pu metal pieces by leaching in hot nitric acid -- calcium fluoride/hydrofluoric acid. | P/S code of ML assigned based on title and description. |
| TWCP-3566/ N-30 (UCNI) | C | Process description | Processing of Contaminated Solids, 420-REC-R00 and R01, 01/26/78 through 07/09/84 | Processing of contaminated solids for Pu recovery. | None |
| TWCP-3566/ N-30A (UCNI) | C | Process description | Dissolution of Materials, 440-REC-R00 through R01, 2/25/78 through 12/16/85 | Dissolution of metals, alloys, casting skulls and plutonium compounds in nitric acid and hydrofluoric acid. Cr may be in the waste from metals, alloys and skulls. | None |
| TWCP-3566/ N-30B (UCNI) | C | Chemical list, process description. | Plutonium Metal Dissolution, 441-REC-R00 through R01, 2/25/78 through 3/2/83 | Dissolution of plutonium metal and alloys in nitric acid and hydrofluoric acid. | R00 was renewed on 3/2/83. R01 has no approval signatures or date. |
| TWCP-3566/ N-30C (UCNI) | C | Chemical list, process description. | Dissolution of Oxide Derived from Calcination of Oxalate; Standard Operating Procedure for the Dissolution of Oxide Whose Nitrate Solutions are Destined for the Metal Prep Line; The Dissolution of Plutonium Dioxide Derived from Calcined Plutonium Oxalate, 442-REC-R00 through R02, 2/25/78 through 5/23/84 | Dissolution of plutonium dioxide derived from calcined plutonium oxalate in nitric acid and hydrofluoric acid. | None |

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|---|---|---|---|---|---|
| TWCP-3566/ N-30D (UCNI) | C | Chemical list, process description. | Dissolution of Oxide Derived from Passivation of Carbides, Metal or Casting Skulls, 443-REC-R00 through R01, 2/25/78 through 8/2/78 | Dissolution of plutonium oxides derived from plutonium carbides, anodes, metal or casting skulls that have been passivated in a furnace. The oxides are dissolved in nitric acid and hydrofluoric acid. | None |
| TWCP-3566/ N-30E (UCNI) | C | Diagram (not P/S), chemical list, process description. | Dissolving Chloride Melt Portion of Electrorefining Residues; Dissolving the Chloride Melt Portion of Salt-Stripping Residue, 444-REC-R00 through R01, 2/25/78 through 9/26/83 | Chloride salts from electrorefining are dissolved in sodium hyroxide. Then nitric-hydrofluoric acid is used to dissolve filtered solids. Acid filtrate is sent to ion exchange. Appears to be related to hydroxide cake dissolution. | None |
| TWCP-3566/ N-30F (UCNI) | C | Chemical list, process description. | Dissolution of Residues for Ion-Exchange Feed; Standard Operating Procedure for the Residue for Ion-Exchange Feed, 447-REC-R00 through R01, 7/13/79 through 6/30/81 | Dissolution of plutonium residues from oxide dissolution in nitric acid and hydrofluoric acid. | None |
| TWCP-3566/ N-31 (UCNI) | C | P/S diagram, chemical list, process description (P/S NC) | Pickling or Surface Leaching, 421-REC-R00 and R01, 1/26/78 through ?; Leaching of Noncombustible Materials in Nitric Acid, 421-REC-R03 through R09, 2/18/87 through 3/27/97 | Recovery of Pu from surface contamination of noncombustible material by pickling or surface leaching. | Draft R09 also contains P/S code DO (Dissolution of Oxide) |
| TWCP-3566/ N-32 (UCNI) | C | P/S diagram; chemical list; process description (P/S HD, CD, HCD) | Dissolution of Chloride Generated Cake in Nitric Acid; Dissolution of Pu Hydroxide Cake in Nitric Acid, 442-REC-R00 through R03, 11/14/88 through 01/16/97 | Dissolution of Pu hydroxide cake from chloride operations in nitric acid. | None |

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|---|---|---|---|---|---|
| TWCP-3566/ N-33 (UCNI) | C | P/S diagram; chemical list; process description (P/S MELL) | Mediated Electro-Oxidation of Low-Level Organic Waste (formerly Catalyzed Electrochemical Plutonium Oxide Dissolver), 490-REC-R02, 9/26/94 | Mediation electro-oxidation of low-level organic waste (MELLOW) uses cobalt nitrate or cerium nitrate as a catalyst to recover Pu from cellulose-based material. | None |
| TWCP-3567/ N-34 (UCNI) | C | Chemical list; process description | Silica Removal from Americium Feed Solutions, 468-REC-R00 and R01, 10/06/83 through 11/29/83 | Silica removal from Am feed solution. | None |
| TWCP-3567/ N-35 (UCNI) | C | Diagram (not P/S); chemical list; process description | Residue Leaching, 426-REC-R00, 2/27/87 | Removal of $SiO_2$ from solid residues by hydrofluorination to recover Pu. | None |
| TWCP-3567/ N-36 (UCNI) | C | P/S diagram; chemical list; process description (P/S AT) | Incinerator Ash R&D Facility, 427-REC-R00, 8/22/88 | Incinerator ash R&D facility for processing of incinerator ash from Los Alamos and Rocky Flats. | None |
| TWCP-3567/ N-37 (UCNI) | C | P/S diagram; chemical list; process description (P/S SP) | Dissolution of Filter Residues and Glovebox Sweepings in Hot HNO3-HF; Dissolution of Filter Residues, Impure Oxide, and Glovebox Sweepings, 446-REC-R00 through R06, 2/3/89 through 3/27/97 | Plutonium recovery from residues using nitric acid with a fluoride catalyst. | None |
| TWCP-3567/ N-37A (UCNI) | C | P/S diagram, chemical list, process description (P/S OD and SP) | Dissolution of Impure Plutonium Dioxides, Filter Residues, and Glovebox Sweepings in Hot HNO3-HF, 447-REC-R02, 12/18/86 | Plutonium recovery from residues using nitric acid with a fluoride catalyst. | P/S diagrams were added via memo on 1/28/85 and 2/13/87. Appears as though P/S diagrams were not finalized. |

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|---|---|---|---|---|---|
| TWCP-3567/ N-38 (UCNI) | D | LANL policy on RCRA F-codes | Interview with Pam Rogers and Alice Barr | Solvent F-codes will apply to all waste streams generated from a processing an intermediate product once solvents are identified in that process. | None |
| TWCP-3567/ N-39 (UCNI) | D | RCRA codes associated with hydroxide cakes. | Interview with Jim Foxx of TA-55 | RCRA codes associated with hydroxide cakes from the chloride process that are fed into the nitrate process. | None |
| TWCP-3567/ N-40 (UCNI) | B | RCRA codes associated with hydroxide cakes from chloride operations that are fed to the nitrate operations at the dissolution step. | Acceptable Knowledge Summary for the TA-55 Chloride Operations | Description of the chloride operations and wastes generated based on review of historic operation procedures from the plutonium facility at TA-55. | None |
| **Nitrate Ion Exchange Procedures** | | | | | |
| TWCP-3567/ N-41 (UCNI) | C | Diagram (not P/S); chemical list; process description (P/S RCM) | Nitrate Anion Exchange for the Rich Column Material System, 472-REC-R00, 2/02/90 | Nitrate anion exchange for the rich column material. | None |
| TWCP-3567/ N-42 (UCNI) | C | P/S diagram; chemical list; process description (P/S LR) | Nitrate Anion Exchange for the Lean Residue System, 471-REC-R00 through R02, 1/29/90 through 3/22/93 | Nitrate anion exchange for the lean residue system to recover and purify Pu to weapon's grade specifications for storage as an oxide. | None |
| TWCP-3567/ N-43 (UCNI) | C | Diagram (not P/S); chemical list; process description (P/S RR) | Nitrate Anion Exchange for the Rich Residues Ion Exchange Column, 470-REC-R00, 11/22/89 | Pu eluate solution from the ion exchange process is precipitated as an oxalate. The Pu oxalate is calcined to an oxide. | None |
| TWCP-3567/ N-44 (UCNI) | C | Diagram (not P/S); chemical list; process description | Nitrate Anion Exchange, 461-REC-R00 through R02, 2/25/78 through 11/29/88 | Nitrate anion exchange utilizing an anion exchange resin in nitric acid that retains the nitrato complex of Pu (IV) over most cationic impurities. | None |

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|---|---|---|---|---|---|
| TWCP-3567/ N-45 (UCNI) | C | P/S diagram, chemical list, process description (P/S RFX LR DS) | Nitrate Anion Exchange [for the Dissolved Solids (DS) System], 473-REC-R00 through R06, 10/17/89 through 7/24/98 | Nitrate anion exchange process in general. The procedure starts out describing only the dissolved solids system and changes to a general description of nitrate anion exchange. | None |
| TWCP-3567/ N-46 (UCNI) | C | Chemical list; process description | Procedure for Eluting Plutonium From Ion Exchange Columns, 473-REC-R00 and R01, 8/15/79 through 12/2/82 | Recovery of accountable amounts of Pu by eluting the Pu from the ion exchange columns used in Am production. | None |
| TWCP-3567/ N-47 (UCNI) | C | P/S diagram; chemical list; process description (P/S RFX) | Nitrate Anion Exchange for the Rich-Feed Ion-Exchange System, 495-REC-R00 and R01, 4/29/92 through 12/15/93 | Nitrate anion exchange for the rich-feed ion exchange system. | None |
| TWCP-3567/ N-48 (UCNI) | C | Process description | Alternate Procedure for Conversion of Plutonium Oxalate to Oxide; Conversion of Plutonium Oxalate to Oxide Using Heat Lamp and Hot Plate, 477-REC-R00 through R02, 2/03/81 through 5/14/87 | Pu oxalate is converted to an oxide by heating with a heat lamp and hot plate. | None |
| TWCP-3567/ N-50 (UCNI) | C | P/S diagram; chemical list; process description (P/S OY) | Oxalate Precipitation of Nitrate Solutions, 479-REC-R00 through R03, 4/30/81 through 2/14/89 | The feed for this precipitation process comes from the nitrate dissolution of relatively pure on-site and off-site oxides. | None |
| TWCP-3567/ N-51 (UCNI) | C | P/S diagram; chemical list; process description (P/S LR, DS, RCM, RR) | Oxalate Precipitation and Calcination of Ion-Exchange Elutes, 466-REC-R00 through R03, 2/25/78 through 6/15/89 | Pu in ion exchange elutes are precipitated as an oxalate and the oxalate is calcined to an oxide. This operation feeds P/S OY. | None |
| TWCP-3567/ N-51A (UCNI) | C | Process description | Calcination; Hydrocalcination, 437-REC-R00 through R01, 3/5/87 through 2/13/89 | Wet plutonium oxalate cake is burned in a furnace and converted to plutonium oxide. | None |

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| TWCP-3567/ N-52 (UCNI) | C | P/S diagram; chemical list, process description (P/S PR) | Peroxide Precipitation, 480-REC-R00 and R01, 1/21/87 to 2/14/89 | Separation of Pu from catatonic impurities with the use of hydrogen peroxide for precipitation of the Pu. | None |
| TWCP-3567/ N-53 (UCNI) | C | Diagram (not P/S); chemical list; process description | Peroxide Precipitation, 464-REC-R00 and R01, 2/25/78 through ? | Separates Pu from cationic impurities such as Ca, Cr, Mg, Ce, Co, Al, and Am by peroxide precipitation | None |
| TWCP-3567/ N-54 (UCNI) | C | Diagram (not P/S); chemical list; process description | Thorium Fluoride Precipitation, 468-REC-R00 and R01, 1/26/78 through ? | Separates thorium from Pu by forming the insoluble $ThF_4$ precipitate. | None |
| TWCP-3567/ N-55 (UCNI) | C | P/S diagram; chemical list; process description (P/S OH) | Procedure for Americium Hydroxide Precipitation and Filtration ; Filtration of Caustic-Treated Peroxide Filtrates, 469-REC-R00 through R03, 8/15/79 through 12/19/86 | Am recovery from the filtrate which results from the precipitation of Pu peroxide in the FFTF Oxide Production Process.<br>Filtration of caustic-treated peroxide filtrates. These solutions are generated with the peroxide filtrate solutions and are dripped in to a caustic solution to destroy peroxide. | None |
| TWCP-3567/ N-56 (UCNI) | C | Process description | Homogenization of Plutonium Oxide Product by Auger Mixing, 432-REC-R00, 02/14/89 | Homogenization of $PuO_2$ by auger mixing. | None |
| TWCP-3567/ N-57 (UCNI) | C | P/S diagram; process description (P/S RB and RBJ) | Oxide Roasting and Blending, 433-REC-R00 through R01, 1/28/87 through 1/30/89 | Assayed oxide from the vault is blended, sintered, reblended and sampled. This material is then used as feed for Pu metal production or direct oxide reduction. Pu metal may also be burned to an oxide. | None |

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| TWCP-3567/ N-57A (UCNI) | C | P/S diagram; process description (P/S RBJ) | Roasting and Blending JR., 443-REC-R00 and 443-REC-R02, 1/30/89 through 10/30/89 | Pu oxide is reburned, sieved, blended, and sampled. | None |
| TWCP-3567/ N-57B (UCNI) | C | P/S diagram; process description (P/S RBJ, RB) | Roasting and Blending JR., 434-NMT7-R00, 3/6/92; 434-NMT7-R03, 3/3/93; 434-REC-R00 (Draft and Final) through 434-REC-R02, 4/15/94 through 8/15/97 | Pu oxide is reburned, sieved, blended, and sampled. | None |
| TWCP-3567/N-59 (UCNI) | C | Process description (P/S DS and RR) | Sampling Procedure for the Ion-Exchange Process – DS and RR, 417-GEN-R00 and R01, 4/17/86 through 1/23/89 | Collecting samples of nitrate solutions to determine plutonium content and determine which ion exchange process should be used for recovery | None |
| **Nitrate Evaporator Procedures** | | | | | |
| TWCP-3568/ N-61 (UCNI) | C | P/S diagram; chemical list; process description (P/S EV) | Treatment of Evaporator Bottoms, 485-REC-R00 through R02, 7/13/84 through 2/09/89 | Treatment of evaporator bottoms generated from the volume reduction of feed from ion exchange columns. The reduced solution goes to cement fixation and the salts are discarded. | None |
| TWCP-3568/ N-62 (UCNI) | C | P/S Diagram; process description (P/S EV) | Computer Operated Nitric Acid Volume Reduction & Treatment of Evaporator Bottoms, 485-REC-R00 through R03, 10/4/89 through 8/31/95 | Computer operated nitric acid volume reduction and treatment of evaporator bottoms. | None |
| TWCP-3568/ N-63 (UCNI) | C | P/S diagram; process description (P/S EV) | Nitric Acid Process Evaporator, 485-REC-R04 and R05, 11/20/96 through 9/9/97 | Evaporation process for reducing the volume of process-generated nitric acid/salt mixtures. | None |

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| TWCP-3568/ N-64 (UCNI) | C | P/S diagram; chemical list process description (P/S EV) | Process Nitric Acid Volume Reduction, 484-REC-R00 through R02, 10/5/84 through 3/15/90 | Nitric acid volume reduction by processing ion exchange effluent through an evaporator. | None |
| TWCP-3568/ N-65 (UCNI) | C | Chemical list; process description | Volume Reduction of Nitrate Feed Solutions Using a Mini-Evaporator, 496-REC-R00, 10/23/95 | Operation of the mini-evaporator to reduce the volume of nitrate feed solutions. | None |
| TWCP-3568/ N-66 (UCNI) | B | RCRA-codes for evaporator bottoms | Development of Control Charts for the Evaporator Bottoms Newly Generated Waste Stream from TA-55, 3/19/99 | Based on the development of control charts for analytical results, evaporator bottoms were determined to be hazardous for chromium, lead, and mercury. | None |
| **Nitrate Cement Fixation Procedures** | | | | | |
| TWCP-3568/ N-67 (UCNI) | C | Process description (P/S CF) | Auxiliary Activities for Cement Fixation, TRU-NMT2-DP11-R00 (Draft), 04/13/94 | Auxiliary activities for cement fixation, such as preparing the 55-gallon drum, attaching and detaching drums from glovebox, and filing the cement hopper. | None |
| TWCP-3568/ N-68 (UCNI) | C | Process description (P/S CF) | Calibration of the pH Electrode for Cement Fixation, TRU-NMT2-DP-06-R00, no date | Calibration and maintenance of pH electrodes used to measure the pH of waste solutions as part of the CF process. | None |
| TWCP-3568/ N-69 (UCNI) | C | P/S Diagram; chemical list; process description (P/S CF) | Cement Fixation of Process Residues in 55-Gallon Drums, TRU-NMT2-DP-04, R00; TRU-NMT7-DP-04, R01 and R02; TRUWM-TA55-DP-04-R00 (Draft), 8/6/93 through 06/21/94 | Cement fixation of liquid and particulate process residues in 55-gallon drums. | None |

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| TWCP-3568/ N-70 (UCNI) | C | P/S Diagram; Process; description (P/S CF ) | Certification of Waste for Cement Fixation, TRU-NMT2-DP-12, R00; Certifying Waste for Cement Fixation, TRUWM-TA55-DP-12-R00; 4/20/93 through 7/10/97 | Describes how TA-55 personnel ensure waste destined for CF are properly characterized, accounted for, and documented. | None |
| TWCP-3568/ N-71 (UCNI) | C | Process description (P/S CF) | Documentation for Cement Fixation, TRU-NMT2-DP-14, R00 and R01; TRUWM-TA55-DP-14-R00; 3/04/93 through 7/10/97 | Documentation for cement fixation. Describes completing the paperwork and assembling the data package that is required to accompany each drum destined for WIPP. | None |
| TWCP-3568/ N-72 (UCNI) | C | Chemical list; process description (P/S CF) | Cement Fixation of Process Residues in One-Gallon Cans, TRU-MST12-DP-03, R00, 04/27/87 | Process residue TRU waste at TA-55 immobilized for compliance with WIPP WAC. | None |
| TWCP-3568/ N-73 (UCNI) | C | Diagram (not P/S); chemical list; process description | Scrubber System for Cement Fixation Operations, 483-REC-R00, 01/30/89 | Operation of the nitric acid scrubber system to prevent the premature replacement of HEPA filters used in cementing operations. | None |
| TWCP-3568/ N-74 (UCNI) | C | Chemical list; process description (P/S CF) | Organic Liquid Emulsification, TRU-NMT2-DP-13, R00; TRUWM-TA55-DP-13-R00; 8/30/93 through 9/30/94 | Emulsifying waste oil and other organic liquids for cement fixation. | None |
| **General Documents Applicable to the Nitrate Process** | | | | | |
| TWCP-3568/ N-76 (UCNI) | D | Comments on draft Nitrate Process AK Report | Interview with Tim Hayes of TA-55 Nitrate Operations, 1/4/00 | Clarifications on various aspects of the Nitrate process, including P/S codes, time periods for P/S codes and specific operations, and appropriate terminology. | None |

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| TWCP-3568/ N-77 (UCNI) | D | Additional P/S diagrams assigned to Nitrate Process | Memo from Jim Foxx of TA-55, 1/17/2000 | P/S diagrams and codes assigned to Nitrate Operations by TA-55 personnel. | The diagrams are provided as "stand-alone" pieces of information. There are no procedures associated with these diagrams and so chemical use, process description, and applicability to the nitrate process can not be established. |
| TWCP-3568/ N-79 (UCNI) | C | Clarification of information for all processes within the nitrates operations | Comments from Tim Hayes and Jim Foxx on the Acceptable Knowledge Summary for TA-55 Nitrate Operations, 2/25/00 | Details provided for all processes within the nitrates operations. | None |
| TWCP-3568/ N-81 (UCNI) | C | Process descriptions, RCRA constituents, dates of generation, waste disposition (various P/S codes) | Nitrate Acceptable Knowledge Report forms completed by SMEs Tim Hayes and Jim Foxx | General process descriptions, RCRA constituents, dates of generation, and waste disposition for P/S codes without procedures. | Procedures do not exist for these P/S codes. This information is based on SME knowledge. |
| TWCP-3568/ N-82 (UCNI) | D | Clarification of specific processes within the Nitrates operations | Jim Foxx, SME, response to comments received on the Acceptable Knowledge Summary for TA-55 Nitrate Operations, 2/25/00 | Resolutions to the questions and issues raised by Pam Rogers during her review of the Acceptable Knowledge Summary for TA-55 Nitrate Operations, 2/25/00 | Information is based on SME knowledge. |
| TWCP-3568/ N-83 (UCNI) | D | Clarification of policy on assigning EPA HWNs to D-listed constituents in TRU waste streams. | Pam Rogers, email to John Musgrave, "Re: A Few Issues," 4/11/00. | All TRU waste streams containing RCRA D-listed hazardous constituents will be assigned the applicable D-code(s) unless analytical data or other acceptable information demonstrates that the concentration of the constituent is below the regulatory limit. The text will establish the caveat that the D-code can be revised (removed) based on obtaining additional information. | This policy is contrary to the WIPP WAP; however, the policy allows revisions to D-code assignments based on additional information obtained. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3568/ N-84 (UCNI) | D | Leaching equipment may result in chromium, cadmium, and/or lead being in the solution.<br>Text regarding ensuring that incompatible waste is not packaged together is provided. | Rosemary Glenn, email to Karen Chandler, "Re: Chromium," 6/8/00 and John Musgrave, email to Karen Chandler, "Re: Light Bulb!" 6/14/00. This email conveys information received from John Musgrave and Pam Rogers. | Processes that leach equipment may have chromium, cadmium, and/or lead in the solutions from stainless steel, shielding, and other metal feed materials.<br>TA-55 runs a DOT incompatibility analysis on waste being sent to TA-54. | |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |
| TWCP-4100 | D | Information on P/S/ code VP2 | Nitrate AK report form completed by SME Jim Foxx, and corrected on 09/26/00 | General process description, RCRA constituents, time line, and waste disposition | Procedures do not exist for these P/S codes. This information is based on SME knowledge |
| TWCP-4162 | D | Answers to questions about P/S codes PB, PuBe, CC, MB, MS, FF, BF, and other issues | Interview with Jim Foxx, 10/12/00 | Answers to questions on use of asbestos at TA-55, non-defense activities, and specific P/S codes in chloride operations. | None |
| TWCP-4164 | D | Answers to questions about various P/S codes | Interview with Jim Foxx, 10/16/00 | Answers to questions on use of Ag, disposal of ash and resins, and use of gases. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of Ag from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that Ag in ash is below limits of regulatory concern | None |
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-5164 | D | Sources of Cs-137 and Pa-231 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 2, 2001 | Plutonium operations never handled Cs-137 or Pa-231 in any of the Pu processing areas at TA-55. However, Cs-137 is expected to be present in the wastes because it is a fission product of several Pu isotopes. Pa-231 is expected to be present (as a function of the age of the waste) because it is a decay chain daughter of Pu-239 and U-235. | None |

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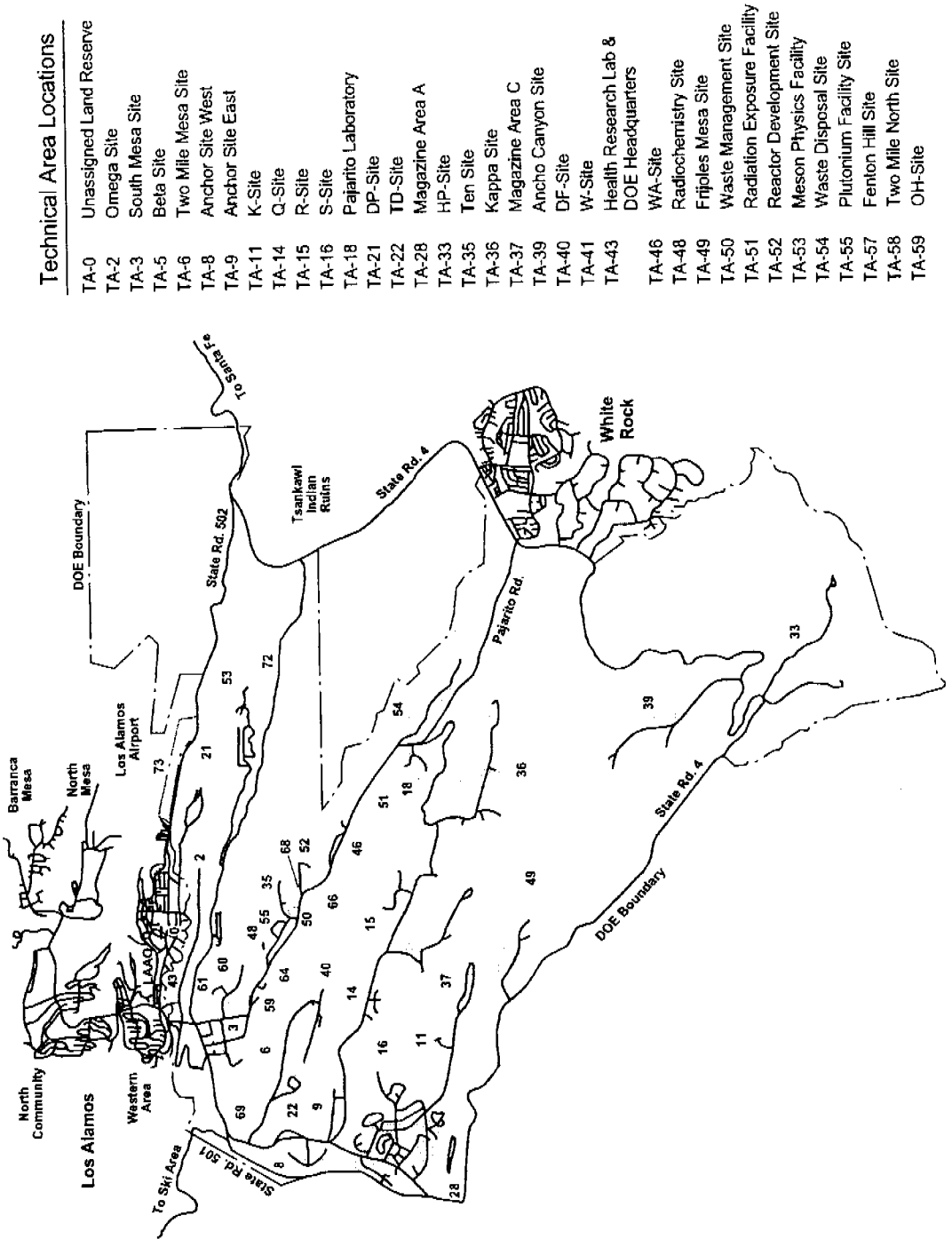
| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-5165 | D | Sources of Cs-137, Pa-231, and Cm-244 in TA-55 TRU waste | Interview with Jim Foxx (TA-55 SME) on April 11, 2001 | Dominant source of Cs-137 expected to be due to residual contamination from original separation of Pu from production fuel. Cm-244 introduced in P/S code DOP starting in 1988, but could also show up after that date in IS, WE, CA and CF. | None |
| TWCP-5371 | D | Source and processing of HRA materials | Interview with Jim Foxx (TA-55 SME) on April | HRA refers to process residues sent from Hanford Reservation to TA-55 for plutonium recovery. This material was sent through nitrate operations but its waste was tracked by its source code (HRA) instead of the P/S code in which the waste was generated. To be conservative, all HWNs that are applicable to P/S codes in nitrate operations (other than the cementation processes CF and HP) are also applied to wastes from HRA. These HWNs are D005, D006, D007, D008, D009, and D011. | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-004,R.2 | A | *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | A | *Process Acceptable Knowledge Report for Pyrochemical Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for pyrochemical operations at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | *Process Acceptable Knowledge Report for Special Processing Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for special processing operations at TA-55 | None |
| TWCP-PLAN-0.2.7-001,R.5 | C | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | LANL TA-55 waste management database, LANL TA-54 TRU waste management database, and TWCP AK reference base on generator's original data | Detailed information on each waste drum and waste stream | None |

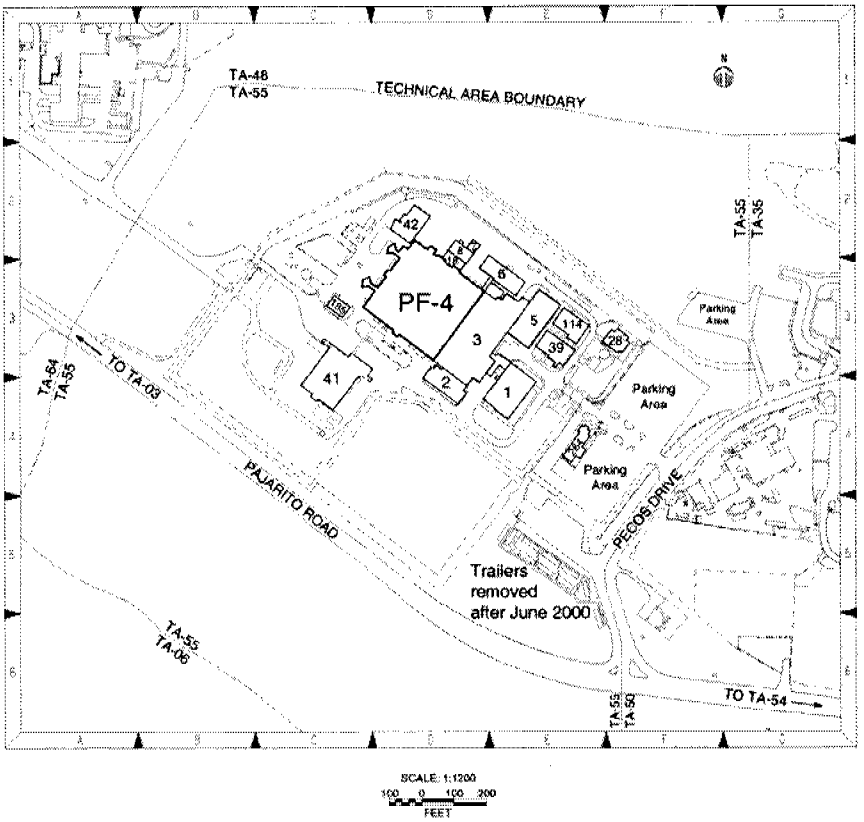
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# MAP OF LANL

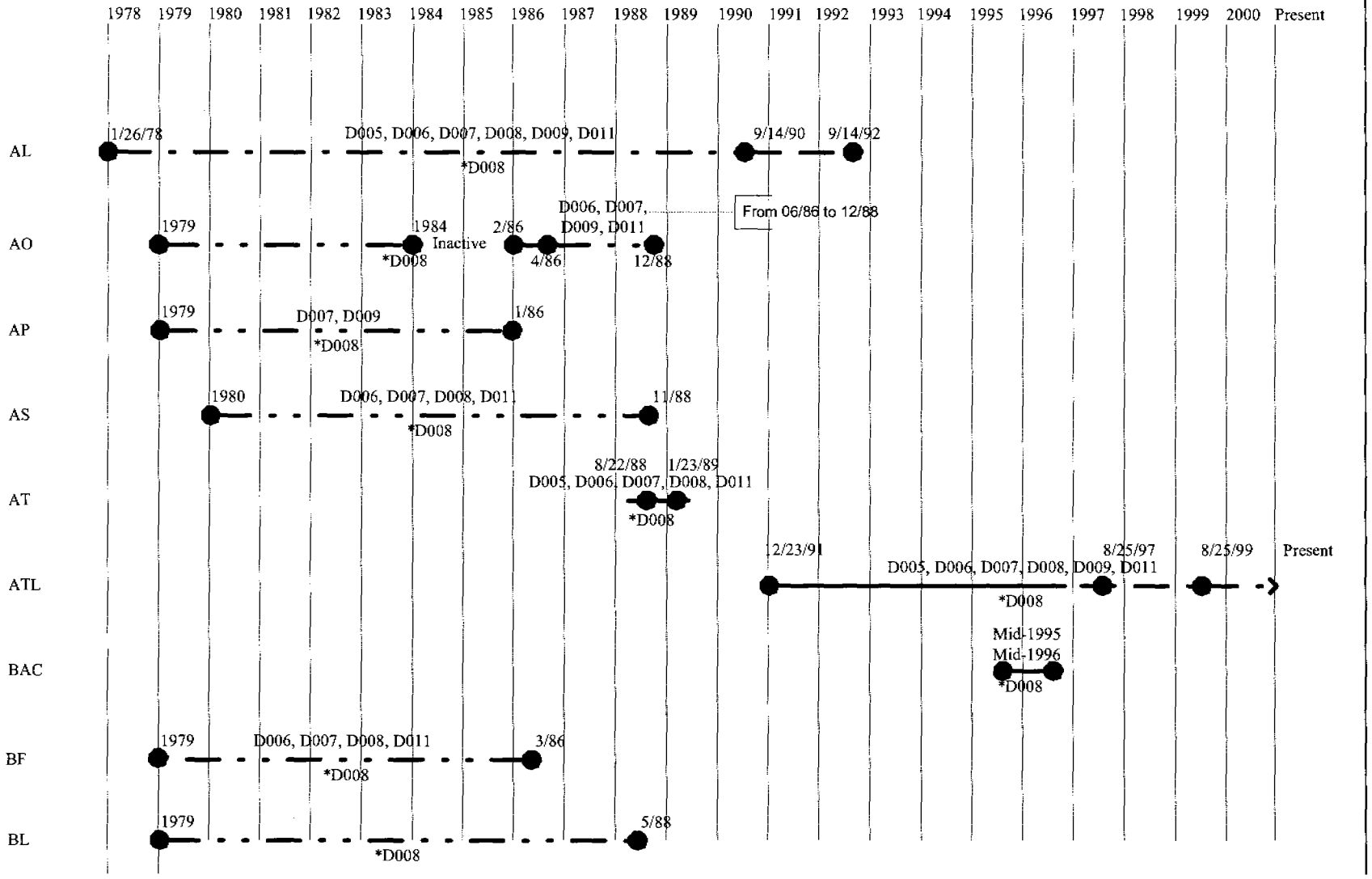

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Espanola
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Los Alamos Airport
Barranca Mesa
North Mesa
LANSCE
North Community
Los Alamos
Western Area
To Ski Area
State Rd. 501
DOE Boundary
State Rd. 4

## MAP OF TA-55

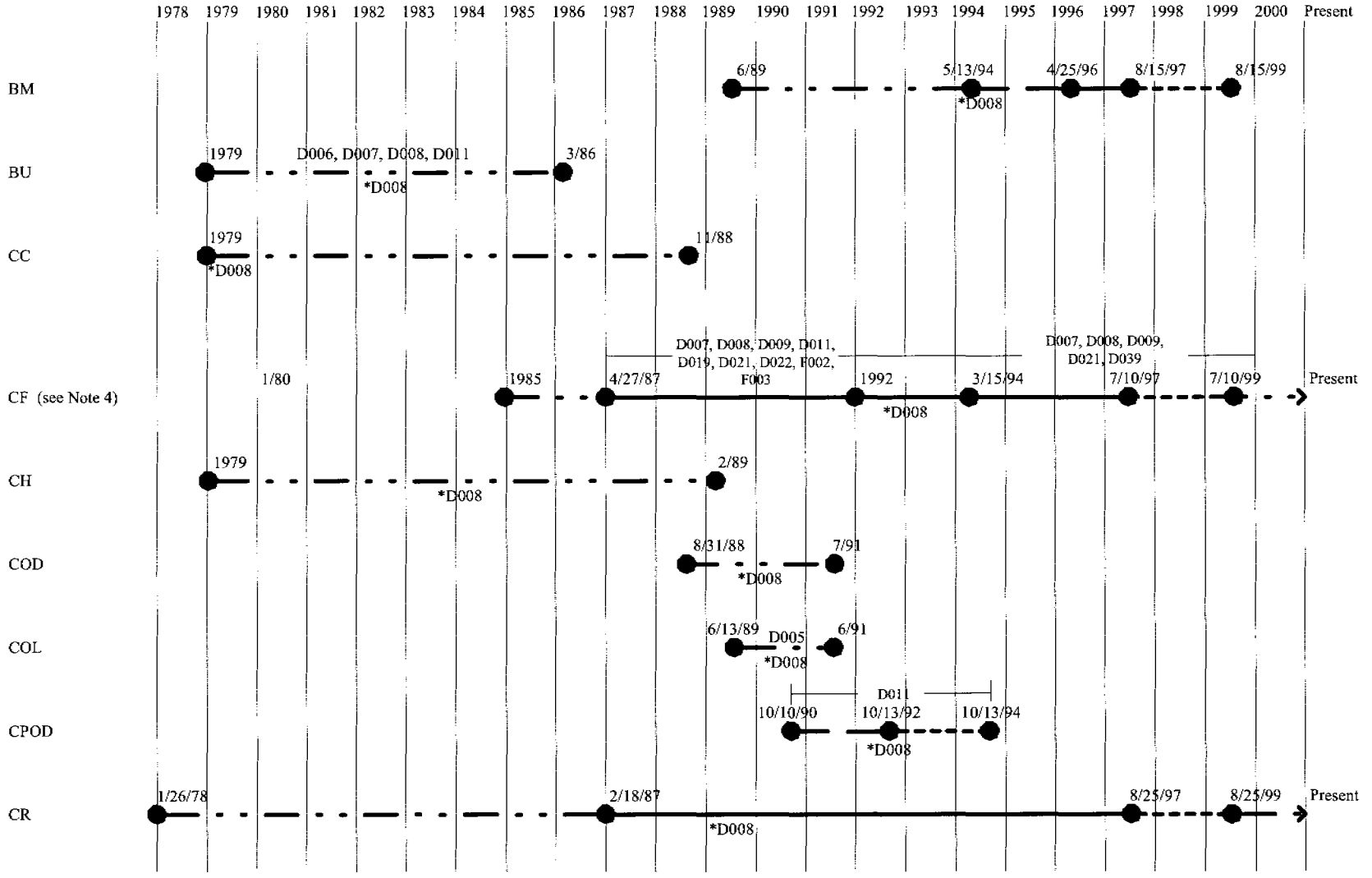
**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.



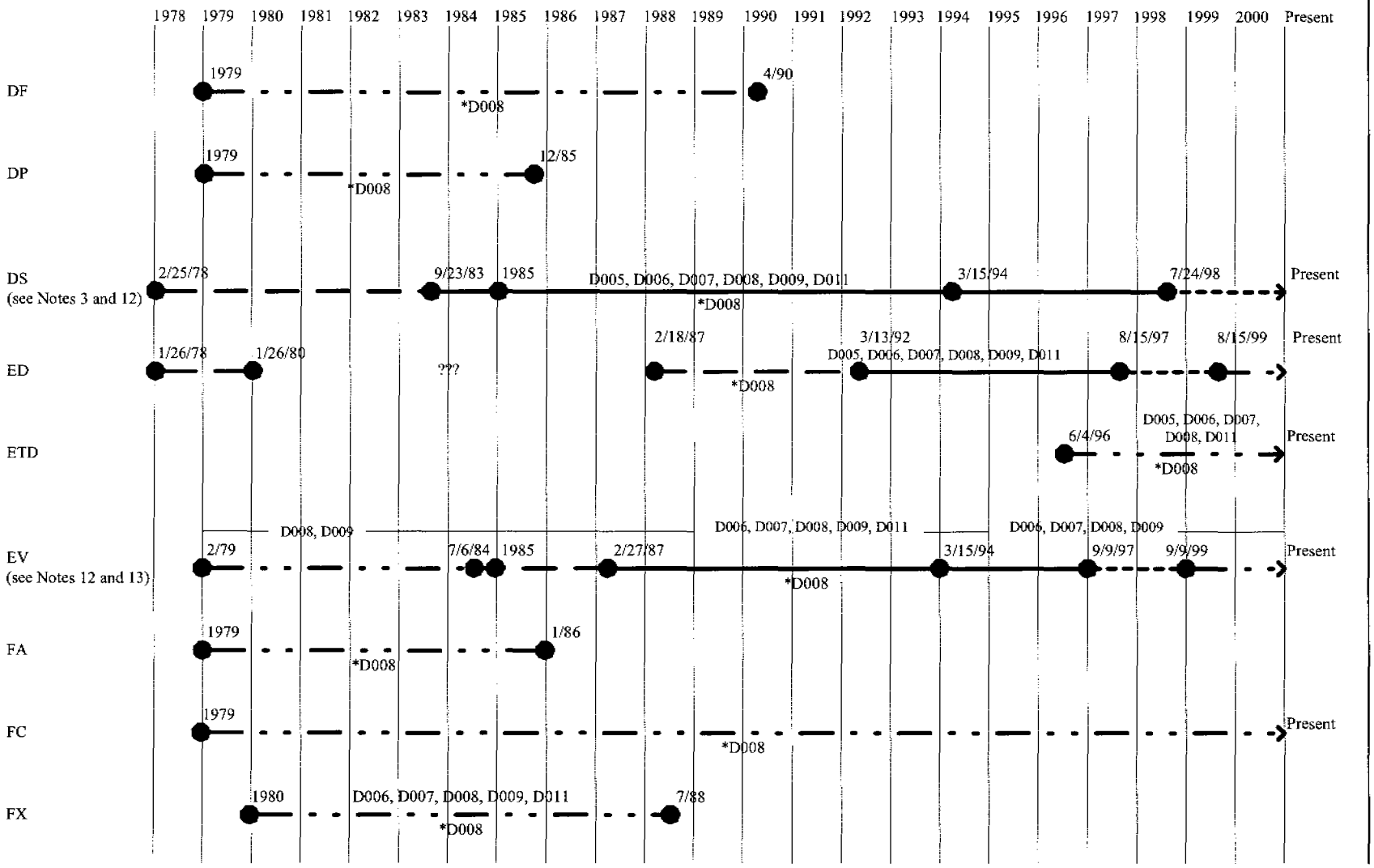
## TIMELINE FOR NITRATE OPERATIONS



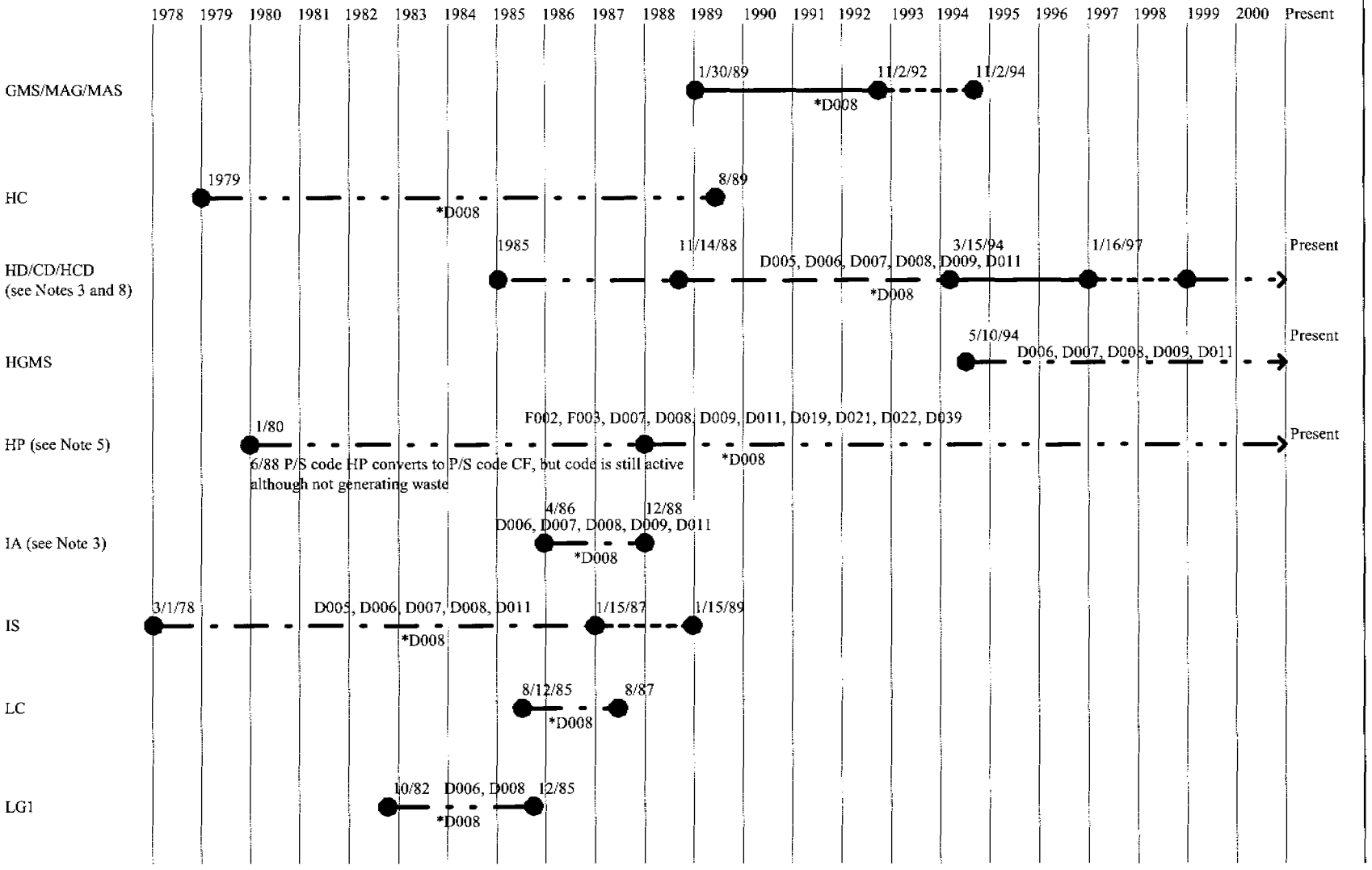
## TIMELINE FOR NITRATE OPERATIONS (continued)



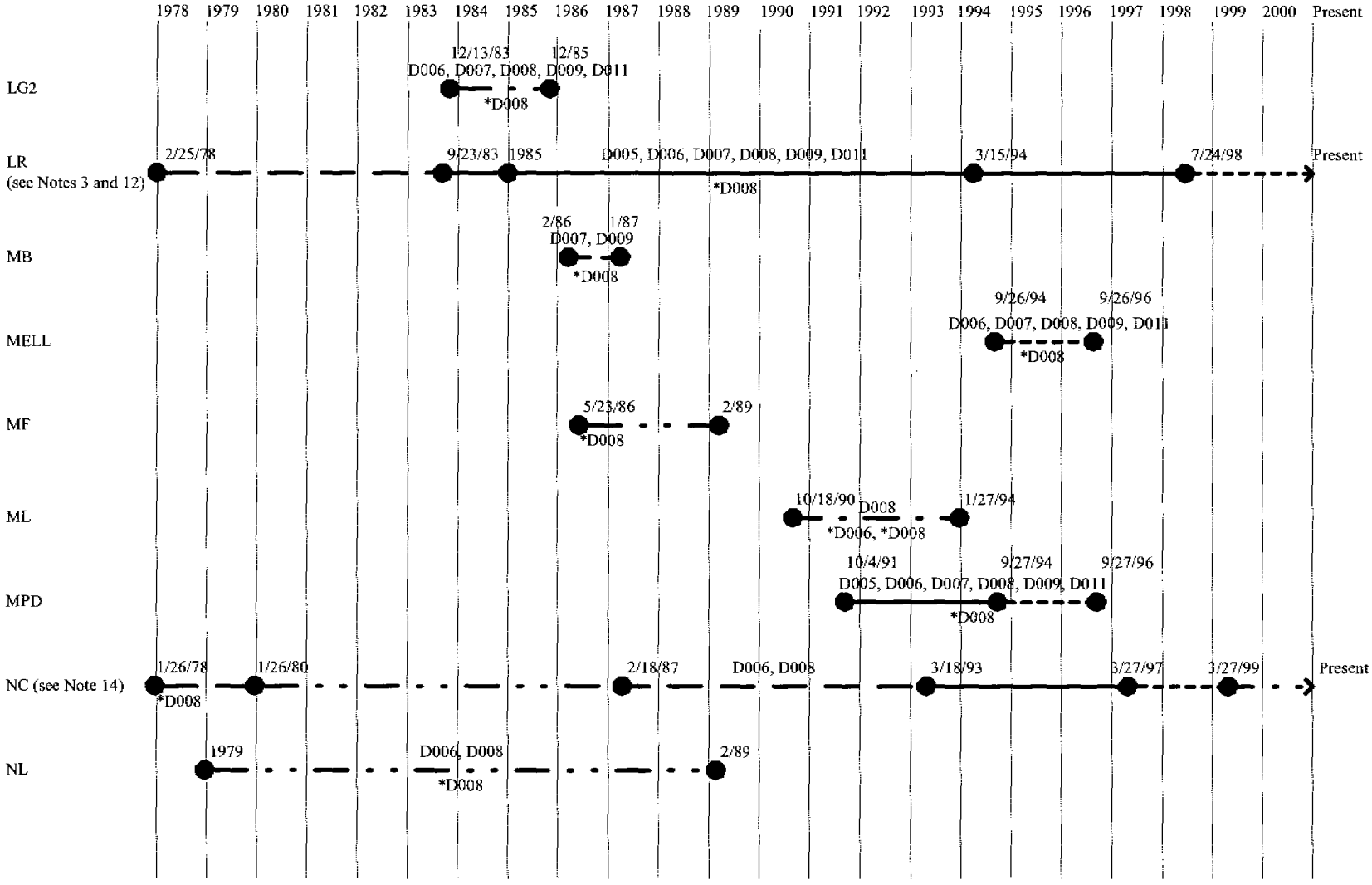
## TIMELINE FOR NITRATE OPERATIONS (continued)



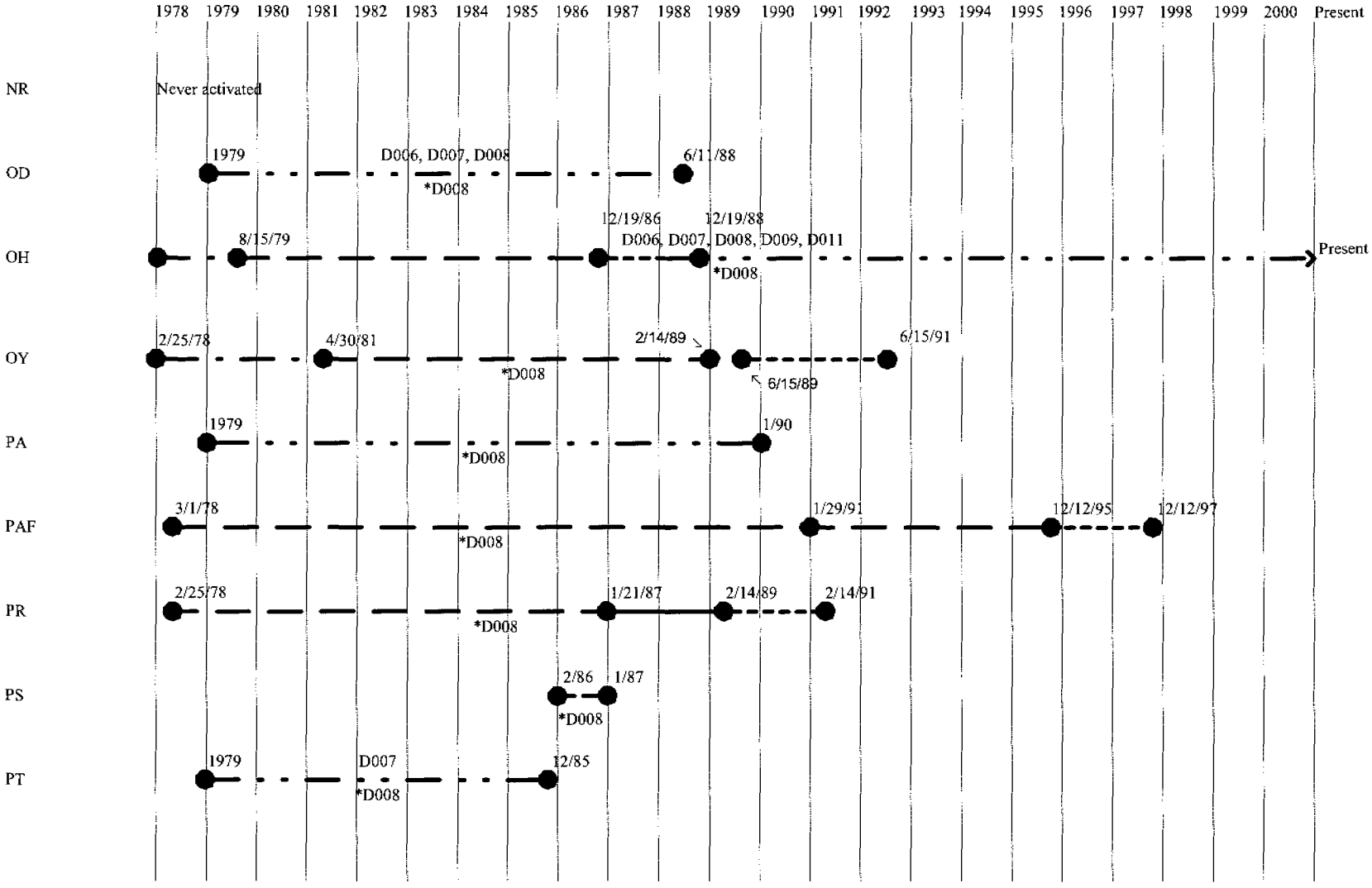
## TIMELINE FOR NITRATE OPERATIONS (continued)



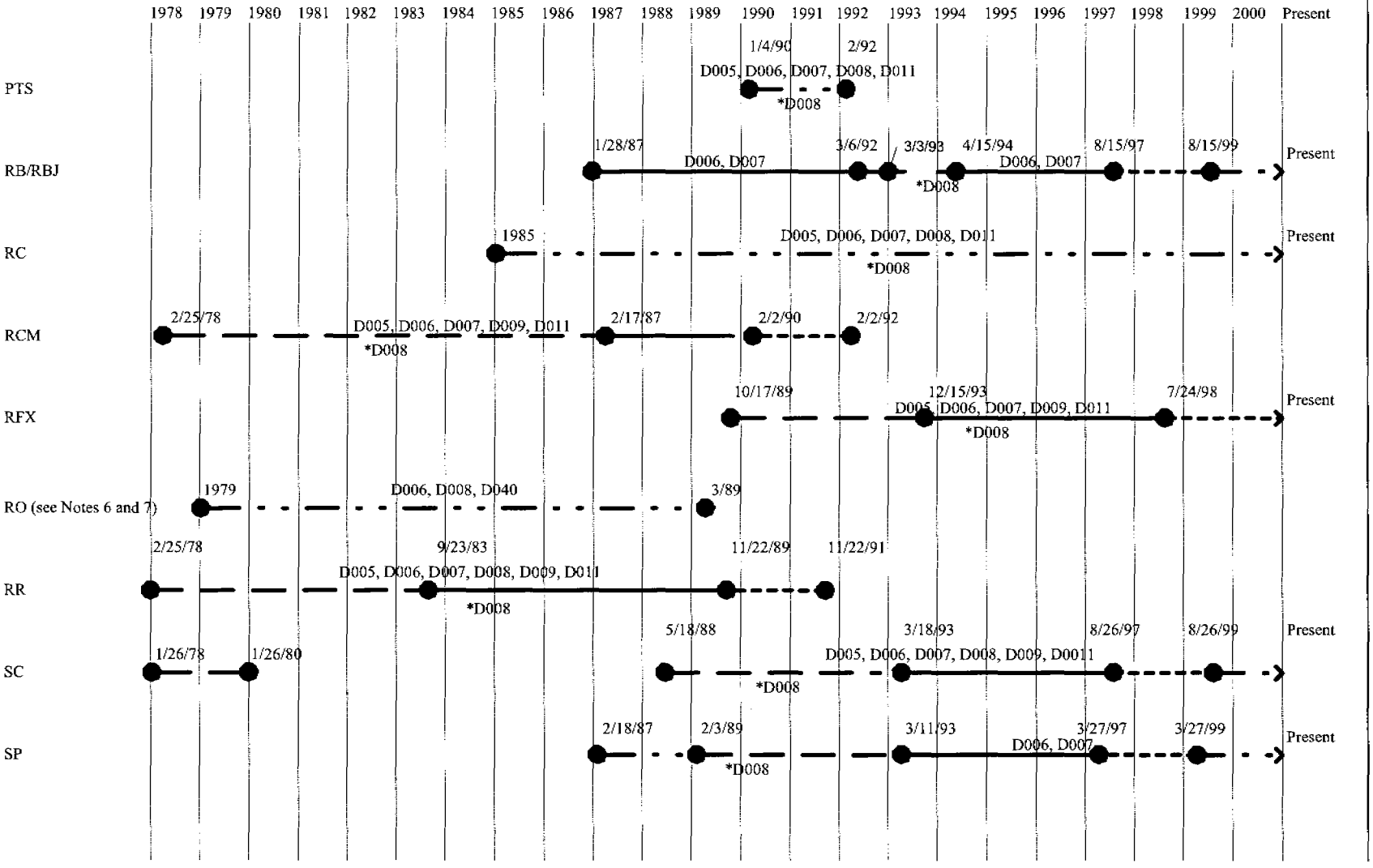
## TIMELINE FOR NITRATE OPERATIONS (continued)



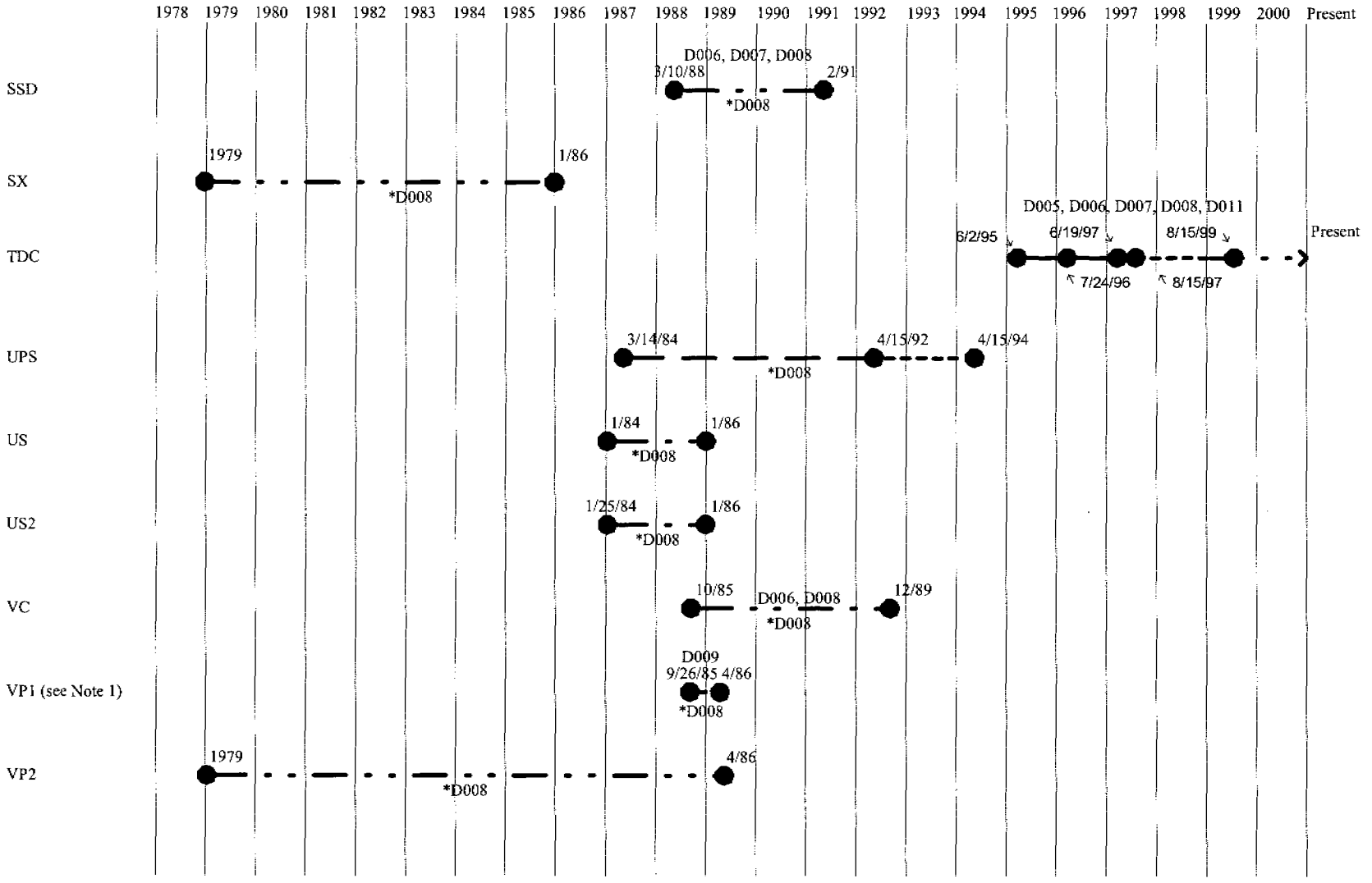
## TIMELINE FOR NITRATE OPERATIONS (continued)



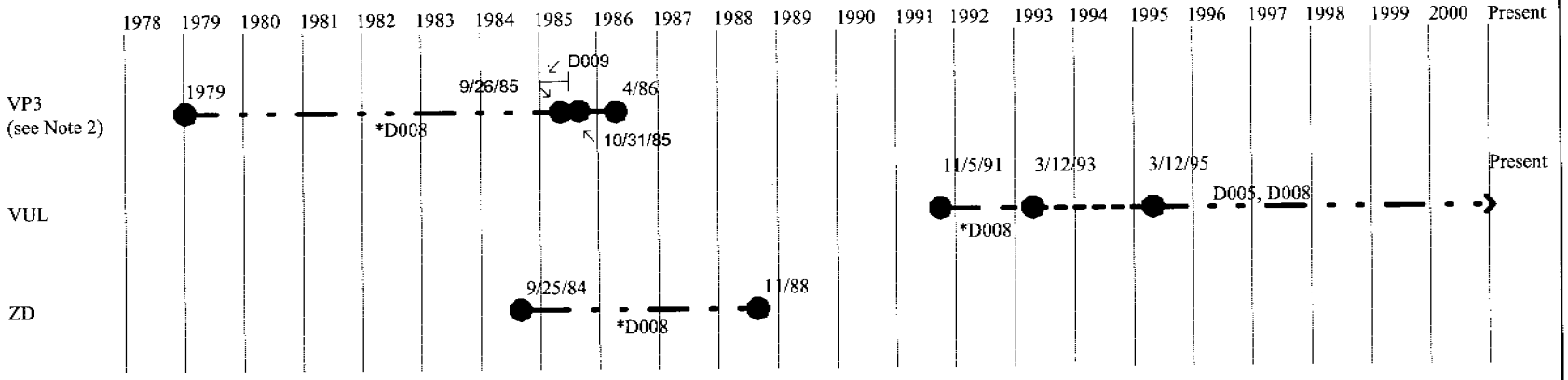
## TIMELINE FOR NITRATE OPERATIONS (continued)



## TIMELINE FOR NITRATE OPERATIONS (continued)



## TIMELINE FOR NITRATE OPERATIONS (continued)




Notes on Time Dependence of RCRA Codes

* D008 - Applies to leaded gloves which were discarded in a separate waste stream after 1992, still under the originating P/S code.
[1] D009 - Mercuric nitrate used in P/S code VP1 from 9/85 to 10/85.
[2] D011 applies to hydroxide cakes in VP3 from 9/85 to 10/85.
[3] D011 -Silver nitrate used in chloride ion exchange from 1985 until end of 1993, hence D011 applies to CD, EV, HCD, HD, IA, DS, and LR.
[4] D011 applies to P/S code CF from 1985 through 1993.
[5] F002 - RCRA-listed solvent use discontinued in chloride operations in 1992, but waste containing these solvents may have been generated until the end of 1993. Affected P/S codes in nitrate are CF and HP.
[6] D006 and D008 applies to P/S code RO from 1979 to 3/89.
[7] D040 applies to P/S code RO during 1979.
[8] D006, D007, D008, D009 applies to P/S codes CD, HCD, and HD from 1985 to the present.
[9] D006 and D008 applies to P/S code ML from 10/18/90 to 1/27/94.
[10] D006 and D008 applies to P/S code VC from 10/85 to 12/89.
[11] D006, D007, and D008 applies to P/S code SSD from 3/88 to 2/91.
[12] D006, D007, D008, D009 applies to P/S codes DS, EV, and LR from 1985 to the present.
[13] D008 and D009 applies from 2/79 to 7/84.
[14] D006 and D008 applies from 1/78 to present.

## TIMELINE EXPLANATION



The P/S code is established in either the P/S diagrams or in both (or all) revisions of the procedures designating the start and end dates (e.g., Rev. 0 to Rev. 1; or Rev. 0 to Rev. 5).



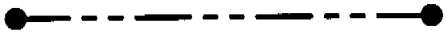
The P/S code is not identified in the procedure, but the process description matches the P/S code and the description in previous or later revisions of the same procedure.



Extrapolate out two (2) years beyond the last procedure to next possible review date.



The P/S code is not identified in the procedure, but the process description matches that of the P/S diagram or P/S code description.



Time period based on subject matter expert comments

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| AL | Ash Leach | Incinerator ash | Nitric acid<br>Calcium fluoride<br>Aluminum nitrate | Plutonium solutions | Leached solids<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-28/TWCP-3566 |
| AO | Americium Processing Calcination | Americium oxalate and hydroxide cakes | None (physical process) | Pure americium oxide | Americium oxide cakes<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-81/TWCP-3568 |
| AP | Americium Purification | Americium in nitric acid solutions | Hydroxylamine nitrate<br>Nitric acid<br>Anion exchange resin | Purified americium solutions<br>Plutonium solutions | Leaded gloves | D007, D008, *D008, D009 | N-81/TWCP-3569 |
| AS | Anode Heel Dissolution | Plutonium oxide | Nitric acid<br>Hydrofluoric acid<br>Calcium fluoride | Plutonium solutions<br>Filtered solids | Leaded gloves | D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| AT | Ash Testing | Incinerator ash | Anion exchange resin<br>Sodium nitrite (20% solution)<br>Ferrous sulfamate (20% solution)<br>Nitric acid<br>Calcium fluoride<br>Silver nitrate (only used in a cold lab; not present in TRU waste) | Plutonium solutions<br>Filtered solids | Filtered solids (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-36/TWCP-3567 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| ATL | Advanced Test Line for Actinide Separations RD&D | Oxides<br>Ash<br>Chloride salts<br>Metals<br>Sand, slag, crucibles | Aluminum nitrate solution<br>Calcium nitrate solution<br>Calcium fluoride<br>Hydrochloric acid<br>Hydrofluoric acid<br>Nitric acid<br>Anion exchange resin<br>Ascorbic acid<br>Ferrous ammonium sulfate<br>Hydrogen peroxide<br>Hydroxylamine nitrate<br>Sodium nitrite<br>Urea<br>Diethyl oxalate<br>Formamide<br>Formic acid<br>Oxalic acid<br>Sodium hydroxide<br>Sulfuric acid | Plutonium oxide cakes | Residues<br>Nitrate salt solutions<br>Bottoms solutions<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-20/TWCP-3566 |
| BAC | Bacterial Decomposition of Cellulose Items | Cellulose rags (cheesecloth) | Bacteria | Solutions of glucose and other byproducts | Leaded gloves | *D008 | N-81/TWCP-3568 |
| BF | Unknown name for this code | Anode heel metal (plutonium oxide) | None (physical process) | Plutonium oxide | Leaded gloves | D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| BL | Blending | Plutonium oxide | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| BM | Burning Metal | Plutonium oxide<br>Plutonium metal | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-14/TWCP-3548 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| BU | Button Burning | Plutonium metal buttons; anode heels | None (physical process) | Plutonium oxide | Leaded gloves | D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| CC | Calcination | Plutonium oxalate cakes | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| CD | Hydroxide Cake Dissolution | Hydroxide cakes (from chloride operations) | Hydrofluoric acid<br>Nitric acid<br>Aluminum nitrate<br>Calcium fluoride | Plutonium in nitric acid solutions | Residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-32/TWCP-3566 |
| CF | Cement Fixation | Aqueous analytical solutions<br>Organic analytical solutions<br>Evaporator bottoms<br>Evaporator salts<br>Fine particulate materials<br>Oils<br>Organic petroleum-based liquids<br>Spent ion exchange resins<br>Americium oxide<br>Calcium chloride salts<br>Chloride solutions<br>Filter aid<br>Glovebox sweepings<br>Graphite powder<br>HEPA filter media<br>High-fired ash<br>Leached ash residues<br>Leached particulate solids | Cement accelerator<br>Nitric acid<br>Organic liquid emulsifier<br>Silicon defoamer<br>Sodium citrate retarder<br>Sodium hydroxide<br>pH 4 phthalate buffer solution<br>pH 7 phosphate buffer solution<br>Gypsum cement | Cemented TRU waste | Leaded gloves | D007, D008, *D008, D009, D011, D019, D021, D022, D039, F002, F003 | N-1/TWCP-3548<br>N-67/TWCP-3568<br>N-68/TWCP-3568<br>N-69/TWCP-3568<br>N-70/TWCP-3568<br>N-71/TWCP-3568<br>N-72/TWCP-3568<br>N-73/TWCP-3568<br>N-74/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| CF (continued) | | Passivated uranium carbide<br>Plutonium/thorium fluoride filter cakes<br>Plutonium/thorium hydroxide filter cakes<br>Plutonium/uranium filings<br>Pump oils<br>Silica solids<br>Trioctyl phosphine oxide (TOPO) and iodine in kerosene<br>Uranium oxide | | | | | |
| CH | Characterization | Plutonium oxide | Nitrogen gas<br>Viscous water-soluble liquid | Plutonium oxide | Plutonium oxide slurries<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| COD | Chlorinated Oxide Dissolution | Chloride pyrochemical salts | Sodium hydroxide solution<br>Nitric acid<br>Hydrofluoric acid | Plutonium oxide cakes<br>Plutonium solutions<br>Plutonium residues | Caustic liquids<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| COL | Chlorinated Oxide Leach | Chlorinated oxides<br>Chloride pyrochemical salts | Sodium hydroxide solution | Plutonium oxide cakes (may contain barium) | Caustic liquids<br>Leaded gloves | D005, *D008 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| CPOD | Catalyzed Electrochemical Plutonium Oxide Dissolver | Plutonium oxide<br>Filter residues<br>Glovebox sweepings<br>Plastic | Nitric acid<br>Silver nitrate<br>Hydrochloric acid<br>Ferric ammonium sulfate hydrate<br>Potassium thiocyanate<br>Calcium fluoride<br>Sodium chloride<br>Water<br>Argon | Plutonium solutions | Electrolytic solutions<br>Silver chloride residues<br>Leaded gloves | *D008, D011 | N-21/TWCP-3566 |
| CR | Crushing and Pulverizing | Sand, slag, crucible residues<br>Skull oxide<br>Graphite<br>Magnesium oxide<br>Ash | None (physical process) | Crushed materials | Leaded gloves | *D008 | N-17/TWCP-3548 |
| DF | DS Furnace and Oxide Preparation | Plutonium oxalate cake | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| DP | Dry Processing | Polycubes (polyethylene with plutonium oxide) | None (physical process) | Crushed polycubes | Leaded gloves | *D008 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| DS | Ion Exchange | Plutonium in nitric acid | Anion exchange resin<br>Aluminum nitrate<br>Nitric acid<br>Sodium nitrite<br>Hydroxylamine nitrate<br>Hydrogen peroxide (30%)<br>Oxalic acid<br>Hydrofluoric acid<br>Sodium hydroxide<br>Ferrous sulfamate<br>Ferrous ammonium sulfate<br>Urea<br>Phenolphthalein in ethanol<br>Potassium fluoride hydrate | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluents and filtrate solutions<br>Ion exchange resins<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-45/TWCP-3567<br>N-51/TWCP-3567<br>N-59/TWCP-3567 |
| ED | Cascade Dissolver | Magnesium oxide crucibles<br>Plutonium oxide<br>Oxidized metal, skulls, etc.<br>Incinerator ash | Nitric acid<br>Calcium fluoride<br>Aluminum nitrate | Plutonium in nitric acid solutions | Crucible and metal residues<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-23/TWCP-3566 |
| ETD | Experimental Thermal Decomposition | Combustible residues | Argon gas | Plutonium oxide<br>Ash | Water scrub solutions | D005, D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| EV | Evaporator | Ion exchange solutions<br>Nitrate salts<br>Oxalate filtrates<br>Nitric acid distillates<br>Vacuum pump seal waters<br>Negative-chilled waters | Nitric acid<br>Formic acid | Plutonium in nitric acid solutions | Nitrate salts<br>Distillate solutions<br>Filtrate solutions<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-61/TWCP-3568<br>N-62/TWCP-3568<br>N-64/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| FA | Americium Processing | Americium/nitric acid solution | Oxalic acid<br>Sodium oxalate | Americium oxalate cakes<br>Americium oxalate solutions | Leaded gloves | *D008 | N-81/TWCP-3568 |
| FC | Canning | Plutonium oxide | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| FX | Cement to Drum | Cemented waste, evaporator bottoms | None (physical process) | None | Packaged cemented waste<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-81/TWCP-3568 |
| GMS | Open Gradient Magnetic Separation | Magnesium oxide<br>Graphite<br>Sand, slag, and crucible residues<br>Plutonium processing residues | None (physical process) | Plutonium-rich materials | Plutonium-lean materials (< DL)<br>Leaded gloves | *D008 | N-2/TWCP-3548 |
| HC | Calcination | Plutonium oxalate cakes | Water vapor | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| HCD | Hydroxide Cake Dissolution | Hydroxide cakes (from chloride operations) | Hydrofluoric acid<br>Nitric acid<br>Aluminum nitrate<br>Calcium fluoride | Plutonium in nitric acid solutions | Residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-32/TWCP-3566 |
| HD | Hydroxide Cake Dissolution | Hydroxide cakes (from chloride operations) | Hydrofluoric acid<br>Nitric acid<br>Aluminum nitrate<br>Calcium fluoride | Plutonium in nitric acid solutions | Residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-32/TWCP-3566 |
| HGMS | High Gradient Magnetic Separation | Soil and clay | Water | Plutonium residues | Plutonium residues (< DL) | D006, D007, D008, D009, D011 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| HP | Cement Fixation | Evaporator bottoms<br>Vacuum pump oils<br>Tributylphosphate and iodine in kerosene<br>Analytical chemistry solutions<br>Salts<br>Leached filter paper residues<br>Ash<br>Miscellaneous solutions<br>Americium oxide | Sodium hydroxide<br>Portland cement<br>Gypsum cement<br>Surfactant (polyoxy-ethylene-20-sorbitan) | | Cemented waste<br>Leaded gloves | D007, D008, *D008, D009, D011, D019, D021, D022, D039, F002, F003 | N-81/TWCP-3568 |
| HRA | Hanford Reservation materials | Process residues from Hanford Reservation | Not specified | Recovered plutonium | Not specified | D004, D005, D006, D007, D008, *D008, D009, D010, D011 | TWCP-5371 |
| IA | Impure Americium Holding for Discard | Americium hydroxide cakes | None (no processing performed) | Americium hydroxide cake | Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-81/TWCP-3568 |
| IS | Incinerator | Combustible materials (e.g., rags, paper wipes, wood) (less than 10% plastic and rubber) | Sodium hydroxide solution<br>Potassium hydroxide solution | Scrubber solutions | Ash<br>Scrubber solutions (< DL)<br>Pump seal solutions<br>Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-5/TWCP-3548 |
| LC | Uranium/ Plutonium Processing | Plutonium oxide | Nitric acid<br>Hydrofluoric acid<br>Oxalic acid<br>Sodium oxalate | Plutonium oxalate | Acidic solutions<br>Uranium nitrate solutions<br>Leaded gloves | *D008 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| LG1 | Non Combustible Leach | Debris (metal, glass, plastic) | Nitric acid | Plutonium in nitric acid solutions | Leaded gloves | D006, D008, *D008 | N-81/TWCP-3568 |
| LG2 | Hydroxide Cake Dissolution | Hydroxide cakes | Nitric acid | Plutonium in nitric acid solutions | Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-81/TWCP-3568 |
| LR | Ion Exchange | Plutonium in nitric acid solutions | Ferrous ammonium sulfate<br>Nitric acid<br>Hydroxylamine nitrate<br>Oxalic acid<br>Aluminum nitrate<br>Hydrofluoric acid<br>Urea<br>Anion exchange resin<br>Sodium nitrite<br>Hydrogen peroxide<br>Ferrous sulfamate<br>Phenolphthalein in ethanol<br>Potassium fluoride hydrate | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluents<br>Acidic filtrate solutions<br>Anion exchange resins<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-42/TWCP-3567<br>N-45/TWCP-3567<br>N-51/TWCP-3567 |
| MAG | Magnetic Separation | Magnesium oxide<br>Graphite<br>Sand, slag, and crucible residues<br>Plutonium processing residues | None (physical process) | Plutonium-rich materials | Plutonium-lean materials (< DL)<br>Leaded gloves | *D008 | N-2/TWCP-3548 |
| MAS | RD&D Experimental Process | Magnesium oxide<br>Graphite<br>Sand, slag, and crucible residues<br>Plutonium processing residues | None (physical process) | Plutonium-rich materials | Plutonium-lean materials (< DL)<br>Leaded gloves | *D008 | N-2/TWCP-3548 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| MB | Nitric Dissolution of Molten Salts | Molten salt extraction salts | Hydrochloric acid<br>Nitric acid | Plutonium solutions | Acidic solution<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| MELL | Mediated Electro-Oxidation of Low Level Waste (LLW) | Cellulose-based materials | Nitric acid<br>Cobalt nitrate<br>Cerium nitrate<br>Platinum anode<br>Titanium anode<br>Stainless steel cathode | Plutonium solutions<br>Plutonium oxide | Plutonium oxide (< DL)<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-33/TWCP-3566 |
| MF | Metals Furnace | Plutonium metal items | None (physical process) | Plutonium oxide | Leaded gloves | *D008 | N-81/TWCP-3568 |
| ML | Non-Plutonium Metal Leach | Metal equipment w/ Pu surface contamination | Nitric acid<br>Calcium fluoride<br>Hydrofluoric acid | Plutonium solutions | Metal equipment<br>Leaded gloves | D006, D008 *D008 | N-29/TWCP-3566 |
| MPD | Cascade Dissolver | Plutonium oxide (salts or residues)<br>Incinerator ash | Nitric acid<br>Calcium fluoride<br>Potassium hydroxide<br>Sodium hydroxide<br>Aluminum nitrate | Plutonium solutions | Plutonium residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-25/TWCP-3566 |
| NC | Non-Combustible Leach | Noncombustible material w/ surface Pu contamination | Calcium fluoride<br>Nitric acid<br>Hydrofluoric acid<br>Aluminum nitrate<br>Argon | Plutonium solutions | Leached noncombustible solids<br>Leaded gloves | D006, D008 *D008 | N-31/TWCP-3566 |
| NL | Non-Combustible Leach | Debris (metal, glass, plastic) | Nitric acid | Plutonium in nitric acid solutions | Residues (< DL)<br>Leaded gloves | D006, D008 *D008 | N-81/TWCP-3568 |
| NR | Nitrate Recovery | None (not activated) | None | None | None | None | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| OD | Oxide Dissolution | Coarse oxides | Nitric acid<br>Hydrofluoric acid<br>Aluminum nitrate<br>Calcium fluoride<br>Argon | Plutonium in acidic solutions | Plutonium residues (< DL)<br>Leaded gloves | D006, D007, D008, *D008 | N-37A/TWCP-3567<br>N-81/TWCP-3568 |
| OH | Hydroxide Precipitation | Americium hydroxide solutions from the FFTF and Breeder Oxide Production processes | Nitric acid<br>Sodium Hydroxide | Americium solutions<br>Plutonium solutions | Americium solutions (<DL)<br>Leaded gloves | D006, D007, D008, *D008, D009, D011 | N-55/TWCP-3567 |
| OY | Oxalate Precipitation | Plutonium nitrate solution (eluate from anion exchange) | Oxalic acid<br>Urea<br>Hydroxylamine nitrate<br>Nitric acid<br>Aluminum nitrate solution | Plutonium oxalate cakes<br>Plutonium oxide<br>Plutonium solutions | Plutonium solutions (< DL)<br>Leaded gloves | *D008 | N-50/TWCP-3567 |
| PA | Passivation | Glovebox sweepings, oxides containing unoxidized plutonium metal, carbides, and nitrides | None (physical process) | Plutonium oxide<br>Passivated materials | Leaded gloves | *D008 | N-81/TWCP-3568 |
| PAF | Passivation Furnaces | Pyrophoric plutonium metal and alloys | Argon gas | Plutonium oxide | Leaded gloves | *D008 | N-7/TWCP-3548 |
| PR | Peroxide Precipitation | Oxide dissolution filtrate | Hydrogen peroxide<br>Nitric acid<br>Sulfuric acid<br>Sodium hydroxide | Plutonium in nitric acid solutions | Leaded gloves | *D008 | N-52/TWCP-3567 |
| PS | Peroxide Precipitation of MSE Salts | Plutonium-containing nitric acid solutions | Hydrogen peroxide<br>Nitric acid<br>Sodium hydroxide solution | Plutonium in nitric acid solutions<br>Americium oxalate cakes | Leaded gloves | *D008 | N-81/TWCP-3568 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| PT | Plutonium/ Thorium Separation | Plutonium/thorium oxide residues | Nitric acid<br>Nitrate-based ion exchange resin<br>Sodium hydroxide<br>Chloride-based ion exchange resin | Plutonium in nitric acid solutions | Caustic liquids<br>Thorium-containing residues<br>Leaded gloves | D007, *D008 | N-81/TWCP-3568 |
| PTS | RD&D Pretreatment Study | Variety of residue matrices, including ash | None (physical process) | None | Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-81/TWCP-3568 |
| RB | Roasting and Blending | Plutonium oxide | None (physical process) | Plutonium oxide | Leaded gloves | D006, D007, *D008 | N-57 N-57A N-57B (all in TWCP-3567) |
| RBJ | Roasting and Blending Jr | Plutonium oxide | None (physical process) | Plutonium oxide | Leaded gloves | D006, D007, *D008 | N-57 N-57A N-57B (all in TWCP-3567) |
| RC | Rotary Calciner | Ash<br>Graphite crucibles<br>Uranium oxide | None (physical process) | Calcined ash | Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-81/TWCP-356 |
| RCM | Rich Column Material Ion Exchange | Plutonium in nitric acid solutions | Anion exchange resin<br>Aluminum nitrate<br>Nitric acid<br>Sodium nitrite<br>Hydroxylamine nitrate<br>Hydrogen peroxide<br>Oxalic acid<br>Hydrofluoric acid | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluent solutions<br>Filtrate solutions<br>Leaded gloves | D005, D006, D007, *D008 D008, D009, D011 | N-41/TWCP-3567<br>N-51/TWCP-3567 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| RFX | Ion Exchange | Plutonium in nitric acid solutions | Anion exchange resin<br>Aluminum nitrate<br>Nitric acid<br>Hydroxylamine nitrate<br>Hydrogen peroxide<br>Oxalic acid<br>Hydrofluoric acid<br>Sodium Nitrite<br>Sodium Hydroxide<br>Phenolphthalein in ethanol<br>Potassium fluoride hydrate | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluents and filtrate solutions<br>Ion exchange resins<br>Leaded gloves | D005, D006, D007, *D008 D008, D009, D011 | N-45/TWCP-3567<br>N-47/TWCP-3567 |
| RO | Oil Recovery | Vacuum pump oils<br>Contaminated organics | Trichloroethylene (used once in 1979) | Plutonium residues | Oils and organics on vermiculite<br>Leaded gloves | D006, *D008, D040 | N-81/TWCP-3568 |
| RR | Ion Exchange | Plutonium in nitric acid solutions | Anion exchange resin<br>Aluminum nitrate<br>Nitric acid<br>Sodium nitrite<br>Hydroxylamine nitrate<br>Hydrogen peroxide<br>Oxalic acid<br>Hydrofluoric acid | Plutonium in nitric acid solutions<br>Plutonium oxide | Acidic effluents and filtrate solutions<br>Ion exchange resins<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-43/TWCP-3567<br>N-51/TWCP-3567<br>N-59/TWCP-3567 |
| SC | Cascade Dissolver, G437 | Sand, slag, and crucible residues<br>Ash<br>Magnesium oxide crucibles | Potassium hydroxide<br>Sodium hydroxide<br>Nitric acid<br>Aluminum nitrate<br>Calcium fluoride<br>Hydrofluoric acid | Plutonium in nitric acid solutions<br>Plutonium oxide residues | Alkaline scrubber solutions<br>Residues (< DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D009, D011 | N-24/TWCP-3566 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| SP | Scrap Dissolution, G438 | Filter residues<br>Glovebox sweepings<br>Coarse oxides | Nitric acid<br>Hydrofluoric acid<br>Aluminum nitrate<br>Calcium fluoride<br>Argon | Plutonium oxide residues<br>Plutonium filtrate solutions | Acidic scrubber solutions<br>Residues (<DL)<br>Leaded gloves | D006, D007, D008, *D008 | N-37/TWCP-3567<br>N-37A/TWCP-3567 |
| SSD | Special Scrap Dissolution | Miscellaneous oxide scrap items | Nitric acid<br>Hydrofluoric acid | Plutonium in nitric acid solutions | Residues<br>Leaded gloves | D006, D007, D008, *D008 | N-81/TWCP-3568 |
| SX | Americium Processing Silicon Removal | Americium-containing hydroxide cakes | Nitric acid | Americium solutions | Silica gels<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| TDC | Thermal Decomposition of Cellulose Items R&D | Cellulose items | Potassium hydroxide<br>Argon<br>Filter Aid | Plutonium solutions<br>Plutonium residue<br>Ash | Caustic scrubber solutions<br>Plutonium solutions (<DL)<br>Leaded gloves | D005, D006, D007, D008, *D008, D011 | N-6/TWCP-3548<br>N-12/TWCP-3548 |
| UPS | Uranium/ Plutonium Separation | Uranium-plutonium oxide mixtures | Aluminum nitrate<br>Nitric acid | Plutonium oxide | Uranium wash and filtrate solutions<br>Leaded gloves | *D008 | N-19/TWCP-3566 |
| US | Uranium Separation for Solid Solution Feed | Calcined solid solutions containing uranium or plutonium oxide | Nitric acid<br>Oxalic acid<br>Sodium oxalate | Plutonium oxide | Acidic uranium solutions<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| US2 | Uranium Separation for Non-Solid Solution Feed | Plutonium/uranium oxide | Nitric acid | Plutonium oxide | Acidic uranium solutions<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| VC | Variable CSMO Scrap Dissolution | Miscellaneous oxide scrap items | Nitric acid<br>Hydrofluoric acid | Plutonium nitrate solutions | Residues (< DL)<br>Leaded gloves | D006, D008, *D008 | N-81/TWCP-3568 |

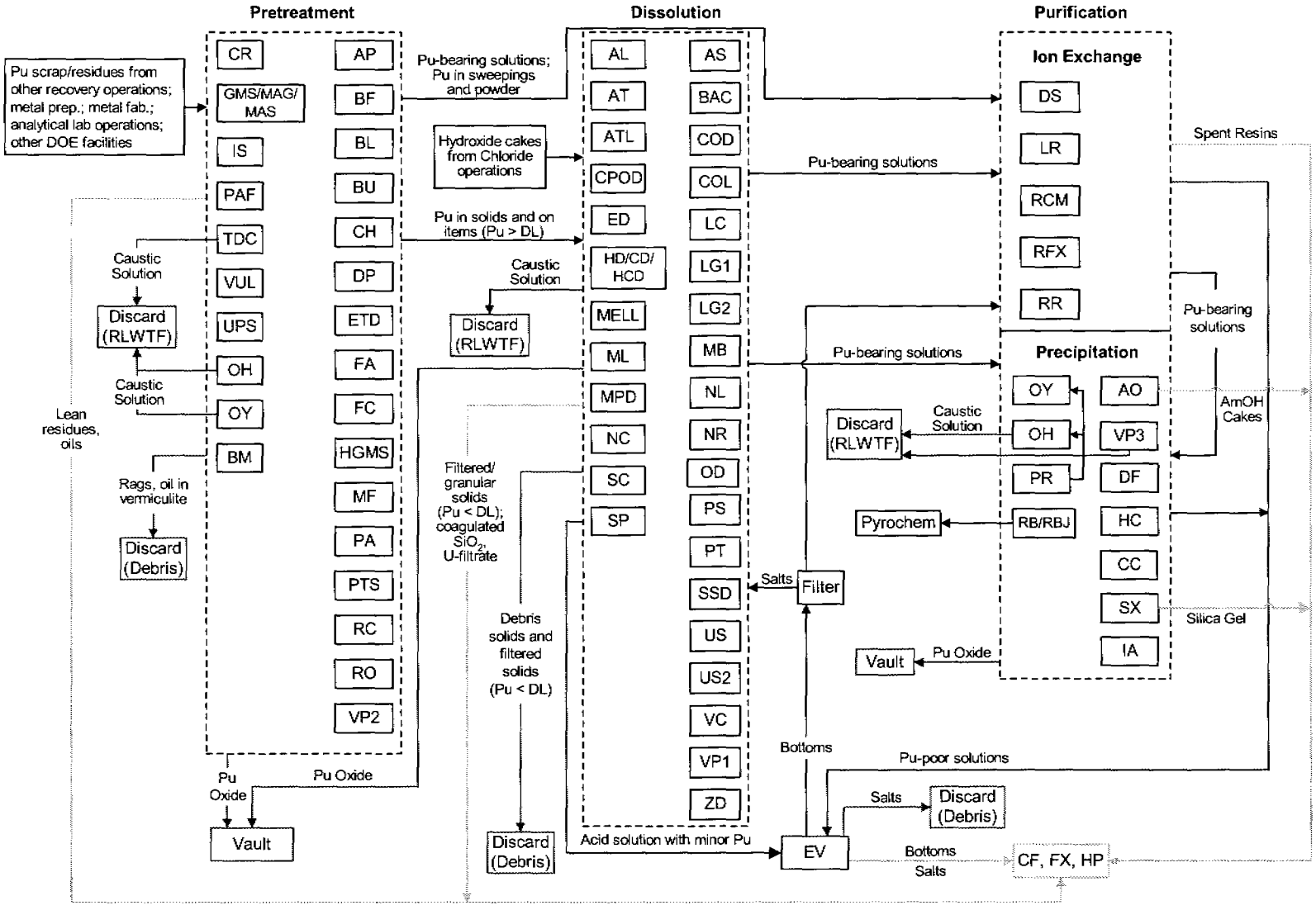
| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| VP1 | CSMO Scrap Dissolution | Plutonium/aluminum alloy | Nitric acid<br>Mercuric nitrate (catalyst)<br>Sodium hydroxide<br>Oxalic acid<br>Sodium oxalate | Plutonium oxide cakes<br>Plutonium oxalate solutions | Aluminum metal pieces<br>Aluminum nitrate sludge<br>Leaded gloves | *D008, D009 | N-81/TWCP-3568 |
| VP2 | Polycube Processing | Skins and fragments of polycubes | None (physical process) | Plutonium oxide | Polystyrene breakdown products (oils)<br>Vacuum pump oil<br>Leaded gloves | *D008 | N-81/TWCP-3568 |
| VP3 | Hydroxide Precipitation | Oxalate solutions | Sodium hydroxide | Plutonium hydroxide cakes | Caustic waste<br>Hydroxide cakes (< DL)<br>Leaded gloves | *D008, D009, D011 | N-81/TWCP-3568 |
| VUL | Vessel Unloading | Vessels | WD-40<br>Vacuum grease<br>Silicon adhesive<br>Pneumatic tool oil | Vessels<br>Residues | Metal and wire debris<br>Leaded gloves | D005, D008, *D008 | N-9/TWCP-3548 |
| ZD | Scrap Oxide Dissolution | Scrap and impure plutonium oxide | Nitric acid<br>Hydrofluoric acid | Plutonium oxide<br>Plutonium solutions | Leaded gloves | *D008 | N-81/TWCP-3568 |

[1]All P/S codes generate routine laboratory debris waste. For those P/S codes that generate only debris waste, this column is left blank. The debris waste may consist of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools.

[2]The EPA hazardous waste codes listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation) before becoming the final waste form to be shipped to the WIPP. The resulting treated waste stream in its final waste form is evaluated for hazardous waste constituents and assigned the applicable EPA hazardous waste codes at that time. All P/S codes have the potential to generate leaded gloves. See discussion in sections 3.6.1 and 4.2 for the disposition of these gloves.

*D008 due to leaded gloves

## GENERALIZED PROCESS STATUS DIAGRAM FOR NITRATE PROCESSES



## Decision/Discrepancies Resolution Documentation
### TA-55 Nitrate Operations

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| HRA | Waste codes D004 and D010 are also applicable to this P/S code | TWCP-5371 | Process report does not address D004 or D010 | Summary report | Discrepancy between report and interview | C—SME indicated add D004 and D010 to timeline pre 1984. After 1984, no D004 or D010 per SME. See attached meeting notes attached. |
| CP | Process report lists D006 as a HWN | Process report | Per Jim Foxx, does not indicate D006 | TWCP-3567 | Process report indicates D006 due to other information | B—SME provided analytical information. Submit data as a record. See attached meeting notes. |
| RO | Page change indicates that no RCRA organic were formed in the process and no RCRA metals were introduced into the process. | TWCP-4100 | AK process report lists D006, D008, and D040<br><br>These sources indicate toluene and styrene are possible contaminants | TWCP-3568/N-83, TWCP-3548/N-10, N-18. | Process report lists the HWN to be conservative | A—SME said to add these codes to be conservative. Possible contamination from pump oils used in process. See attached meeting notes. |
| AL | Per Jim Foxx, Ag (D011) not above regulatory limits | TWCP4167 | Process reports list D011 | Process Report | Reported D011 | B—cannot locate analytical data. Applying D011 to be conservative. See attached meeting notes. |

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| IS and CF | Indicates possibility of Cm-244 in ash produced by the IS operation. After 1988, interview suggests Cm-244 could be present in CF from evaporator bottoms | TWCP-5165 | Process report does not indicate Cm-244 | Process report | Process report does not indicate Cm-244. | B—SME wants Cm-244 added to report as it is important to NDA measurements. Submit email to records. See attached email. |
| All | TA-55 waste was defense related based on other interviews and budget | TWCP-614 | Commingling of defense and non-defense, segregation after 1997 and 1998. Estimated to be 80/20 defense/non-defense for Pu.-239 and 50/50 for Pu-238 processing | TWCP—887, TWCP-4162 | Summary report states commingling and segregation timeline. | C—Memo dated 8/27/98 says segregation begun. See attached meeting notes. TWCP-4167 |

Sandy Wander — AK Investigator — Sandy Wander — 2/25/02
Evaluator (Print Name) — Title — Signature — Date

P Rogers — Pamela Rogers — 2/26/02
SPM Review (Print Name) — Signature — Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other (Specify)]



Source: TWCP-07910

# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-005 New Rev/IC: R.2/IC1

Preparer: Sandy Wander

Document Title:
Process Acceptable Knowledge Report for Nitrate Operations at TA-55

Blank entries are Not Applicable items.

☒ Procedure number verified
☒ Procedu
☒ Procedu AK-005R.2/I Effective date 3/21/02 – Posted to web on 3/27/02
☒ Paginat Pending response from CBFO
☒ Docum Per Jim Bailey
☒ Attachn RMDC
☐ Hazard 3/27/02
☒ Effective/Review Date/LAUR# on cover page
☐ Copy of final to Training/Signature Copies

☒ Signatures and Dates typed on cover page
☒ Revision History table reflect changes and ective date
☒ ms have been marked as SAMPLE, if applicable
☒ ms extracted for Web publishing
☒ ctronic files archived
☒ kette Prepared for Document Control
☒ —
☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 3/27/2002 Signed Initials: JJS

## Step 8: Document Control - Tracking and Web Conversion

Date Received: 3/27/02

☑ Verify Signatures
☑ Verify Effective Date cover/history
☑ Verify IC added to document (if applicable)
☑ Log into Database/Make Assignment
☑ Print Receipts/Cover sheets

☑ Copy document: 2
☑ Control Stations Updated - Date: 3/27/02
☑ Master Index Updated - Date: 3/27/02
☒ NA Archive old revision (Record)

☑ Capture Document: __ Word ✓ PDF
☑ Forms: __ Yes ✓ No
☑ Transfer to Web Server
☑ Quality check to Original
☑ Verify Signatures ✓ Signature Dates ✓
☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date

☑ Web Page TOC: ✓ No/Rev ✓ Effective Date ✓ LAUR ✓ Title __ Link ✓ Test
☑ On-line test: ✓ Open Doc
☑ Electronic Notification: ✓ Sent ✓ Printed
☒ NA CBFO: __ Electronic Copy __ Printed
☐ Change Control Notification ___ Sent ___ Printed ✓ NA

Date Completed: 3/27/02 Signed Initials: JAK

# TWCP/WRR
# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☐ Revision ☒ Interim Change

Date Received: 3/21/2002

Current Rev/IC: R.2

Document ID: TWCP-AK-2.1-005

Rev/IC: R.2/IC1

Document Title:

Process Acceptable Knowledge Report for Nitrate Operations at TA-55

Preparer: Sandy Wander Date to DP Team: 3/21/2002

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

03/27/02: Prepared document for transmittal to Document Control

## Step 3: Preliminary Review Cycle

☒ IC - Not Applicable (enter action in comments section)

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle

☒ IC - Not Applicable (enter action in comments section)

| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

## Step 5: Final Signature Cycle

☒ IC - Not Applicable (enter action in comments section)

| Signature | Position | Sent Out | Returned | Comments |
|---|---|---|---|---|
| | | | | |
| | | | | |
| | | | | |

Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
| Change Control | G M Polley | 3/21/2002 | 3/25/2002 | NA |
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## TWCP-AK-2.1-005,R.2/IC1

**Effective Date** 3-21-2002 **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR NITRATE OPERATIONS AT TA-55 (LA-UR-02-1715)

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
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From: Patricia G Patton <pgp@lanl.gov>
Subject: Procedure Notification
Cc: fabi,bailey, lpc
Bcc:
Attached:

The following are revised AK reports.

Effective Date: 3/21/02

**TWCP-AK-2.1-004,R.2/IC1 -** Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55 (LA-UR-02-1714)

**TWCP-AK-2.1-005,R.2/IC1 -** Process Acceptable Knowledge Report for Nitrate Operations at TA-55 (LA-UR-02-1715)

**TWCP-AK-2.1-006,R.2/IC1** - Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55 (LA-UR-02-1713)

**TWCP-AK-2.1-007,R.2/IC1** - Process Acceptable Knowledge Report for Special Processing at TA-55 (LA-UR-02-1712)

**TWCP-AK-2.1-009,R.0/IC1** - Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55 (LA-UR-02-1709)

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

***Patricia G. Patton***

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# TWCP/WRR
# Document Modification/Review Cycle

## Step 7: Preparation for Document Control

☒ Revision ☐ Interim Change
Document ID: TWCP-AK-2.1-005 New Rev/IC: R.2
Preparer: John Musgrave
Document Title:
Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 5/17/2001 Signed Initials: JJS

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Reconciled Comments Returned: .....
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Preparer Review of Modifications: .....
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| J. Fabryka-Martin | Technical | 5/7/2001 | 5/7/2001 | Independent Technical Reviewer/Editor |
| M. Lin | SPM | 5/12/2001 | 5/12/2001 | Site Project Manager |
| S. Wander | QA | 5/14/2001 | 5/14/2001 | Waste Certification Official |
| M. Gavett | QA | 5/14/2001 | 5/14/2001 | Site Project QA Officer |
| C. Foxx | Fac Mgr | 5/7/2001 | 5/7/2001 | Facility Representative |
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## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☒ Revision ☐ Interim Change

Date Received: 4/1/2001

Current Rev/IC: R.1

Document ID: TWCP-AK-2.1-005

Rev/IC: R.2

Document Title:

Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55

Preparer: John Musgrave Date to DP Team: 4/1/2001

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

04/01/01 through 05/16/01: Incorporate changes from author, reviewers, and auditors

## Step 3: Preliminary Review Cycle

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Cc: fl@lanl.gov, manmtz@lanl.gov
Bcc:
Attached:

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**TWCP-AK-2.1-002,R.2 - Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55**

**TWCP-AK-2.1-003,R.2 - Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55**

**TWCP-AK-2.1-004,R.2 - Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55**

**TWCP-AK-2.1-005,R.2 - Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55**

To: wipp.notify@wipp.carlsbad.nm.us
From: Louise Garcia <louise@lanl.gov>
Subject: [Procedure]
Cc: Tammy.Bowden@wipp.carlsbad.nm.us
Bcc: fl@lanl.gov
Attached: K:\twcp\RMDC\AK\TWCP-AK-2.1-002\TWCP-AK-2^1-002R2.pdf; K:\twcp\RMDC\AK\TWCP-AK-2.1-003\TWCP-AK-2^1-003R2.pdf; K:\twcp\RMDC\AK\TWCP-AK-2.1-004\TWCP-AK-2^1-004R2.pdf; K:\twcp\RMDC\AK\TWCP-AK-2.1-005\TWCP-AK-2^1-005R2.pdf;

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**TWCP-AK-2.1-002,R.2 - Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55**

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**TWCP-AK-2.1-004,R.2 - Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55**

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**Document Title** PROCESS ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR NITRATE OPERATIONS AT TA-55

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# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-005,R.2

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, HRA, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

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| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| ED | Cascade Dissolver | Nitrate Operations | 3.5.2, Att. 4 |
| ETD | Experimental Thermal Decomposition | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 |
| EV | Evaporator | Nitrate Operations | 3.5.4, Att. 4 |
| FA | Americium Processing | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 |
| FC | Canning | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 |
| FX | Cement to Drum | Nitrate Operations | 3.5.6, Att. 4 |
| GMS | Open gradient Magnetic Separation | Nitrate Operations | 3.5.1, Att. 4 |
| HC | Calcination | Nitrate Operations | 3.5.3, 3.5.6, Att. 4 |
| HCD | Hydroxide Cake Dissolution | Nitrate Operations | 3.5.2, Att. 4 |
| HD | Hydroxide Cake Dissolution | Nitrate Operations | 3.5.2, Att. 4 |
| HGMS | High Gradient Magnetic Separation | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 |
| HP | Cement Fixation | Nitrate Operations | 3.5.5, Att. 4 |
| IA | Impure Americium Holding for Discard | Nitrate Operations | 3.5.5, 3.5.6, Att. 4 |
| IB | Matrix Study of Pyrochemical Salts | Miscellaneous Operations | 3.5.6, Att. 4 |
| IS | Incinerator | Nitrate Operations | 3.5.1, Att. 4 |
| LC | Uranium/plutonium Processing | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 |
| LG1 | Noncombustible Leach | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 |
| LG2 | Hydroxide Cake Dissolution | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 |
| LR | Ion Exchange | Nitrate Operations | 3.5.3, Att. 4 |
| MAG | Magnetic Separation | Nitrate Operations | 3.5.1, Att. 4 |
| MAS | RD&D Experimental Processes | Nitrate Operations | 3.5.1, Att. 4 |
| MB | Nitric Dissolution of Molten Salts | Chloride Operations<br>Nitrate Operations | 3.5.2, Att. 4<br>3.5.2, 3.5.6, Att. 4 |
| MELL | Mediated Electro-Oxidation of LLW | Nitrate Operations | 3.5.2, Att. 4 |
| MF | Metals Furnace | Nitrate Operations | 3.5.1, 3.5.6, Att. 4 |
| ML | Non Pu Metal Leach | Nitrate Operations | 3.5.2, Att. 4 |
| MPD | Cascade Dissolver | Nitrate Operations | 3.5.2, Att. 4 |
| NC | Noncombustible Leach | Nitrate Operations | 3.5.2, Att. 4 |
| NL | Noncombustible Leach | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 |
| NR | Nitrate Recovery | Nitrate Operations | 3.5.2, 3.5.6, Att. 4 |
| OD | Oxide Dissolution | Nitrate Operations | 3.5.2, Att. 4 |

present in the process wastes, based on subject matter expert (SME) interviews and any ~~available data~~ relevant record

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) will be contained in these records, and will not be included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK summary report is part of a set of closely related reports about TRU-waste generating activities at TA-55. For convenience in organizing AK for plutonium processing at this facility, the processes were categorized into six arbitrary operational areas. The multiple processes in each area are then described in detail in the following six process AK reports for plutonium:

- *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* (TWCP-AK-2.1-002)
- *Process Acceptable Knowledge Summary Report for Metal Operation Processes at TA-55* (TWCP-AK-2.1-003)
- *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* (TWCP-AK-2.1-004)
- *Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55* (TWCP-AK-2.1-005) (this report)
- *Process Acceptable Knowledge Summary Report for Pyrochemical Processes at TA-55* (TWCP-AK-2.1-006)
- *Process Acceptable Knowledge Summary Report for Special Processing at TA-55* (TWCP-AK-2.1-007)

Each process AK report contains information on multiple individual processes that are assigned unique identifiers called process/status (P/S) codes. For example, nitrate operations include over 80 individual processes that are each assigned a P/S code, as listed on the cover page of this report. The search and compilation of AK information was based on P/S code because that is the most detailed level of process information generally recorded in waste generation records. The process AK reports frequently cross-reference one another because P/S codes in one operational area often provide the material feed for P/S codes in another area. An index of P/S codes cited in this process AK report follows the list of acronyms; this index lists process descriptions and the primary process AK report in which that P/S code is discussed.

group, waste matrix code, and potential for the presence of hazardous constituents. In the Sampling Plan, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- ~~First~~ by radioisotope content (Pu-238 or Pu-239 material type)
- ~~Then~~ by material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- ~~Then~~ by hazardous waste status (mixed, non-mixed, or special case waste streams)

## 3.3 Waste Physical Form and Content Description

Wastes generated during nitrate operations are primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. General debris waste categories from nitrate operations include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles
- Metal debris (for example, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from nitrate operations. The cemented waste includes cemented organics and cemented inorganics, including emulsified oils.

## 3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1979, when nitrate operations first began at TA-55, to the present. Process wastes from nitrate operations have different associated EPA hazardous waste numbers (HWNs) depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding RCRA codes are shown graphically in Attachment 3, Time Lines.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

## 3.5 Waste Generation Processes

The following subsections describe the generation of waste by nitrate operations, as well as product and waste outputs to other processes or operations.

thiocyanate, and silver nitrate (CPOD) (TWCP-3548/N-1 and TWCP-3566/N-21). The electrochemical cell used in this process relied on silver acting as a catalyst for the dissolution of plutonium. Waste from this process was considered suspect hazardous for the presence of silver and was assigned the EPA HWN D011. This process was replaced in 1994 by a similar electrochemical process (MELL) that used cobalt nitrate or cerium nitrate in place of silver nitrate to reduce the generation of hazardous and mixed waste at TA-55 (TWCP-3548/N-1 and TWCP-3566/N-33).

Two dissolution processes were designed to remove excess silica from either solid residues during dissolution or from plutonium-bearing solutions after dissolution (TWCP-3567/N-34 and N-35). In both these processes, silica was removed from solutions prior to sending them to purification. One process involved the following steps: adjusting the acidity of the feed solution using nitric acid; distilling to concentrate the solution; adjusting the plutonium valence (to +4) with hydrogen peroxide; heating the solution until the hydrogen peroxide is destroyed; and filtering the solution to remove the silica solids (TWCP-3567/N-34). The solution from this process went to anion exchange purification process. The second silica-removal process used a hydrofluorinator with a potassium hydroxide scrubber solution (TWCP-3567/N-35). The solution from this process was sent to the TA-50-1 RLWTF via the caustic waste line if the plutonium content was below the DL or to the lean residue ion exchange (LR) purification process if the content was above the DL. The filtered silica solids from both processes were re-dissolved if plutonium concentrations were above the DL or disposed to cement fixation (CF) if concentrations were below the DL.

Uranium-plutonium oxide mixtures were leached using nitric acid to preferentially dissolve the uranium (UPS) (TWCP-3566/N-19). Aluminum nitrate was added to the solution to complex any fluoride ion that might be present. The uranium-bearing filtrate was disposed to cement fixation (CF). The plutonium-bearing solids were sent to dissolution (ED, MPD, or SP) and then to either an anion-exchange process or the oxalate-precipitation process (OY) for purification.

A caustic (hydroxide) leach process has been used to pretreat electro-refining furnace scrapings from the Rocky Flats Plant and other residues high in chlorides. Chlorides were removed using sodium hydroxide, and the treated residues were then dissolved in nitric and hydrofluoric acid (TWCP-3566/N-26, N-26A, and N-30E). The filtered solids continued through the dissolution process. If the plutonium content in the solution was above the DL, the solution was refiltered (TWCP-3566/N-26). If the plutonium content was below the DL, the caustic solution was disposed to the TA-50-1 RLWTF (TWCP-3566/N-26A).

3.5.3 Purification and Oxide Conversion (P/S codes AO, AP, CC, CH, DF, DS, FA, FC, HC, LR, OH, OY, PR, RB, RBJ, RCM, RFX, RR, SX, and VP3)

A peroxide precipitation process (PR) was used to achieve excellent separation of plutonium from the cationic impurities calcium, chromium, magnesium, cesium, cobalt, and aluminum, as well as americium (TWCP-3567/N-52). Peroxide was added to the oxide dissolution filtrate feed material to convert the plutonium to valence state (+4). Additional peroxide resulted in the precipitation of $[PuO_2]^{+2}$, then $[PuO_4]^{+4}$, and finally $Pu_2O_7$. The resulting peroxide filter cake was dissolved in nitric acid and the solution was sent to oxalate precipitation (OY). The filtrate solution from the peroxide precipitation was sent to hydroxide precipitation (OH), also known as the peroxide kill process.

Plutonium-bearing solutions generated in the dissolution step are directed to purification for plutonium recovery (TWCP-3548/N-1). Purification consists of both ion exchange and precipitation processes. There are three primary ion exchange processes based on the concentration of plutonium in solution: rich feed (RCM), dissolver solutions (DS), and lean residue (LR). After ion exchange, plutonium-bearing solutions are directed to oxide precipitation and then to an oxidation process. The oxidation process generates plutonium oxide, a stable form of plutonium suitable for storage or further processing into plutonium metal.

The ion exchange processes use resin-filled columns to collect plutonium (P/S codes DS, RCM, LR, RR, RFX) (TWCP-3548/N-1; TWCP-3567/N-41, N-42, N-43, N-44, N-46, N-47, and N-53). The pH of incoming solutions is adjusted with nitric acid and the plutonium is stabilized by changing the plutonium valence state to (+4) using hydrogen peroxide. Other chemicals used to adjust acidity or to "condition" incoming solutions to address the presence of fluoride, silica, metal impurities, or plutonium (+6) include: aluminum nitrate, ferrous ammonium sulfate, hydrogen peroxide, sodium hydroxide, sodium nitrite, sulfuric acid, and urea. Certain intermediate solutions used to condition the ion exchange feed, especially caustic solutions used to "kill" the peroxide, are filtered and then disposed to the TA-50-1 RLWTF if they meet the TA-50-1 WAC.

If solutions high in americium are "conditioned" with hydrogen peroxide, an americium hydroxide precipitate forms when the solutions are dripped into sodium hydroxide to "kill" the peroxide (TWCP-3567/N-55). This precipitate is dissolved using nitric acid, sent through an ion exchange column, and then sent on to the oxalate precipitation process to recover the americium and convert it to americium oxide (P/S codes AO, AP, FA, and SX).

exchange resins are disposed to cement fixation (CF) (TWCP-3567/N-41 through N-53).

Chemicals used in the dissolution steps are listed in Table 5 in Section 3.5.3. Chemicals used in these steps that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are (1) hydrofluoric, nitric, and oxalic acid; (2) sodium hydroxide, and (3) hydrogen peroxide (an oxidizer)(TWCP-3567/N-41 through N-47, N-50, N-51, N-53, N-54, and N-55; TWCP-3568/N-81). EPA HWNs D001 and D002 do not apply to the solid wastes because of the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes. Any excess hydrogen peroxide was reacted with base, sodium hydroxide.

However, EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the material feed (see Table 1 in Section 3.6) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (discussed in section 4.2). For example, RCRA-regulated hazardous constituents introduced to P/S codes DS and LR with the hydroxide filtrate cakes include cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). Similarly, plutonium oxide from the vault may have been roasted and blended in P/S codes RB and RBJ to provide a more homogeneous feed for the metal preparation line (P/S code MP); these oxides may have contained cadmium (D006), chromium (D007), and lead (D008) (TWCP-3567/N-56, N-57, N-57A, and N-57B). Leaded gloves were discarded as described in section 3.6.1.

**NOTE:** For some of these P/S codes, no formal procedures could be found and the necessary information was extracted from process flow diagrams and SME input. More detailed descriptions of such P/S codes that are included in this purification section are provided in section 3.5.6, as follows: P/S codes AO, AP, CC, CH, DF, FA, FC, HC, and VP3.

### 3.5.4 Evaporator (P/S code EV)

Plutonium-poor ion exchange effluents and oxalate precipitation filtrates are sent to the evaporators to re-concentrate plutonium, if possible, and reduce the volume of disposed waste (TWCP-3548/N-1, TWCP-3568/N-61 through N-65). General facility maintenance solutions (e.g., wet vacuum water, mop water, chiller water) are also sent to the evaporator if they do not meet the TA-50-1 WAC (TWCP-3568/N-76). The wet vacuum water and chilled circulating water are contaminated with nitric acid, hydrochloric acid, or caustic solutions having the same characteristics as those sent to the TA-50-1 RLWTF, only richer in

Solvents
~~liquids~~ are emulsified by the addition of a surfactant before they are mixed with the neutralized evaporator bottom solutions (TWCP-3568/N-74). The miscellaneous solutions were treated in a manner much like the evaporator bottoms solution.

The discard of impure americium oxide from P/S code AO (section 3.5.6.1) was mostly accomplished by stirring it into a one-gallon can of evaporator bottom cement paste (up to 140 g americium/can). When all cement was being stirred in one-gallon cans, the americium-containing can was placed in the center of the middle layer of cans in a drum to provide maximum shielding. When storage of the impure americium hydroxide cakes in P/S code AO became a radiation exposure problem, a significant portion of the stored material was placed in P/S code IA until the material could be immobilized in cement for disposal. P/S code IA was active from April 1986 to December 1988. It did not involve any type of processing and, therefore, did not generate any waste.

In July 1988, the cementation process was changed from stirring the cement in one-gallon cans to stirring cement monoliths in 55-gallon drums attached to the glovebox (under P/S code CF). Although P/S code HP is still open, it has not been used since July 1988.

**NOTE:** The strategy proposed for shielding americium-containing cans, after the operation converted to 55-gallon drum monoliths, was to push the one-gallon americium-containing can down into the wet cement paste in the drum. However, the SME did not believe that it was ever attempted.

P/S code CF began in August 1988 and continues to the present time. Solvents, Wastes collected for disposal in 55-gallon drums include aqueous and organic ~~liquids~~ from analytical chemistry; evaporator bottoms and evaporator salts; fine particulate materials, such as salts filtered from solutions, leached filter paper residues, and ash; oils, organic petroleum-Solvents based ~~liquids~~, and spent ion exchange resins. As was the case for P/S code HP, the primary feed to this process has been the evaporator bottoms solutions. In 1996, the cementation process again converted from gypsum cement powder (last used in June 1996) back to Portland cement powder (reuse began in July 1996). A driver for this change was the finding that the gypsum-cemented waste could not meet the Toxicity Characteristic Leaching Procedure (TCLP) limits for chromium (TWCP-4233). In addition, tests showed that this waste form barely met the TCLP for cadmium and lead. In contrast, Portland cement was easily able to retain these three problem metals during the leaching test.

Chemicals used in the cement fixation step under P/S codes CF and HP include: cement accelerator, gypsum cement, nitric acid (pH

adjustment), organic ~~liquid~~ solvent emulsifier (which acts as a surfactant), Portland cement, silicon defoamer, sodium citrate retarder, and sodium hydroxide (pH adjustment) (TWCP-3568/N-69, N-71, N-72, N-74). Phthalate buffer solution for pH 4 and phosphate buffer solution for pH 7 were used in P/S code CF only. EPA HWNs D001 and D002 do not apply to the solid wastes from cement fixation as a result of these chemicals because there is no free liquid in these wastes.

Although RCRA-regulated organics and metals were not used in either of the two cement fixation processes, regulated chemicals were present in the materials sent to be immobilized in cement. Therefore, the waste streams generated by these processes may contain RCRA-regulated solvents and metals above the regulatory limits.

- Analysis of evaporator bottoms at TA-55 between 1994 and 1998 and statistical evaluation of analytical results using control charts have also shown that chromium (D007), lead (D008) and mercury (D009) are above the regulatory limit for this waste (TWCP-3568/N-66).

- Hydroxide cakes from the chloride operations, which started in 1982 (TWCP-3567/N-40), are introduced to the nitrate operations in the dissolution step (TWCP-3567/N-39). Therefore, RCRA-regulated hazardous constituents associated with the feed materials from the chloride operations as well as those derived from other nitrate dissolution processes may carry through to cement fixation (TWCP-3567/N-38). The hazardous constituents contained in the hydroxide cakes from chloride operations include cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). The use of silver in chloride operations ended at the end of 1993. After 1993, heavy metal analyses have been conducted on the solutions, with chromium, lead, cadmium, and mercury being detected at levels above the regulatory levels at times.

- Gypsum cement was found to leach heavy metals above regulatory levels, but the Portland cement does not (N-66/TWCP-3568). Thus, the chromium, lead and mercury are no longer considered hazardous after 1995. In addition, arsenic, barium, cadmium, selenium and silver concentrations were all below the regulatory threshold limits for these metals.

- The presence of RCRA constituents in waste analytical chemistry solutions was noted in the data packages beginning in 1990. The RCRA-regulated organic chemicals found in these solutions included carbon tetrachloride (D019), n-butanol (F003), acetone (F003), methanol (F003), tetrachloroethylene (D039, F003), xylene (F003),

one of the plutonium ion exchange columns for recovery of the plutonium.

RCRA-regulated organic solvents and metals were not used in this process and were not present in the feed material from P/S code SX; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. Chemicals, such as hydroxylamine nitrate, were used to adjust the valence of the plutonium. The waste stream generated by this process consisted of the usual glovebox waste items, such as glass vessels, HEPA filters, and rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.3 Anode Heel Dissolution (AS)

This process was performed from 1980 to November 1988. The plutonium oxide generated as the result of burning anode heels in P/S code BU was dissolved in a nitric acid/hydrofluoric acid mixture or in calcium fluoride, and filtered to remove the nondissolving residues. These residues were dried and collected and sent after assay to P/S code SP for more rigorous dissolution. The filtrate was sent to the rich residue ion exchange column (RR) for purification.

Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium ~~(D005)~~, D006 chromium (D007), lead (D008), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.4 Bacterial Decomposition of Cellulose Items (BAC)

This process was performed from mid-1995 to mid-1996 and was an alternative to thermal decomposition. The process involved the decomposition of cellulose rags using a living organism to digest the cellulose to glucose and other byproducts. Cheesecloth rags, bacteria, and water were added to a flask and allowed to sit while the bacteria digested the rags. The resulting solution was sent to the lean residue ion exchange (LR).

RCRA-regulated organics and metals were not used in this process and were not introduced by the feed materials; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process.

3.5.6.5 P/S code BF

Activities under this P/S code were nearly identical to those under P/S code BU because the feed was also anode heel metal. Heels were burned under P/S code BF between September 1985 and November 1986 came from the electrorefining step (P/S codes ER or SS) at TA-55. Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium (D006), chromium (D006), lead (D007), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.6 Blending (BL)

This process was performed from 1979 to May 1988. Various lots of plutonium oxide in the vault or in-house P/S codes were fed into this process. Each container of oxide was weighed, opened, and screened to remove oversized material. The oversized material was ground with a mortar and pestle and rescreened. The individual contents were combined and blended in a V-blender to make a homogeneous lot of feed oxide that was sent as feed to the roasting and blending process (RB).

This is a physical process in which no additional materials or chemicals are used. RCRA-regulated organics and metals were not used in the process and were not introduced with the feed material; therefore, there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. The waste generated consisted of typical glovebox waste items, such as HEPA filters, glass, ceramic boats and plates, cleaning rags, brushes, metal containers and equipment, and plastics. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.7 Button Burning (BU)

This process was performed from approximately 1979 to 1986. Metal buttons were received from offsite DOE facilities (usually Hanford, but possibly Rocky Flats as well). The metal buttons were burned in a furnace at about 600°C. The oxide produced from six buttons was combined and blended to make up a uniform feed lot for the anode heel dissolution process (AS).

Although RCRA-regulated organic solvents and metals were not used in this process, residual RCRA-regulated heavy metals present in the electrorefining step were concentrated in the anode heels. Therefore, any RCRA-regulated metals in the anode heel feed could also be present in the waste generated by this process. These are cadmium (D005), chromium (D006), lead (D007), and silver (D011). The waste generated by this process includes glassware, plastic filter boats, cleaning rags, HEPA filters, metal cans, and brushes. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.8 Calcination (CC)

This process was performed from 1979 to November 1988. Plutonium oxalate cakes from the oxalate precipitation process (OY) were calcined by heating in air in a furnace to form pure plutonium oxide. The oxide became feed for the oxide reduction process.

This was a physical process, not involving any chemical reagents. RCRA-regulated organics and metals were not used in this process and were not introduced by the feed materials. The oxalate cakes were of high purity. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals. The waste generated from this process consists of the usual glovebox waste items plus metal tools, containers, and equipment; ceramic furnace elements; rags; and brushes.

3.5.6.9 Characterization (CH)

This process was performed from 1979 to February 1989 and received samples of blended lots of oxide from the blending process (BL). Portions of the samples were weighed out for four analyses to demonstrate that the oxide powders met the acceptance criteria for preparation of driver fuel for the Fast

Flux Test Facility (FFTF). The Loss on Ignition Analysis involved heating the powder and measuring the weight loss from driving off adsorbed water and gases. The Surface Area Analysis involved absorption of nitrogen gas on the oxide at liquid nitrogen temperatures. The Particle Size Analysis measured the settling rate of oxide particles dispersed in a viscous, water-soluble liquid using the absorption of X-rays by the particles. The slurry was discarded to cement fixation (HP). Finally, some of the powder was pressed into pellets and sintered at 160 degrees C before measuring and weighing them for density. The pellets and oxide residues were packaged separately and sent to the vault as archives and eventually recycled. Oxide powders from other sources were also partially characterized many times. The process was also used to make water-dampened plutonium oxide pucks for a criticality experiment and to test the reactivity of calcium nodules from pyrochemical operations.

RCRA-regulated organics and metals were not used in this process and were not introduced by the feed materials. The oxide samples were high-purity materials. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals. The waste generated by this process included the usual glovebox waste of HEPA filters, window glass and glass containers, metal containers and tools, brushes, and cleaning rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.10 Chlorinated Oxide Dissolution (COD)

This process was performed from August 31, 1988 to July 1991. The front-end of this process looked identical to the chlorinated oxide leach process (COL). Chloride pyrochemical salts were dissolved in sodium hydroxide solution and filtered. The filtrate was discarded into the caustic waste line to the TA-50-1 RLWTF or immobilized in cement (CF). The dried plutonium oxide cake was dissolved in a nitric acid-hydrofluoric acid mixture as part of this process, or sent to a cascade dissolver (ED). The solution from the acid dissolution step was filtered and the solids were returned to the dissolution step. The solution volume was reduced by distillation. The distillate was processed in one of the ion exchange columns. The concentrated solution was refiltered and all of the filter residues were sent to a cascade dissolver (ED) or to the filter residues dissolution process

(SP). The filtrate was sent to one of the ion exchange columns for recovery.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials. The pyrochemical salts should be of high purity. Therefore, the waste generated from this process would not contain any RCRA-regulated organics or metals.

3.5.6.11 Chlorinated Oxide Leach (COL)

This process was performed from June 13, 1989 to June 1991. Chlorinated oxides or plutonium oxide contained in chloride-based pyrochemical salts from Rocky Flats were subjected to leaching with sodium hydroxide. The chloride salts would dissolve in the solution that would then be filtered. If the filtrate met the TA-50-1 WAC, it would be discarded into the process caustic waste line to the TA-50-1 RLWTF. If not, it would be discarded to cement fixation (CF). The cake containing the plutonium oxide would be dried and sent to the cascade dissolver (ED) or to chlorinated oxide dissolution (COD).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials. RCRA-regulated metals also were not used in this process. However, the Rocky Flats salts that fed this process would contain any barium present in their electrorefining salts. Barium is not expected to be present above the regulatory limits in the waste generated by this process; however, without analytical results or other acceptable information to support this, the EPA HWN for barium (D005) is assigned to the liquid waste sent to cement fixation (CF) (TWCP-3568/N-83). The waste generated by this process consists of the usual glovebox waste, such as glassware, plastic filter boats and tubing, and rags. Leaded gloves were disposed of as described in Section 3.6.1.

3.5.6.12 DS Furnace and Oxide Prep (DF)

This process was performed from 1979 to April 1990. The wet plutonium oxalate cake from the ion exchange process (DS) was placed in a metal can and heated in air in a furnace to dry the cake and then decompose the oxalate to an oxide product. The oxide product was returned to the ion exchange process (DS) prior to being sent to the vault.

mixture was filtered to separate insoluble residues, which were dried and discarded as solid TRU waste. The plutonium nitrate-containing filtrate was sent to P/S code LR for purification. This filtrate may have contained chromium, cadmium, and/or lead that was leached out from the stainless steel, shielding, or other metal feed materials (TWCP-3568/N-84).

RCRA-regulated organics were not used in this process and were not introduced with the feed materials (TWCP-3568/N-81). Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. The metal feed materials generally consisted of steel, stainless steel, aluminum, and copper. Any RCRA-regulated metals leached from these feed materials would be in the filtrate sent to P/S code LR. However, the leached materials may still contain concentrations of cadmium and/or lead that may leach out above the regulatory limit, resulting in the debris waste requiring the applicable EPA HWNs (D006, D008) (TWCP-3568/N-84). The chromium in stainless steel does not leach out above the regulatory limit. This process generated the usual glovebox waste, plus metal, glass, plastic, plastic filter boats, filter papers, glassware, rags, and brushes (TWCP-3568/N-81).

3.5.6.24 Hydroxide Cake Dissolution (LG2)

This process was active from October 1982 to December 1985. Hydroxide cakes from P/S codes CS and VP3 were dissolved in nitric acid and the solution was filtered. Any residue or filter cake was sent back to the dissolution step. The filtrate containing the plutonium nitrate was sent to P/S code LR for purification.

RCRA-regulated metals and organics were not used in this process; however, during the 1985 time period, certain metals could have been introduced with P/S code CS (from chloride operations), and mercury could have been introduced with the P/S code VP3 feed material. These metals would be found in the nitric acid filtrate, which fed into P/S code LR. Therefore, there would not be any RCRA-regulated solvents in the waste streams generated by this process. However, there may have been cadmium (D005), chromium (D006), mercury (D009), or silver (D011) in the feed material from 1984 through December 1985. This process generated the usual glovebox waste, plus glassware, metal tools and

3.5.6.32 RD&D Pretreatment Study (PTS)

This process was active from January 4, 1990 to February 1992. A variety of residue matrices were pulled into P/S code PTS to be characterized for impurities, state of division, and even pretreatment (milling, grinding, etc.) to achieve a desired state for use in fluoride volatility studies in P/S code CK. Most of the effort was expended on ash from LANL and Rocky Flats.

RCRA-regulated organics and metals were not used in this process, but the ash feed would have been high in heavy metals such that this P/S code would generate waste potentially contaminated with non-volatile heavy metals: barium (D004), cadmium (D005), chromium (D006), lead (D008), and silver (D011). Arsenic, mercury and selenium would not be present because they would have been volatilized. This process generated the typical glovebox waste streams, plus metal tools, containers, and equipment; plastic bags; ceramic furnace elements; ceramic boats; rags; and brushes.

3.5.6.33 Rotary Calciner (RC)

This process has been active from 1985 to the present. Ash from P/S codes IS and TDC and other carbon-containing ash and graphite crucibles are calcined in an oxygen or air stream. This removes organic carbon. The calcined ash is blended and sent to recovery. This process is also used to calcine uranium oxides before uranium separation.

RCRA-regulated organics and metals were not used in this process, but the ash feed would have been high in heavy metals such that this P/S code would generate waste potentially contaminated with non-volatile heavy metals: barium (D004), cadmium (D005), chromium (D006), lead (D008), and silver (D011). Arsenic, mercury and selenium would not be present because they would have been volatilized. This process generated the typical glovebox waste streams, plus metal tools, containers, and equipment; plastic bags; ceramic furnace elements; ceramic boats; rags; and brushes.

3.5.6.34 Oil Recovery (RO)

This process was active from 1979 to March 1989. Vacuum pump oils and other contaminated organics from various

| Feed Materials | Potential Presence of RCRA-Regulated Substances | P/S Codes in Nitrate Operations |
|---|---|---|
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters, Hanford [Hanford materials]) | Typically contaminated with RCRA-regulated heavy metals Ag, Cd, Hg, Pb and possibly Cr (D006, D008, D009, D011, and D007) get in order | ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, HRA, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD |
| MSE salts | Typically fairly pure, suspect contaminated with barium but no other RCRA substances present | MB, PS |
| Pu metal or metal alloy, Hanford (Hanford materials) | High purity, no RCRA-regulated substances, unless noted otherwise | ATL, BM, BU, MF, PAF, VP1 |
| Pu oxalates | High purity, no RCRA-regulated substances, unless noted otherwise | CC, DF, HC |
| Pu oxides, Hanford (Hanford materials) | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008)<br>High purity oxides and material from Hanford from P/S codes CA and MA, and from the vault | ATL, BL, CH, CPOD, DP, ED, FC, HRA, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2 |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than Ba are present | COD, COL, MB |

**Table 2. P/S Codes with Radionuclides Other Than Pu in Feed Materials**

| P/S code in nitrate operations | Radionuclide in feed material |
|---|---|
| AO, AP, FA, PR | Am-241 |
| ATL | Np-237 |
| CF | Am-341, U, Th-232 |
| HP, IA, OH, SX | Am-241 |
| LC, RC, UPS, US | U |
| PT | Th-232 |

No K or P listings apply to solid wastes generated from any of the P/S codes in this report because no K-listed or P-listed chemicals were present in the feed materials, chemicals or equipment used in these processes. All drums destined for WIPP will undergo headspace gas sampling and analysis to confirm the presence of listed solvents.

4.2 Toxicity Listings

D008 (lead) applies to all P/S codes due to the potential to generate leaded gloves. Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded-glove waste stream, still under the originating P/S code (TWCP-4166). Lead-containing debris waste is segregated and packaged separately from other debris waste (TWCP-3567/N-39); these wastes also are assigned D008.

Waste from most P/S codes in nitrate operations carry several EPA HWNs due to the presence of metals with toxicity characteristics in the feed materials. P/S codes covered by this report carry the following codes for heavy metals:

| | |
|---|---|
| AL | D005, D006, D007, D008, D011 |
| AP | D007, D009 |
| AS | D006, D007, D008, D011 |
| AT | D005, D006, D007, D008, D011 |
| ATL | D005, D006, D007, D008, D011 |
| BF | D006, D007, D008, D011 |
| BU | D006, D007, D008, D011 |
| CD | D006, D007, D008, D009, D011 |
| CF | D007, D008 , D009, D011, D019, D021, D022, D039 |
| COL | D005 |
| CPOD | D011 |
| DS | D006, D007, D008, D009, D011 |
| ED | D005, D006, D007, D008, D011 |
| ETD | D005, D006, D007, D008, D011 |
| EV | D006, D007, D008, D009, D011 |
| FX | D006, D007, D008, D009, D011 |
| HCD | D006, D007, D008, D009, D011 |
| HD | D006, D007, D008, D009, D011 |
| HGMS | D006, D007, D008, D009, D011 |
| HP | D007, D008, D009, D011, D019, D021, D022, D039 |
| HRA | D004, D005, D006, D007, D008, D009, D010, D011 |
| IA | D006, D007, D008, D009, D011 |

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the nitrate operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs listed in Table 1, Table 5, and Attachment 4. In the cement fixation process (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal. This oil does not enter the LANL disposal operations.

## 8.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.5)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Record Management TWCP-QP-1.1-004

5/7/01 JJm

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Nitrate Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-005,R.2 (LA-UR-01-) HRA

**WASTE GENERATED FROM PROCESS/STATUS CODES:** AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD

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## HISTORY OF REVISIONS

| Revision No. | Date | Pages Revised | Reason for Change |
|---|---|---|---|
| 0 | 06/23/00 | — | New report (TWCP-03940) |
| 1 | 12/04/00 | All | Make report a controlled document and respond to CAR-00-036 |
| 2 | | All | Respond to CBFO review comments + update to include new AK information |
| | | | |
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2 LANL and TA-55 Site Maps (2 pages)
3 Timeline for Nitrate Operations (10 pages)
4 Process Inputs and Outputs (15 pages)
5 Generalized Process Status Diagram for Nitrate Processes (1 page)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| CFR | *Code of Federal Regulations* |
| CSMO | Central Scrap Management Office |
| D | RCRA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DL | discard limit |
| DOE | U.S. Department of Energy |
| DWLS | Discardable Waste Log Sheet |
| EPA | U.S. Environmental Protection Agency |
| F | RCRA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| FFTF | Fast Flux Test Facility |
| HEPA | high efficiency particulate air |
| K | RCRA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LLW | low-level [radioactive] waste |
| MSE | molten salt extraction |
| MT | material type |
| P | RCRA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| PCB | polychlorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| P/S [code] | process status [code] |
| PVC | polyvinyl chloride |
| QA | quality assurance |
| R&D | research and development |
| RCRA | Resource Conservation and Recovery Act |
| RD&D | research, development, and demonstration |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| Sampling Plan | *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) |
| SME | subject matter expert |
| SOP | safe/standard operating procedure |
| TA | technical area |
| TOPO | trioctyl phosphate oxide |
| TRU | transuranic |
| TWCP | Transuranic Waste Characterization/Certification Project |
| UCNI | Unclassified Controlled Nuclear Information |
| WAC | waste acceptance criteria |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**Note:** This index indicates the main process AK summary report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| AL | Ash Leach | Nitrate Operations | 3.4.2, Att. 4 |
| AO | Americium Processing Calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 |
| AP | Americium Purification | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 |
| AS | Anode Heel Dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 |
| AT | Ash Testing | Nitrate Operations | 3.4.2, Att. 4 |
| ATL | Advanced Test Line for actinide separation (RD&D) | Nitrate Operations | 3.4.2, Att. 4 |
| BAC | Bacterial Decomposition of Cellulose Items | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 |
| BF | Unknown name for this P/S code | Nitrate Operations | 3.4.6, Att. 4 |
| BL | Blending | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 |
| BM | Burning Metal | Nitrate Operations | 3.4.1, Att. 4 |
| BU | Button Burning | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 |
| CC | Calcination | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 |
| CD | Hydroxide Cake Dissolution | Nitrate Operations | 3.4.2, Att. 4 |
| CF | Cement Fixation | Nitrate Operations | 3.4.5, Att. 4 |
| CH | Characterization | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 |
| CK | RD&D Volatile Fluoride Pu Recovery | Miscellaneous Operations | 3.4.2, Att. 4 |
| CL | Crucible Processing | Chloride Operations | 3.4.2, 3.4.3, Att. 4 |
| CN | C-N-O Analysis | Metal Operation Processes | 3.4.1, Att. 4 |
| COD | Chlorinated Oxide Dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 |
| COL | Chlorinated oxide leach | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 |
| CPOD | Catalyzed Electrochemical Plutonium Oxide Dissolver | Nitrate Operations | 3.4.2, Att. 4 |
| CR | Crushing and Pulverizing | Nitrate Operations | 3.4.1, Att. 4 |
| CS | Chloride Solutions | Chloride Operations | 3.4.3, Att. 4 |
| CX | Chloride Anion Exchange | Chloride Operations | 3.4.2, 3.4.3, 3.4.4, Att. 4 |
| DF | DS Furnace and Oxide Preparation | Nitrate Operations | 3.4.3, 3.4.6, Att. 4 |
| DP | Dry Processing | Nitrate Operations | 3.4.1, 3.4.6, Att. 4 |
| DS | Ion Exchange | Nitrate Operations | 3.4.3, Att. 4 |

| P/S Code | P/S Name | Process AK Summary Report and Report Section* | |
|---|---|---|---|
| VUL | Vessel Unloading | Nitrate Operations | 3.4.1, Att. 4 |
| ZD | Scrap Oxide Dissolution | Nitrate Operations | 3.4.2, 3.4.6, Att. 4 |

* Process AK summary reports: Chloride Operations (TWCP-AK-2.1-002,R.1), Metal Operations (TWCP-AK-2.1-003,R.1), Miscellaneous Operations (TWCP-AK-2.1-004,R.1), and Nitrate Operations (this report)

R.2

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Nitrate Operations

**P/S codes**: AL, AO, AP, AS, AT, ATL, BAC, BF, BL, BM, BU, CC, CD, CF, CH, COD, COL, CPOD, CR, DF, DP, DS, ED, ETD, EV, FA, FC, FX, GMS, HC, HCD, HD, HGMS, HP, IA, IS, LC, LG1, LG2, LR, MAG, MAS, MB, MELL, MF, ML, MPD, NC, NL, NR, OD, OH, OY, PA, PAF, PR, PS, PT, PTS, RB, RBJ, RC, RCM, RFX, RO, RR, SC, SP, SSD, SX, TDC, UPS, US, US2, VC, VP1, VP2, VP3, VUL, ZD HRA

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed debris; waste immobilized in cement

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste contaminated scrap, residues, and debris generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes from nitrate operations are generated from plutonium recovery and purification for defense and non-defense programs; these wastes are generated and produced in the same rooms and gloveboxes and so were not segregated until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

Process wastes from nitrate operations are generated in Building PF-4, Rooms 208, 401, 409, 420, and 434, of the TA-55 Plutonium Facility. Plutonium operations included reclaiming plutonium from scrap and residues produced from numerous feed sources.

**Description of the process waste (physical form and typical content description):**

Waste from nitrate operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, and glass debris; and waste sent for cement fixation.

Summary Category Groups: Waste Matrix Codes:

**Description of the waste-generating process:**

The overall goal of the nitrate operations is to recover plutonium from metal, metal alloys, scrap, and residues and produce a purified plutonium oxide product or feedstock for conversion to metal. Processes include pretreatment, dissolution, purification, evaporation, and cement fixation.

**Process feed:**

Plutonium metal or metal alloys, oxides and hydroxide cakes; pyrochemical salts; crucible pieces; anode heels; ash; analytical laboratory solutions; and residues from other DOE facilities.

**Radioisotopic content of the waste:**

Variety of plutonium material types with different well-defined isotopic compositions. Am-241, Np-237, and U-234 may be present at detectable concentrations as decay products of their plutonium precursors. Some of the processes separate plutonium and americium so that the waste will usually be enriched in ~~americium~~ Am-241 or U-234, or Pu and U, but may also be depleted in some cases.

**RCRA Constituents/EPA Hazardous Waste Numbers:** Pa 231 + Cs 137 may be present in trace amounts due to their widespread presence as contaminants in TA-55 operations

- F002 and F003: P/S codes CF and HP
- No K or P codes
- D008: all P/S codes in nitrate operations for the generation of leaded gloves
- D005: P/S codes COL, MB
- D005, D006, D007, D008, D011: P/S codes AL, AT, ATL, ED, ETD, IS, MPD, PTS, RC, SC, TDC
- D005, D008: P/S code VUL
- D006, D007, D008: P/S codes OD, SSD
- D006, D007, D008, D009, D011: P/S codes CD, DS, EV, FX, HCD, HD, HGMS, IA, LG2, LR, MELL, OH, RR
- D006, D007, D008, D011: P/S codes AS, BF, BU
- D006, D008: P/S codes LG1, ML, NC, NL, VC
- D006, D008, D040: P/S code RO
- D007: P/S codes PT, SP
- D007, D008 , D009, D011, D019, D021, D022, D039: P/S codes CF, HP
- D007, D009: P/S codes AP, MB
- D009: P/S codes VP1, VP3
- D011: P/S code CPOD

HRA: D005, 6, 7, 8, 9, 11

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1979–present

# PROCESS ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR NITRATE OPERATIONS AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK summary report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes ~~used by~~ that generate one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for ~~one~~ several ~~or more~~ waste stream AK summary reports that include these process wastes.

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to ~~Technical Area~~ (TA)-55 waste streams resulting from nitrate operations covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Sampling Plan* (TWCP-PLAN-0.2.7-001) (Sampling Plan) that includes information regarding all TRU waste streams
- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)

**NOTE:** Much of the AK information related to nitrate operations is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record Nos. TWCP-3548, TWCP-3566, TWCP-3567, and TWCP-3568. Individual documents in this record have been assigned a separate identifier, N-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe processes used in nitrate operations, and identify the resulting wastes as well as outputs that are sent to other operations, such as pyrochemical operations, for further processing.

### 3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2.

Most processes in nitrate operations were solely defense related (TWCP-614, TWCP-4162). However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level discard limits (DLs) (TWCP-816).

### 3.2 Basis, Rationale, and Assumption Used to Delineate the Waste Strream(s)

### 3.3 Waste Physical Form and Content Description

Wastes generated during nitrate operations are primarily debris wastes and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) ~~are covered by this process AK report~~. General debris waste categories from nitrate operations include

- Cellulose-based waste (for example, paper, cloth)
- Plastic-based waste (for example, gloves, tape, labware)
- Rubber
- Magnesium oxide crucibles
- Metal debris (for example, wire, hose clamps, tools, labware)
- Glass debris

These debris items are contaminated with small amounts of radioactive and chemical substances from nitrate operations.

3.4 Waste Volume and Time Period of Waste Generation

This report covers waste streams generated from 1979, when nitrate operations first began at TA-55, to the present. Process wastes from nitrate operations have different associated ~~RCRA codes~~ depending on the time period during which they were generated. The P/S codes, their time period of generation, and corresponding RCRA codes are shown graphically in Attachment 3, Time Lines.

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are assigned to waste streams in the Sampling Plan, and waste stream volumes are reported in that document.

3.5 Waste Generation Processes

The following subsections describe the generation of waste by nitrate operations, as well as product and waste outputs to other processes or operations.

Manufacturing and research operations performed at TA-55 in the production of plutonium also generate plutonium-contaminated scrap and residues. These residues are processed to recover as much plutonium as is practical. TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites. These recovery and manufacturing operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU waste generated at TA-55.

Detailed background information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352 and TWCP-886). This report addresses the aqueous nitrate-based recovery processes.

The primary feed source for the nitrate recovery operations is plutonium residues from other recovery operations (e.g., chloride or pyrochemical), metal preparation, metal fabrication, analytical laboratory operations, and residues from other DOE facilities (TWCP-3548/N-1). The overall goal of the nitrate recovery operations is to recover plutonium from scrap and residues and produce a purified plutonium oxide for conversion to metal. The nitrate recovery operations can be broken down into the following process steps:

- Pretreatment
- Dissolution
- Purification, including conversion to oxide
- Cement fixation

Each of these process categories is described below. The timeframe and EPA hazardous waste numbers (HWNs) associated with each P/S code are shown on

first column overflows to the second column and so on (TWCP-3548/N-1; TWCP-3566/N-23, N-24, N-24A, and N-25; TWCP-3567/N-36). After dissolution in the dissolvers, the solutions are filtered and then sent to purification. The filtered solids are sent to other dissolution processes if plutonium concentrations are above the DL, or to cement fixation (CF) or disposed as debris waste if concentrations are below the DL.

Another feed material for the nitrate operations is hydroxide filtrate cakes from the chloride operations (TWCP-3548/N-1). This material is dissolved using the standard leach solution, which is then filtered (CD, HCD, HD) (TWCP-3566/N-32). Aluminum nitrate is added to the solution and the solution is re-filtered. The filtrate is sent to purification. Filtered solids are re-dissolved if plutonium concentrations are above the DL, or disposed to cement fixation (CF) if concentrations are below the DL. From 1985 to 1994, the hydroxide cakes from the chloride operations contained cadmium, chromium, lead, mercury, and silver (TWCP-3567/N-39 and N-40). After 1994, silver is not present in the cakes. The debris waste generated from the dissolution of hydroxide cakes from the chloride operations is not expected to contain the listed metals above the regulatory limit. However, without analytical data or other acceptable information confirming that the concentrations of these hazardous constituents are below the regulatory levels, the applicable D-codes (D006, D007, D008, D009, and D011) are assigned pending additional information (TWCP-3568/N-83).

In overview, filtered solids from the dissolution step are re-dissolved until plutonium concentrations are below the DL, then sent to cement fixation (CF); debris items are disposed after the plutonium contamination is removed from the surface by leaching; plutonium-bearing solutions are sent on to purification or to the metal preparation line (P/S code MP) (TWCP-3548/N-1; TWCP-3566/N-21 through N-33; TWCP-3567/N-34 through N-36).

6 Chemicals used in the dissolution steps are listed in Table 5 in Section 3.3.3. Chemicals used in these steps that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are (1) ascorbic, formic, hydrochloric, hydrofluoric, nitric, oxalic, and sulfuric acid; (2) potassium and sodium hydroxide, (3) hydrogen peroxide (an oxidizer), and (4) mercuric and silver nitrate (TWCP-3566/N-21, N-22, N-23, N-24, N-25, N-28, N-29, N-30B, N-30C, N-30D, N-30E, N-30F, N-31, N-32, and N-33; TWCP-3567/N-34, N-35, N-36, N-37, and N-37A; TWCP-3568/N-81). EPA HWNs D001 and D002 do not apply to the solid wastes because of the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes. Mercuric nitrate was used as a catalyst in P/S code VP1, which is accordingly assigned the code for mercury, D009. Silver nitrate was

used in P/S code AT and CPOD, which are therefore assigned the code for silver, D011.

Additional EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the material feed (see Table 1 in Section 3.5) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (discussed in section 4.2). For example, RCRA-regulated hazardous constituents introduced to the nitrate operation at the dissolution step from hydroxide filtrate cakes include cadmium, chromium, lead, mercury, and silver (TWCP-3567/ N-39, N-40). Leaded gloves were discarded as described in section 3.5.1.

**NOTE:** For some of these P/S codes, no formal procedures could be found and the necessary information was extracted from process flow diagrams and SME input. More detailed descriptions of such P/S codes that are included in this dissolution section are provided in section 3.4.6, as follows: P/S codes AS, BAC, COD, COL, LC, LG1, LG2, MB, NL, NR, PS, PT, SSD, US, US2, VC, VP1, and ZD.

3.5.3 Purification and Oxide Conversion (P/S codes AO, AP, CC, CH, DF, DS, FA, FC, HC, LR, OH, OY, PR, RB, RBJ, RCM, RFX, RR, SX, and VP3)

A peroxide precipitation process (PR) was used to achieve excellent separation of plutonium from the cationic impurities calcium, chromium, magnesium, cesium, cobalt, and aluminum, as well as americium (TWCP-3567/N-52). Peroxide was added to the oxide dissolution filtrate feed material to convert the plutonium to valence state (+4). Additional peroxide resulted in the precipitation of $[PuO_2]^{+5}$, then $[PuO_4]^{+4}$, and finally $Pu_2O_7$. The resulting peroxide filter cake was dissolved in nitric acid and the solution was sent to oxalate precipitation (OY). The filtrate solution from the peroxide precipitation was sent to hydroxide precipitation (OH), also known as the peroxide kill process.

Plutonium-bearing solutions generated in the dissolution step are directed to purification for plutonium recovery (TWCP-3548/N-1). Purification consists of both ion exchange and precipitation processes. There are three primary ion exchange processes based on the concentration of plutonium in solution: rich feed (RCM), dissolver solutions (DS), and lean residue (LR). After ion exchange, plutonium-bearing solutions are directed to oxide precipitation and then to an oxidation process. The oxidation process generates plutonium oxide, a stable form of plutonium suitable for storage or further processing into plutonium metal.

Hydroxide cakes from the chloride operations, which started in 1985 (TWCP-3567/N-40), are introduced to the nitrate operations in the dissolution step (TWCP-3567/N-39). The outputs from the dissolution of chloride operations hydroxide cakes are sent to P/S code LR or DS. Therefore, RCRA-regulated hazardous constituents associated with the feed materials from the chloride operations may carry through to P/S codes DS and LR (TWCP-3567/N-38). The hazardous metal constituents contained in hydroxide cakes from 1982 (based on the start of the chloride operations) until 1994, include cadmium, chromium, lead, mercury, and silver (TWCP-3567/N-40). Beginning in 1994, only cadmium, chromium, lead, and mercury are expected to be present. These metals may be present above the regulatory limits in the waste streams generated by P/S codes DS and LR. Therefore, the EPA HWNs D006, D007, D008, D009, and D011 are assigned to the waste from 1982 to 1994; and D006, D007, D008, and D009 are assigned from 1994 forward.

In overview, plutonium oxide from the purification step is transferred to the vault for storage or to the metal preparation line; solutions are sent to the evaporator for re-concentration and then returned to ion exchange or sent to P/S codes CF or HP for immobilization in cement. The distillates are disposed to the RLWTF if they meet the TA-50 WAC. Spent ion exchange resins are disposed to cement fixation (CF) (TWCP-3567/N-41 through N-53).

Chemicals used in the dissolution steps are listed in Table 5 in Section 3.5.3. Chemicals used in these steps that are covered by 40 CFR Part 261, including Appendix VIII of those regulations, are (1) hydrofluoric, nitric, and oxalic acid; (2) sodium hydroxide, and (3) hydrogen peroxide (an oxidizer)(TWCP-3567/N-41 through N-47, N-50, N-51, N-53, N-54, and N-55; TWCP-3568/N-81). EPA HWNs D001 and D002 do not apply to the solid wastes because of the use of acids, bases and an oxidizing solution in these processes because there is no free liquid in these wastes.

However, EPA HWNs apply to most of these P/S codes as a result of the presence of regulated chemicals in the material feed (see Table 1 in Section 3.5) or as a result of contamination introduced from the use of laboratory equipment or supplies or from glovebox maintenance operations (discussed in section 4.2). For example, RCRA-regulated hazardous constituents introduced to P/S codes DS and LR with the hydroxide filtrate cakes include cadmium (D006), chromium (D007), lead (D008), mercury (D009), and silver (D011) (TWCP-3567/N-39 and N-40). Similarly, plutonium oxide from the vault may have been roasted and blended in P/S codes RB and RBJ to provide a more homogeneous feed for the metal preparation line (P/S code MP); these oxides may

filter cakes; pump oils; silica solids; spent ion exchange resins; trioctyl phosphine oxide and iodine in kerosene; uranium oxide; and uranium solutions (TWCP-3568/N-72).

Since 1981, the primary feed to this process was the evaporator bottoms solution. Evaporator bottoms were treated by hydroxide precipitation and filtered. The cakes would dry only very slowly so the wet cakes were rolled in plastic bags with Portland cement powder or were stirred in one-gallon cans with Portland cement to make them set. In 1981, hydroxide precipitation was discontinued and the neutralized bottoms solutions were stirred directly with Portland cement powder in one-gallon cans. In January 1983, Gypsum cement powder replaced the Portland cement powder. The evaporator bottoms solution was adjusted to a pH of about 3 for Gypsum cement or to a basic pH (7-10) for Portland cement. The cement powder was then mixed into the solution. Any particulate matter was added during the stirring operations.

(Calcium sulfate)

also known as Enviro stone cement)

Waste oil/organic solutions set up in cement were restricted to TRU vacuum pump oils and mixtures of trioctyl phosphine oxide (TOPO) and iodine dissolved in kerosene. Some of the miscellaneous solutions sent for cement fixation included analytical chemistry solution residues that contained RCRA-regulated organics or heavy metals. Oils and organic liquids are emulsified by the addition of a surfactant before they are mixed with the neutralized evaporator bottom solutions (TWCP-3568/N-74). The miscellaneous solutions were treated in a manner much like the evaporator bottoms solution.

The discard of impure americium oxide from P/S code AO (section 3.4.6.1) was mostly accomplished by stirring it into a one-gallon can of evaporator bottom cement paste (up to 140 g americium/can). When all cement was being stirred in one-gallon cans, the americium-containing can was placed in the center of the middle layer of cans in a drum to provide maximum shielding. When storage of the impure americium hydroxide cakes in P/S code AO became a radiation exposure problem, a significant portion of the stored material was placed in P/S code IA until the material could be immobilized in cement for disposal. P/S code IA was active from April 1986 to December 1988. It did not involve any type of processing and, therefore, did not generate any waste.

In July 1988, the cementation process was changed from stirring the cement in one-gallon cans to stirring cement monoliths in 55-gallon drums attached to the glovebox (under P/S code CF). Although P/S code HP is still open, it has not been used since July 1988.

**NOTE:** The strategy proposed for shielding americium-containing cans, after the operation converted to 55-gallon drum monoliths, was to push the one-gallon

The waste generated by this process includes the usual glovebox waste plus metal screens and tools, rags, brushes, and containers.

3.5.6.20 HRA

3.5.6.20 Impure Americium Holding for Discard (IA)

This P/S code was active from April 1986 to December 1988. When storage of the impure americium hydroxide cakes in P/S code AO became a radiation exposure problem, a significant portion of the stored material was placed in P/S code IA until the material could be fixed in cement for disposal. This P/S code did not involve any type of processing and, therefore, did not generate any waste.

Because this P/S code simply held excess americium hydroxide cakes from P/S code AO, the EPA HWNs applicable to P/S code AO apply to P/S code IA. These EPA HWNs include D006, D007, D008, D009, and D011.

3.5.6.21 Uranium/Plutonium Processing Nitrate Hydrofluoric Dissolution (LC)

This process was active from August 12, 1985 to August 1987. Plutonium oxides from P/S codes US (later renamed US1) and US2 were dissolved in nitric acid and hydrofluoric acid, concentrated by distillation, and filtered. The distillate solution was sent to P/S code EV. Any filter residues were calcined and recycled into the dissolution process. The uranium-plutonium solution was subjected to an oxalate precipitation with oxalic acid or sodium oxalate to precipitate the plutonium. The slurry was filtered and the plutonium oxalate was sent to a calcination process. The uranium nitrate solution was cemented in P/S code HP.

RCRA-regulated organics and metals were not used in this process and were not introduced with the feed materials; therefore there would not be any RCRA-regulated solvents or metals in the waste streams generated by this process. This process generated the usual glovebox waste, plus glassware, heating mantles, plastic filter boats, filter paper, rags, brushes, and metal tools and equipment.

3.5.6.22 Non Combustible Leach (LG1)

This process was active from October 1982 to December 1985. Metal, glass, and plastic from most PF-4 processes were leached with nitric acid to remove plutonium

materials listed in Table 1 that are obtained either from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites. Although Pu is usually the radioactive element of interest in the feed materials, in some cases the feed material consisted of other radioactive elements, as indicated by Table 2.

The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

3.6.1 Physical Form Identification

Solid waste from nitrate operations primarily consists of metal and debris waste, as well as cemented waste discarded under P/S codes CF or HP. Debris waste contains glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Lead-containing debris items are segregated and packaged separately (TWCP-3567/N-39). Prior to 1987, leaded gloves were discarded in the combustible and non-combustible debris waste streams. Between 1987 and May 1992, leaded gloves were segregated from combustible debris and discarded in the metal debris waste stream because of concern that explosive lead oxides might form if the combustible debris waste ~~was~~ were incinerated. Since May 1992, leaded gloves have been routinely segregated from other metal debris waste and assigned to a separate leaded-glove waste stream.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a

**Table 1. Process Feed Materials for Nitrate Operations**

| Feed Materials | Potential Presence of RCRA-Regulated Substances | P/S Codes in Nitrate Operations |
|---|---|---|

| Feed Materials | Potential Presence of RCRA-Regulated Substances | P/S Codes in Nitrate Operations |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated constituents<br>• All analytical laboratory solutions are potentially contaminated with chromium (D007), lead (D008), and mercury (D009)<br>• CLS-1 solutions potentially contaminated with mercury (D009) and lead (D008), as well as RCRA-listed organic substances used as solvents, including acetone (F003), butyl alcohol (F003), carbon tetrachloride (D019), chlorobenzene (F002, D021), chloroform (D022), methanol (F003), methylene chloride (F002), tetrachloroethylene (F002, D039), xylene (F003) (Cl-25/TWCP-3547). | CF, HP (if solutions contained Pu >DL) |
| Anode heels | Typically contaminated with RCRA-regulated heavy metals Cd, Cr, Pb and Ag (D006, D007, D008, D011). Heavy metals As, Hg, and Se are not present because they are volatilized from the Pu oxide feed at the high temperatures to which this material is subjected in P/S codes ER, RM, and SS (electrorefining step). | AS, BU, NC |
| Ash from P/S codes ETD and TDC; or from other DOE sites such as Hanford | Usually suspect contaminated with Ba, Cd, Cr, Pb, and Ag (D005, D006, D007, D008, D011). As, Hg, and Se may also be present although these metals are volatilized at high temperatures if present in the oxide and chloride forms. | AL, AT, ATL, ED, HGMS, IS, MPD, PTS, RC, SC ↑ HRA, |
| Crucible pieces (tantalum, magnesium oxide) | Typically fairly pure, no RCRA substances present | MAS, SC |
| Disassembled weapons components | High-purity Pu and U material types, no RCRA substances present | BM, RB, RBJ |
| Experimental R&D feed materials; various isotopes and isotopic mixtures of actinides in various matrices | Variable purity | MAS |
| Hydroxide cakes | Typically contaminated with RCRA-regulated heavy metals Cd, Pb, Hg, Ag and possibly Cr (D006, D008, D009, D011, and D007) | CD, HCD, HD, LG2 |

| Feed Materials | Potential Presence of RCRA-Regulated Substances | P/S Codes in Nitrate Operations |
|---|---|---|
| Miscellaneous materials contaminated with Pu (e.g. sand, slag, tools, crucibles, metal, glass, plastic, labware, scrap, rags, glovebox sweepings, pump oils, HEPA filters, Hanford [Hanford materials]) | Typically contaminated with RCRA-regulated heavy metals Ag, Cd, Hg, Pb and possibly Cr (D006, D008, D009, D011, and D007) | ATL, BAC, CPOD, CR, ED, ETD, GMS, HGMS, IS (combustible material), LG1 (non-combustible material), MAG, MAS, MELL (cellulosic material), ML (metal equipment), NC (non-combustible material), NL (non-combustible material), PA (glovebox sweepings), PAF, RO (organics), SC, SP, TDC (cellulosic material), VC, ZD |
| MSE salts | Typically fairly pure, suspect contaminated with barium but no other RCRA substances present | MB, PS |
| Pu metal or metal alloy, Hanford (Hanford materials) | High purity, no RCRA-regulated substances, unless noted otherwise | ATL, BM, BU, MF, PAF, VP1 HRA, |
| Pu oxalates | High purity, no RCRA-regulated substances, unless noted otherwise | CC, DF, HC |
| Pu oxides, Hanford (Hanford materials) | Variable purity from P/S codes RB, RBJ and others, and from the vault; suspect contaminated with RCRA-regulated heavy metals Cd, Cr and Pb (D006, D007, D008)<br>High purity oxides and material from Hanford from P/S codes CA and MA, and from the vault | ATL, BL, CH, CPOD, DP, ED, FC, LC, MPD, OD, PT, RB, RBJ, SP, SSD, UPS, US, US2 HRA, |
| Pyrochemical salts | Typically fairly pure, no RCRA substances other than Ba are present | COD, COL, MB |

**Table 2. P/S Codes with Radionuclides Other Than Pu in Feed Materials**

| P/S code in nitrate operations | Radionuclide in feed material |
|---|---|
| AO, AP, FA, PR | Am-241 |
| ATL | Np-237 |
| CF | Am-341, U, Th-232 |
| HP, IA, OH, SX | Am-241 |
| LC, RC, UPS, US | U |
| PT | Th-232 |

Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item number and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance (QA) personnel. Example forms for one drum of waste generated can be viewed in record TWCP-2513.

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for nitrate operations at TA-55 are listed in Table 3. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Please note that Table 3 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. These bounding calculations provide a basis for identifying enrichment or depletion of one radionuclide versus another based on radioassays of individual waste containers. The results of these calculations are also tabulated in Table 3, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in americium depending on whether the source of contamination is the process product or the process residues (TWCP-882). Table 4 indicates some P/S codes in which enrichment of radioelements other than Pu are expected to be greater than usual.

Am-231 or U-234

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from nitrate operations at TA-55, with exceptions as noted in Tables 2 and 4. In addition,

Pa-231 + Cs-137

## Table 3. Average Isotopic Content of Plutonium Material Types and Enrichments

| Material Type (MT) | Plutonium Isotope (Weight%) and Half-Life | | | | | | Upper Bounds for Dimensionless Weight Ratios[a] | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 ($8.26 \times 10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 51 | 0.006 | 96.77 | 3.13 | 0.076 | 0.018 | — | $1 \times 10^{-5}$ | 0.001 | 0.0006 |
| MT 52 | 0.01 | 93.78 | 6 | 0.2 | 0.02 | — | $2 \times 10^{-5}$ | 0.001 | 0.002 |
| MT 53 | 0.03 | 91.08 | 8.45 | 0.366 | 0.071 | — | $7 \times 10^{-5}$ | 0.0009 | 0.003 |
| MT 54 | 0.046 | 87.42 | 11.5 | 0.81 | 0.22 | — | 0.0001 | 0.0009 | 0.007 |
| MT 55 | 0.06 | 83.88 | 14.73 | 1.03 | 0.304 | — | 0.0002 | 0.0009 | 0.009 |
| MT 56 | 0.061 | 81.9 | 16.51 | 1.18 | 0.355 | — | 0.0002 | 0.0009 | 0.01 |
| MT 57 | 0.433 | 74.63 | 20.7 | 2.55 | 1.69 | — | 0.001 | 0.0008 | 0.02 |
| MT 42 | | | | | | | | | |
| 84% | 1.02 | 1.37 | 10.32 | 3.13 | 84.14 | 0.02 | 0.003 | $1 \times 10^{-5}$ | 0.03 |
| 90% | 0.72 | 1.26 | 6.4 | 1.86 | 89.77 | — | 0.002 | $1 \times 10^{-5}$ | 0.02 |
| 95% | 0.45 | 0.56 | 2.47 | 0.906 | 95.58 | 0.029 | 0.001 | $6 \times 10^{-6}$ | 0.008 |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

Superscript (a) These ratios are calculated under the assumption that no chemical fractionation occurs and, hence, are intended to be used to identify fractionation when it is present by comparing these upper bounds to radioassay data.

Source: TWCP-698

## Table 4. Secondary Radionuclides in Process Wastes

| P/S code | Secondary radionuclide in process waste |
|---|---|
| AO | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1985—1987, impure $AmO_2$ for disposal) |
| AP | Am-241 (1979—1984, Am-241 production) |
| ATL | Np-237 (1993—1994, NDA standards material) |
| CD, HCD, HD | Am-241 (1992—present) |
| CF, ED, EV, RB, RFX | Np-237 as decay product in MSE (1992—present) |
| EV | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1992—present) |
| FA | Am-241 (1979—1984, Am-241 production) |
| HP | Am-241 (1979—1984, Am-241 production)<br>Am-241 (1985—1987, impure $AmO_2$ for disposal)<br>Am-241 (1992—present) |
| IS | Cm-244 (March 1987—April 1987) |
| LR, PR | Am-241 (1979—1984, Am-241 production) |
| PS | Am-241 (1985—1987, impure $AmO_2$ for disposal) |
| PT | Th-232 (1980—1985) |

| | |
|---|---|
| LG1 | D006, D008 |
| LG2 | D006, D007, D008, D009, D011 |
| LR | D006, D007, D008, D009, D011 |
| MB | D007, D008, and D009 (in accordance with discussion in TWCP-AK-2.1-002,R2, section 3.4.2) |
| MELL | D006, D007, D008, D009, D011 |
| ML | D006, D008 |
| MPD | D005, D006, D007, D008, D011 |
| NC | D006, D008 |
| NL | D006, D008 |
| OD | D006, D007, D008 |
| OH | D006, D007, D008, D009, D011 |
| PT | D007 |
| PTS | D005, D006, D007, D008, D011 |
| RC | D005, D006, D007, D008, D011 |
| RO | D006, D008, D040 |
| RR | D006, D007, D008, D009, D011 |
| SC | D005, D006, D007, D008, D011 |
| SP | D007 |
| SSD | D006, D007, D008 |
| TDC | D005, D006, D007, D008, D011 |
| VC | D006, D008 |
| VP1 | D009 |
| VP3 | D009 |
| VUL | D005, D008 |

No D001 (ignitable), D002 (corrosive) or D003 (reactive) listings apply to the solid wastes from nitrate operations because no ignitable chemicals were used in these processes and because the solid wastes do not contain any free liquids (see Section 6.0).

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. If a misfire should occur, the requirement is to destroy the unspent powder by burning. (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data will be used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 6.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated

for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

For items of pyrochemical salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the Rocky Flats Environmental Technology Site (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, (3) and no sparking. Experimental results on the reactivity of LANL Direct Oxide Reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 L in volume is obtained from radiography of each waste containers and visual examination of selected containers during TWCP characterization activities. Any free liquids are remediated, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the waste container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007). For administrative controls on the prohibition of pyrophorics, see Sections 6.0 and 7.0.
5 6

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the nitrate operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in the process inputs

listed in Table 1, Table 5, and Attachment 4. In the cement fixation process (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs. All transformers known to contain PCBs have been tracked from the time of startup of TA-55 in 1978. Whenever any transformer oil is drained, it is handled by a subcontractor who is wholly responsible for its disposal. This oil does not enter the LANL disposal operations.

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261—Identification and Listing of Hazardous Wastes
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021,R.5)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- Waste Analysis Plan, Attachment B to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

List is incorrect

## ACCEPTABLE KNOWLEDGE ROADMAP

Waste from ~~P/S Codes AL, AT, ATL, BM, CD, CF, CPOD, CR, DS, ED, EV, GMS, HCD, HD,~~ IS, LR, MAG, MAS, MELL, ML, ~~MPD,~~ NC, OH, OY, PAF, PR, RB, RBJ, ~~RCM, RFX,~~ RR, SC, SP, TDC, UPS, VUL

HRA

Copies of these documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-352 | B | Description of plutonium recovery processes | Wastes from Plutonium Conversion and Scrap Recovery Operations, LA-11069, March 1988 | Document describes the Pu residues and the various treatment approaches used in recovering plutonium from scrap | Document does not give information about RCRA constituents introduced or present in the processes |
| TWCP-614 | D | All TA-55 waste is Defense related. | Memo from Doug Sankey. | All TA-55 waste is Defense related. | Budget information may not be acceptable. |
| TWCP-697 | C | Waste was controlled to meet WIPP WAC requirements as early as 1983. | *Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* WCP-HSE7-CPL-01, R.2 (November 1984) | Waste was controlled to meet WIPP WAC requirements as early as 1983. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-698 | B | Gives Material Type compositions | NMT Memo, NMT-7 WM/EC-96-032<br>Benchmark Environmental Corp. Memo, AL-7193 BEC | Gives Material Type compositions | Does not give information on how material may fractionate in TA-55 waste processes. |
| TWCP-700 | C | *Attachment 3 to the Los Alamos TRU Waste Certification Plan for Newly Generated TRU Waste,* R05 | *NMT-7 Attachment, January 1995,* TRUWM-TA55-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-701 | C | *TA-55 Generator Attachment* to the *TRU Waste Certification Plan for Newly Generated TRU Waste* | *TA-55 Attachment, 1987,* TRU-MST12-CPA-03,R00 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4166 | D | Answers to questions about P/S codes DO, EV, HP, CF, OR, RM, PY | Interview with Jim Foxx, 10/17/00 | Answers to questions on use of Cr and Ag, RCRA metals in cement, asbestos in furnaces and gloves, and disposal of spray cans used in gloveboxes. | None |
| TWCP-4167 | D | Answers to questions about segregation of non-defense wastes; leachability of Ag from ash | Interview with Jim Foxx, 10/18/00 | Segregation of non-defense wastes began on 27 August 1998; analytical data show that Ag in ash is below limits of regulatory concern | None |
| TWCP-AK-2.1-002,R.2 | A | *Process Acceptable Knowledge Summary Report for Chloride Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for chloride operations at TA-55 | None |
| TWCP-AK-2.1-003,R.2 | A | *Process Acceptable Knowledge Summary Report for Metal Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for metal operations at TA-55 | None |
| TWCP-AK-2.1-004,R.2 | A | *Process Acceptable Knowledge Summary Report for Miscellaneous Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for miscellaneous operations at TA-55 | None |
| TWCP-AK-2.1-006,R.2 | A | *Process Acceptable Knowledge Summary Report for Pyrochemical Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for pyrochemical operations at TA-55 | None |
| TWCP-AK-2.1-007,R.2 | A | *Process Acceptable Knowledge Summary Report for Special Processing Operations at TA-55* | Generators interview and TWCP AK references | Detailed information on each P/S code for special processing operations at TA-55 | None |

Insert TWCP-4720, 5164 5165

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| HP | Cement Fixation | Evaporator bottoms<br>Vacuum pump oils<br>Tributylphosphate and iodine in kerosene<br>Analytical chemistry solutions<br>Salts<br>Leached filter paper residues<br>Ash<br>Miscellaneous solutions<br>Americium oxide | Sodium hydroxide<br>Portland cement<br>Gypsum cement<br>Surfactant (polyoxy-ethylene-20-sorbitan) | | Cemented waste<br>Leaded gloves | D007, D008, D009, D011, D019, D021, D022, D039, F002, F003 | N-81/TWCP-3568 |
| IA | Impure Americium Holding for Discard | Americium hydroxide cakes | None (no processing performed) | Americium hydroxide cake | Leaded gloves | D006, D007, D008, D009, D011 | N-81/TWCP-3568 |
| IS | Incinerator | Combustible materials (e.g., rags, paper wipes, wood) (less than 10% plastic and rubber) | Sodium hydroxide solution<br>Potassium hydroxide solution | Scrubber solutions | Ash<br>Scrubber solutions (< DL)<br>Pump seal solutions<br>Leaded gloves | D005, D006, D007, D008, D011 | N-5/TWCP-3548 |
| LC | Uranium/ Plutonium Processing | Plutonium oxide | Nitric acid<br>Hydrofluoric acid<br>Oxalic acid<br>Sodium oxalate | Plutonium oxalate | Acidic solutions<br>Uranium nitrate solutions<br>Leaded gloves | D008 | N-81/TWCP-3568 |
| LG1 | Non Combustible Leach | Debris (metal, glass, plastic) | Nitric acid | Plutonium in nitric acid solutions | Leaded gloves | D006, D008 | N-81/TWCP-3568 |
| LG2 | Hydroxide Cake Dissolution | Hydroxide cakes | Nitric acid | Plutonium in nitric acid solutions | Leaded gloves | D006, D007, D008, D009, D011 | N-81/TWCP-3568 |

D015
AK-7

# INTERIM CHANGE REQUEST

| ☑ TWCP ☐ WRR ☐ Other<br>If Other, please identify: _____ | IC Number: 1 |
|---|---|
| **Person Requesting this Interim Change:** Sandy Wander | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55 | **Document No./Revision:** TWCP-AK-2.1-009,R.0 (LA-UR-02-1709) |
| **Effective Date of Current Document:** 08/07/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| TA-55 Process/ Status (P/S) Code Index / p. vi | Delete "summary" from "NOTE" at top of p. vi and from "*" note at bottom of p. vi<br>Change 3rd column heading on page vi to read "Process AK Report"<br>Delete entire 4th column | Clarification |
| RCRA Constituents/ EPA Hazardous Waste Numbers / p. viii | Add ASP, C1, WD, and WS to P/S codes in 3rd bullet | Report updated to add P/S codes that were not included. Typo error identified during review. |
| Global | Change all occurrences of "Sampling Plan" to "AK Information Summary" | Title change |
| Global | Delete "summary" from "Process AK summary report" and delete "Summary" from "Process Acceptable Knowledge Summary Report" | Clarification |
| Attach 3 / p. 1 | Add "D008" to all timelines | Per SME, all P/S waste codes have potential to have leaded gloves. Timelines updated to reflect information. |
| | Delete "D006" and "D011" from R8 timeline | Per SME, concentrations below TCLP limits. Data available. |
| | Create C1 timeline with P/S code D008*, | |
| | Delete "D005 applies to salt waste" from WS timeline | Per SME, barium used in process was ultra high purity and feed barium was below TCLP limits in salt waste. |
| | Add the following footnote: "*Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded glove waste stream, still under the originating P/S code (TWCP-4166)." | Footnote added to clarify segregation of leaded gloves. |

| | | |
|---|---|---|
| Attach 4 / pp. 1 and 2 | In "EPA Codes" column, delete all text and insert "*D008" for rows ASP, GPHS, MTL, P1, R8, RC1, SCP, and WS.<br>Add the following footnote to the table: "*D008 due to leaded gloves" | Updated report to reflect addition of leaded gloves to timelines and all P/S codes per SME.<br>Per SME, Barium used in process was ultra high purity and below TCLP limits in salt waste. |
| Attach. 6 | Add new Attachment 6 and update "Contents" page to reflect addition<br>Add following paragraph to end of Section 2.0:<br>"When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6)." | New TWCP-QP-1.1-021 requirement |

| | | | |
|---|---|---|---|
| **Date changes submitted**: 02/12/02 | | **Desired effective date for changes**: | |
| **INTERIM CHANGE APPROVAL** | | | |
| Document Preparer: S Wander | | Reviewer (if applicable): Facility Rep | |
| Signature: Sandy Wander | Date: 3/19/02 | Signature: Wayne A. Punjak | Date: 3/20/02 |
| Site Project QA Officer: M A Gavett | | LAAO (if implementing WAP requirements): NA | |
| Signature: M A Gavett | Date: 3/21/02 | Signature: | Date: |
| ☑ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | | Do changes affect WAP data collection, data quality, or performance criteria? | |
| Site Project Mgr/Line Mgr: P Rogers | | ☐ Yes ☑ No | |
| Signature: Pamela Rogers | Date: 3/19/02 | If yes, date of CBFO approval: _____ (documentation attached) | |
| USQ Screener (if applicable): NA | | | |
| Signature: G M Polley | Date: 3-25-02 | | |
| **NOTE:** Changes can be designated on the document and attached to this form. | | | |
| **Effective date for this interim change: 03/21/02** | | | |

# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-009,R.0 (LA-UR-01-4200)

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- 2 LANL and TA-55 Site Maps (2 pages)
- 3 Timeline for Pu-238 Operations (2 pages)
- 4 Process Inputs and Outputs (2 pages)
- 5 Simplified Pu-238 Process Flow Diagrams (2 pages)
- 6 Decision/Discrepancies Resolution Documentation (2 pages)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| AK Information Summary | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001,R.5) |
| CFR | *Code of Federal Regulations* |
| CMR | Chemistry and Metallurgy Research [Facility] |
| D | EPA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DWLS | Discardable Waste Log Sheet |
| EP-60 | type of inner shipping container |
| EPA | U.S. Environmental Protection Agency |
| F | EPA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| GPHS | General Purpose Heat Source |
| HF | hydrofluoric acid |
| HEPA | high-efficiency particulate air |
| $HNO_3$ | nitric acid |
| HWN | [EPA] hazardous waste number |
| K | EPA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LWRHU | Lightweight Radioisotope Heater Unit |
| M | molar |
| MASS | Material Accountability and Safeguards System |
| $MgCl_2$ | magnesium chloride |
| MgO | magnesium oxide |
| MSDS | material safety data sheet |
| MT | material type |
| MWG | Milliwatt Generator |
| NMT | Nuclear Materials Technology [Division] |
| P | EPA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| P/S [code] | process/status [code] |
| PCB | polychorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| Pu-238 | plutonium-238 |
| $PuO_2$ | plutonium oxide |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| SME | subject matter expert |

| | |
|---|---|
| SOP | standard operating procedure |
| SRS | Savannah River Site |
| TA | technical area |
| TCLP | Toxicity Characteristic Leaching Protocol |
| TRU | transuranic |
| TWCP | Transuranic Waste Certification/Characterization Project |
| UCNI | Unclassified Controlled Nuclear Information |
| UF/PF | ultrafiltration/polymer filtration |
| WAC | waste acceptance criteria |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WIPP | Waste Isolation Pilot Plant |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request Form |
| µm | micron |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**NOTE:** This index indicates the main process AK report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| ASP | Aqueous Scrap Processing | Plutonium-238 Operations |
| C1 | Pu-238 Heat Source Calorimetry | Plutonium-238 Operations |
| CA | Casting | Metal Operation Processes |
| CF | Cement Fixation | Nitrate Operations |
| ED | Cascade Dissolver | Nitrate Operations |
| GPHS | General Purpose Heat Source Fabrication | Plutonium-238 Operations |
| HP | Cement Fixation | Nitrate Operations |
| ITF/ITF4 | Impact Test Facility | Metal Operation Processes |
| MPD | Cascade Dissolver | Nitrate Operations |
| MTL | Metallography | Plutonium-238 Operations |
| OR | Direct Oxide Reduction | Pyrochemical Processes |
| P1 | Routine Pu-238 Heat Source Production | Plutonium-238 Operations |
| PPD | Plutonium Pellet Dissolution | Special Processing |
| R8 | Routine Pu-238 Solidification | Plutonium-238 Operations |
| R8 | Recovery of Pu-238 from Sucrose Solutions | Plutonium-238 Operations |
| RCI | Recovery of Pu-238 from Contaminated Iridium | Plutonium-238 Operations |
| SC | Cascade Dissolver, G437 | Nitrate Operations |
| SCP | Routine Pu-238 Scrap Processing | Plutonium-238 Operations |
| SP | Scrap Dissolution, G438 | Nitrate Operations |
| TDC | Thermal Decomposition of Cellulose Items | Nitrate Operations |
| WD | Welding and Decon for GPHS | Plutonium-238 Operations |
| WM | Waste Management | Miscellaneous Operations |
| WS | Pu-238 Direct Oxide Reduction | Plutonium-238 Operations |

* Process AK reports: Metal Operation Processes (TWCP-AK-2.1-003), Miscellaneous Operations (TWCP-AK-2.1-004), Nitrate Operations (TWCP-AK-2.1-005), Plutonium-238 Operations (this report), Pyrochemical Processes (TWCP-AK-2.1-006), and Special Processing (TWCP-AK-2.1-007)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Plutonium-238 processes

**P/S codes**: ASP, C1, GPHS, MTL, P1, PP, R8, RCI, SCP, WD, WS

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed, combustible and non-combustible debris; mixed oil and vermiculite waste; mixed solidified inorganic process waste including leached solids, salts and metal oxides.

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris waste generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense programs. These wastes may have been generated in the same rooms and gloveboxes as were used for non-defense activities, and were not segregated from non-defense waste until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

In the 200 Wing of the TA-55 Plutonium Facility (Building PF-4), Rooms 201, 204, 205, 206, and 207 have been used exclusively for Pu-238 processes. Plutonium-238 operations include chemical and radiochemical analysis, process tests and development, plutonium research, and heat source fabrication as well as recovery of Pu-238 from scrap and residues produced by numerous feeds.

**Description of the process waste (physical form and typical content description):**

Waste from Pu-238 operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, glass debris, HEPA filters, and steel packaging materials. Other Pu-238 waste includes oil and vermiculite waste and solidified inorganic process waste including leached solids, salts and metal oxides. Liquid waste is sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50.

*Summary Categories:* S3000, S5000

*Waste Matrix Codes:* S3100, S3200, S5000, S5100, S5410

**Description of the waste-generating process:**

The overall goal of the Pu-238 processes is to produce heat sources for various applications. Limited recovery of plutonium from metal, metal alloys, scrap, and residues is also part of Pu-238 processing operations.

**Process Input:**

Plutonium metal and oxides; pyrochemical salts; ash; analytical laboratory solutions; and residues from other DOE facilities.

**Radioisotopic content of the waste:**

Pu-238 material types with well-defined isotopic compositions. U-234 is often present as a decay product of its plutonium precursor. Less common radionuclides present as trace-level contaminants are Am-241, Am-243, Cs-137, Np-237, Th-232, U-235 and U-238.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D007 (chromium), D008 (lead), and D009 (mercury) apply to waste from P/S code R8.
- D008 (lead) applies to debris waste from all P/S codes from Pu-238 operations for discarded leaded gloves.
- No other D codes apply to waste generated by P/S codes ASP, C1, WD, WS GPHS, MTL, P1, RCI, or SCP.
- No F, K or P codes apply to any of the P/S codes under Pu-238 operations.

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1978–present

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR PLUTONIUM-238 OPERATIONS AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes that generate TRU waste in the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for one or more waste stream AK summary reports which include these process wastes, such as the *Acceptable Knowledge Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47* (TWCP-AK-2.1-011).

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to TA-55 waste streams resulting from Pu-238 processes and Pu-238 heat source fabrication covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001) (AK Information Summary) that includes information regarding all TRU waste streams
- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be present in the process wastes, based on subject matter expert (SME) interviews and any relevant data

**NOTE:** Much of the AK information related to Pu-238 processes is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No.

TWCP-3545. Individual documents in this record have been assigned a separate identifier, P238-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) is contained in these records, and is not included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK report contains information on 11 individual processes that have each been assigned a unique identifier called a process status (P/S) code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generation records.

The TA-55 Plutonium Facility tracks waste items both by the process from which they originated and their material content. Waste items are labeled with an item identification code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item. Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. Further complication is introduced because the waste streams for TA-55 have been defined based primarily on the physical form and material content of the waste and only secondarily on the waste generation process through mixed or non-mixed waste stream designations. Hence, any given Pu-238 waste stream could potentially contain items from all of the plutonium Pu-238 processes that were active at TA-55 over the time span of the generation of the waste stream.

Do we want to focus on 238only

We have attempted to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number) by providing separate AK reports for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in this process AK report.

When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6).

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe Pu-238 processes, and identify the resulting wastes as well as outputs that are sent to other Pu-238 operations for further processing.

3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. The contaminated scrap and residues, if containing plutonium above the discard limit, are processed to recover as much plutonium as is practical (TWCP-351, TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium-239 from residues and scraps generated from operations at various LANL facilities and other Department of Energy (DOE) sites and is establishing similar recovery capabilities for Pu-238 (TWCP-3545/P238-01). These recovery operations, associated maintenance operations, manufacturing operations, and plutonium research are the sources of TRU waste generated at TA-55. Detailed information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352). Information specific to Pu-238 processes is provided in TWCP-415. A full-block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2. In the 200 Wing of Building PF-4, Rooms 201, 204, 205, 206, and 207 are used exclusively for Pu-238 processes (TWCP-3545/P238-01). The Pu-238 processes include recovery operations and heat source fabrication processes. The latter processes include fuel fabrication, pellet production, and scrap/process residues processing.

The Pu-238 processing activities were strictly segregated from all other Pu-processing activities at TA-55 because cross-contamination of the materials would adversely affect the quality and usability of the end products (TWCP-1037). The Pu-238 operations consisted of activities supporting both defense and non-defense applications. However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level waste threshold value (TWCP-816).

3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Stream(s)

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated

guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the AK Information Summary. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type) (TWCP-934)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

## 3.3 Waste Physical Form and Content Description

Wastes generated by Pu-238 operations include $^{238}$Pu-contaminated debris waste, high-efficiency particulate air (HEPA) filters, filter cake, salts, and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. Detailed information regarding the generation process, characterization, and disposal of these wastes is provided in Section 3.5 of this report.

The debris waste includes the following categories:

- Cellulose (e.g., paper, cheesecloth, cellulosic personnel protective equipment)
- Plastic (e.g., gloves, tape)
- Rubber (e.g., tubing, leaded gloves)
- Metal (e.g., wire, tools, process equipment)
- Glass (e.g., labware)
- Filters (HEPA)
- Graphite
- Ceramic
- Calcined hydroxide precipitation cakes
- Pyrochemical salts

3.4 Waste Volume and Time Period of Waste Generation

The period of generation of the Pu-238 wastes is from 1978 until the present. The P/S codes, their time periods of generation, and corresponding EPA HWNs are shown graphically in Attachment 3, Timeline for Pu-238 Operations.

Waste volumes for individual P/S codes are not tracked. Instead, waste items are segregated into similar material types and packaged into containers. Waste containers are assigned to waste streams in the AK Information Summary, and waste stream volumes are reported in that document, and in the associated AK summary reports (e.g., *Acceptable Knowledge Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47* [TWCP-AK-2.1-011]).

3.5 Waste Generation Processes

The Pu-238 for all heat source fabrication processes was produced, separated, and purified at the Savannah River Site (SRS). SRS information indicates that no RCRA-listed chemicals were used in the purification process and that the purified Pu-238 contains no RCRA constituents (TWCP-1044). The Pu-238 processes at TA-55 use no organic solvents. Also, the oxide feed materials do not contain any organic solvents. If the oxides did contain organic solvents, the latter would be boiled off or destroyed by the high temperatures used in the fabrication processes.

Pu-238 processing operations involve several different processes. The processes and P/S codes applicable to Pu-238 operations are listed below:

- P/S code ASP Aqueous Scrap Processing
- P/S code C1 Pu-238 Heat Source Calorimetry
- P/S code GPHS General Purpose Heat Source Fabrication
- P/S code MTL Metallography
- P/S code P1 Routine Pu-238 Heat Source Production
- P/S code PP Pellet Production for GPHS
- P/S code PPD Plutonium Pellet Dissolution
- P/S code R8 Pu-238 Sucrose Solutions and Waste Solidification
- P/S code RCI Recovery of $^{238}PuO_2$ (plutonium oxide) from Contaminated Iridium
- P/S code SCP Routine Scrap Processing
- P/S code WD Welding and Decontamination for GPHS
- P/S code WS Pu-238 Direct Oxide Reduction

Each of these processes is described below in detail. Timelines for these processes are shown in Attachment 3. A complete listing of P/S codes for Pu-238

operations, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. Simplified process flow diagrams for Pu-238 operations are found in Attachment 5.

Wastes from P/S code PPD, which involved the dissolution of Pu-238 pellets in Room 209, were packaged with Pu-238 wastes. This P/S code is described in the *Process AK Report for Special Processing* (TWCP-AK-2.1-007). In addition, ash from P/S code TDC was packaged with other Pu-238 wastes when combustible material from Pu-238 processes were ashed under this activity. P/S code TDC is discussed in the *Process AK Report for Nitrate Operations* (TWCP-AK-2.1-005).

3.5.1 Aqueous Scrap Processing (P/S code ASP)

P/S code ASP is a new activity that covers work involved in the purification of solid $^{238}PuO_2$ in a nitric acid stream (TWCP-5600), similar to the recovery activities already established for Pu-239 as part of TA-55 nitrate operations (e.g., P/S codes ED, MPD, SC and SP described in Section 3.5.2 of TWCP-AK-2.1-005,R.2). A flow chart showing the Pu-238 Aqueous Scrap Recovery Process (P/S code ASP) is shown in Attachment 5.

During comminution, the weighed Pu-238 solid is ground to a particle size < 5 μm. After the comminution, all or a portion of the ground material is put into a dissolution vessel.

The $^{238}Pu$ solid is dissolved in a mixture of refluxing concentrated nitric acid ($HNO_3$) and hydrofluoric acid (HF) for up to 8 hours. After dissolution is performed, the $^{238}Pu$-rich solution is filtered through a 5-μm teflon membrane. The used teflon membrane is stored in a stainless steel can. A portion of the filtrate may be processed through ion exchange, or the entire filtrate may be treated for oxalate precipitation.

Oxalate precipitation involves an acid adjustment of the filtrate to 1-2 M $HNO_3$, while the solution is continuously stirred using the mechanical stir bar. Urea is added to scavenge nitrite salt that could interfere with further chemical pretreatment. Hydroxylamine nitrate is added to adjust the valence of the plutonium to (III). Oxalic acid is added to form a Pu-oxalate precipitate. The precipitate is filtered, and calcination converts the Pu-238-oxalate to $^{238}PuO_2$ product. The solid product is cooled, weighed, and stored.

The dissolution Pu-238-filtrate destined for ion exchange may undergo an aluminum nitrate treatment. The dissolution Pu-238-filtrate is added to aluminum nitrate dissolved in dilute nitric acid, followed by a filtration step to collect any formed solids. (Typically, the aluminum nitrate treatment is not performed.) The filtrate then undergoes a pretreatment involving urea, sodium nitrite, and ferrous salt prior to ion

exchange. The Pu-rich eluate is collected and undergoes oxalate precipitation as described above. The Pu-lean effluent, which contains impurity metal ions, as well as the aluminum from the aluminum nitrate treatment, is neutralized to pH 10-12 with sodium hydroxide. Under these neutralization conditions, the majority of the impurity ions and Pu-238 (not precipitated as an oxalate precipitate) will precipitate as metal hydroxides.

The hydroxide precipitate is calcined then stored, and the hydroxide filtrate is sampled to determine the radioactivity level. If above the discard limit, the hydroxide filtrates are transferred to the residue solidification process (P/S code R8). In this process, any soluble Pu-238 is recovered with ferric nitrate and sodium hydroxide, and the filtrate resulting from the solidification process is sent to the TA-50 RLWTF through the caustic waste line.

The Pu-238 in the hydroxide filtrates can also be recovered by a ultrafiltration/ polymer filtration (UF/PF) process operated by NMT-11 personnel.

The $^{238}PuO_2$ product is sent to P/S code P1. The hydroxide cakes are stored either in the vault or in the glovebox line under P/S codes MM or ASP.

3.5.2 Heat Source Fabrication (P/S codes GPHS and P1)

Pu-238 heat sources that are routinely fabricated at TA-55 include the General Purpose Heat Source (GPHS, produced under the P/S code with the same name), Lightweight Radioisotope Heater Unit (LWRHU), and Milliwatt Generator (MWG) Program. The latter two heat sources are produced under P/S code P1. Heat source production involves fuel fabrication, pellet production, and scrap and process residues processing. Each of these is a separate operation, using different materials and generating different types of waste; therefore, they are addressed individually. Debris waste containing lead gloves may be generated by any of these processes. This waste is segregated from non-lead debris waste and disposed as RCRA-regulated TRU waste (TWCP-3545/P238-02).

Fuel Fabrication

The fuel fabrication process occurs in Room 207. The feed material for fuel fabrication is $^{238}PuO_2$ from SRS. The SRS has been directly or indirectly the source of all feed material for fuel fabrication (TWCP-3545/P238-01). The material physically resides in the TA-55 vault or in Pu-238 heat source calorimetry operations (P/S code C1, does not generate TRU waste) before being introduced into the fabrication

process. This material goes through the physical processes of weighing, splitting, ball milling, slugging and screening, and granule seasoning. The material also undergoes oxygen isotopic exchange, in which oxygen-17 and oxygen-18 are replaced by oxygen-16 as the material is heated to 775 °C. In GPHS and LWRHU processing, oxygen exchange is followed by heating to 1000 °C to release alpha-decay helium from the $PuO_2$ crystal structure. GPHS and LWRHU season a portion of the granules at 1600 °C and a second portion at 1100 °C. The latter two processes ultimately hot press the pellets at 1530 °C and later heat treat the pellets at 1000 °C and finally at 1527 °C. By contrast, the MWG processing scheme seasons all the granules at 1600 °C, then mixes the $PuO_2$ with powdered yttrium metal and heats it at 1350 °C to form a sub-stoichiometric plutonium oxide. In all cases, the high temperatures ensure that any organic material that might have been present in the initial feedstock would not carry through to the final product.

No RCRA-regulated solvents or metals are introduced to the process, and all waste generated from the fuel fabrication process is nonmixed waste. The residues and products from this process feed into other Pu-238 processing operations (e.g., pellet production and scrap and process residues processing). (TWCP-3545/P238-03)

During the fuel fabrication process, analytical samples are frequently required for both $^{238}PuO_2$ feed material and product specimens either to characterize the material or to determine whether the material meets current production specifications (TWCP-3545/P238-04). The sampling occurs in Room 207. The sampling points are identified in the P1 Fuel Fabrication flow diagram (TWCP-3545/P238-03). All spatulas are stainless steel and the containers used to transfer or store the samples are stainless steel, tantalum, or glass. The primary capsule is cleaned in an ultrasonic cleaner with ethanol and allowed to air-dry (TWCP-3545/P238-04). This spent ethanol is not TRU waste. Sampling tools are wiped down with cheesecloth containing ethanol, resulting in cloth contaminated with ethanol and possibly a small amount of Pu-238 (TWCP-3545/P238-05). However, the ethanol on the cheesecloth would have been used up in the wipe-down process (TWCP-3545/P238-01). Thus, TRU waste generated from sampling operations includes Pu-238-contaminated debris consisting of cheesecloth (ethanol would have been used up in the process), stainless steel spatulas and containers, glass and tantalum capsules, and plastic secondary capsules.

A sample from the fuel fabrication process is taken to perform particle size analysis on $^{238}PuO_2$. This analysis is conducted in Rooms 201 and 206. Ethylene glycol is used to suspend the $^{238}PuO_2$ powder. Cleaning solutions containing water, soap, and Fantastik are used to clean the external surfaces of the sample cuvettes. These are the only chemicals

used in this analytical process and do not constitute RCRA-regulated waste. (TWCP-3545/P238-06)

The sample is placed into a disposable polystyrene cuvette containing a magnetic stir bar and 2 milliliters (mL) ethylene glycol. The cuvette is sealed with a polystyrene cap coated with Duco cement. After the glue has set, the cuvette is ultrasonically cleaned in a water bath containing a high-purity soap (e.g., Alconox), is cleaned a second time in a bath of distilled water, and is wiped down with a cheesecloth pad soaked in Fantastik cleaning solution. The cuvette is then transferred to another hood for final decontamination with Fantastik-soaked cheesecloth (TWCP-3545/P238-06). This process of cleaning and transferring the cuvette occurred up to 1994. From early 1994 onward, the water bath does not contain soap and Fantastik is not used because all work is performed in the same glovebox line and there is no need to decontaminate the cuvette. Before 1994, if the water was radioactively contaminated, it was discarded to the RLWTF. From 1994 onward, the water has been evaporated. (TWCP-3545/P238-20)

Upon completion of the analysis, the ethylene glycol containing the $^{238}PuO_2$ is poured through a coarse sieve and collected in a polyethylene bottle. When 200 - 500 mL of ethylene glycol has accumulated in the bottle, the contents are poured through a filter. The residue and filter paper are allowed to dry and are sent to a plutonium recovery process. The contaminated ethylene glycol is collected until a sufficient amount is available to discard, and then it is poured onto a bed of vermiculite for absorption. The resulting waste is nonmixed, solid TRU waste. The magnetic stir bars and cuvette caps are reused. The debris waste generated by this process would include $^{238}Pu$-contaminated cheesecloth, polystyrene cuvettes, polyethylene bottles, and routine laboratory trash. (TWCP-3545/P238-06)

Pellet Production

The feed material for the pellet production process consists of $^{238}PuO_2$ from fuel fabrication. This material undergoes the physical processes of screening and weighing, die loading, hot pressing, sintering, and dimensioning. The product is sent to the vault and any residues are sent to the scrap and process residues processing operation. No solvents or metals are introduced in this process; therefore, any waste generated is nonmixed TRU debris waste. (TWCP-3545/P238-07)

Decontamination

A solution of nitric and hydrofluoric acid is used for decontaminating the fuel clads. The clad heat sources are immersed in the solution a minimum of three times to allow the acids to dissolve any $PuO_2$ particles

on the clad surface. Each time, the heat sources are removed from the acid solution and placed on a rag dampened with water. A rubbing action removes contamination while the heat of the source causes the acid solution and water on the rag to evaporate at a fairly rapid rate. The TRU acid solutions generated by the decontamination steps are neutralized to precipitate plutonium, and the filtrate is discarded into the caustic waste line to the RLWTF at TA-50. The plutonium precipitate is discarded if they meet the DL. The only other process chemical, UCAR C-34, is an epoxy for sealing the graphite aeroshell of the LWRHU heat source assembly. The epoxy is not RCRA-regulated (TWCP-1027).

Scrap and Process Residues Processing

The scrap and process residues processing operation receives materials from the vault and various other processes, such as fuel fabrication, pellet production, calorimetry, and metallography. This is a physical process consisting of weighing, sorting, segregating, and loading into a shipping container. The product from this process either goes to the vault or feeds into calorimetry operations (P/S code C1, which does not generate any TRU waste). No solvents or metals are introduced into this process. Therefore, the waste generated is nonmixed TRU debris contaminated with $^{238}Pu$. (TWCP-3545/P238-08)

### 3.5.3 Metallography (P/S code MTL)

The metallography process in Room 201 began in 1992 and is still active. It receives feed material from P/S code P1 processes in the form of $^{238}PuO_2$ fuel recovered from encapsulated heat sources, impacted heat sources, fuel pellets, or other sources. The metallography process is a physical process involving cutting, mounting, grinding, polishing, photography, and etching (TWCP-3545/P238-09). No oils are used in any of these operations. Although chemicals are used to mount and etch the $^{238}PuO_2$, this process only generates $^{238}Pu$-contaminated debris waste (TWCP-3545/P238-10).

An epoxy-based mounting resin, hardener, and mount filler is used to mount the $^{238}PuO_2$ (TWCP-3545/P238-10). The epoxy resin, hardener, and mount filler consist of diethylenetriamine, Epon® Resin 8132, and a citofix/durofix liquid. Epon® Resin 8132 is a liquid that polymerizes when mixed with an amine (e.g., diethylenetriamine). The citofix/durofix liquid is also a polymer. These chemicals harden (polymerize) upon use and are not a hazardous waste. (TWCP-3545/P238-20)

One end of a phenolic ring is covered with aluminum tape. The $^{238}PuO_2$ sample is placed in the center of the interior surface of the tape. The mixture of epoxy resin, hardener, and filler is poured into the mount

ring. The mounted sample is placed in a small aluminum film can, which is placed in a pressure bomb. The bomb is pressurized for a minimum of 10 hours, then vented, and the sample is removed. The mounted $^{238}PuO_2$ sample then undergoes grinding and polishing. (TWCP-3545/P238-10)

Manual grinding and polishing involves moving the mounted sample across wet silicon carbide grinding papers of varying grits that are laid over a glass plate. Between each grinding step and after the last grinding step, the sample is ultrasonically cleaned in distilled water. The mounted sample is polished using aqueous suspensions of aluminum oxide or diamond. After polishing, the sample is cleaned in distilled water. Automated grinding and polishing involves using programmable equipment. The grinding process uses a metal or cloth platen that has been coated with an abrasive slurry. This process also involves cleaning the polished sample in distilled water. (TWCP-3545/P238-10)

Whenever there is a requirement to examine and/or document the $^{238}PuO_2$ grain boundaries, the surface of the polished sample is etched using a solution consisting of 93% hydrobromic acid, 5% hydrochloric acid, and 2% hydrofluoric acid. The etching solution is made up on an as-needed basis and only in quantities less than 100 mL. The etching solution applied to the sample surface readily dries and must be replenished; therefore, there will not be any excess etching solution contaminated with $^{238}Pu$ that would be considered waste. Upon completion of etching, the sample is rinsed with distilled water and allowed to dry. (TWCP-3545/P238-10)

Residues from the metallography process feed into the P/S code P1 process. Before 1994, the $^{238}PuO_2$ was physically removed from the plastic mount (no solvent or chemical was used), and the mount was bagged out with other plastic debris. The $^{238}PuO_2$ sample removed from the mount is sent to the P1 scrap and process residue processing operation for plutonium recovery (TWCP-3545/P238-09). However, since 1994, the $^{238}PuO_2$ has been left on the mount and archived (stored) in the glovebox line. (TWCP-3545/P238-20)

The waste generated from the metallography process includes aluminum tape, grinding papers and polishing cloths, aqueous abrasive slurries, acid etching solutions, and aqueous washing and cleaning solutions. All of these wastes are nonmixed, $^{238}Pu$-contaminated wastes. The grinding papers and polishing cloths are dried and discarded as debris waste, as is the aluminum tape. The aqueous abrasive slurries, which are not RCRA-regulated, are feed material for the $^{238}Pu$ waste solidification process (P/S code R8). Any etching solution remaining on the $^{238}PuO_2$ sample is rinsed off using distilled water and is collected with the aqueous wash solutions. These solutions, which are not RCRA-regulated, are also sent

to the waste solidification process (P/S code R8). Any excess etching solution, which is a corrosive liquid, would not be contaminated with $^{238}Pu$ and, therefore, is not TRU waste. (TWCP-3545/P238-10)

The metallography process may generate debris waste containing lead (e.g., gloves). This waste is segregated from non-lead debris waste and discarded as RCRA-regulated TRU waste (TWCP-3545/P238-02).

3.5.4 Routine Scrap Processing (P/S code SCP)

The scrap processing operation, which occurred from 1988 to 1996, received its feed material ($^{238}PuO_2$) from calorimetry operations (P/S code C1), heat source operations (P/S codes P1 and GPHS), and the vault. The feed material did not contain any hazardous constituents. The scrap processing operation took place in Room 204, and was a physical process that involved opening, weighing, sorting, and segregating the $^{238}PuO_2$ that arrived in a stainless steel inner shipping container (EP-60). The $^{238}PuO_2$ was then transferred into an outer shipping container (EP-61) and sent to the calorimetry process, and then to the vault. (TWCP-3545/P238-11)

No solvents or metals were introduced into the process; therefore, the only waste generated is solid debris waste (TWCP-3545/P238-12). Any debris waste containing lead (e.g., gloves) was segregated from non-lead debris waste and discarded as RCRA-regulated TRU waste (TWCP-3545/P238-02). The types of materials in the debris waste include cheesecloth pads and metal tools and equipment (TWCP-3545/P238-12).

3.5.5 Recovery of $^{238}PuO_2$ from Contaminated Iridium (P/S code RCI)

The process of recovering $^{238}PuO_2$ from contaminated iridium occurred from 1990 to 1992 in Room 201 (TWCP-3545/P238-13). The feed material for this process came from metal items in the iridium inventory in Building PF-4 or in the Chemistry and Metallurgy Research (CMR) Facility at TA-3. This process used both molten magnesium chloride ($MgCl_2$) and electrochemical dissolution to remove $^{238}Pu$ from iridium. (TWCP-3545/P238-14)

The first step in this process involved immersing the $^{238}PuO_2$-contaminated iridium metal in molten $MgCl_2$. The $MgCl_2$ was placed into a magnesium oxide (MgO) crucible and heated above its melting point. The same salt was used for subsequent runs until it had lost its effectiveness. The iridium shells were placed into a tantalum basket and immersed in the molten $MgCl_2$. At the end of the treatment, the iridium metal was removed from the molten $MgCl_2$, and the salt coating on the metal was removed with a water wash. This water wash was sent to the $^{238}Pu$ solidification process (P/S code R8) (TWCP-3545/P238-20). The

expended $MgCl_2$ and MgO crucible were bagged out and assayed before being discarded as $^{238}Pu$-contaminated TRU solid waste. The iridium metal was sent to the vault unless additional treatment was necessary. If further treatment was required, the iridium metal underwent electrochemical dissolution. (TWCP-3545/P238-13)

The electrolyte solution consisted of a dilute mineral acid (nitric acid, hydrochloric acid, or sulfuric acid [TWCP-3545/P238-21]) with optional salt. The iridium metal was immersed in the solution, and a current was passed between the iridium metal and a reference electrode (composed of graphite [TWCP-3545/P238-21]). At the end of the run, the iridium metal was washed with water and allowed to dry. The clean iridium metal was sent to the vault (TWCP-3545/P238-15). No solvents or toxic metals were introduced into this process (TWCP-3545/P238-21).

The waste generated from the recovery process includes solid TRU debris waste, such as $MgCl_2$ salt, MgO crucibles, tantalum and stainless steel cans, and routine laboratory trash. Any debris waste containing lead (e.g., gloves) was segregated from non-lead debris waste and discarded as RCRA-regulated TRU waste (TWCP-3545/P238-02). The spent electrolyte solution, which was acidic and contaminated with small amounts of iridium and $^{238}Pu$, and the water wash were sent to the $^{238}Pu$ solidification process (P/S code R8) (TWCP-3545/P238-20).

3.5.6 Routine $^{238}Pu$ Waste Solidification (P/S code R8)

The process of solidifying $^{238}Pu$ in waste solutions has been conducted since 1978 in Room 206 and is still active. The feed material for this process comes from analytical operations (LANL groups CHM-1 and CLS-1), $^{238}Pu$ heat source fabrication operations, metallography operations, and $^{238}Pu$ decontamination operations (TWCP-3545/P238-16, 17, 18). The feed solutions are strongly acidic, contain heavy metals (TWCP-3545/P238-18), and have $^{238}Pu$ concentrations orders of magnitude above the discard limit for radioactive waste solutions. The solidification process uses sodium hydroxide, ferric nitrate [$Fe(NO_3)_3 \cdot 9H_2O$], and phenolphthalein (1%) in ethanol to precipitate the $^{238}Pu$. (TWCP-3545/P238-16)

Ferric nitrate solids are dissolved into the feed solutions to act as a flocculant. Concentrated sodium hydroxide solution is then added to convert the acidic solutions into basic (caustic) solutions, and cause the ferric ions and the $^{238}Pu$ ions in the solutions to co-precipitate as hydroxides. The phenolphthalein solution is used to indicate when the solution is basic. After sedimentation and vacuum filtration, the liquid portion (filtrate) is sampled and alpha-assayed to determine the residual $^{238}Pu$ concentration. The sludge is heated (calcined), such that the hydroxides are converted into oxides for disposal. This procedure is

repeated as necessary for the filtrate until the $^{238}$Pu concentration in the filtrate is below the discard limit. (TWCP-3545/P238-16)

The waste generated by this process consists of calcined ferric oxide solids containing $^{238}$Pu, a caustic solution containing $^{238}$Pu below the discard limit, and solid debris. The oxide solids are sent to the vault or disposed as waste, depending on the $^{238}$Pu concentration. The caustic solution is discarded into the caustic drain to the pretreatment plant at the RLWTF (TA-50, Building 1, Room 60). The solid debris waste consists of glassware, teflon, ceramic, stainless steel, tygon tubing, plastic, and paper.

The only potential sources of RCRA-regulated constituents in this process are the analytical solutions received as feed materials from LANL groups CHM-1, CLS-1, and other analytical chemistry groups. Nine $^{238}$Pu solutions were stored in the vault at the time that this process was performed but none of these contained RCRA-regulated constituents, according to the coding remarks on the Material Accountability and Safeguards System (MASS) printouts. This absence of RCRA-regulated materials is consistent with the Waste Profile Request Form (WPRF) under which the solutions were received from LANL Groups CHM-1 and CLS-1. The WPRF was generated on 04/27/92 by T.K. Marshall and identifies corrosive acids and radioisotopes as being the only hazardous constituents in the solutions. No organic constituents were noted on the WPRF for these solutions. (TWCP-3545/P238-01)

The analytical techniques for $^{238}$Pu solutions do not require the introduction of organic solvents or heavy metals into the solutions. In addition, the $^{238}$Pu solutions returning from analytical chemistry are analyzed for heavy metals (totals) in a random fashion along with routine analyses for pH (or acid concentration) and radioactivity. Thus, between 1992 and 1997, 68 analyses were performed on 49 solutions returning from Group CLS-1, as follows: arsenic (4 analyses), barium (3), cadmium (4), chromium (24), lead (3), mercury (6), selenium (5), and silver (19). None of the analytical results for total metals (adjusted for the 20:1 dilution factor in accordance with Toxicity Characteristic Leaching Protocol [TCLP]) exceeded the RCRA regulatory level for the toxicity characteristic for the metals. Two of the results for mercury were inconclusive due to insufficient sensitivity in the analysis. (TWCP-3545/P238-01, 18)

The hydroxide ferroflocculation process conceivably could concentrate the heavy metals from the analytical solutions sufficiently to put them above the regulatory level for toxicity in the hydroxide cakes. Based on the concentration of metals in the feed waste stream (CLS-1 solutions)

and the chemistry involved in the solidification process, arsenic, barium, some chromium, and selenium will remain in the filtrate. Cadmium, lead, mercury, and silver will precipitate with the hydroxide cakes and will remain in the cakes during the calcination process. Since May 1991, the filtrate from this process has been analyzed for metals and all results have been below the RCRA regulatory limits.

Recent analytical information on Pu-238 hydroxide cakes that were calcined indicate that neither silver nor cadmium are present in concentrations large enough to be of concern. This is based on the fact that the primary source of these elements is as impurities in the plutonium oxide as supplied by SRS. Based on historical and present DLs for Pu-238 waste streams, if the Pu-238 concentrations are low enough to meet the DLs, silver and cadmium concentrations will readily occur at less than the TCLP limits for hazardous materials. Thus only chromium, lead, and mercury are present in concentrations in the calcined cake to require the use of the corresponding HWNs.

In addition, a review of nondestructive analysis results on hydroxide cakes revealed that the highest plutonium concentration in a set of calcined cakes was 7.4 weight percent Pu. Because the heavy metal contaminants are concentrated in the course of performing the hydroxide precipitation, contamination of other waste matices by the hydroxide cake is the most likely souce of RCRA levels of of the heavy metals in those waste streams. If the Pu content of the hydroxide cake is 7.4 weight percent and the maximum Pu allowed in a waste matrix other than hydroxide cake is 18.6 grams of Pu per kilogram of combustibles, then

The solid debris waste generated from this process is disposed as TRU solid, non-mixed waste. Any debris waste containing lead (e.g., leaded gloves) would have been discarded as mixed TRU waste to which EPA HWN D008 would be applicable (TWCP-3545/P238-02).

3.5.7 Recovery of $^{238}Pu$ from Sucrose Solutions (P/S code R8)

The recovery of $^{238}Pu$ from sucrose solutions, which occurred from 1978 to 1988, was performed in Room 206. The feed material for this process consisted of a 35% sucrose solution composed of sodium pyrophosphate, water, and sucrose. Sucrose solutions were used as a dispersive medium in particle size analysis of $^{238}PuO_2$; therefore, the feed solutions contained $^{238}PuO_2$. (TWCP-3545/P238-19)

The $^{238}Pu$ was recovered from these sucrose suspensions by filtering out the $^{238}PuO_2$ in a ceramic filter boat and evaporating the solution to dryness over low heat. The $^{238}PuO_2$ residue was scraped off the filter paper and calcined, then sent off-site for reprocessing. The residue from the evaporated solution was calcined and sent for discard if the $^{238}Pu$

content was below the discard limit. If the residue was not discardable, it was sent to another location. (TWCP-3545/P238-19)

This recovery operation was a physical process. No solvents were introduced during the process or with the feed material. The wastes generated from this process consist of a calcined residue of sucrose and solid debris waste. The debris waste may contain stainless steel, ceramic, glassware, tygon tubing, and filter paper. All of the waste generated is solid TRU waste. Any laboratory debris waste containing lead (e.g., gloves) is segregated from non-lead debris waste and is discarded as RCRA-regulated TRU waste (TWCP-3545/P238-02).

3.5.8 Pu-238 Direct Oxide Reduction (P/S code WS)

P/S code WS was an activity that was performed in October 1998 and October 1999 (TWCP-5707). There are no current plans to perform this operation again but the code is still active. P/S code WS is a single cycle process that uses Direct Oxide Reduction (DOR) (described for P/S code OR in TWCP-AK-2.1-006,R.2). In this process, $PuO_2$ and calcium metal are reacted in molten calcium chloride ($CaCl_2$) to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible at 820°C to 875°C. Any arsenic, mercury or selenium present in the impure plutonium oxide would be driven off due to their volatility at this high temperature (TWCP-1258). The reaction proceeds to completion when excess calcium is present and when sufficient $CaCl_2$ is available to dissolve the calcium oxide (CaO) product.

After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide. All DOR salts are exposed to air to oxidize any pyrophoric metals that might be present. The salt is then either routed through aqueous recovery operations (P/S code ASP) to recover the plutonium, or else discarded as waste along with the remaining calcium metal, which has been converted to calcium oxide, and MgO crucible pieces.

3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for Pu-238 operations at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for Pu-238 operations consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites. The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

**Table 1. Process Feed Materials for Pu-238 Operations**

| Feed Material | RCRA-Regulated Substances | P/S Codes in Pu-238 Operations |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated heavy metals: chromium (D007), lead (D008), and mercury (D009 | R8 |
| Scrap oxide | Variable purity, no RCRA substances present | ASP |
| Iridium metal | Typically fairly pure, no RCRA substances present | RCI |
| Pu oxalates and hydroxides | Typically fairly pure, no RCRA substances present | ASP |
| Pu oxide | Incoming Pu-238 oxide from SRS exceeds regulatory limits for chromium (D007) and may exceed limits for cadmium (D006), lead D008) and silver (D011) for some fuel lots (TWCP-1025, TWCP-1026, TWCP-1030). However, calculations documented in TWCP-AK-2.1-011 support the conclusion that the levels of these metals in TA-55 waste streams from Pu-238 operations are below RCRA's regulatory limits. | ASP, GPHS, MTL, P1, SCP |
| Plutonium oxide | Typically fairly pure, no RCRA substances present | WS |

3.6.1 Physical Waste Form Identification

Solid waste from Pu-238 operations primarily consists of debris waste and ferric oxide (derived from calcination of ferric hydroxide precipitates). Debris waste contains glassware, plastics, ceramic materials, cellulose-based personal protective equipment, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated as process waste. Prior to May 1992, leaded gloves were discarded as metal debris and were not segregated from other metal wastes. Since that time, they have been routinely segregated from other metal debris waste and assigned EPA HWN D008. The ferric oxide is sent to the vault or discarded, depending on its $^{238}$Pu content. In addition, caustic solutions from ferric hydroxide precipitation are discarded through the waste line to the RLWTF at TA-50.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item identification number and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance personnel.

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for Pu-238 operations at TA-55 are listed in Table 2. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

**Table 2. Average Isotopic Content of Pu-238 Material Types and Enrichments**

| Material Type (MT) | Plutonium isotope and half-life (Weight %) | | | | | | Upper limits for weight ratios | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

Source: TWCP-698

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in americium depending on whether the source of contamination is the process product or the process residues (TWCP-882).

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from Pu-238 operations at TA-55.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all. U-234 is expected to be the most common uranium isotope in MT 83 waste because it is the decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total Pu would be about 0.14U-238 would only be present if purposefully added to the feed material. U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. No U-236 is present.

Less common radionuclides present as trace-level contaminants in TA-55 plutonium operations, including the Pu-238 operations, are Am-241, Am-243, Cs-137, Np-237, Th-232, U-235, and U-238.

Table 3 lists analyses of actinide impurities in several $^{238}PuO_2$ fuel lots as received from SRS for LWRHU production. For the actinides measured, the total concentrations of actinide impurities in the sampled fuel lots are less than 5000 ppm, or 0.5 weight percent.

**Table 3. Actinide Impurities in $^{238}PuO_2$ Fuel Lots for Cassini Program**

| Isotope | Concentration in LANL Fuel Lot (μg/g Pu) | | | | |
|---|---|---|---|---|---|
| | *272* | *274* | *275* | *285* | *286* |
| $^{232}Th$ | 1700 | 1800 | 2300 | 2190 | 1845 |
| $^{234}U$ | 300 | 190 | 1070 | 720 | 615 |
| $^{236}Pu$ | <1 | <1 | <1 | <1 | <1 |
| $^{237}Np$ | 1030 | 1060 | 1460 | 1500 | 1545 |
| $^{241}Am$ | 46 | 49 | 71 | 29 | 36 |
| Total | 3076 | 3099 | 4901 | 4439 | 4041 |

Source: TWCP-1030

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The AK report for Pu-238 waste streams will be updated to incorporate the results of these comparisons.

3.6.3 Chemical Content Identification

Chemical inputs to Pu-238 operation processes are listed in Table 4. The use of strong acids, bases, or oxidizers does not result in RCRA listings for solid wastes from these processes because of the absence of free liquids in this waste.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

EPA HWN assignments to process wastes from Pu-238 operations are summarized below, as well as on the process timelines in Attachment 3, and in the table of process inputs and outputs in Attachment 4. These assignments take into account the possible presence of RCRA-listed chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

4.1 F, K, and P Listings

RCRA-regulated F-listed, K-listed and P-listed materials are not present in the feed materials and are not introduced as a part of Pu-238 operations. Therefore, no F-listed, K-listed or P-listed constituents are present in solid waste generated by Pu-238 operations.

**Table 4. Chemical Inputs to Processes Described in This Report**

| Chemical Input | Comments on Applicability of RCRA Listing |
|---|---|
| **Gas** | No RCRA-regulated gases are used |
| Argon gas | |
| **Acids** | |
| Hydrobromic acid | D002 (corrosivity) does not apply to the solid debris waste because there are no free liquids in this waste. D001 (oxidizer) does not apply to the use of nitric acid for the same reason. |
| Hydrochloric acid | |
| Hydrofluoric acid | |
| Nitric acid | |
| Oxalic acid | |
| Sulfuric acid | |
| **Base** | |
| Sodium hydroxide | D002 does not apply to the solid debris waste because there are no free liquids in this waste. |
| **Inorganic Chemicals** | No RCRA-regulated inorganic chemicals are used |
| Aluminum nitrate | |
| Aluminum oxide | |
| Calcium chloride | |
| Diamond | |
| Ferric nitrate | |
| Ferrous salt | |
| Hydroxylamine nitrate | |
| Magnesium chloride | |
| Magnesium oxide | |
| Silicon carbide | |
| Sodium nitrite | |
| Sodium pyrophosphate | |
| **Metals** | No RCRA-regulated metals are used |
| Calcium | |
| Iridium | |
| Yttrium | |
| **Organic Chemicals** | |
| Diethylenetriamine | |
| Duco cement (glue) | |
| Epoxy mounting resin | |
| Ethanol | D001 (ignitability) does not apply because there is no free liquid in solid debris waste. |
| Ethylene glycol | |
| Fantastik | |
| Ion exchange resins | |
| Phenophthalein | |
| Sucrose | |
| UCAR C-34 cement | |
| Urea | |

4.2 Toxicity Listings

EPA HWNs D007 (chromium), D008 (lead), and D009 (mercury) are applicable to only the calcined hydroxide cake waste generated by P/S code R8.

Sampling and analysis of waste material from Pu-238 waste streams has been performed to confirm that these waste streams do not contain regulated heavy metals above regulatory levels (TWCP-1698, TWCP-AK-2.1-011). Table 5 summarizes the analytical results, which show that all of the randomly selected items for the TCLP test are below the regulated concentrations. These analyses confirm the high purity of the SRS feed material, and the absence of RCRA-regulated metals from Pu-238 processing operations at TA-55.

**Table 5. TCLP Concentrations (ppm) in Wastes from Pu-238 Operations**

| Description | Silver | Arsenic | Barium | Cadmium | Chromium | Lead | Selenium | Mercury |
|---|---|---|---|---|---|---|---|---|
| *Detection Limit* [a] | *0.022* | *0.33* | *0.0055* | *0.022* | *0.055* | *0.22* | *0.55* | *0.0001* |
| *RCRA regulatory threshold* | *5* | *5* | *100* | *1* | *5* | *5* | *1* | *0.2* |
| Metal I | 0.031 | --- | 0.14 | --- | --- | --- | --- | 0.0003 [b] |
| Metal II | --- [c] | --- | 0.17 | --- | --- [c] | --- | --- | 0.005 |
| Plastic I | --- | --- | 0.62 | 0.44 | --- | --- | --- | --- [b] |
| Plastic II | --- [c] | --- | 0.39 | --- | 0.093 [c] | --- | --- | 0.0002 |
| Plastic III | --- [c] | --- | 0.24 | --- | 0.21 [c] | --- | --- | 0.0002 |
| Rubber I | --- | --- | 1.8 | --- | 0.099 | --- | --- | --- [b] |
| Rubber II | --- [c] | --- | 0.34 | --- | 0.071 [c] | --- | --- | 0.0002 |
| Combustible and rags I | --- [c] | --- | 0.32 | 0.057 | --- [c] | --- | --- | 0.0002 |
| Combustible and rags II | --- [c] | --- | 0.37 | 0.101 | 0.079 [c] | 2.1 | --- | 0.0006 |
| HEPA filter I | --- [c] | --- | 1.5 | 0.11 | 1.2 [c] | --- | --- | 0.0001 |
| HEPA filter II | --- [c] | --- | 1.4 | 0.83 | 2.7 [c] | --- | --- | 0.0495 |
| HEPA ALB [d] | --- | --- | 0.006 | --- | 0.058 | --- | --- | --- [b] |
| HEPA SSH [d] | --- | --- | 0.009 | --- | 0.062 | --- | --- | --- [b] |

--- indicates "not detected," i.e., measured values below the detection limit.

[a] Detection limit represents the instrument detection limit multiplied by a dilution factor, in accordance with the Toxicity Characteristic Leaching Protocol

[b] Detection limit is 0.0003 ppm for these samples

[c] These data have been qualified during data validation. See Appendix C in TWCP-1698 for details

[d] Cold (non-radioactive) surrogate HEPA filter metal housing samples

Source: Table III.1 in TWCP-1698

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. In the event of a misfire or unconsumed explosives, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data are used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, and any containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 liters in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

Administrative and procedural controls on the prohibited pyrophorics in TRU waste and the absence of pyrophorics has been verified through testing. For items of pyrochemical

salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the RFETS (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of LANL direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Chemical Waste Disposal Requests dated as early as June 1980 included boxes that were required to be checked if the waste contained pyrophoric, flammable, corrosive, or explosive materials.

In addition, for wastes generated after the implementation of the 1987 Certification Plan, Generator Attachments, associated waste packaging procedures, and quality assurance systems, the waste generator has signed a statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The TA-55 Attachment to the Certification Plan describes how these restrictions were verified by waste management personnel (TWCP-701, Sections 3.8.5 through 3.8.7).

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the nitrate operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in lists of process inputs documented in the TA-55 process AK reports.

- In the cement fixation process (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs.

- All transformers known to contain PCBs have been tracked from initiation of operations of TA-55 in 1978. When any transformer oil is drained, the oil is handled by a subcontractor who is wholly responsible for its disposal; this oil does not enter the LANL disposal operations (TWCP-3568/N-82).

- Ballast in fluorescent light fixtures could contain PCBs, but at TA-55 these light fixtures are outside the gloveboxes and hence would not enter the TRU waste stream.

- Oil-filled capacitors are not known to have been used in TA-55 gloveboxes.

In addition, if the possibility exists for the waste to contain PCBs, RTR operators are required to check for indications of PCB-containing materials or PCB-contaminated materials. If there is reason to suspect that an item may contain PCBs (based on AK, operator training, or previous operator experience), then the operator submits a PWR and places a hold tag on the waste container (Section 6.6.6 and Table 3 in *Performing Nondestructive Testing Using the Mobile Real-Time Radiography System* [TWCP-DTP-1.2-008]).

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Performing Nondestructive Testing Using the Mobile Real-Time Radiography System* (TWCP-DTP-1.2-008)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

# ACCEPTABLE KNOWLEDGE ROADMAP

**P/S Codes:** ASP, GPHS, MTL, P1, R8, RCI, SCP, WS

Copies of these documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-0351 | C | Pu-238 discard limits | TA-55 Waste Management, 539-GEN-R02, 10/18/96, Appendix J | Lists Pu-238 discard limits in various process materials. | None |
| TWCP-0352 | C | Generic plutonium recovery process description | Wastes from Plutonium Conversion and Scrap Recovery Operation; LA-11069-MS; March 1998 | Document describes the Pu residues and the various treatment approaches used in recovering Pu from scrap. | None |
| TWCP-0415 | B | TA-55 Pu-238 processes | FSAR for TA-55 (Section 2.5.9, pp. 2-164 to 2-166) | Describes the TA-55 Pu-238 operations. | Document does not give information about RCRA constituents introduced or present in the processes. |
| TWCP-0697 | B | Waste controls | Los Alamos Certification Plan, WCP-HSE7-CPL-01,R2, 1984 | Waste was controlled to meet WIPP WAC requirements as early as 1984. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-0698 | D | Material Type compositions | Memo from Bill Schueler, NMT-7. | Gives Material Type compositions | Does not give information on actual material used in the Pu-238 processes. |
| TWCP-0700 | C | Waste controls | TA-55 Generator Attachment to the LANL Certification Plan, TRU-TA55-CPA-03,R00, 1995 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-0701 | C | Waste controls | TA-55 Generator Attachment to the LANL Certification Plan, TRU-MST12-CPA-03,R00, 1987 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-0813 | D | Waste characterization | Memo from Davis Christensen, EM-SWO: 97-201 | Clarifies the history of assigning EPA hazardous waste codes in the TRU Database to waste generated before 1993. | Indicates that EPA assignments made on the basis of AK in 1992 are subject to change through additional AK information. |
| TWCP-0816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Provides an explanation of why some containers of combustible debris may be packaged with 6 layers of confinement | No direct way to differentiate between 4 and 6 layers of packaging |
| TWCP-0882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from TA-55 Subject Matter Expert C.L. (Jim) Foxx | Wastes may be either depleted or enriched in Am-241 and U-234, depending upon whether the source of contamination is the process product or the process residue. | Text does not specifically discuss Pu-238 processes although these P/S codes are listed in the table attached to the memo |
| TWCP-0886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-0887 | D | Defense and non-defense TRU waste management | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997. | None |
| TWCP-0934 | D | Pu-238 and Pu-239 waste management | Memo from TA-55 Subject Matter Expert C.L. (Jim) Foxx | Pu-238 and Pu-239 processes and the wastes generated from those processes were segregated at TA-55. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-1025 | C | Characterization of LWRHU waste | LANL Report number LA-11166-MS pp. 8, 9, 14 | Provides tables of summarized analytical results for as-received and partially processed Pu-238 used in the Galileo LWRHU process. | Materials in these waste streams would have been produced as the result of processing many of the lots. |
| TWCP-1026 | C | Characterization of MWG waste | LANL Progress Report numbers LA-9170-PR LA-9672-PR LA-11217-PR LA-11220-PR LA-11346-PR LA-12236-PR LA-13258-PR | Tables of trace element analytical results show that some RCRA metals are present below regulatory threshold limits in the waste from the Milliwatt Generator Program, and allow calculation of maximum concentration limits for other RCRA metals. | None |
| TWCP-1027 | B | Characterization of epoxy cement used in Pu-238 process | MSDS for epoxy cement, UCAR C-34, Union Carbide Corporation | Indicates that the epoxy cement used in the Pu-238 process does not contain any RCRA-regulated materials. | None |
| TWCP-1030 | C | Characterization of LWRHU waste | LANL Report number LA-13143-MS pp. 5-6, 7-8, 17-18. | Summarized analytical results of as-received and partially processed Pu-238 materials used in the Cassini LWRHU process. | Materials in these waste streams generally would have been produced as the result of processing many of the lots. |
| TWCP-1037 | D | $^{238}$Pu fabrication process description | Written information obtained from a TA-55 waste management expert. | Detailed information of all facets of $^{238}$Pu fabrication activities. | References to documents providing additional information are not provided in the memo, but have been added to the AK Summary Report. |
| TWCP-1044 | D | Waste characterization | SRS Memo NMS-EHB-970073, March 12, 1997 | Describes the SRS process for producing the Pu-238 that was used at TA-55 and presents analyses for metals in the Cassini material. | No flow diagram included. |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-1698 | | Analyses of TRU waste from TA-55-43, Lot No. 1 | Cover letter and enclosed report, "Sampling and Analysis Project Validates Acceptable Knowledge on TA-55-43, Lot No. 01" | Analytical results confirm that TA-55-43 is not a hazardous waste regulated by RCRA | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests are on residues rather than waste that is lower in Pu content; hence, they are conservative. |
| TWCP-3545/P238-01 | C | General process information | Comments from Jim Foxx on the draft $^{238}$Pu AK Summary Report, 11/99 | Details for the $^{238}$Pu process, specifically RCRA-regulated metals in the R8 process and radioisotope information. | None |
| TWCP-3545/P238-02 | D | General $^{238}$Pu process information | Interview with Jim Foxx, 9/21/99 | Waste generated from $^{238}$Pu processes. | None |
| TWCP-3545/P238-03 | C | Pu-238 fuel fabrication process description (P/S code P1) | Process flow diagram for Routine Pu-238 Heat Source Production – Fuel Fabrication, 5/14/98 | Overview of the Pu-238 fuel fabrication process, identifying steps within the process and process outputs. Date established is 9/25/91. | None |
| TWCP-3545/P238-04 | C | Heat source production process description (P/S code P1) | Sampling $PuO_2$ Procedure; HS-CMB11-PP13, Rev. 0 through Rev. 3, 2/20/80 through 3/24/82; HS-MST11-PP-13, Rev. 4 through Rev. 10, 10/22/82 through 4/26/89 | Step-by-step instructions for sampling $PuO_2$ during processing operations. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for P1 Fuel Fabrication, this procedure is assigned to P/S code P1. |
| TWCP-3545/P238-05 | D | General $^{238}$Pu process information | Interview with Jim Foxx, 8/31/99 | Waste generated from specific $^{238}$Pu processes. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3545/P238-06 | C | Chemical list, process description (P/S P1) | Particle Size Analysis of Oxide Powders Procedure, HS-NMT9-PP-42, Rev. 0 through Rev. 1, 4/22/91 through 12/11/91 | Step-by-step instructions for analyzing metal oxides and the waste disposal process. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for P1Pellet Production, this procedure is assigned to P/S code P1. |
| TWCP-3545/P238-07 | C | Pellet production process description (P/S code P1) | Process flow diagram for Routine Pu-238 Heat Source Production – Pellet Production, 5/14/98 | Overview of the pellet production process, identifying steps within the process and process outputs. Date established is 9/25/91. | None |
| TWCP-3545/P238-08 | C | Scrap and process residues process description (P/S code P1) | Process flow diagram for Routine Pu-238 Heat Source Production – Scrap and Process Residues Processing, 5/14/98 | Overview of the residues processing process, identifying steps within the process and process outputs. Date established is 6/16/88. | None |
| TWCP-3545/P238-09 | C | Metallography process description (P/S code MTL) | Process flow diagram for Metallography, 6/22/97 | Overview of the metallography process, identifying steps within the process and process outputs. Date established is 7/26/94. | None |
| TWCP-3545/P238-10 | C | Chemical list, process description (P/S code MTL) | Ceramography of $^{238}PuO_2$ fuel samples; HS-NMT9-PP-44, Rev. 0, 1/8/92 | Step-by-step instructions for the preparation and examination of $^{238}PuO_2$ fuel samples and the waste disposal process. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for MTL, this procedure is assigned to P/S code MTL. |
| TWCP-3545/P238-11 | C | Scrap processing process description (P/S code SCP) | Process flow diagram for Routine Pu-238 Scrap Processing, 8/27/91 | Overview of the scrap processing operation, identifying steps within the process and process outputs. Date established is 6/16/88. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3545/P238-12 | C | $^{238}PuO_2$ transfer process description (P/S code SCP) | Introductory Glovebox Transfer of an EP-60 into an EP-61, HS-NMT9-PP-46, Rev. 0 through Rev. 1, 12/23/91 through 9/24/92 | Step-by-step instructions for transferring $^{238}PuO_2$ from an inner shipping container into an outer shipping container. | None |
| TWCP-3545/P238-13 | C | Chemical list and process description (P/S code RCI) | Decontamination of Ir Using Molten $MgCl_2$, HS-NMT9-PP-38, Rev. 0, 5/9/90 through 10/8/92 | Provides step-by-step instructions for decontaminating Ir coated with $^{238}PuO_2$. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for RCI, this procedure is assigned to P/S code RCI. Handwritten note at top of procedure: "obsolete 10/8/92 per WI 1392." This agrees with the "SOP Document History Report" attached to the procedure. |
| TWCP-3545/P238-14 | C | Process description (P/S code RCI) | Process flow diagram for Recovery of PuO2 238 from Contaminated Iridium, 6/10/91 | Overview of the $^{238}Pu$ recovery process, identifying steps within the process and process outputs. Date established is 5/15/91. | None |
| TWCP-3545/P238-15 | C | Chemical list, process description (P/S code RCI) | Dissolution of Ir by Electrochemical Methods; HS-NMT9-PP-39, Rev. 0, 5/9/90 | Step-by-step instructions for decontaminating Ir coated with $^{238}PuO_2$ using electrochemical dissolution. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for RCI, this procedure is assigned to P/S code RCI. Handwritten note at top of procedure: "obsolete 10/8/92 per WI 1392." This agrees with the "SOP Document History Report" attached to the procedure. |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3545/P238-16 | C | Chemical list, process description (P/S code R8) | 238Pu Waste Solidification, HS-MST11-PP-34, Rev. 0, 8/4/86; HS-NMT9-PP-34, Rev. 1 through Rev. 3, 9/6/90 through 12/9/92 | Step-by-step instructions for solidifying $^{238}Pu$ waste solutions. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for R8 Waste Solidification, this procedure is assigned to P/S code R8. |
| TWCP-3545/P238-17 | C | $^{238}Pu$ waste solidification process description (P/S code R8) | Process flow diagram for $^{238}Pu$ Waste Solidification, 2/25/99 | Overview of the $^{238}Pu$ solidification process, identifying steps within the process and process outputs. Date established is 1/27/84. | None |
| TWCP-3545/P238-18 | C | Feed input for $^{238}Pu$ solidification process (P/S code R8) | Email from Jim Foxx, "RCRA Codes for Pu-238," 12/9/99 | Analytical results for RCRA-regulated metals in analytical solutions feeding the $^{238}Pu$ solidification process. | Some of the detection limits appeared to be above the regulatory limits |
| TWCP-3545/P238-19 | C | Chemical list, process description (P/S code R8) | Recovery of Plutonium-238 from Sucrose, 483-REC-R00 through R01, 5/17/83 through 9/30/83; Recovery of Plutonium-238 from Sucrose Solutions; HS-MST11-PP-36, Rev. 0, 12/18/87 | Step-by-step instructions for recovering $^{238}Pu$ from sucrose solutions. | The P/S code is not identified in the procedure. Based on the process described in the procedure, this procedure is assigned to P/S code R8 ($^{238}Pu$ recovery from sucrose). Handwritten note at top of 483-REC-R01: "Transferred to MS-11." Handwritten note at top of HS-MST11-PP-36 procedure: "obsolete 5/11/92 per WI 1324." |
| TWCP-3545/P238-20 | D | Process description and chemicals used | Interview with Jim Foxx and Gary Rinehart | Details on process description and chemicals used in the processes based on a review of the draft Pu-238 AK Summary Report. | None |
| TWCP-3545/P238-21 | D | Chemicals used in P/S code RCI | Interview with Jake Espinosa | Specific information regarding the electrolyte solution and electrodes used in the RCI process. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3545/P238-22 | C | Process descriptions for P/S codes ASP, PPD, and WS | Information provided by Jim Foxx (1/17/00) | Process flow diagram for P/S codes ASP, PPD, WS | Procedures describing the process for the P/S codes have not been identified. |
| TWCP-3545/P238-23 | D | Process information | Email from John Musgrave conveying information from Jim Foxx. | LWRHU and MWG processes are performed under P/S code P1. | None |
| TWCP-3568 /N-74 | C | Chemical list; process description (P/S code CF) | Organic Liquid Emulsification, TRU-NMT2-DP-13, R00; TRUWM-TA55-DP-13-R00; 8/30/93 through 9/30/94 | Emulsifying waste oil and other organic liquids for cement fixation. | None |
| TWCP-3568 /N-82 | C | Clarification of specific processes within the nitrate operations at TA-55 | Jim Foxx, SME, response to comments received on the *Acceptable Knowledge Summary Report for TA-55 Nitrate Operations*, draft dated 2/25/00 | Resolutions to the questions and issues raised by Pam Rogers during her review of the *Acceptable Knowledge Summary Report for TA-55 Nitrate Operations*, draft dated 2/25/00 | Information is based on SME knowledge. |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4162 | D | Segregation of non-defense wastes from defense wastes | Interview with Jim Foxx, 10/12/00 | Wastes from various processes were not segregated by funding source until recently (1997 or 1998), but rather were segregated and packaged based on waste type | Specific date for segregation by funding source not given |
| TWCP-4164 | D | Use of gases in PF-4 | Interview with Jim Foxx, 10/16/00 | Most gases used at PF-4 are stored outside the building and the gas is plumbed into the glovebox from outside the building. | None |
| TWCP-4166 | D | Disposal of spray cans used in gloveboxes | Interview with Jim Foxx, 10/17/00 | Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992. These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes. | None |
| TWCP-4167 | D | Segregation of non-defense wastes from defense wastes | Interview with Jim Foxx, 10/18/00 | Wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

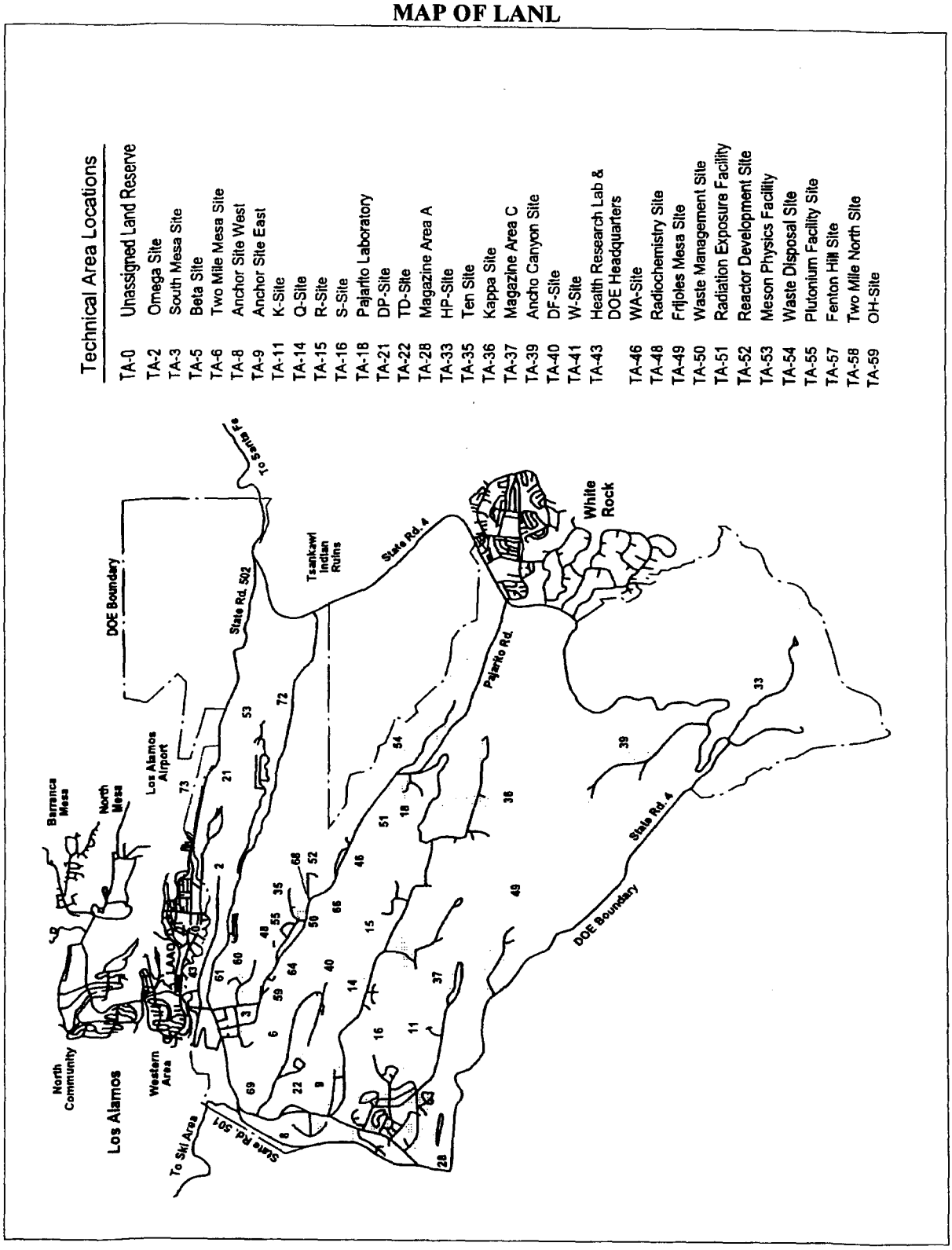
| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-5086 | B | P/S Codes for TA-55 waste items, listed by drum | P/S codes for waste items in individual drums are either from the TA-55 Waste Management System or from the certified data base | P/S codes for waste items in individual waste containers from TA-55 | Only some drums are included |
| TWCP-5600 | D | Description of P/S code ASP, including process flow chart | Interview with SME on work conducted under P/S code ASP | Description and flow chart of steps involved in P/S code ASP, Pu-238 Aqueous Scrap Recovery | None |
| TWCP-5706 | B | Procedure for Direct Oxide Reduction of 238PuO2 (P/S code WS) | NMT9-SOP-0089-R02, Direct Oxide Reduction of 238PuO2 | Description of process for P/S code WS (Direct Oxide Reduction of 238PuO2) | None |
| TWCP-5707 | D | Description of P/S code WS | Interview with SME on work conducted under P/S code WS | Description of work conducted under P/S code WS, Pu-238 Direct Oxide Production | None |
| TWCP-AK-2.1-003, R.2 | B | Summarizes AK information on processes conducted in the TA-55 metal operation processes | *Process Acceptable Knowledge Report for Metal Operation Processes* | Discusses P/S code | None |
| TWCP-AK-2.1-004, R.2 | B | Summarizes AK information on processes conducted in the TA-55 miscellaneous processes | *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* | Discusses P/S code WM | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-005, R.2 | B | Summarizes AK information on processes conducted in the TA-55 nitrate operations | *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* | Discusses P/S codes CF, ED, HP, MPD, SC, SP, and TDC | None |
| TWCP-AK-2.1-006, R.2 | B | Summarizes AK information on processes conducted in the TA-55 pyrochemical operations | *Process Acceptable Knowledge Report for Pyrochemical Operations at TA-55* | Discusses P/S code | None |
| TWCP-AK-2.1-007, R.2 | B | Summarizes AK information on processes conducted in the TA-55 special processing operations | *Process Acceptable Knowledge Report for Special Processing at TA-55* | Discusses P/S code PPD | None |
| TWCP-AK-2.1-011, R.0 | B | Waste stream report that relies upon the AK information presented in the Pu-238 process AK report | *Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47* | Relies on information in the Pu-238 process AK report | None |
| TWCP-PLAN-0.2.7-001,R.5 | B | Summarizes AK information for individual TRU waste containers | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | Assignment of individual TRU waste containers to specific waste streams | Out of date |

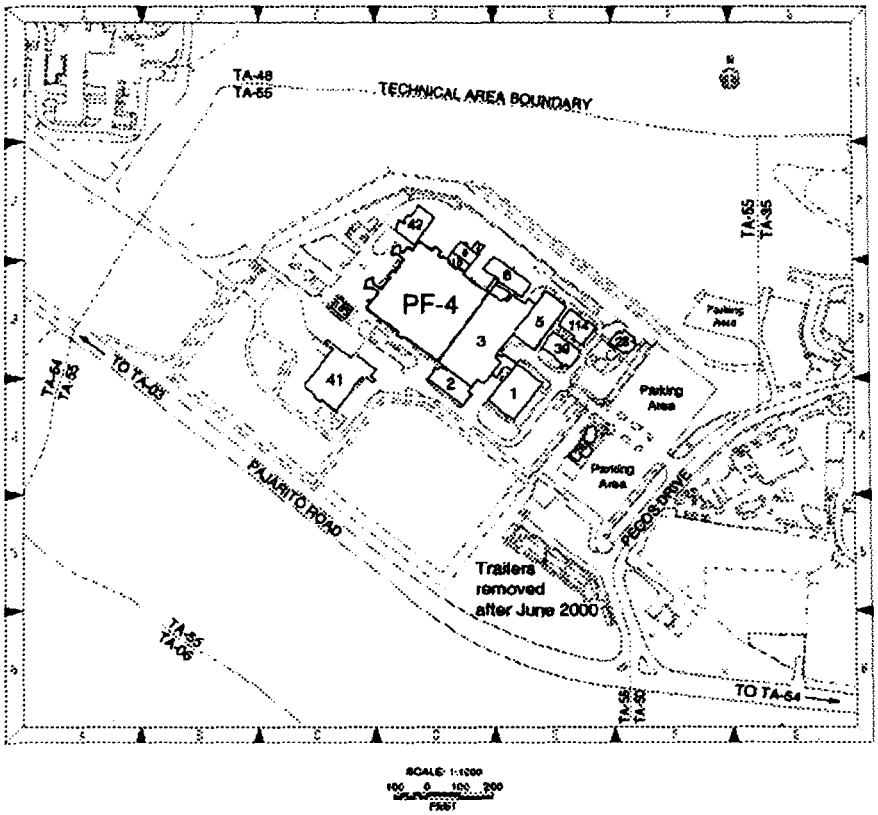
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# MAP OF LANL

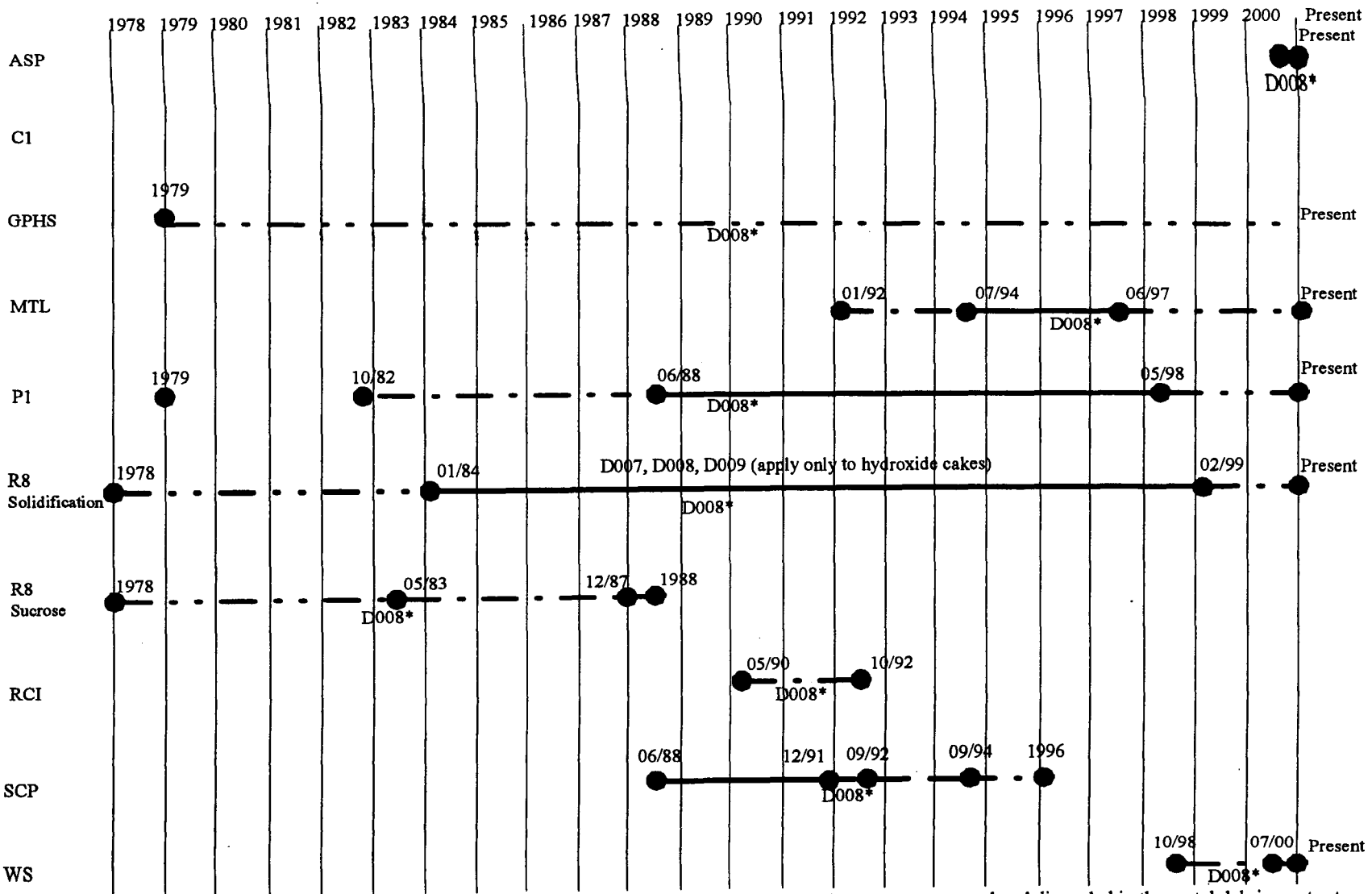

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Barranca Mesa
North Mesa
Los Alamos Airport
North Community
Los Alamos
Western Area
State Rd. 501
To Ski Area
DOE Boundary

## MAP OF TA-55

**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.



## TIMELINE FOR Pu-238 PROCESSES




*Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded glove waste stream, still under the originating P/S code (TWCP-4166).

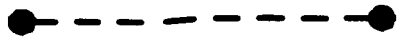
## TIMELINE EXPLANATION



The P/S code is established either in the P/S diagrams or in both (or all) revisions of the procedures designating the start and end dates (e.g., Rev. 0 to Rev. 1 or Rev. 0 to Rev. 5.



The P/S code is not identified in the procedure, but the process description matches the P/S code and the description in previous or later revisions of the same procedure.



Extrapolate out two (2) years beyond the last revision date for the procedure to the next possible review date.



Time period based on subject matter expert comments.

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| ASP | Aqueous Scrap Processing | Scrap items, oxide | Nitirc acid, sodium hydroxide, sodium oxalate | Plutonium oxalate, plutonium hydroxide | Debris | *D008 | TWCP-5600 |
| GPHS | General Purpose Heat Source | Pu-238 oxide | Yttrium metal, UCAR C-34 cement | Heat sources | Debris | *D008 | P238-01<br>P238-07<br>P238-08 |
| MTL | Metallography | Samples from P1 | Epoxy mounting resin, aluminum oxide, diamond powder, hydrobromic acid, hydrochloric acid, hydrofluoric acid | Polished samples (archived in glovebox line) | Aqueous abrasive slurries to P/S code R8, debris | *D008 | P238-10<br>P238-20 |
| P1 | Heat Source Production | Pu-238 oxide | Yttrium metal, UCAR C-34 cement | Heat sources | Debris | *D008 | P238-01<br>P238-07<br>P238-08 |
| R8 | Waste Solidification | Analytical solutions from CHM-1, CLS-1, NMT-1, C-AAC; metallography; heat source production, and plutonium decontamination operations | Sodium hydroxide, ferric nitrate, phenolphthalien, ethanol, | No product | Hydroxide cakes, debris | HWNs apply only to hydroxide cakes D006, D007, D008, *D008 D009, D011 | P238-02<br>P238-14<br>P238-15<br>P238-16<br>P238-17<br>P238-18<br>P238-20<br>P238-21 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| R8 | Recovery of Pu-238 from Sucrose Solutions | Sucrose solutions (containing sodium pyrophosphate and sucrose) used in particle size analysis of $^{238}PuO_2$ | None | calcined $^{238}PuO_2$ for reprocessing (if above DL) | Calcined residue of sucrose. Solid debris waste including stainless steel, ceramic, glassware, Tygon tubing, filter paper | *D008 | P238-02<br>P238-19 |
| RCI | Pu-238 Recovery from Iridium | Iridium contaminated with Pu-238 oxide | Magnesium chloride, nitric acid, hydrochloric acid, sulfuric acid | Cleaned iridium metal | Debris, magnesium oxide crucibles | *D008 | P238-13<br>P238-14<br>P238-20 |
| SCP | Scrap Processing | Pu-238 oxide | Physical process – no chemicals used | Pu-238 oxide | Debris | *D008 | P238-11<br>P238-12 |
| WS | Pu-238 Direct Oxide Reduction | plutonium oxide (high purity) | Calcium metal, oxygen gas, chlorine gas, calcium chloride, calcium fluoride | plutonium metal | Calcium chloride salt, magnesia crucibles, calcium oxide, calcium metal, debris | *D008 | TWCP-5706<br>TWCP-5707 |

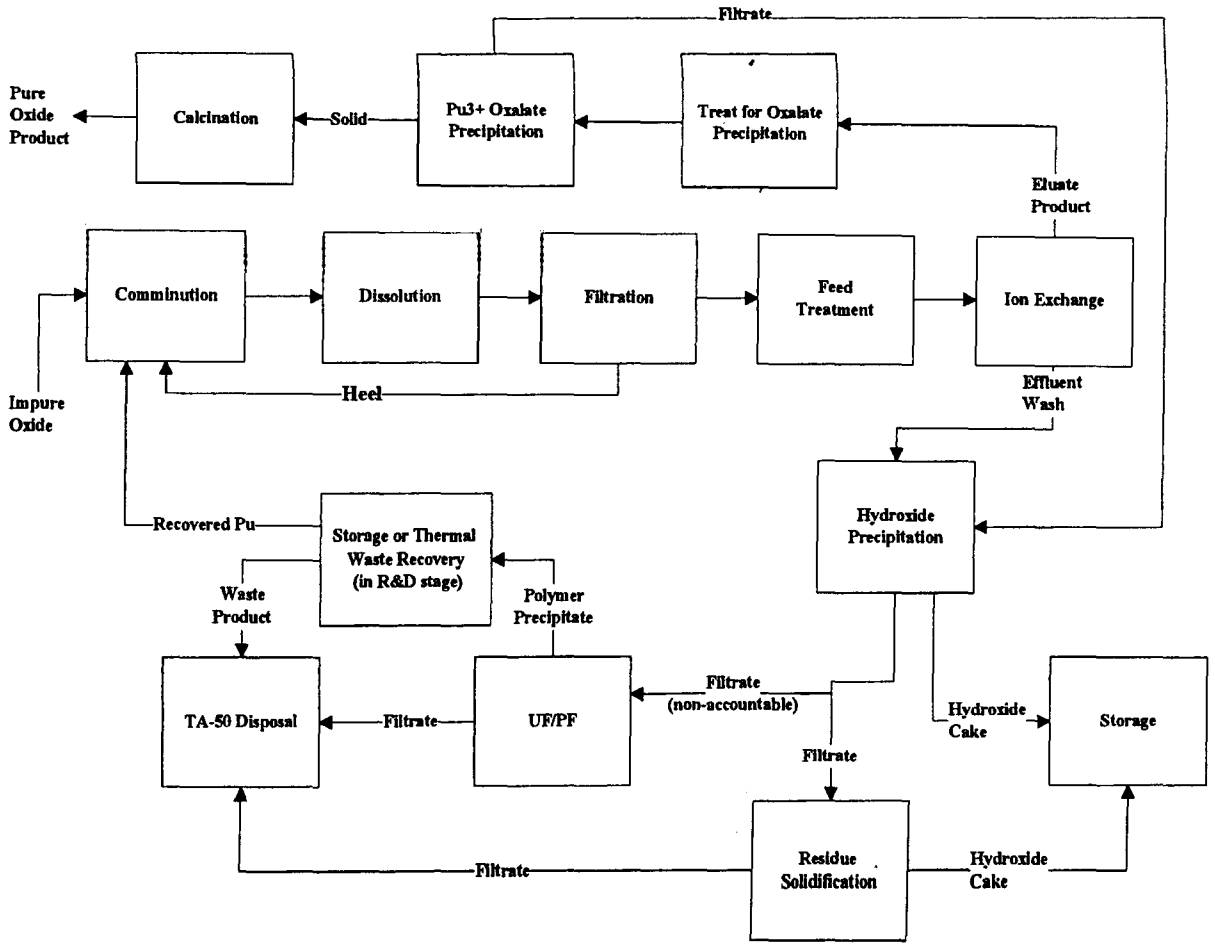
[1] All P/S codes generate routine laboratory debris waste consisting of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated.

[2] See discussion in Section 4.0 for details on the applicability of the RCRA codes listed in this column. The RCRA hazardous waste codes listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation). The resulting treated waste stream is evaluated for hazardous waste constituents and assigned the applicable EPA hazardous waste codes. All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other metal debris waste and are assigned EPA hazardous waste code D008 under the originating P/S code.

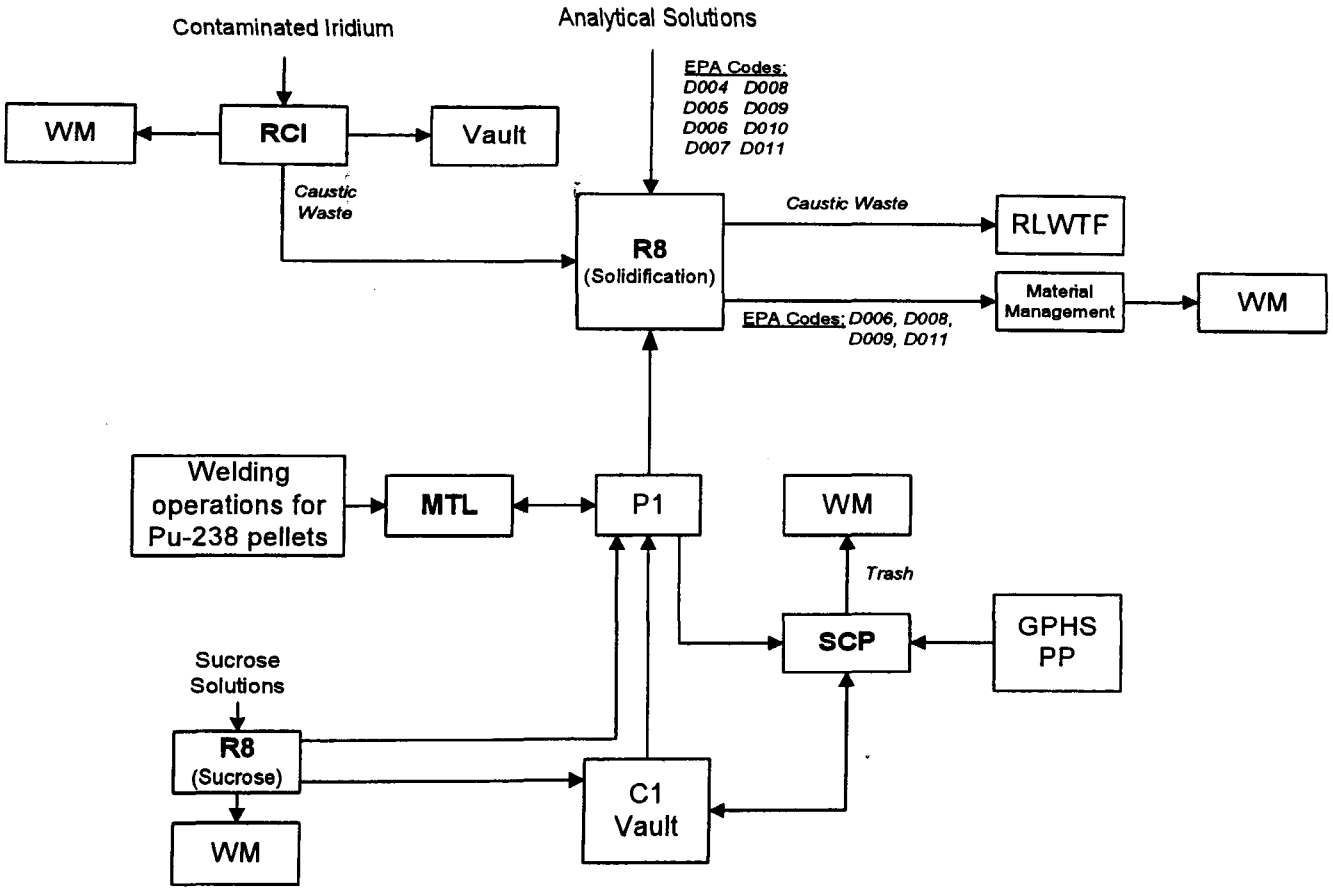
[3] Refer to the Acceptable Knowledge Roadmap in Attachment 1. References listed as P238-*nn* (where *nn* is a 2-digit number) are in TWCP-3545.

*D008 due to leaded gloves

# SIMPLIFIED Pu-238 PROCESS FLOW DIAGRAMS: AQUEOUS SCRAP PROCESSING (P/S code ASP) (TWCP-5600)



# SIMPLIFIED Pu-238 PROCESS FLOW DIAGRAMS: OTHER Pu-238 PROCESSES



## Decision/Discrepancy Resolution Documentation
### TA-55 Pu-238 Operations

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| WS | WS performed in 10/98 and 10/99 | TWCP-5707 | P/S WS--'75-'77 experimental work performed at DP site, waste not out of TA-55 | TWCP-3545/P238-2 | Process report describes activities as in TWCP-5707 | C—meeting with SMEs indicate work performed under P/S code WS in '75-'77 was at another site, not TA-55, so waste did not ever become TA-55 owned. See attached meeting notes. |
| MTL | The older metalography operations(before 1992) used solvent (e.g. trichloroethane) | TWCP-3545/P238-2 | Process report section 3.5 states Pu-238 processes at TA-55 used no organic solvents. | Process Report | Process report does not list any solvents. | C—meeting with SMEs indicated P/S code MTL did not begin until after 1992, so no trichloroethane would be in the waste post 1992. See attached meeting notes. |
| PTS | Indicates that P/S code PTS was associated with R and D research studies with Pu-238. | TWCP-3545/P238-2 | Process report does not describe PTS | Process Report | PTS code not included in process report. | C—Pu-238 PTS operations were performed in another glovebox, therefore this waste would be in under another P/S code per John Musgrave. PTS is Pretreatment studies on LANL and RFETS material, it would be under nitrate operations. See attached meeting notes. |
| PI | P/S Code PI should be taken from Pu-238 report and added to another report (report not referenced). Also indicates time line back to 1978 | TWCP-3545/P238-20 | PI still discussed in this summary report<br><br>Report timeline goes back to 1979. | Summary report | PI P/S code is very similar to CHS and LWRHU and the waste streams would be the same. Therefore the PI information should be moved to another report. | C—in meeting with SMEs, this statement meant that this information was in a previous Pu-238 draft report and needed to be included in this current report which it is. See attached meeting notes. |

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| All | Leaded gloves were always separated | TWCP-3545/P238-2 | Process report says prior to May 1992, lead gloves were discarded as metal debris and were not segregated from other metal wastes | Process Report, section 3.6.1 | | A—Process report is correct. The first statement is not correct per meeting with SMEs. See attached meeting notes. |
| General | Only lead contaminated debris is lead-lined gloves | TWCP-3545/P238-20 | Cd, Cr, and Pb are typical impurity in Pu Oxide product | TWCP-1044 | Process report, section 3.5 refers to 1044 stating there are no RCRA constituents. Questions remain if analytical data indicates they are below TCLP limits. | B—Gloves segregated after 1992 per Jim Foxx, but apply waste code to all P/S codes. See attached meeting notes. Analytical data in TWCP-2102 indicate below TCLP limits. |
| All | Two issues need to be resolved by R. Glenn—needing more info regarding electrode and electrode solutions; generators signing data package to confirm certain materials were not in the waste | TWCP-3545-P238-20 | No discussion of either of these issues in the Process report | Process report | | C—At the time TWCP-3545-P238-20 was documented, the P/S code was unknown. SMEs said that the correct P/S code was RSI and this refers to decontamination operations, which could have been performed two ways, using dilute mineral acid, or electrolyte ($MgCl_2$). No RCRA constituents. Issues are resolved. See attached meeting notes. |

Sandy Wander — AK Investigator — Sandy Wander — 2/25/02
Evaluator (Print Name) — Title — Signature — Date

Pamela Rogers — Pamela Rogers — 4/26/02
SPM Review (Print Name) — Signature — Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other (specify)]



Source: TWCP-07907

D015-AK7

QP-00-004,R.0
Effective Date: 06/18/03

TWCP-15417 C

# RECORDS SUBMITTAL

**INSTRUCTIONS:** This form is prepared by the record source when submitting individual records, batch data reports, or a records package to the RMDC Center. For records packages, a Table of Contents (TOC) must also be submitted. Each record submitted requires a complete form.

**MANDATORY:** X To the best of my knowledge, the record(s) have no radioactive contamination.

Signature: _____

**RECORD TYPE:**

X Project 2010 ☐ Facility (RRES)

☐ Other: _____ ☐ UCNI ☐ Proprietary

**RECORD SOURCE:**

Submittal Date: 7/25/03 Z No.: 109592 Name/Org: PATRICIA PATTON – RRES-CE

Originator: JOHN MUSGRAVE Organization: NMT

**TYPE OF RECORD/ACTION TO BE TAKEN**

X Individual Record ☐ Batch Data Report ☐ Records Package (+ TOC)

X New ☐ Revision* ☐ Addition* ☐ Supersedes*

*Record Barcode Number: _____ *Review Cycle (if applicable): ☐ Yes ☐ No ☐ NA

**RECORD ID NUMBER:** (e.g., memo symbol number, procedure (include revision), deficiency number, batch data report number, unique record identifier if applicable):

TWCP-AK-2.1-009, R.0

Record Date: 8/7/01 Physical Page Count: 93 X Single Sided ☐ Double Sided

Category Number: (from page two): 07

**RECORD TITLE, SUBJECT, AND/OR KEYWORDS:**

TWCP-AK-2.1-009, R.0/IC1 Process AK Report for Pu-238 Operations at TA-55 (INCLUDES INTERIM CHANGE 1) - LA-UR-01-4200 – LA-UR-02-1709

**RECORD CENTER USE ONLY**

☑ Accepted Date: 7-28-03 ☐ Return Date: _____

Signature: Danette Manlove Resubmitted: _____

RIDs Type: LT

X-Sender: chsmith@norris-mail.lanl.gov
X-Mailer: QUALCOMM Windows Eudora Version 5.1
Date: Thu, 24 Jul 2003 10:37:16 -0600
To: pgp@lanl.gov
From: Cathy Smith <chsmith@lanl.gov>
Subject: Please retire Process AK Reports
Cc: sgw@lanl.gov
X-Scanned-By: MIMEDefang 2.35

Hi Patsy,

As we discussed yesterday, here is the list of Process AK Reports that we would like to retire as controlled documents and submit as records to RMDC. Could you let Betty Humphrey and myself know when you have the record IDs - we need to update the references in the main AKIS document.

Thanks a million!

Cheers, Cathy

The following can be turned into Records, to be referenced in our AKIS or AK Summaries...

1. TWCP-AK-2.1-002, R.2/IC1 Process AK Report for Chloride Operations at TA-55

2. TWCP-AK-2.1-003, R.2/IC1 Process AK Report for Metal Operations Processes at TA-55

3. TWCP-AK-2.1-004, R.2/IC2 Process AK Report for Miscellaneous Operations at TA-55

4. TWCP-AK-2.1-005, R.2/IC1 Process AK Report for Nitrate Operations at TA-55

5. TWCP-AK-2.1-006, R.2/IC1 Process AK Report for Pyrochemical Processes at TA-55

6. TWCP-AK-2.1-007, R.2/IC1 Process AK Report for Special Processing at TA-55

7. TWCP-AK-2.1-009, R.0/IC1 Process AK Report for Pu-238 Operations at TA-55

8. TWCP-AK-2.1-013, R.0 AK Report for NG Waste from Nitrate Operations at TA-55

9. TWCP-AK-2.1-014,R.0 AK Report for NG Waste from Miscellaneous Operations at TA-55

10. TWCP-AK-2.1-016,R.0 AK Report for NG Waste from Special Processing Operations at TA-55

11. TWCP-AK-2.1-017,R.0 AK Report for NG Waste from Metal/Pyrochemical Operations at TA-55

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*"The simplest questions are the hardest to answer."*
*Northrop Frye*

Catherine H. Smith
***Project 2010***
RRES-CE Certification Group
Risk Reduction & Environmental Stewardship Division
Phone: 667-0113 Page: 664-7104

## INTERIM CHANGE REQUEST

LA-UR-02-1709

| ☑ TWCP ☐ WRR ☐ Other<br>If Other, please identify: _____ | IC Number: 1 |
|---|---|
| **Person Requesting this Interim Change:** Sandy Wander | |
| **DOCUMENT INFORMATION** | |
| **Document Title:** Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55 | **Document No./Revision:** TWCP-AK-2.1-009,R.0 (LA-UR-02-1709) |
| **Effective Date of Current Document:** 08/07/01 | **Document Preparer:** John Musgrave |

**CHANGE INFORMATION: Please ensure the following changes are made:**

| Section/Page | Change: | Reason/Justification: |
|---|---|---|
| TA-55 Process/ Status (P/S) Code Index / p. vi | Delete "summary" from "NOTE" at top of p. vi and from "*" note at bottom of p. vi<br>Change 3rd column heading on page vi to read "Process AK Report"<br>Delete entire 4th column | Clarification |
| RCRA Constituents/ EPA Hazardous Waste Numbers / p. viii | Add ASP, C1, WD, and WS to P/S codes in 3rd bullet | Report updated to add P/S codes that were not included. Typo error identified during review. |
| Global | Change all occurrences of "Sampling Plan" to "AK Information Summary" | Title change |
| Global | Delete "summary" from "Process AK summary report" and delete "Summary" from "Process Acceptable Knowledge Summary Report" | Clarification |
| Attach 3 / p. 1 | Add "D008" to all timelines | Per SME, all P/S waste codes have potential to have leaded gloves. Timelines updated to reflect information. |
| | Delete "D006" and "D011" from R8 timeline | Per SME, concentrations below TCLP limits. Data available. |
| | Create C1 timeline with P/S code D008*, | |
| | Delete "D005 applies to salt waste" from WS timeline | Per SME, barium used in process was ultra high purity and feed barium was below TCLP limits in salt waste. |
| | Add the following footnote: "*Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded glove waste stream, still under the originating P/S code (TWCP-4166)." | Footnote added to clarify segregation of leaded gloves. |

| | | |
|---|---|---|
| Attach 4 / pp. 1 and 2 | In "EPA Codes" column, delete all text and insert "*D008" for rows ASP, GPHS, MTL, P1, R8, RC1, SCP, and WS.<br>Add the following footnote to the table: "*D008 due to leaded gloves" | Updated report to reflect addition of leaded gloves to timelines and all P/S codes per SME.<br>Per SME, Barium used in process was ultra high purity and below TCLP limits in salt waste. |
| Attach. 6 | Add new Attachment 6 and update "Contents" page to reflect addition<br>Add following paragraph to end of Section 2.0:<br>"When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6)." | New TWCP-QP-1.1-021 requirement |

**Date changes submitted:** 02/12/02 | **Desired effective date for changes:**

**INTERIM CHANGE APPROVAL**

| | | | |
|---|---|---|---|
| Document Preparer: S Wander | | Reviewer (if applicable): Facility Rep | |
| Signature: Sandy Wander | Date: 3/19/02 | Signature: Wayne A Pringle | Date: 3/20/02 |
| Site Project QA Officer: M A Gayet | | LAAO (if implementing WAP requirements): NA | |
| Signature: M A Gayet | Date: 3/21/02 | Signature: | Date: |
| ☑ IC Approved ☐ Major Rev. ☐ Hold for next Rev. | | Do changes affect WAP data collection, data quality, or performance criteria? | |
| Site Project Mgr/Line Mgr: P Rogers | | ☐ Yes ☑ ~~No~~ | |
| Signature: Pamela Rogers | Date: 3/19/02 | If yes, date of CBFO approval: _____ (documentation attached) | |
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| Signature: | Date: 3 25 02 | | |

**NOTE:** Changes can be designated on the document and attached to this form.

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# TA-55 PLUTONIUM FACILITY
## ACCEPTABLE KNOWLEDGE REPORT

**REPORT TITLE:** Process Acceptable Knowledge Summary Report for Plutonium-238 Operations at TA-55

**REPORT NUMBER:** TWCP-AK-2.1-009,R.0 (LA-UR-01-4200)

**WASTE GENERATED FROM PROCESS/STATUS CODES:** ASP, GPHS, MTL, P1, R8, RCI, SCP, WS

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1 Acceptable Knowledge Roadmap (11 pages)
2 LANL and TA-55 Site Maps (2 pages)
3 Timeline for Pu-238 Operations (2 pages)
4 Process Inputs and Outputs (2 pages)
5 Simplified Pu-238 Process Flow Diagrams (2 pages)
6 Decision/Discrepancies Resolution Documentation (2 pages)

## ACRONYMS

| | |
|---|---|
| AK | acceptable knowledge |
| AK Information Summary | *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001,R.5) |
| CFR | *Code of Federal Regulations* |
| CMR | Chemistry and Metallurgy Research [Facility] |
| D | EPA hazardous waste number prefix for wastes with hazardous characteristics, defined in 40 CFR Subpart C, Sections 261.21 to 261.24 |
| DOE | U.S. Department of Energy |
| DOR | direct oxide reduction |
| DWLS | Discardable Waste Log Sheet |
| EP-60 | type of inner shipping container |
| EPA | U.S. Environmental Protection Agency |
| F | EPA hazardous waste number prefix for hazardous wastes from non-specific sources, defined in 40 CFR Subpart D, Section 261.31 |
| GPHS | General Purpose Heat Source |
| HF | hydrofluoric acid |
| HEPA | high-efficiency particulate air |
| $HNO_3$ | nitric acid |
| HWN | [EPA] hazardous waste number |
| K | EPA hazardous waste number prefix for hazardous wastes from specific sources, defined in 40 CFR Subpart D, Section 261.32 |
| LANL | Los Alamos National Laboratory |
| LWRHU | Lightweight Radioisotope Heater Unit |
| M | molar |
| MASS | Material Accountability and Safeguards System |
| $MgCl_2$ | magnesium chloride |
| MgO | magnesium oxide |
| MSDS | material safety data sheet |
| MT | material type |
| MWG | Milliwatt Generator |
| NMT | Nuclear Materials Technology [Division] |
| P | EPA hazardous waste number prefix for acute hazardous waste defined in 40 CFR Subpart D, Section 261.33 |
| P/S [code] | process/status [code] |
| PCB | polychorinated biphenyl |
| PF-4 | Plutonium Facility, Building 4 |
| Pu-238 | plutonium-238 |
| $PuO_2$ | plutonium oxide |
| RCRA | Resource Conservation and Recovery Act |
| RFETS | Rocky Flats Environmental Technology Site |
| RLWTF | Radioactive Liquid Waste Treatment Facility |
| RMDC | Records Management/Document Control |
| SME | subject matter expert |

| | |
|---|---|
| SOP | standard operating procedure |
| SRS | Savannah River Site |
| TA | technical area |
| TCLP | Toxicity Characteristic Leaching Protocol |
| TRU | transuranic |
| TWCP | Transuranic Waste Certification/Characterization Project |
| UCNI | Unclassified Controlled Nuclear Information |
| UF/PF | ultrafiltration/polymer filtration |
| WAC | waste acceptance criteria |
| WIPP WAC | *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069) |
| WIPP WAP | Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) |
| WIPP | Waste Isolation Pilot Plant |
| WODF | Waste Origination and Disposition Form |
| WPRF | Waste Profile Request Form |
| µm | micron |

## TA-55 PROCESS/STATUS (P/S) CODE INDEX

**NOTE:** This index indicates the main process AK report and report section that covers each P/S code mentioned in this report.

| P/S Code | P/S Name | Process AK Report* |
|---|---|---|
| ASP | Aqueous Scrap Processing | Plutonium-238 Operations |
| C1 | Pu-238 Heat Source Calorimetry | Plutonium-238 Operations |
| CA | Casting | Metal Operation Processes |
| CF | Cement Fixation | Nitrate Operations |
| ED | Cascade Dissolver | Nitrate Operations |
| GPHS | General Purpose Heat Source Fabrication | Plutonium-238 Operations |
| HP | Cement Fixation | Nitrate Operations |
| ITF/ITF4 | Impact Test Facility | Metal Operation Processes |
| MPD | Cascade Dissolver | Nitrate Operations |
| MTL | Metallography | Plutonium-238 Operations |
| OR | Direct Oxide Reduction | Pyrochemical Processes |
| P1 | Routine Pu-238 Heat Source Production | Plutonium-238 Operations |
| PPD | Plutonium Pellet Dissolution | Special Processing |
| R8 | Routine Pu-238 Solidification | Plutonium-238 Operations |
| R8 | Recovery of Pu-238 from Sucrose Solutions | Plutonium-238 Operations |
| RCI | Recovery of Pu-238 from Contaminated Iridium | Plutonium-238 Operations |
| SC | Cascade Dissolver, G437 | Nitrate Operations |
| SCP | Routine Pu-238 Scrap Processing | Plutonium-238 Operations |
| SP | Scrap Dissolution, G438 | Nitrate Operations |
| TDC | Thermal Decomposition of Cellulose Items | Nitrate Operations |
| WD | Welding and Decon for GPHS | Plutonium-238 Operations |
| WM | Waste Management | Miscellaneous Operations |
| WS | Pu-238 Direct Oxide Reduction | Plutonium-238 Operations |

* Process AK reports: Metal Operation Processes (TWCP-AK-2.1-003), Miscellaneous Operations (TWCP-AK-2.1-004), Nitrate Operations (TWCP-AK-2.1-005), Plutonium-238 Operations (this report), Pyrochemical Processes (TWCP-AK-2.1-006), and Special Processing (TWCP-AK-2.1-007)

## PROCESS ACCEPTABLE KNOWLEDGE SUMMARY

**Waste-generating process**: Plutonium-238 processes

**P/S codes**: ASP, C1, GPHS, MTL, P1, PP, R8, RCI, SCP, WD, WS

**Type of waste generated:**

Retrievably stored and newly generated, mixed and non-mixed, combustible and non-combustible debris; mixed oil and vermiculite waste; mixed solidified inorganic process waste including leached solids, salts and metal oxides.

**Site**: LANL

**Facility Mission (including defense and non-defense programs):**

TA-55 has extensive capabilities for the extraction and recovery of plutonium from residues and scraps generated from operations at various LANL facilities and other DOE sites in the defense complex. The recovered plutonium is converted into pure plutonium feedstock. These manufacturing and recovery operations, associated maintenance operations, and TA-55 plutonium research are the sources of TRU-contaminated scrap, residues, and debris waste generated at TA-55. The scrap and residues are processed to recover as much plutonium as practicable before disposal. Wastes are generated from plutonium recovery and purification for defense programs. These wastes may have been generated in the same rooms and gloveboxes as were used for non-defense activities, and were not segregated from non-defense waste until August 27, 1998.

**Area(s) or building(s) where the process waste was generated (including operations carried out in those areas):**

In the 200 Wing of the TA-55 Plutonium Facility (Building PF-4), Rooms 201, 204, 205, 206, and 207 have been used exclusively for Pu-238 processes. Plutonium-238 operations include chemical and radiochemical analysis, process tests and development, plutonium research, and heat source fabrication as well as recovery of Pu-238 from scrap and residues produced by numerous feeds.

**Description of the process waste (physical form and typical content description):**

Waste from Pu-238 operations consists primarily of debris waste, including cellulose-based waste, plastic-based waste, rubber, metal debris, glass debris, HEPA filters, and steel packaging materials. Other Pu-238 waste includes oil and vermiculite waste and solidified inorganic process waste including leached solids, salts and metal oxides. Liquid waste is sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50.

***Summary Categories:*** S3000, S5000

***Waste Matrix Codes:*** S3100, S3200, S5000, S5100, S5410

**Description of the waste-generating process:**

The overall goal of the Pu-238 processes is to produce heat sources for various applications. Limited recovery of plutonium from metal, metal alloys, scrap, and residues is also part of Pu-238 processing operations.

**Process Input:**

Plutonium metal and oxides; pyrochemical salts; ash; analytical laboratory solutions; and residues from other DOE facilities.

**Radioisotopic content of the waste:**

Pu-238 material types with well-defined isotopic compositions. U-234 is often present as a decay product of its plutonium precursor. Less common radionuclides present as trace-level contaminants are Am-241, Am-243, Cs-137, Np-237, Th-232, U-235 and U-238.

**RCRA Constituents/EPA Hazardous Waste Numbers:**

- D007 (chromium), D008 (lead), and D009 (mercury) apply to waste from P/S code R8.
- D008 (lead) applies to debris waste from all P/S codes from Pu-238 operations for discarded leaded gloves.
- No other D codes apply to waste generated by P/S codes ASP, C1, WD, WS GPHS, MTL, P1, RCI, or SCP.
- No F, K or P codes apply to any of the P/S codes under Pu-238 operations.

**Process waste volume (if known):**

Waste volumes for each P/S code have not been tracked. Instead, waste items are segregated into similar material types and packaged in waste containers. Waste containers are segregated into waste streams in the AK Information Summary, and waste stream volumes are reported in that document.

**Years of generation for the process waste**: 1978–present

# PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR PLUTONIUM-238 OPERATIONS AT TA-55

## 1.0 INTRODUCTION

All transuranic (TRU) waste must be sufficiently characterized and certified before it is shipped to the Waste Isolation Pilot Plant (WIPP). The U.S. Environmental Protection Agency (EPA) allows use of acceptable knowledge (AK) for waste characterization. EPA uses the term AK in its guidance document, *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste.* Attachment B, Waste Analysis Plan, to the *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088) (WIPP WAP) defines AK and provides guidelines on how AK should be obtained and documented.

This process AK report was prepared in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The primary purpose of this report is to systematically organize, evaluate, and summarize detailed AK information about individual processes that generate TRU waste in the Plutonium Facility at Technical Area (TA) 55, one of the TRU-waste generators at Los Alamos National Laboratory (LANL). By doing so, this report provides detailed technical support for one or more waste stream AK summary reports which include these process wastes, such as the *Acceptable Knowledge Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47* (TWCP-AK-2.1-011).

## 2.0 METHODOLOGY USED TO SEARCH FOR AK RECORDS

The AK search for the information related to TA-55 waste streams resulting from Pu-238 processes and Pu-238 heat source fabrication covered:

- Review of the *Los Alamos National Laboratory Transuranic Waste Characterization Acceptable Knowledge Information Summary* (TWCP-PLAN-0.2.7-001) (AK Information Summary) that includes information regarding all TRU waste streams
- Review of documents related to waste generation and waste management activities at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Interviews with personnel involved with waste generation and waste management at TA-55 as listed on the Acceptable Knowledge Roadmap (Attachment 1)
- Analyses of individual processes generating waste, and evaluations of the potential for Resource Conservation and Recovery Act (RCRA)-regulated constituents to be present in the process wastes, based on subject matter expert (SME) interviews and any relevant data

**NOTE:** Much of the AK information related to Pu-238 processes is contained in Transuranic Waste Characterization/Certification Project (TWCP) Record No.

TWCP-3545. Individual documents in this record have been assigned a separate identifier, P238-nn, where nn is a sequential 1- or 2-digit number. This referencing nomenclature is used throughout this report and its attachments.

The TWCP Records Management/Document Control (RMDC) Center contains copies of the documents referenced in this report. Any Unclassified Controlled Nuclear Information (UCNI) is contained in these records, and is not included in this report. Such records are identified as UCNI in the Acceptable Knowledge Roadmap (Attachment 1).

This process AK report contains information on 11 individual processes that have each been assigned a unique identifier called a process status (P/S) code. The search and compilation of AK information was based on P/S code, because that is the greatest level of process detail recorded in waste generation records.

The TA-55 Plutonium Facility tracks waste items both by the process from which they originated and their material content. Waste items are labeled with an item identification code that contains information on the waste material parameter of the item and an embedded P/S code that corresponds to the process that produced the waste item. Waste items are packaged into waste containers based on the material content of the waste, without regard to P/S code. This practice complicates AK tracking because a single waste container can include waste items from several P/S codes. Further complication is introduced because the waste streams for TA-55 have been defined based primarily on the physical form and material content of the waste and only secondarily on the waste generation process through mixed or non-mixed waste stream designations. Hence, any given Pu-238 waste stream could potentially contain items from all of the plutonium Pu-238 processes that were active at TA-55 over the time span of the generation of the waste stream.

We have attempted to mitigate confusion resulting from these two different ways of categorizing TA-55 waste (by process of generation and P/S code or by material content and waste stream number) by providing separate AK reports for each categorization method (i.e., process AK reports for process areas, and AK summary reports for waste streams). The AK information search was performed based on the processes used at TA-55 and tracked by the P/S codes, and it is summarized in this process AK report.

When discrepancies in AK information are discovered, they are documented and resolved in accordance with *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021). The resulting documentation is found in Decision/Discrepancies Resolution Documentation (Attachment 6).

## 3.0 DESCRIPTION OF THE PROCESS WASTE

The following sections describe Pu-238 processes, and identify the resulting wastes as well as outputs that are sent to other Pu-238 operations for further processing.

3.1 Facility and Mission

The TA-55 Plutonium Facility (Building PF-4) recovers plutonium from scrap and residues generated throughout the U.S. Department of Energy (DOE) defense complex, and processes it into pure plutonium oxide for conversion to metal and other products. The contaminated scrap and residues, if containing plutonium above the discard limit, are processed to recover as much plutonium as is practical (TWCP-351, TWCP-352). TA-55 has extensive capabilities for the extraction and recovery of plutonium-239 from residues and scraps generated from operations at various LANL facilities and other Department of Energy (DOE) sites and is establishing similar recovery capabilities for Pu-238 (TWCP-3545/P238-01). These recovery operations, associated maintenance operations, manufacturing operations, and plutonium research are the sources of TRU waste generated at TA-55. Detailed information about the TA-55 plutonium recovery processes can be found in *Waste from Plutonium Conversion and Scrap Recovery Operations* (TWCP-352). Information specific to Pu-238 processes is provided in TWCP-415. A full-block flow diagram for plutonium processing and waste management at TA-55 is given in reference TWCP-886.

A LANL site map and a detailed map of the buildings at TA-55, including Building PF-4, are shown in Attachment 2. In the 200 Wing of Building PF-4, Rooms 201, 204, 205, 206, and 207 are used exclusively for Pu-238 processes (TWCP-3545/P238-01). The Pu-238 processes include recovery operations and heat source fabrication processes. The latter processes include fuel fabrication, pellet production, and scrap/process residues processing.

The Pu-238 processing activities were strictly segregated from all other Pu-processing activities at TA-55 because cross-contamination of the materials would adversely affect the quality and usability of the end products (TWCP-1037). The Pu-238 operations consisted of activities supporting both defense and non-defense applications. However, wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type (TWCP-887, TWCP-4162, TWCP-4167). Consequently, a single waste container often contains wastes from multiple processes. Some debris waste was also co-mingled with room trash related to these same operations (both defense and non-defense), and was initially boxed as low-level waste. Subsequently, some of these waste boxes were returned for disposal in drums as TRU waste when on-site radioassay results showed them exceeding the low-level waste threshold value (TWCP-816).

3.2 Basis, Rationale, and Assumptions Used to Delineate the Waste Stream(s)

The basis for delineation of TA-55 waste streams was established by the evolving set of LANL and TA-55 waste management plans and site-specific procedures, which date back to the start of operations at the Plutonium Facility in 1978 (TWCP-352, TWCP-697, TWCP-700, TWCP-701, TWCP-3943). The stated

guidance and practice from the beginning, continuing to the present day, has been to handle and package all combustible and noncombustible debris waste in a similar fashion, regardless of the process (i.e., P/S code) of origin. Inspection, collection, documentation and packaging operations of solid, certifiable TRU wastes at TA-55 are conducted in PF-4 by a waste management section or team (TWCP-352, TWCP-700, TWCP-701, TWCP-3943). Wastes from all TRU waste-generating activities at TA-55 are handled and packaged into waste containers by this team based on the material content of the waste, without regard to P/S code. Materials are considered waste only when they have been received and processed by the waste management team.

Assignment of a particular waste container to a waste stream is then made on the basis of waste generator information compiled in the AK Information Summary. Waste generator information is reviewed to identify the types and sources of waste items present in each drum, to evaluate the most appropriate waste summary group, waste matrix code, and potential for the presence of hazardous constituents. In the AK Information Summary, TA-55 wastes have been assigned to waste streams based on the waste segregation schemes used by TA-55:

- By radioisotope content (Pu-238 or Pu-239 material type) (TWCP-934)
- By material matrix (combustible, noncombustible, metal, glass, etc. waste types)
- By hazardous waste status (mixed, non-mixed, or special case waste streams)

## 3.3 Waste Physical Form and Content Description

Wastes generated by Pu-238 operations include $^{238}$Pu-contaminated debris waste, high-efficiency particulate air (HEPA) filters, filter cake, salts, and wastes entered into the cement fixation process or sent to the Radioactive Liquid Waste Treatment Facility (RLWTF) at TA-50. Detailed information regarding the generation process, characterization, and disposal of these wastes is provided in Section 3.5 of this report.

The debris waste includes the following categories:

- Cellulose (e.g., paper, cheesecloth, cellulosic personnel protective equipment)
- Plastic (e.g., gloves, tape)
- Rubber (e.g., tubing, leaded gloves)
- Metal (e.g., wire, tools, process equipment)
- Glass (e.g., labware)
- Filters (HEPA)
- Graphite
- Ceramic
- Calcined hydroxide precipitation cakes
- Pyrochemical salts

3.4 Waste Volume and Time Period of Waste Generation

The period of generation of the Pu-238 wastes is from 1978 until the present. The P/S codes, their time periods of generation, and corresponding EPA HWNs are shown graphically in Attachment 3, Timeline for Pu-238 Operations.

Waste volumes for individual P/S codes are not tracked. Instead, waste items are segregated into similar material types and packaged into containers. Waste containers are assigned to waste streams in the AK Information Summary, and waste stream volumes are reported in that document, and in the associated AK summary reports (e.g., *Acceptable Knowledge Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47* [TWCP-AK-2.1-011]).

3.5 Waste Generation Processes

The Pu-238 for all heat source fabrication processes was produced, separated, and purified at the Savannah River Site (SRS). SRS information indicates that no RCRA-listed chemicals were used in the purification process and that the purified Pu-238 contains no RCRA constituents (TWCP-1044). The Pu-238 processes at TA-55 use no organic solvents. Also, the oxide feed materials do not contain any organic solvents. If the oxides did contain organic solvents, the latter would be boiled off or destroyed by the high temperatures used in the fabrication processes.

Pu-238 processing operations involve several different processes. The processes and P/S codes applicable to Pu-238 operations are listed below:

- P/S code ASP Aqueous Scrap Processing
- P/S code C1 Pu-238 Heat Source Calorimetry
- P/S code GPHS General Purpose Heat Source Fabrication
- P/S code MTL Metallography
- P/S code P1 Routine Pu-238 Heat Source Production
- P/S code PP Pellet Production for GPHS
- P/S code PPD Plutonium Pellet Dissolution
- P/S code R8 Pu-238 Sucrose Solutions and Waste Solidification
- P/S code RCI Recovery of $^{238}PuO_2$ (plutonium oxide) from Contaminated Iridium
- P/S code SCP Routine Scrap Processing
- P/S code WD Welding and Decontamination for GPHS
- P/S code WS Pu-238 Direct Oxide Reduction

Each of these processes is described below in detail. Timelines for these processes are shown in Attachment 3. A complete listing of P/S codes for Pu-238

operations, their descriptions, feed materials, and inputs and outputs is found in Attachment 4. Simplified process flow diagrams for Pu-238 operations are found in Attachment 5.

Wastes from P/S code PPD, which involved the dissolution of Pu-238 pellets in Room 209, were packaged with Pu-238 wastes. This P/S code is described in the *Process AK Report for Special Processing* (TWCP-AK-2.1-007). In addition, ash from P/S code TDC was packaged with other Pu-238 wastes when combustible material from Pu-238 processes were ashed under this activity. P/S code TDC is discussed in the *Process AK Report for Nitrate Operations* (TWCP-AK-2.1-005).

3.5.1 Aqueous Scrap Processing (P/S code ASP)

P/S code ASP is a new activity that covers work involved in the purification of solid $^{238}PuO_2$ in a nitric acid stream (TWCP-5600), similar to the recovery activities already established for Pu-239 as part of TA-55 nitrate operations (e.g., P/S codes ED, MPD, SC and SP described in Section 3.5.2 of TWCP-AK-2.1-005,R.2). A flow chart showing the Pu-238 Aqueous Scrap Recovery Process (P/S code ASP) is shown in Attachment 5.

During comminution, the weighed Pu-238 solid is ground to a particle size < 5 μm. After the comminution, all or a portion of the ground material is put into a dissolution vessel.

The $^{238}Pu$ solid is dissolved in a mixture of refluxing concentrated nitric acid ($HNO_3$) and hydrofluoric acid (HF) for up to 8 hours. After dissolution is performed, the $^{238}Pu$-rich solution is filtered through a 5-μm teflon membrane. The used teflon membrane is stored in a stainless steel can. A portion of the filtrate may be processed through ion exchange, or the entire filtrate may be treated for oxalate precipitation.

Oxalate precipitation involves an acid adjustment of the filtrate to 1-2 M $HNO_3$, while the solution is continuously stirred using the mechanical stir bar. Urea is added to scavenge nitrite salt that could interfere with further chemical pretreatment. Hydroxylamine nitrate is added to adjust the valence of the plutonium to (III). Oxalic acid is added to form a Pu-oxalate precipitate. The precipitate is filtered, and calcination converts the Pu-238-oxalate to $^{238}PuO_2$ product. The solid product is cooled, weighed, and stored.

The dissolution Pu-238-filtrate destined for ion exchange may undergo an aluminum nitrate treatment. The dissolution Pu-238-filtrate is added to aluminum nitrate dissolved in dilute nitric acid, followed by a filtration step to collect any formed solids. (Typically, the aluminum nitrate treatment is not performed.) The filtrate then undergoes a pretreatment involving urea, sodium nitrite, and ferrous salt prior to ion

exchange. The Pu-rich eluate is collected and undergoes oxalate precipitation as described above. The Pu-lean effluent, which contains impurity metal ions, as well as the aluminum from the aluminum nitrate treatment, is neutralized to pH 10-12 with sodium hydroxide. Under these neutralization conditions, the majority of the impurity ions and Pu-238 (not precipitated as an oxalate precipitate) will precipitate as metal hydroxides.

The hydroxide precipitate is calcined then stored, and the hydroxide filtrate is sampled to determine the radioactivity level. If above the discard limit, the hydroxide filtrates are transferred to the residue solidification process (P/S code R8). In this process, any soluble Pu-238 is recovered with ferric nitrate and sodium hydroxide, and the filtrate resulting from the solidification process is sent to the TA-50 RLWTF through the caustic waste line.

The Pu-238 in the hydroxide filtrates can also be recovered by a ultrafiltration/ polymer filtration (UF/PF) process operated by NMT-11 personnel.

The $^{238}PuO_2$ product is sent to P/S code P1. The hydroxide cakes are stored either in the vault or in the glovebox line under P/S codes MM or ASP.

3.5.2 Heat Source Fabrication (P/S codes GPHS and P1)

Pu-238 heat sources that are routinely fabricated at TA-55 include the General Purpose Heat Source (GPHS, produced under the P/S code with the same name), Lightweight Radioisotope Heater Unit (LWRHU), and Milliwatt Generator (MWG) Program. The latter two heat sources are produced under P/S code P1. Heat source production involves fuel fabrication, pellet production, and scrap and process residues processing. Each of these is a separate operation, using different materials and generating different types of waste; therefore, they are addressed individually. Debris waste containing lead gloves may be generated by any of these processes. This waste is segregated from non-lead debris waste and disposed as RCRA-regulated TRU waste (TWCP-3545/P238-02).

Fuel Fabrication

The fuel fabrication process occurs in Room 207. The feed material for fuel fabrication is $^{238}PuO_2$ from SRS. The SRS has been directly or indirectly the source of all feed material for fuel fabrication (TWCP-3545/P238-01). The material physically resides in the TA-55 vault or in Pu-238 heat source calorimetry operations (P/S code C1, does not generate TRU waste) before being introduced into the fabrication

process. This material goes through the physical processes of weighing, splitting, ball milling, slugging and screening, and granule seasoning. The material also undergoes oxygen isotopic exchange, in which oxygen-17 and oxygen-18 are replaced by oxygen-16 as the material is heated to 775 °C. In GPHS and LWRHU processing, oxygen exchange is followed by heating to 1000 °C to release alpha-decay helium from the $PuO_2$ crystal structure. GPHS and LWRHU season a portion of the granules at 1600 °C and a second portion at 1100 °C. The latter two processes ultimately hot press the pellets at 1530 °C and later heat treat the pellets at 1000 °C and finally at 1527 °C. By contrast, the MWG processing scheme seasons all the granules at 1600 °C, then mixes the $PuO_2$ with powdered yttrium metal and heats it at 1350 °C to form a sub-stoichiometric plutonium oxide. In all cases, the high temperatures ensure that any organic material that might have been present in the initial feedstock would not carry through to the final product.

No RCRA-regulated solvents or metals are introduced to the process, and all waste generated from the fuel fabrication process is nonmixed waste. The residues and products from this process feed into other Pu-238 processing operations (e.g., pellet production and scrap and process residues processing). (TWCP-3545/P238-03)

During the fuel fabrication process, analytical samples are frequently required for both $^{238}PuO_2$ feed material and product specimens either to characterize the material or to determine whether the material meets current production specifications (TWCP-3545/P238-04). The sampling occurs in Room 207. The sampling points are identified in the P1 Fuel Fabrication flow diagram (TWCP-3545/P238-03). All spatulas are stainless steel and the containers used to transfer or store the samples are stainless steel, tantalum, or glass. The primary capsule is cleaned in an ultrasonic cleaner with ethanol and allowed to air-dry (TWCP-3545/P238-04). This spent ethanol is not TRU waste. Sampling tools are wiped down with cheesecloth containing ethanol, resulting in cloth contaminated with ethanol and possibly a small amount of Pu-238 (TWCP-3545/P238-05). However, the ethanol on the cheesecloth would have been used up in the wipe-down process (TWCP-3545/P238-01). Thus, TRU waste generated from sampling operations includes Pu-238-contaminated debris consisting of cheesecloth (ethanol would have been used up in the process), stainless steel spatulas and containers, glass and tantalum capsules, and plastic secondary capsules.

A sample from the fuel fabrication process is taken to perform particle size analysis on $^{238}PuO_2$. This analysis is conducted in Rooms 201 and 206. Ethylene glycol is used to suspend the $^{238}PuO_2$ powder. Cleaning solutions containing water, soap, and Fantastik are used to clean the external surfaces of the sample cuvettes. These are the only chemicals

used in this analytical process and do not constitute RCRA-regulated waste. (TWCP-3545/P238-06)

The sample is placed into a disposable polystyrene cuvette containing a magnetic stir bar and 2 milliliters (mL) ethylene glycol. The cuvette is sealed with a polystyrene cap coated with Duco cement. After the glue has set, the cuvette is ultrasonically cleaned in a water bath containing a high-purity soap (e.g., Alconox), is cleaned a second time in a bath of distilled water, and is wiped down with a cheesecloth pad soaked in Fantastik cleaning solution. The cuvette is then transferred to another hood for final decontamination with Fantastik-soaked cheesecloth (TWCP-3545/P238-06). This process of cleaning and transferring the cuvette occurred up to 1994. From early 1994 onward, the water bath does not contain soap and Fantastik is not used because all work is performed in the same glovebox line and there is no need to decontaminate the cuvette. Before 1994, if the water was radioactively contaminated, it was discarded to the RLWTF. From 1994 onward, the water has been evaporated. (TWCP-3545/P238-20)

Upon completion of the analysis, the ethylene glycol containing the $^{238}PuO_2$ is poured through a coarse sieve and collected in a polyethylene bottle. When 200 - 500 mL of ethylene glycol has accumulated in the bottle, the contents are poured through a filter. The residue and filter paper are allowed to dry and are sent to a plutonium recovery process. The contaminated ethylene glycol is collected until a sufficient amount is available to discard, and then it is poured onto a bed of vermiculite for absorption. The resulting waste is nonmixed, solid TRU waste. The magnetic stir bars and cuvette caps are reused. The debris waste generated by this process would include $^{238}Pu$-contaminated cheesecloth, polystyrene cuvettes, polyethylene bottles, and routine laboratory trash. (TWCP-3545/P238-06)

Pellet Production

The feed material for the pellet production process consists of $^{238}PuO_2$ from fuel fabrication. This material undergoes the physical processes of screening and weighing, die loading, hot pressing, sintering, and dimensioning. The product is sent to the vault and any residues are sent to the scrap and process residues processing operation. No solvents or metals are introduced in this process; therefore, any waste generated is nonmixed TRU debris waste. (TWCP-3545/P238-07)

Decontamination

A solution of nitric and hydrofluoric acid is used for decontaminating the fuel clads. The clad heat sources are immersed in the solution a minimum of three times to allow the acids to dissolve any $PuO_2$ particles

on the clad surface. Each time, the heat sources are removed from the acid solution and placed on a rag dampened with water. A rubbing action removes contamination while the heat of the source causes the acid solution and water on the rag to evaporate at a fairly rapid rate. The TRU acid solutions generated by the decontamination steps are neutralized to precipitate plutonium, and the filtrate is discarded into the caustic waste line to the RLWTF at TA-50. The plutonium precipitate is discarded if they meet the DL. The only other process chemical, UCAR C-34, is an epoxy for sealing the graphite aeroshell of the LWRHU heat source assembly. The epoxy is not RCRA-regulated (TWCP-1027).

Scrap and Process Residues Processing

The scrap and process residues processing operation receives materials from the vault and various other processes, such as fuel fabrication, pellet production, calorimetry, and metallography. This is a physical process consisting of weighing, sorting, segregating, and loading into a shipping container. The product from this process either goes to the vault or feeds into calorimetry operations (P/S code C1, which does not generate any TRU waste). No solvents or metals are introduced into this process. Therefore, the waste generated is nonmixed TRU debris contaminated with $^{238}Pu$. (TWCP-3545/P238-08)

3.5.3 Metallography (P/S code MTL)

The metallography process in Room 201 began in 1992 and is still active. It receives feed material from P/S code P1 processes in the form of $^{238}PuO_2$ fuel recovered from encapsulated heat sources, impacted heat sources, fuel pellets, or other sources. The metallography process is a physical process involving cutting, mounting, grinding, polishing, photography, and etching (TWCP-3545/P238-09). No oils are used in any of these operations. Although chemicals are used to mount and etch the $^{238}PuO_2$, this process only generates $^{238}Pu$-contaminated debris waste (TWCP-3545/P238-10).

An epoxy-based mounting resin, hardener, and mount filler is used to mount the $^{238}PuO_2$ (TWCP-3545/P238-10). The epoxy resin, hardener, and mount filler consist of diethylenetriamine, Epon® Resin 8132, and a citofix/durofix liquid. Epon® Resin 8132 is a liquid that polymerizes when mixed with an amine (e.g., diethylenetriamine). The citofix/durofix liquid is also a polymer. These chemicals harden (polymerize) upon use and are not a hazardous waste. (TWCP-3545/P238-20)

One end of a phenolic ring is covered with aluminum tape. The $^{238}PuO_2$ sample is placed in the center of the interior surface of the tape. The mixture of epoxy resin, hardener, and filler is poured into the mount

ring. The mounted sample is placed in a small aluminum film can, which is placed in a pressure bomb. The bomb is pressurized for a minimum of 10 hours, then vented, and the sample is removed. The mounted $^{238}PuO_2$ sample then undergoes grinding and polishing. (TWCP-3545/P238-10)

Manual grinding and polishing involves moving the mounted sample across wet silicon carbide grinding papers of varying grits that are laid over a glass plate. Between each grinding step and after the last grinding step, the sample is ultrasonically cleaned in distilled water. The mounted sample is polished using aqueous suspensions of aluminum oxide or diamond. After polishing, the sample is cleaned in distilled water. Automated grinding and polishing involves using programmable equipment. The grinding process uses a metal or cloth platen that has been coated with an abrasive slurry. This process also involves cleaning the polished sample in distilled water. (TWCP-3545/P238-10)

Whenever there is a requirement to examine and/or document the $^{238}PuO_2$ grain boundaries, the surface of the polished sample is etched using a solution consisting of 93% hydrobromic acid, 5% hydrochloric acid, and 2% hydrofluoric acid. The etching solution is made up on an as-needed basis and only in quantities less than 100 mL. The etching solution applied to the sample surface readily dries and must be replenished; therefore, there will not be any excess etching solution contaminated with $^{238}Pu$ that would be considered waste. Upon completion of etching, the sample is rinsed with distilled water and allowed to dry. (TWCP-3545/P238-10)

Residues from the metallography process feed into the P/S code P1 process. Before 1994, the $^{238}PuO_2$ was physically removed from the plastic mount (no solvent or chemical was used), and the mount was bagged out with other plastic debris. The $^{238}PuO_2$ sample removed from the mount is sent to the P1 scrap and process residue processing operation for plutonium recovery (TWCP-3545/P238-09). However, since 1994, the $^{238}PuO_2$ has been left on the mount and archived (stored) in the glovebox line. (TWCP-3545/P238-20)

The waste generated from the metallography process includes aluminum tape, grinding papers and polishing cloths, aqueous abrasive slurries, acid etching solutions, and aqueous washing and cleaning solutions. All of these wastes are nonmixed, $^{238}Pu$-contaminated wastes. The grinding papers and polishing cloths are dried and discarded as debris waste, as is the aluminum tape. The aqueous abrasive slurries, which are not RCRA-regulated, are feed material for the $^{238}Pu$ waste solidification process (P/S code R8). Any etching solution remaining on the $^{238}PuO_2$ sample is rinsed off using distilled water and is collected with the aqueous wash solutions. These solutions, which are not RCRA-regulated, are also sent

to the waste solidification process (P/S code R8). Any excess etching solution, which is a corrosive liquid, would not be contaminated with $^{238}Pu$ and, therefore, is not TRU waste. (TWCP-3545/P238-10)

The metallography process may generate debris waste containing lead (e.g., gloves). This waste is segregated from non-lead debris waste and discarded as RCRA-regulated TRU waste (TWCP-3545/P238-02).

3.5.4 Routine Scrap Processing (P/S code SCP)

The scrap processing operation, which occurred from 1988 to 1996, received its feed material ($^{238}PuO_2$) from calorimetry operations (P/S code C1), heat source operations (P/S codes P1 and GPHS), and the vault. The feed material did not contain any hazardous constituents. The scrap processing operation took place in Room 204, and was a physical process that involved opening, weighing, sorting, and segregating the $^{238}PuO_2$ that arrived in a stainless steel inner shipping container (EP-60). The $^{238}PuO_2$ was then transferred into an outer shipping container (EP-61) and sent to the calorimetry process, and then to the vault. (TWCP-3545/P238-11)

No solvents or metals were introduced into the process; therefore, the only waste generated is solid debris waste (TWCP-3545/P238-12). Any debris waste containing lead (e.g., gloves) was segregated from non-lead debris waste and discarded as RCRA-regulated TRU waste (TWCP-3545/P238-02). The types of materials in the debris waste include cheesecloth pads and metal tools and equipment (TWCP-3545/P238-12).

3.5.5 Recovery of $^{238}PuO_2$ from Contaminated Iridium (P/S code RCI)

The process of recovering $^{238}PuO_2$ from contaminated iridium occurred from 1990 to 1992 in Room 201 (TWCP-3545/P238-13). The feed material for this process came from metal items in the iridium inventory in Building PF-4 or in the Chemistry and Metallurgy Research (CMR) Facility at TA-3. This process used both molten magnesium chloride ($MgCl_2$) and electrochemical dissolution to remove $^{238}Pu$ from iridium. (TWCP-3545/P238-14)

The first step in this process involved immersing the $^{238}PuO_2$-contaminated iridium metal in molten $MgCl_2$. The $MgCl_2$ was placed into a magnesium oxide (MgO) crucible and heated above its melting point. The same salt was used for subsequent runs until it had lost its effectiveness. The iridium shells were placed into a tantalum basket and immersed in the molten $MgCl_2$. At the end of the treatment, the iridium metal was removed from the molten $MgCl_2$, and the salt coating on the metal was removed with a water wash. This water wash was sent to the $^{238}Pu$ solidification process (P/S code R8) (TWCP-3545/P238-20). The

expended $MgCl_2$ and MgO crucible were bagged out and assayed before being discarded as $^{238}Pu$-contaminated TRU solid waste. The iridium metal was sent to the vault unless additional treatment was necessary. If further treatment was required, the iridium metal underwent electrochemical dissolution. (TWCP-3545/P238-13)

The electrolyte solution consisted of a dilute mineral acid (nitric acid, hydrochloric acid, or sulfuric acid [TWCP-3545/P238-21]) with optional salt. The iridium metal was immersed in the solution, and a current was passed between the iridium metal and a reference electrode (composed of graphite [TWCP-3545/P238-21]). At the end of the run, the iridium metal was washed with water and allowed to dry. The clean iridium metal was sent to the vault (TWCP-3545/P238-15). No solvents or toxic metals were introduced into this process (TWCP-3545/P238-21).

The waste generated from the recovery process includes solid TRU debris waste, such as $MgCl_2$ salt, MgO crucibles, tantalum and stainless steel cans, and routine laboratory trash. Any debris waste containing lead (e.g., gloves) was segregated from non-lead debris waste and discarded as RCRA-regulated TRU waste (TWCP-3545/P238-02). The spent electrolyte solution, which was acidic and contaminated with small amounts of iridium and $^{238}Pu$, and the water wash were sent to the $^{238}Pu$ solidification process (P/S code R8) (TWCP-3545/P238-20).

3.5.6 Routine $^{238}Pu$ Waste Solidification (P/S code R8)

The process of solidifying $^{238}Pu$ in waste solutions has been conducted since 1978 in Room 206 and is still active. The feed material for this process comes from analytical operations (LANL groups CHM-1 and CLS-1), $^{238}Pu$ heat source fabrication operations, metallography operations, and $^{238}Pu$ decontamination operations (TWCP-3545/P238-16, 17, 18). The feed solutions are strongly acidic, contain heavy metals (TWCP-3545/P238-18), and have $^{238}Pu$ concentrations orders of magnitude above the discard limit for radioactive waste solutions. The solidification process uses sodium hydroxide, ferric nitrate [$Fe(NO_3)_3 \cdot 9H_2O$], and phenolphthalein (1%) in ethanol to precipitate the $^{238}Pu$. (TWCP-3545/P238-16)

Ferric nitrate solids are dissolved into the feed solutions to act as a flocculant. Concentrated sodium hydroxide solution is then added to convert the acidic solutions into basic (caustic) solutions, and cause the ferric ions and the $^{238}Pu$ ions in the solutions to co-precipitate as hydroxides. The phenolphthalein solution is used to indicate when the solution is basic. After sedimentation and vacuum filtration, the liquid portion (filtrate) is sampled and alpha-assayed to determine the residual $^{238}Pu$ concentration. The sludge is heated (calcined), such that the hydroxides are converted into oxides for disposal. This procedure is

repeated as necessary for the filtrate until the $^{238}Pu$ concentration in the filtrate is below the discard limit. (TWCP-3545/P238-16)

The waste generated by this process consists of calcined ferric oxide solids containing $^{238}Pu$, a caustic solution containing $^{238}Pu$ below the discard limit, and solid debris. The oxide solids are sent to the vault or disposed as waste, depending on the $^{238}Pu$ concentration. The caustic solution is discarded into the caustic drain to the pretreatment plant at the RLWTF (TA-50, Building 1, Room 60). The solid debris waste consists of glassware, teflon, ceramic, stainless steel, tygon tubing, plastic, and paper.

The only potential sources of RCRA-regulated constituents in this process are the analytical solutions received as feed materials from LANL groups CHM-1, CLS-1, and other analytical chemistry groups. Nine $^{238}Pu$ solutions were stored in the vault at the time that this process was performed but none of these contained RCRA-regulated constituents, according to the coding remarks on the Material Accountability and Safeguards System (MASS) printouts. This absence of RCRA-regulated materials is consistent with the Waste Profile Request Form (WPRF) under which the solutions were received from LANL Groups CHM-1 and CLS-1. The WPRF was generated on 04/27/92 by T.K. Marshall and identifies corrosive acids and radioisotopes as being the only hazardous constituents in the solutions. No organic constituents were noted on the WPRF for these solutions. (TWCP-3545/P238-01)

The analytical techniques for $^{238}Pu$ solutions do not require the introduction of organic solvents or heavy metals into the solutions. In addition, the $^{238}Pu$ solutions returning from analytical chemistry are analyzed for heavy metals (totals) in a random fashion along with routine analyses for pH (or acid concentration) and radioactivity. Thus, between 1992 and 1997, 68 analyses were performed on 49 solutions returning from Group CLS-1, as follows: arsenic (4 analyses), barium (3), cadmium (4), chromium (24), lead (3), mercury (6), selenium (5), and silver (19). None of the analytical results for total metals (adjusted for the 20:1 dilution factor in accordance with Toxicity Characteristic Leaching Protocol [TCLP]) exceeded the RCRA regulatory level for the toxicity characteristic for the metals. Two of the results for mercury were inconclusive due to insufficient sensitivity in the analysis. (TWCP-3545/P238-01, 18)

The hydroxide ferroflocculation process conceivably could concentrate the heavy metals from the analytical solutions sufficiently to put them above the regulatory level for toxicity in the hydroxide cakes. Based on the concentration of metals in the feed waste stream (CLS-1 solutions)

and the chemistry involved in the solidification process, arsenic, barium, some chromium, and selenium will remain in the filtrate. Cadmium, lead, mercury, and silver will precipitate with the hydroxide cakes and will remain in the cakes during the calcination process. Since May 1991, the filtrate from this process has been analyzed for metals and all results have been below the RCRA regulatory limits.

Recent analytical information on Pu-238 hydroxide cakes that were calcined indicate that neither silver nor cadmium are present in concentrations large enough to be of concern. This is based on the fact that the primary source of these elements is as impurities in the plutonium oxide as supplied by SRS. Based on historical and present DLs for Pu-238 waste streams, if the Pu-238 concentrations are low enough to meet the DLs, silver and cadmium concentrations will readily occur at less than the TCLP limits for hazardous materials. Thus only chromium, lead, and mercury are present in concentrations in the calcined cake to require the use of the corresponding HWNs.

In addition, a review of nondestructive analysis results on hydroxide cakes revealed that the highest plutonium concentration in a set of calcined cakes was 7.4 weight percent Pu. Because the heavy metal contaminants are concentrated in the course of performing the hydroxide precipitation, contamination of other waste matices by the hydroxide cake is the most likely souce of RCRA levels of of the heavy metals in those waste streams. If the Pu content of the hydroxide cake is 7.4 weight percent and the maximum Pu allowed in a waste matrix other than hydroxide cake is 18.6 grams of Pu per kilogram of combustibles, then

The solid debris waste generated from this process is disposed as TRU solid, non-mixed waste. Any debris waste containing lead (e.g., leaded gloves) would have been discarded as mixed TRU waste to which EPA HWN D008 would be applicable (TWCP-3545/P238-02).

3.5.7 Recovery of $^{238}Pu$ from Sucrose Solutions (P/S code R8)

The recovery of $^{238}Pu$ from sucrose solutions, which occurred from 1978 to 1988, was performed in Room 206. The feed material for this process consisted of a 35% sucrose solution composed of sodium pyrophosphate, water, and sucrose. Sucrose solutions were used as a dispersive medium in particle size analysis of $^{238}PuO_2$; therefore, the feed solutions contained $^{238}PuO_2$. (TWCP-3545/P238-19)

The $^{238}Pu$ was recovered from these sucrose suspensions by filtering out the $^{238}PuO_2$ in a ceramic filter boat and evaporating the solution to dryness over low heat. The $^{238}PuO_2$ residue was scraped off the filter paper and calcined, then sent off-site for reprocessing. The residue from the evaporated solution was calcined and sent for discard if the $^{238}Pu$

content was below the discard limit. If the residue was not discardable, it was sent to another location. (TWCP-3545/P238-19)

This recovery operation was a physical process. No solvents were introduced during the process or with the feed material. The wastes generated from this process consist of a calcined residue of sucrose and solid debris waste. The debris waste may contain stainless steel, ceramic, glassware, tygon tubing, and filter paper. All of the waste generated is solid TRU waste. Any laboratory debris waste containing lead (e.g., gloves) is segregated from non-lead debris waste and is discarded as RCRA-regulated TRU waste (TWCP-3545/P238-02).

3.5.8 Pu-238 Direct Oxide Reduction (P/S code WS)

P/S code WS was an activity that was performed in October 1998 and October 1999 (TWCP-5707). There are no current plans to perform this operation again but the code is still active. P/S code WS is a single cycle process that uses Direct Oxide Reduction (DOR) (described for P/S code OR in TWCP-AK-2.1-006,R.2). In this process, $PuO_2$ and calcium metal are reacted in molten calcium chloride ($CaCl_2$) to produce plutonium metal. The reaction is conducted in a magnesium oxide (MgO) crucible at 820°C to 875°C. Any arsenic, mercury or selenium present in the impure plutonium oxide would be driven off due to their volatility at this high temperature (TWCP-1258). The reaction proceeds to completion when excess calcium is present and when sufficient $CaCl_2$ is available to dissolve the calcium oxide (CaO) product.

After cooling, a plutonium metal button is removed by breaking the crucible. A layer of salt above the button contains unreacted oxide. All DOR salts are exposed to air to oxidize any pyrophoric metals that might be present. The salt is then either routed through aqueous recovery operations (P/S code ASP) to recover the plutonium, or else discarded as waste along with the remaining calcium metal, which has been converted to calcium oxide, and MgO crucible pieces.

3.6 Material Inputs to the Waste Generation Process

Attachment 4 lists P/S codes for Pu-238 operations at TA-55, including process descriptions, feed material, other process inputs, process outputs, and type of waste. The feed materials for Pu-238 operations consist of the general types of materials listed in Table 1 that are obtained either from the storage vault, as process output from other P/S codes, or from sources outside TA-55, including other DOE sites. The remainder of this section summarizes the nature of the process waste in terms of its physical, chemical and radioisotopic characteristics.

**Table 1. Process Feed Materials for Pu-238 Operations**

| Feed Material | RCRA-Regulated Substances | P/S Codes in Pu-238 Operations |
|---|---|---|
| Analytical laboratory solutions | Potentially contaminated with RCRA-regulated heavy metals: chromium (D007), lead (D008), and mercury (D009 | R8 |
| Scrap oxide | Variable purity, no RCRA substances present | ASP |
| Iridium metal | Typically fairly pure, no RCRA substances present | RCI |
| Pu oxalates and hydroxides | Typically fairly pure, no RCRA substances present | ASP |
| Pu oxide | Incoming Pu-238 oxide from SRS exceeds regulatory limits for chromium (D007) and may exceed limits for cadmium (D006), lead D008) and silver (D011) for some fuel lots (TWCP-1025, TWCP-1026, TWCP-1030). However, calculations documented in TWCP-AK-2.1-011 support the conclusion that the levels of these metals in TA-55 waste streams from Pu-238 operations are below RCRA's regulatory limits. | ASP, GPHS, MTL, P1, SCP |
| Plutonium oxide | Typically fairly pure, no RCRA substances present | WS |

3.6.1 Physical Waste Form Identification

Solid waste from Pu-238 operations primarily consists of debris waste and ferric oxide (derived from calcination of ferric hydroxide precipitates). Debris waste contains glassware, plastics, ceramic materials, cellulose-based personal protective equipment, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated as process waste. Prior to May 1992, leaded gloves were discarded as metal debris and were not segregated from other metal wastes. Since that time, they have been routinely segregated from other metal debris waste and assigned EPA HWN D008. The ferric oxide is sent to the vault or discarded, depending on its $^{238}$Pu content. In addition, caustic solutions from ferric hydroxide precipitation are discarded through the waste line to the RLWTF at TA-50.

Because items from several different processes are usually combined into individual waste drums, the physical waste form of each drum must be determined independently. This information is documented on a Waste Origination and Disposition Form (WODF) by the waste generator according to controlled procedures. The P/S code for each waste item is also documented on this form. In the packaging process, a standard form, the Discardable Waste Log Sheet (DWLS), was used to list each item identification number and record its matrix material. This form was signed by the waste packager, reviewed, and approved by quality assurance personnel.

3.6.2 Radionuclide Content Identification

The primary plutonium material type inputs for Pu-238 operations at TA-55 are listed in Table 2. The designation *material type* (MT) (e.g., MT 52) is used within the DOE Complex to describe the isotopic composition of common blends of radioactive materials used within the Complex. The material type notation was developed because it is a convenient way to describe material types that have very consistent isotopic compositions. Table 2 indicates the isotopic composition of the material types at the time the waste was characterized.

The material type provides the basis for estimating an upper bound for U-234, U-235, and Am-241 contents based on the rate of decay of their precursors, Pu-238, Pu-239 and Pu-241, respectively. The results of these calculations are also tabulated in Table 2, assuming (a) none of these isotopes were initially present in the material, (b) the oldest Pu material in inventory dates back to 1 January 1960, and (c) the waste was packaged on 1 January 1996, making it 36 years old (TWCP-698).

**Table 2. Average Isotopic Content of Pu-238 Material Types and Enrichments**

| Material Type (MT) | Plutonium isotope and half-life (Weight %) | | | | | | Upper limits for weight ratios | | |
|---|---|---|---|---|---|---|---|---|---|
| | Pu-238 (87.74 yr) | Pu-239 (24120 yr) | Pu-240 (6564 yr) | Pu-241 (14.35 yr) | Pu-242 (376,300 yr) | Pu-244 (8.26 x $10^7$ yr) | U-234/ Total Pu | U-235/ Total Pu | Am-241/ Total Pu |
| MT 83 | | | | | | | | | |
| 83% | 83.89 | 13.8 | 1.9 | 0.32 | 0.09 | — | 0.26 | 0.0002 | 0.003 |
| 89% | 89.26 | 10.07 | 0.633 | 0.021 | 0.015 | — | 0.28 | 0.0001 | 0.0002 |

Source: TWCP-698

The material type used in the process generating each waste item was documented on the WODF and DWLS. However, some of the plutonium recovery processes separate plutonium and americium, or plutonium and uranium, so that their relative ratios may be altered in the process outputs and wastes. Waste items may be either depleted or enriched in americium depending on whether the source of contamination is the process product or the process residues (TWCP-882).

Residues submitted for reprocessing often contain Np-237, the decay product of Am-241 (half-life, 458 yr). This radioisotope is expected to be present in minor amounts in nearly all debris waste from Pu-238 operations at TA-55.

In general, uranium and its isotopes are expected to be present only at trace levels, if at all. U-234 is expected to be the most common uranium isotope in MT 83 waste because it is the decay product of Pu-238 (half-life, 87.74 years). After 20 years, 14.6 percent of the initial Pu-238 would have decayed to U-234. For MT 83 with an initial content of 83.89 percent Pu-238, the atomic ratio U-234 to total Pu would be about 0.14U-238 would only be present if purposefully added to the feed material. U-235 ingrowth from the decay of Pu-239 (half-life, 24,120 years) would be negligible due to the long half-life of Pu-239. No U-236 is present.

Less common radionuclides present as trace-level contaminants in TA-55 plutonium operations, including the Pu-238 operations, are Am-241, Am-243, Cs-137, Np-237, Th-232, U-235, and U-238.

Table 3 lists analyses of actinide impurities in several $^{238}PuO_2$ fuel lots as received from SRS for LWRHU production. For the actinides measured, the total concentrations of actinide impurities in the sampled fuel lots are less than 5000 ppm, or 0.5 weight percent.

**Table 3. Actinide Impurities in $^{238}PuO_2$ Fuel Lots for Cassini Program**

| Isotope | Concentration in LANL Fuel Lot (μg/g Pu) | | | | |
|---|---|---|---|---|---|
| | *272* | *274* | *275* | *285* | *286* |
| $^{232}Th$ | 1700 | 1800 | 2300 | 2190 | 1845 |
| $^{234}U$ | 300 | 190 | 1070 | 720 | 615 |
| $^{236}Pu$ | <1 | <1 | <1 | <1 | <1 |
| $^{237}Np$ | 1030 | 1060 | 1460 | 1500 | 1545 |
| $^{241}Am$ | 46 | 49 | 71 | 29 | 36 |
| Total | 3076 | 3099 | 4901 | 4439 | 4041 |

Source: TWCP-1030

During TWCP characterization, the contents of each waste package undergo non-destructive analysis to provide detailed radioisotopic data. These data will be used to evaluate the accuracy of AK information in accordance with *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064). The AK report for Pu-238 waste streams will be updated to incorporate the results of these comparisons.

3.6.3 Chemical Content Identification

Chemical inputs to Pu-238 operation processes are listed in Table 4. The use of strong acids, bases, or oxidizers does not result in RCRA listings for solid wastes from these processes because of the absence of free liquids in this waste.

## 4.0 ASSIGNMENT OF EPA HAZARDOUS WASTE NUMBERS

EPA HWN assignments to process wastes from Pu-238 operations are summarized below, as well as on the process timelines in Attachment 3, and in the table of process inputs and outputs in Attachment 4. These assignments take into account the possible presence of RCRA-listed chemicals in process waste as a result of their suspected or known presence in feed materials, chemical inputs, equipment, and glovebox surfaces.

4.1 F, K, and P Listings

RCRA-regulated F-listed, K-listed and P-listed materials are not present in the feed materials and are not introduced as a part of Pu-238 operations. Therefore, no F-listed, K-listed or P-listed constituents are present in solid waste generated by Pu-238 operations.

**Table 4. Chemical Inputs to Processes Described in This Report**

| Chemical Input | Comments on Applicability of RCRA Listing |
|---|---|
| **Gas** | No RCRA-regulated gases are used |
| Argon gas | |
| **Acids** | |
| Hydrobromic acid | D002 (corrosivity) does not apply to the solid debris waste because there are no free liquids in this waste. D001 (oxidizer) does not apply to the use of nitric acid for the same reason. |
| Hydrochloric acid | |
| Hydrofluoric acid | |
| Nitric acid | |
| Oxalic acid | |
| Sulfuric acid | |
| **Base** | |
| Sodium hydroxide | D002 does not apply to the solid debris waste because there are no free liquids in this waste. |
| **Inorganic Chemicals** | No RCRA-regulated inorganic chemicals are used |
| Aluminum nitrate | |
| Aluminum oxide | |
| Calcium chloride | |
| Diamond | |
| Ferric nitrate | |
| Ferrous salt | |
| Hydroxylamine nitrate | |
| Magnesium chloride | |
| Magnesium oxide | |
| Silicon carbide | |
| Sodium nitrite | |
| Sodium pyrophosphate | |
| **Metals** | No RCRA-regulated metals are used |
| Calcium | |
| Iridium | |
| Yttrium | |
| **Organic Chemicals** | |
| Diethylenetriamine | |
| Duco cement (glue) | |
| Epoxy mounting resin | |
| Ethanol | D001 (ignitability) does not apply because there is no free liquid in solid debris waste. |
| Ethylene glycol | |
| Fantastik | |
| Ion exchange resins | |
| Phenophthalein | |
| Sucrose | |
| UCAR C-34 cement | |
| Urea | |

4.2 Toxicity Listings

EPA HWNs D007 (chromium), D008 (lead), and D009 (mercury) are applicable to only the calcined hydroxide cake waste generated by P/S code R8.

Sampling and analysis of waste material from Pu-238 waste streams has been performed to confirm that these waste streams do not contain regulated heavy metals above regulatory levels (TWCP-1698, TWCP-AK-2.1-011). Table 5 summarizes the analytical results, which show that all of the randomly selected items for the TCLP test are below the regulated concentrations. These analyses confirm the high purity of the SRS feed material, and the absence of RCRA-regulated metals from Pu-238 processing operations at TA-55.

**Table 5. TCLP Concentrations (ppm) in Wastes from Pu-238 Operations**

| Description | Silver | Arsenic | Barium | Cadmium | Chromium | Lead | Selenium | Mercury |
|---|---|---|---|---|---|---|---|---|
| *Detection Limit*[a] | *0.022* | *0.33* | *0.0055* | *0.022* | *0.055* | *0.22* | *0.55* | *0.0001* |
| *RCRA regulatory threshold* | *5* | *5* | *100* | *1* | *5* | *5* | *1* | *0.2* |
| Metal I | 0.031 | --- | 0.14 | --- | --- | --- | --- | 0.0003 [b] |
| Metal II | ---[c] | --- | 0.17 | --- | ---[c] | --- | --- | 0.005 |
| Plastic I | --- | --- | 0.62 | 0.44 | --- | --- | --- | ---[b] |
| Plastic II | ---[c] | --- | 0.39 | --- | 0.093[c] | --- | --- | 0.0002 |
| Plastic III | ---[c] | --- | 0.24 | --- | 0.21[c] | --- | --- | 0.0002 |
| Rubber I | --- | --- | 1.8 | --- | 0.099 | --- | --- | ---[b] |
| Rubber II | ---[c] | --- | 0.34 | --- | 0.071[c] | --- | --- | 0.0002 |
| Combustible and rags I | ---[c] | --- | 0.32 | 0.057 | ---[c] | --- | --- | 0.0002 |
| Combustible and rags II | ---[c] | --- | 0.37 | 0.101 | 0.079[c] | 2.1 | --- | 0.0006 |
| HEPA filter I | ---[c] | --- | 1.5 | 0.11 | 1.2[c] | --- | --- | 0.0001 |
| HEPA filter II | ---[c] | --- | 1.4 | 0.83 | 2.7[c] | --- | --- | 0.0495 |
| HEPA ALB[d] | --- | --- | 0.006 | --- | 0.058 | --- | --- | ---[b] |
| HEPA SSH[d] | --- | --- | 0.009 | --- | 0.062 | --- | --- | ---[b] |

--- indicates "not detected," i.e., measured values below the detection limit.

[a] Detection limit represents the instrument detection limit multiplied by a dilution factor, in accordance with the Toxicity Characteristic Leaching Protocol

[b] Detection limit is 0.0003 ppm for these samples

[c] These data have been qualified during data validation. See Appendix C in TWCP-1698 for details

[d] Cold (non-radioactive) surrogate HEPA filter metal housing samples

Source: Table III.1 in TWCP-1698

## 5.0 VERIFICATION THAT IGNITABLE, REACTIVE, AND CORROSIVE WASTES WERE EXCLUDED

According to the WIPP WAP, "The prohibition of liquids and containerized gases prevents the shipment of corrosive, ignitable, or reactive wastes." Administrative controls on waste packaging were in place at various times to ensure the absence of such items from the waste stream.

- Liquids were prohibited from solid waste streams at TA-55 when the facility opened in January 1978. A waste management procedure written to cover operations at the new facility, *TA-55 Standard Operating Procedure (SOP) 406-GEN-R00*, stated that "Liquids are not permitted in any container of solid waste materials" (TWCP-3943).

- Chemical Waste Disposal Requests introduced in June 1980 included checkboxes which the waste generator was required to check if the waste contained corrosive acids or bases, or pyrophoric, flammable, corrosive, explosive, toxic, carcinogenic or highly reactive materials.

- The Certification Plan (TWCP-697) and related Generator Attachments (TWCP-701) were implemented in 1987. Waste generators were required to sign a statement on the WODF documenting that the waste contained "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." Checkboxes were also present for indicating the presence or absence of corrosive chemicals. Full implementation of this generator statement occurred in May 1987.

- Waste management inspectors perform visual examination of the waste prior to its initial packaging, thus allowing the inspectors to verify the generator's WODF statement (TWCP-701, Sections 3.8.5 to 3.8.6).

- In addition to the above-mentioned prohibitions on explosives in wastes, explosives were prohibited from TA-55 until installation of the Impact Test Facility in the early 1990s. Explosives continue to be banned in the solid waste streams up to the present time. In the event of a misfire or unconsumed explosives, the requirement is to destroy the unspent powder by burning (TWCP-4720).

- The Waste Profile Request Form (WPRF), which has been in use at LANL since 1991, includes a statement which must be authenticated by the waste generator, that the waste is not ignitable (flash point >200°F), reactive, or corrosive.

- The TA-55 Generator Attachments to the Certification Plan were updated in 1995 (TWCP-700) but the prohibition on liquids in the waste, and the waste management inspection, remained in effect.

Hence, since the inception of operations at TA-55, corrosive and reactive wastes have been excluded from TA-55 solid wastes through the prohibition of liquids.

The absence of these prohibited items is verified through radiography of each waste container and visual examination of selected containers during TWCP characterization activities. These data are used to assess the accuracy of AK information in accordance with *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028). Any free liquids are remediated, and any containerized gases that are found to be present are removed, or the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

## 6.0 VERIFICATION THAT INCOMPATIBLE CHEMICALS WERE PROHIBITED

Section 5.0 summarizes administrative controls in place at TA-55 that prohibit incompatible chemicals in the waste, and measures taken to verify their absence. In addition, all waste containers shipped from TA-55 to TA-54 for storage were evaluated for potentially incompatible chemicals in accordance with 49 CFR Subpart C—Segregation and separation chart of hazardous materials; Section 177.848, Segregation of hazardous materials, and were determined to be in compliance with this requirement.

## 7.0 VERIFICATION THAT THERE ARE NO COMPRESSED GASES, FREE LIQUIDS, NONRADIONUCLIDE PYROPHORICS, SEALED CONTAINERS GREATER THAN FOUR LITERS IN VOLUME, OR >1% RADIONUCLIDE PYROPHORICS

Most gases used at the TA-55 Plutonium Facility are stored outside the building and the gas is plumbed into the glovebox from outside the building (TWCP-4164). Occasionally, a lecture bottle may have been used for a process inside the building, but these bottles were kept outside of the glovebox with the gas plumbed into the glovebox. Consequently, compressed gas cylinders or containers are not expected to be in any of the TRU wastes generated by TA-55 operations.

Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992 (TWCP-4166). These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes.

Verification that individual waste drums do not contain compressed gases, free liquids, or sealed containers greater than 4 liters in volume is obtained from radiography of each waste container and visual examination of selected containers during TWCP characterization activities. Any free liquids are absorbed, and any sealed containers greater than 4 L in volume, or unpunctured or unvented gas containers, are removed; or else the container is tagged as non-compliant by filing a Prohibited Waste Report in accordance with *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007).

Administrative and procedural controls on the prohibited pyrophorics in TRU waste and the absence of pyrophorics has been verified through testing. For items of pyrochemical

salt waste, the procedures of oxygen sparging and/or carbonate oxidation have been used since May 1987 to ensure that pyrophorics were oxidized. In addition, screening tests on similar pyrochemical salts and residues (which contain higher amounts of plutonium) at the RFETS (TWCP-2501) have shown (1) no autoignition, (2) no spontaneous combustion, and (3) no sparking. Experimental results on the reactivity of LANL direct oxide reduction (DOR) salt with water and the reactivity in air of heated calcium metal nodules from DOR salts indicate the absence of "dangerous when wet materials" and pyrophoricity in these salts (TWCP-3730, TWCP-3731, TWCP-3732).

Chemical Waste Disposal Requests dated as early as June 1980 included boxes that were required to be checked if the waste contained pyrophoric, flammable, corrosive, or explosive materials.

In addition, for wastes generated after the implementation of the 1987 Certification Plan, Generator Attachments, associated waste packaging procedures, and quality assurance systems, the waste generator has signed a statement on the WODF for each waste item stating that waste contains "no free liquids, pyrophorics, explosives, compressed gases, powders or materials other than the indicated matrix." The TA-55 Attachment to the Certification Plan describes how these restrictions were verified by waste management personnel (TWCP-701, Sections 3.8.5 through 3.8.7).

## 8.0 VERIFICATION THAT THERE ARE NO POLYCHLORINATED BIPHENYLS (PCBs) IN THE WASTE STREAM

No PCBs were introduced into the nitrate operations, based on documentation in TA-55 procedures reviewed during the AK investigation and summarized in lists of process inputs documented in the TA-55 process AK reports.

- In the cement fixation process (P/S codes CF and HP), oils are sometimes added to drums of cemented waste. There is no indication these oils contain PCBs, and they are added to the 55-gallon drums of cement in small quantities (maximum of 6 liters [TWCP-3568/N-74]). The oils are primarily vacuum pump oils, along with some oils used in heat-treating (cooking or silicone oils) or in grinding (TWCP-3568/N-82). None of these oils are known to contain PCBs.

- All transformers known to contain PCBs have been tracked from initiation of operations of TA-55 in 1978. When any transformer oil is drained, the oil is handled by a subcontractor who is wholly responsible for its disposal; this oil does not enter the LANL disposal operations (TWCP-3568/N-82).

- Ballast in fluorescent light fixtures could contain PCBs, but at TA-55 these light fixtures are outside the gloveboxes and hence would not enter the TRU waste stream.

- Oil-filled capacitors are not known to have been used in TA-55 gloveboxes.

In addition, if the possibility exists for the waste to contain PCBs, RTR operators are required to check for indications of PCB-containing materials or PCB-contaminated materials. If there is reason to suspect that an item may contain PCBs (based on AK, operator training, or previous operator experience), then the operator submits a PWR and places a hold tag on the waste container (Section 6.6.6 and Table 3 in *Performing Nondestructive Testing Using the Mobile Real-Time Radiography System* [TWCP-DTP-1.2-008]).

## 9.0 CITED PROCEDURES AND REQUIREMENTS DOCUMENTS

- 40 CFR Part 261, Subpart C—Characteristics of hazardous waste, Sections 261.21 (*Characteristic of ignitability*), 261.22 (*Characteristic of corrosivity*), 261.23 (*Characteristic of reactivity*), and 261.24 (*Toxicity characteristic*)
- 40 CFR Part 261, Subpart D—Lists of hazardous waste, Sections 261.31 *(Hazardous wastes from non-specific sources),* 261.32 *(Hazardous wastes from specific sources),* and 261.33 *(Discarded commercial chemical products, off-specification species, container residues, and spill residues thereof)*
- 49 CFR Subpart C—Segregation and separation chart of hazardous materials. Section 177.848, *Segregation of hazardous materials*
- *Acceptable Knowledge Documentation* (TWCP-QP-1.1-021)
- *Nonconformance Reporting and Tracking* (TWCP-QP-1.1-007)
- *Performing Nondestructive Testing Using the Mobile Real-Time Radiography System* (TWCP-DTP-1.2-008)
- *Reconciliation of Visual Examination and Radiography Information* (TWCP-QP-1.1-028)
- *Waste Acceptance Criteria for the Waste Isolation Pilot Plant* (DOE/WIPP-069)
- *Waste Analysis at Facilities that Generate, Treat, Store and Dispose of Hazardous Waste* (EPA/OSWER 9938.4-03)
- *Hazardous Waste Facility Permit Issued to the Waste Isolation Pilot Plant* (EPA No. NM4890139088)
- *Waste Characterization Data Reconciliation with Acceptable Knowledge* (TWCP-DTP-1.2-064)

# ACCEPTABLE KNOWLEDGE ROADMAP

**P/S Codes:** ASP, GPHS, MTL, P1, R8, RCI, SCP, WS

Copies of these documents are in the TWCP RMDC Center.

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-0351 | C | Pu-238 discard limits | TA-55 Waste Management, 539-GEN-R02, 10/18/96, Appendix J | Lists Pu-238 discard limits in various process materials. | None |
| TWCP-0352 | C | Generic plutonium recovery process description | Wastes from Plutonium Conversion and Scrap Recovery Operation; LA-11069-MS; March 1998 | Document describes the Pu residues and the various treatment approaches used in recovering Pu from scrap. | None |
| TWCP-0415 | B | TA-55 Pu-238 processes | FSAR for TA-55 (Section 2.5.9, pp. 2-164 to 2-166) | Describes the TA-55 Pu-238 operations. | Document does not give information about RCRA constituents introduced or present in the processes. |
| TWCP-0697 | B | Waste controls | Los Alamos Certification Plan, WCP-HSE7-CPL-01,R2, 1984 | Waste was controlled to meet WIPP WAC requirements as early as 1984. Generator Attachments were used to describe and reference specific generator procedures. | Overview document - Generator Attachments provide more detailed information. |
| TWCP-0698 | D | Material Type compositions | Memo from Bill Schueler, NMT-7. | Gives Material Type compositions | Does not give information on actual material used in the Pu-238 processes. |
| TWCP-0700 | C | Waste controls | TA-55 Generator Attachment to the LANL Certification Plan, TRU-TA55-CPA-03,R00, 1995 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-0701 | C | Waste controls | TA-55 Generator Attachment to the LANL Certification Plan, TRU-MST12-CPA-03,R00, 1987 | Documents controls to meet WIPP WAC were implemented and how independent verification was accomplished. | Information is not extremely detailed. |
| TWCP-0813 | D | Waste characterization | Memo from Davis Christensen, EM-SWO: 97-201 | Clarifies the history of assigning EPA hazardous waste codes in the TRU Database to waste generated before 1993. | Indicates that EPA assignments made on the basis of AK in 1992 are subject to change through additional AK information. |
| TWCP-0816 | D | Jim Foxx Interview on Number of Layers of Packaging | C.L. Foxx, Los Alamos National Laboratory | Provides an explanation of why some containers of combustible debris may be packaged with 6 layers of confinement | No direct way to differentiate between 4 and 6 layers of packaging |
| TWCP-0882 (UCNI) | D | Secondary Radionuclides and Toxic Metals in TA-55 TRU Waste | Memo from TA-55 Subject Matter Expert C.L. (Jim) Foxx | Wastes may be either depleted or enriched in Am-241 and U-234, depending upon whether the source of contamination is the process product or the process residue. | Text does not specifically discuss Pu-238 processes although these P/S codes are listed in the table attached to the memo |
| TWCP-0886 | C | Color Flow Diagram of Pu-processes at TA-55. | Diagram from Jim Foxx | Indicates that process inputs are thermally treated and that heavy metals from process inputs end up in the nitric acid evaporator bottoms. | Does not indicate solvent input to processes. |
| TWCP-0887 | D | Defense and non-defense TRU waste management | Memo from Jim Foxx | Wastes generated from defense and non-defense activities were not segregated at TA-55 through 1997. | None |
| TWCP-0934 | D | Pu-238 and Pu-239 waste management | Memo from TA-55 Subject Matter Expert C.L. (Jim) Foxx | Pu-238 and Pu-239 processes and the wastes generated from those processes were segregated at TA-55. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-1025 | C | Characterization of LWRHU waste | LANL Report number LA-11166-MS pp. 8, 9, 14 | Provides tables of summarized analytical results for as-received and partially processed Pu-238 used in the Galileo LWRHU process. | Materials in these waste streams would have been produced as the result of processing many of the lots. |
| TWCP-1026 | C | Characterization of MWG waste | LANL Progress Report numbers LA-9170-PR LA-9672-PR LA-11217-PR LA-11220-PR LA-11346-PR LA-12236-PR LA-13258-PR | Tables of trace element analytical results show that some RCRA metals are present below regulatory threshold limits in the waste from the Milliwatt Generator Program, and allow calculation of maximum concentration limits for other RCRA metals. | None |
| TWCP-1027 | B | Characterization of epoxy cement used in Pu-238 process | MSDS for epoxy cement, UCAR C-34, Union Carbide Corporation | Indicates that the epoxy cement used in the Pu-238 process does not contain any RCRA-regulated materials. | None |
| TWCP-1030 | C | Characterization of LWRHU waste | LANL Report number LA-13143-MS pp. 5-6, 7-8, 17-18. | Summarized analytical results of as-received and partially processed Pu-238 materials used in the Cassini LWRHU process. | Materials in these waste streams generally would have been produced as the result of processing many of the lots. |
| TWCP-1037 | D | $^{238}$Pu fabrication process description | Written information obtained from a TA-55 waste management expert. | Detailed information of all facets of $^{238}$Pu fabrication activities. | References to documents providing additional information are not provided in the memo, but have been added to the AK Summary Report. |
| TWCP-1044 | D | Waste characterization | SRS Memo NMS-EHB-970073, March 12, 1997 | Describes the SRS process for producing the Pu-238 that was used at TA-55 and presents analyses for metals in the Cassini material. | No flow diagram included. |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-1698 | | Analyses of TRU waste from TA-55-43, Lot No. 1 | Cover letter and enclosed report, "Sampling and Analysis Project Validates Acceptable Knowledge on TA-55-43, Lot No. 01" | Analytical results confirm that TA-55-43 is not a hazardous waste regulated by RCRA | None |
| TWCP-2501 | B | "Backlog Waste Reassessment Baseline Book, Waste Form 34" | Rocky Flats Environmental Technology Site Report 1995 | Page WF34-10 contains results of tests for corrosivity | Tests are on residues rather than waste that is lower in Pu content; hence, they are conservative. |
| TWCP-3545/P238-01 | C | General process information | Comments from Jim Foxx on the draft $^{238}Pu$ AK Summary Report, 11/99 | Details for the $^{238}Pu$ process, specifically RCRA-regulated metals in the R8 process and radioisotope information. | None |
| TWCP-3545/P238-02 | D | General $^{238}Pu$ process information | Interview with Jim Foxx, 9/21/99 | Waste generated from $^{238}Pu$ processes. | None |
| TWCP-3545/P238-03 | C | Pu-238 fuel fabrication process description (P/S code P1) | Process flow diagram for Routine Pu-238 Heat Source Production – Fuel Fabrication, 5/14/98 | Overview of the Pu-238 fuel fabrication process, identifying steps within the process and process outputs. Date established is 9/25/91. | None |
| TWCP-3545/P238-04 | C | Heat source production process description (P/S code P1) | Sampling $PuO_2$ Procedure; HS-CMB11-PP13, Rev. 0 through Rev. 3, 2/20/80 through 3/24/82; HS-MST11-PP-13, Rev. 4 through Rev. 10, 10/22/82 through 4/26/89 | Step-by-step instructions for sampling $PuO_2$ during processing operations. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for P1 Fuel Fabrication, this procedure is assigned to P/S code P1. |
| TWCP-3545/P238-05 | D | General $^{238}Pu$ process information | Interview with Jim Foxx, 8/31/99 | Waste generated from specific $^{238}Pu$ processes. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3545/P238-06 | C | Chemical list, process description (P/S P1) | Particle Size Analysis of Oxide Powders Procedure, HS-NMT9-PP-42, Rev. 0 through Rev. 1, 4/22/91 through 12/11/91 | Step-by-step instructions for analyzing metal oxides and the waste disposal process. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for P1Pellet Production, this procedure is assigned to P/S code P1. |
| TWCP-3545/P238-07 | C | Pellet production process description (P/S code P1) | Process flow diagram for Routine Pu-238 Heat Source Production – Pellet Production, 5/14/98 | Overview of the pellet production process, identifying steps within the process and process outputs. Date established is 9/25/91. | None |
| TWCP-3545/P238-08 | C | Scrap and process residues process description (P/S code P1) | Process flow diagram for Routine Pu-238 Heat Source Production – Scrap and Process Residues Processing, 5/14/98 | Overview of the residues processing process, identifying steps within the process and process outputs. Date established is 6/16/88. | None |
| TWCP-3545/P238-09 | C | Metallography process description (P/S code MTL) | Process flow diagram for Metallography, 6/22/97 | Overview of the metallography process, identifying steps within the process and process outputs. Date established is 7/26/94. | None |
| TWCP-3545/P238-10 | C | Chemical list, process description (P/S code MTL) | Ceramography of $^{238}PuO_2$ fuel samples; HS-NMT9-PP-44, Rev. 0, 1/8/92 | Step-by-step instructions for the preparation and examination of $^{238}PuO_2$ fuel samples and the waste disposal process. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for MTL, this procedure is assigned to P/S code MTL. |
| TWCP-3545/P238-11 | C | Scrap processing process description (P/S code SCP) | Process flow diagram for Routine Pu-238 Scrap Processing, 8/27/91 | Overview of the scrap processing operation, identifying steps within the process and process outputs. Date established is 6/16/88. | None |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3545/P238-12 | C | $^{238}PuO_2$ transfer process description (P/S code SCP) | Introductory Glovebox Transfer of an EP-60 into an EP-61, HS-NMT9-PP-46, Rev. 0 through Rev. 1, 12/23/91 through 9/24/92 | Step-by-step instructions for transferring $^{238}PuO_2$ from an inner shipping container into an outer shipping container. | None |
| TWCP-3545/P238-13 | C | Chemical list and process description (P/S code RCI) | Decontamination of Ir Using Molten $MgCl_2$, HS-NMT9-PP-38, Rev. 0, 5/9/90 through 10/8/92 | Provides step-by-step instructions for decontaminating Ir coated with $^{238}PuO_2$. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for RCI, this procedure is assigned to P/S code RCI. Handwritten note at top of procedure: "obsolete 10/8/92 per WI 1392." This agrees with the "SOP Document History Report" attached to the procedure. |
| TWCP-3545/P238-14 | C | Process description (P/S code RCI) | Process flow diagram for Recovery of PuO2 238 from Contaminated Iridium, 6/10/91 | Overview of the $^{238}Pu$ recovery process, identifying steps within the process and process outputs. Date established is 5/15/91. | None |
| TWCP-3545/P238-15 | C | Chemical list, process description (P/S code RCI) | Dissolution of Ir by Electrochemical Methods; HS-NMT9-PP-39, Rev. 0, 5/9/90 | Step-by-step instructions for decontaminating Ir coated with $^{238}PuO_2$ using electrochemical dissolution. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for RCI, this procedure is assigned to P/S code RCI. Handwritten note at top of procedure: "obsolete 10/8/92 per WI 1392." This agrees with the "SOP Document History Report" attached to the procedure. |

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| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3545/P238-16 | C | Chemical list, process description (P/S code R8) | 238Pu Waste Solidification, HS-MST11-PP-34, Rev. 0, 8/4/86; HS-NMT9-PP-34, Rev. 1 through Rev. 3, 9/6/90 through 12/9/92 | Step-by-step instructions for solidifying $^{238}$Pu waste solutions. | The P/S code is not identified in the procedure. Based on the process described in the procedure and the flow diagram for R8 Waste Solidification, this procedure is assigned to P/S code R8. |
| TWCP-3545/P238-17 | C | $^{238}$Pu waste solidification process description (P/S code R8) | Process flow diagram for $^{238}$Pu Waste Solidification, 2/25/99 | Overview of the $^{238}$Pu solidification process, identifying steps within the process and process outputs. Date established is 1/27/84. | None |
| TWCP-3545/P238-18 | C | Feed input for $^{238}$Pu solidification process (P/S code R8) | Email from Jim Foxx, "RCRA Codes for Pu-238," 12/9/99 | Analytical results for RCRA-regulated metals in analytical solutions feeding the $^{238}$Pu solidification process. | Some of the detection limits appeared to be above the regulatory limits |
| TWCP-3545/P238-19 | C | Chemical list, process description (P/S code R8) | Recovery of Plutonium-238 from Sucrose, 483-REC-R00 through R01, 5/17/83 through 9/30/83; Recovery of Plutonium-238 from Sucrose Solutions; HS-MST11-PP-36, Rev. 0, 12/18/87 | Step-by-step instructions for recovering $^{238}$Pu from sucrose solutions. | The P/S code is not identified in the procedure. Based on the process described in the procedure, this procedure is assigned to P/S code R8 ($^{238}$Pu recovery from sucrose).<br>Handwritten note at top of 483-REC-R01: "Transferred to MS-11."<br>Handwritten note at top of HS-MST11-PP-36 procedure: "obsolete 5/11/92 per WI 1324." |
| TWCP-3545/P238-20 | D | Process description and chemicals used | Interview with Jim Foxx and Gary Rinehart | Details on process description and chemicals used in the processes based on a review of the draft Pu-238 AK Summary Report. | None |
| TWCP-3545/P238-21 | D | Chemicals used in P/S code RCI | Interview with Jake Espinosa | Specific information regarding the electrolyte solution and electrodes used in the RCI process. | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-3545/P238-22 | C | Process descriptions for P/S codes ASP, PPD, and WS | Information provided by Jim Foxx (1/17/00) | Process flow diagram for P/S codes ASP, PPD, WS | Procedures describing the process for the P/S codes have not been identified. |
| TWCP-3545/P238-23 | D | Process information | Email from John Musgrave conveying information from Jim Foxx. | LWRHU and MWG processes are performed under P/S code P1. | None |
| TWCP-3568 /N-74 | C | Chemical list; process description (P/S code CF) | Organic Liquid Emulsification, TRU-NMT2-DP-13, R00; TRUWM-TA55-DP-13-R00; 8/30/93 through 9/30/94 | Emulsifying waste oil and other organic liquids for cement fixation. | None |
| TWCP-3568 /N-82 | C | Clarification of specific processes within the nitrate operations at TA-55 | Jim Foxx, SME, response to comments received on the *Acceptable Knowledge Summary Report for TA-55 Nitrate Operations*, draft dated 2/25/00 | Resolutions to the questions and issues raised by Pam Rogers during her review of the *Acceptable Knowledge Summary Report for TA-55 Nitrate Operations*, draft dated 2/25/00 | Information is based on SME knowledge. |
| TWCP-3730 (UCNI) | B | Pyrophoricity characterization | Characterization of Direct Oxide Salts (LA-CP-95-0098) | Hydrogen generation and pyrophoricity of DOR salts. Also gives reference for MSE, ER, and Cr-containing salts. | None |
| TWCP-3731 | D | Sodium pyrophoricity in pyrochemical salts | Memo (MST-12-ARO-88-052) | Treatment of sodium in salts is effective | Sodium only |
| TWCP-3732 | C | Experimental data on calcium pyrophoricity in salts | Memo (MST-12-ARO-88-077) | Treatment of calcium in salts is effective | Calcium only |
| TWCP-3943 | B | Procedure for Waste Management at TA-55 | TA-55 Document, 406-GEN-R00 | Contains information on waste management procedures in 1978 | None, but doesn't address today's waste management concerns |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4162 | D | Segregation of non-defense wastes from defense wastes | Interview with Jim Foxx, 10/12/00 | Wastes from various processes were not segregated by funding source until recently (1997 or 1998), but rather were segregated and packaged based on waste type | Specific date for segregation by funding source not given |
| TWCP-4164 | D | Use of gases in PF-4 | Interview with Jim Foxx, 10/16/00 | Most gases used at PF-4 are stored outside the building and the gas is plumbed into the glovebox from outside the building. | None |
| TWCP-4166 | D | Disposal of spray cans used in gloveboxes | Interview with Jim Foxx, 10/17/00 | Spray cans, especially WD-40, were in common use in TA-55 gloveboxes until May 1992. These were routinely discarded as metal debris waste. From 1988 until May 1992, the protocol was to vent or puncture the spray cans inside the glovebox; venting was indicated by inserting a metal wire into the valve. After May 1992, spray cans were no longer used in gloveboxes. | None |
| TWCP-4167 | D | Segregation of non-defense wastes from defense wastes | Interview with Jim Foxx, 10/18/00 | Wastes from various processes were not segregated by funding source, waste-generating process, or waste-generating location (e.g., room or glovebox) until recently (August 27, 1998), but rather were segregated and packaged based on waste type | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

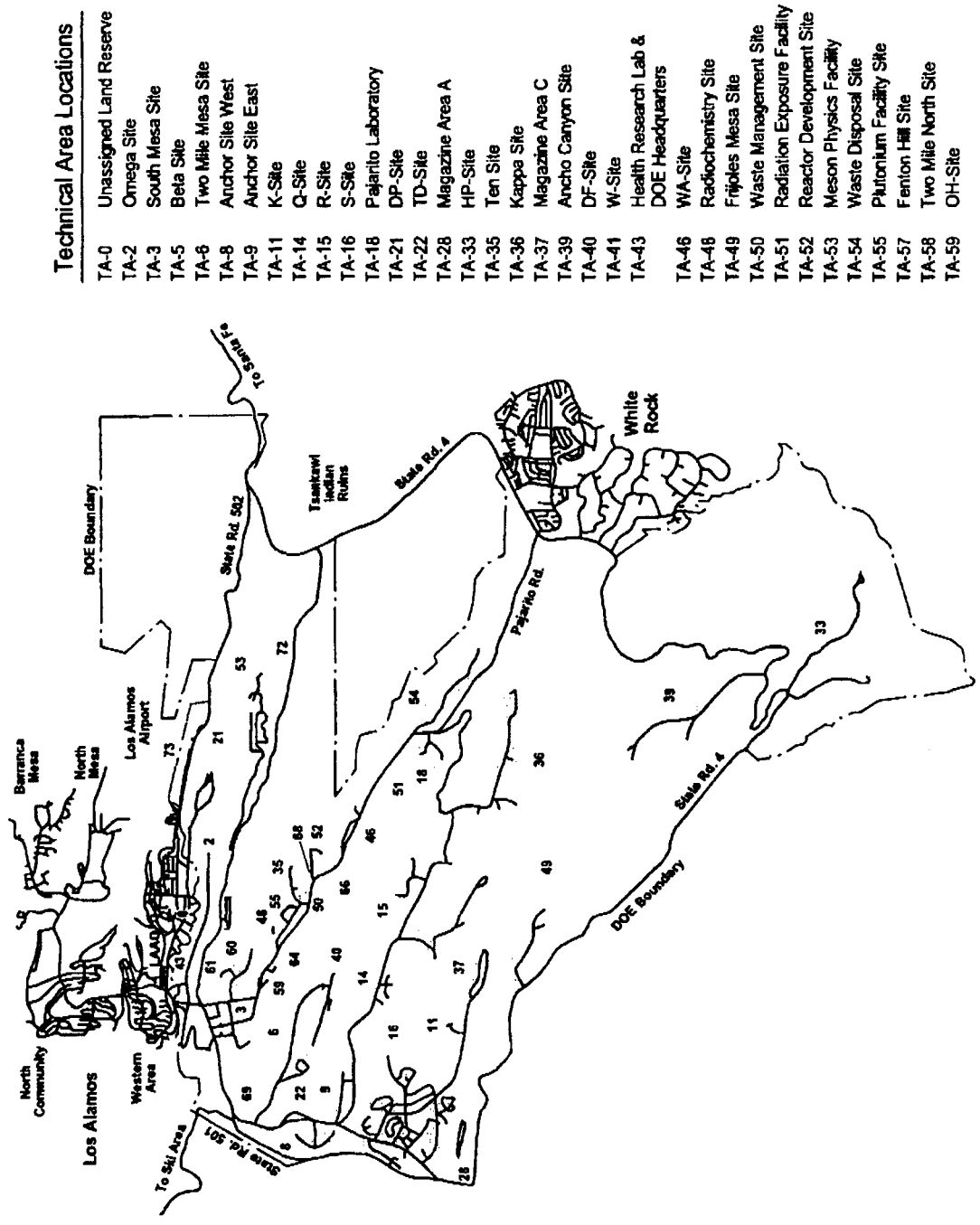
| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-4720 | B | Describes the procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun, P/S codes ITF and ITF4) to ensure that explosives do not enter the waste stream | 40-mm Powder Breech Project Waste Management Plan, Rev. 2 (issued March 27, 2000) | Procedure to be taken at TA-55 in the event of a misfire or unconsumed explosives (from the Impact Test Facility 40-mm gun) to ensure that explosives do not enter the waste stream | Does not appear to be a controlled document. Without revision history, cannot tell when this document was first issued, and how the potential for unconsumed explosives was addressed when the Impact Test Facility (ITF) began in 1996 |
| TWCP-5086 | B | P/S Codes for TA-55 waste items, listed by drum | P/S codes for waste items in individual drums are either from the TA-55 Waste Management System or from the certified data base | P/S codes for waste items in individual waste containers from TA-55 | Only some drums are included |
| TWCP-5600 | D | Description of P/S code ASP, including process flow chart | Interview with SME on work conducted under P/S code ASP | Description and flow chart of steps involved in P/S code ASP, Pu-238 Aqueous Scrap Recovery | None |
| TWCP-5706 | B | Procedure for Direct Oxide Reduction of 238PuO2 (P/S code WS) | NMT9-SOP-0089-R02, Direct Oxide Reduction of 238PuO2 | Description of process for P/S code WS (Direct Oxide Reduction of 238PuO2) | None |
| TWCP-5707 | D | Description of P/S code WS | Interview with SME on work conducted under P/S code WS | Description of work conducted under P/S code WS, Pu-238 Direct Oxide Production | None |
| TWCP-AK-2.1-003, R.2 | B | Summarizes AK information on processes conducted in the TA-55 metal operation processes | *Process Acceptable Knowledge Report for Metal Operation Processes* | Discusses P/S code | None |
| TWCP-AK-2.1-004, R.2 | B | Summarizes AK information on processes conducted in the TA-55 miscellaneous processes | *Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55* | Discusses P/S code WM | None |

* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

| TWCP Record No. | Information Category Code* | Information | Source | Summary | Limitations |
|---|---|---|---|---|---|
| TWCP-AK-2.1-005, R.2 | B | Summarizes AK information on processes conducted in the TA-55 nitrate operations | *Process Acceptable Knowledge Report for Nitrate Operations at TA-55* | Discusses P/S codes CF, ED, HP, MPD, SC, SP, and TDC | None |
| TWCP-AK-2.1-006, R.2 | B | Summarizes AK information on processes conducted in the TA-55 pyrochemical operations | *Process Acceptable Knowledge Report for Pyrochemical Operations at TA-55* | Discusses P/S code | None |
| TWCP-AK-2.1-007, R.2 | B | Summarizes AK information on processes conducted in the TA-55 special processing operations | *Process Acceptable Knowledge Report for Special Processing at TA-55* | Discusses P/S code PPD | None |
| TWCP-AK-2.1-011, R.0 | B | Waste stream report that relies upon the AK information presented in the Pu-238 process AK report | *Acceptable Knowledge Summary Report for Waste Streams TA-55-43, TA-55-44, TA-55-45, TA-55-46 and TA-55-47* | Relies on information in the Pu-238 process AK report | None |
| TWCP-PLAN-0.2.7-001,R.5 | B | Summarizes AK information for individual TRU waste containers | *Los Alamos National Laboratory Transuranic Waste Characterization AK Information Summary* | Assignment of individual TRU waste containers to specific waste streams | Out of date |

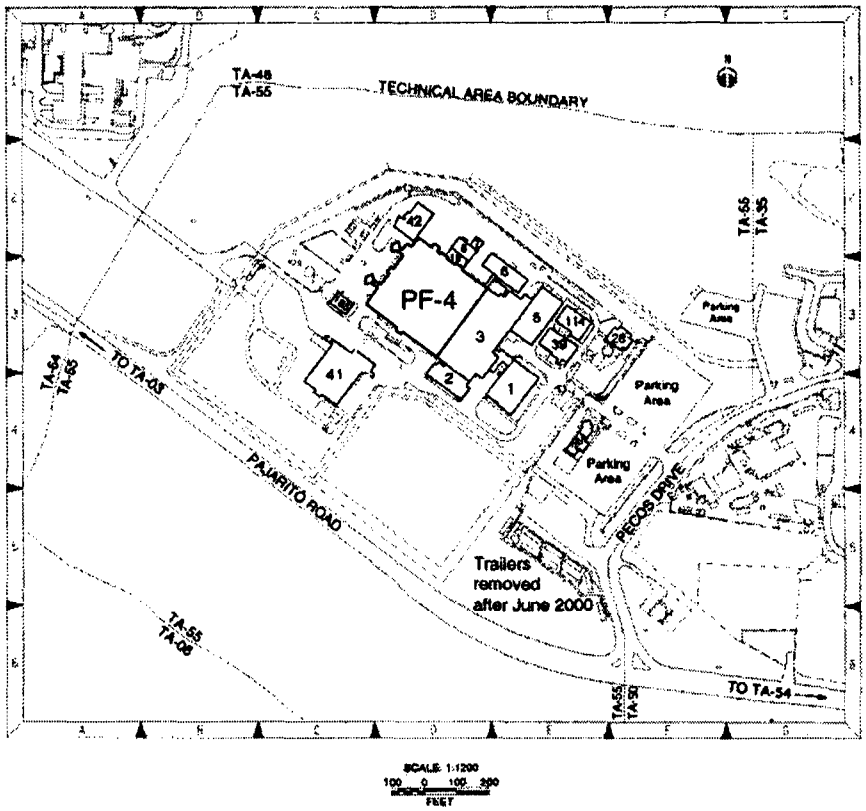
* Information Category Codes: A = forms intended for use in waste certification, B = data from controlled databases and published documents, C = unpublished data, and D = interviews, memos, and letters

# MAP OF LANL

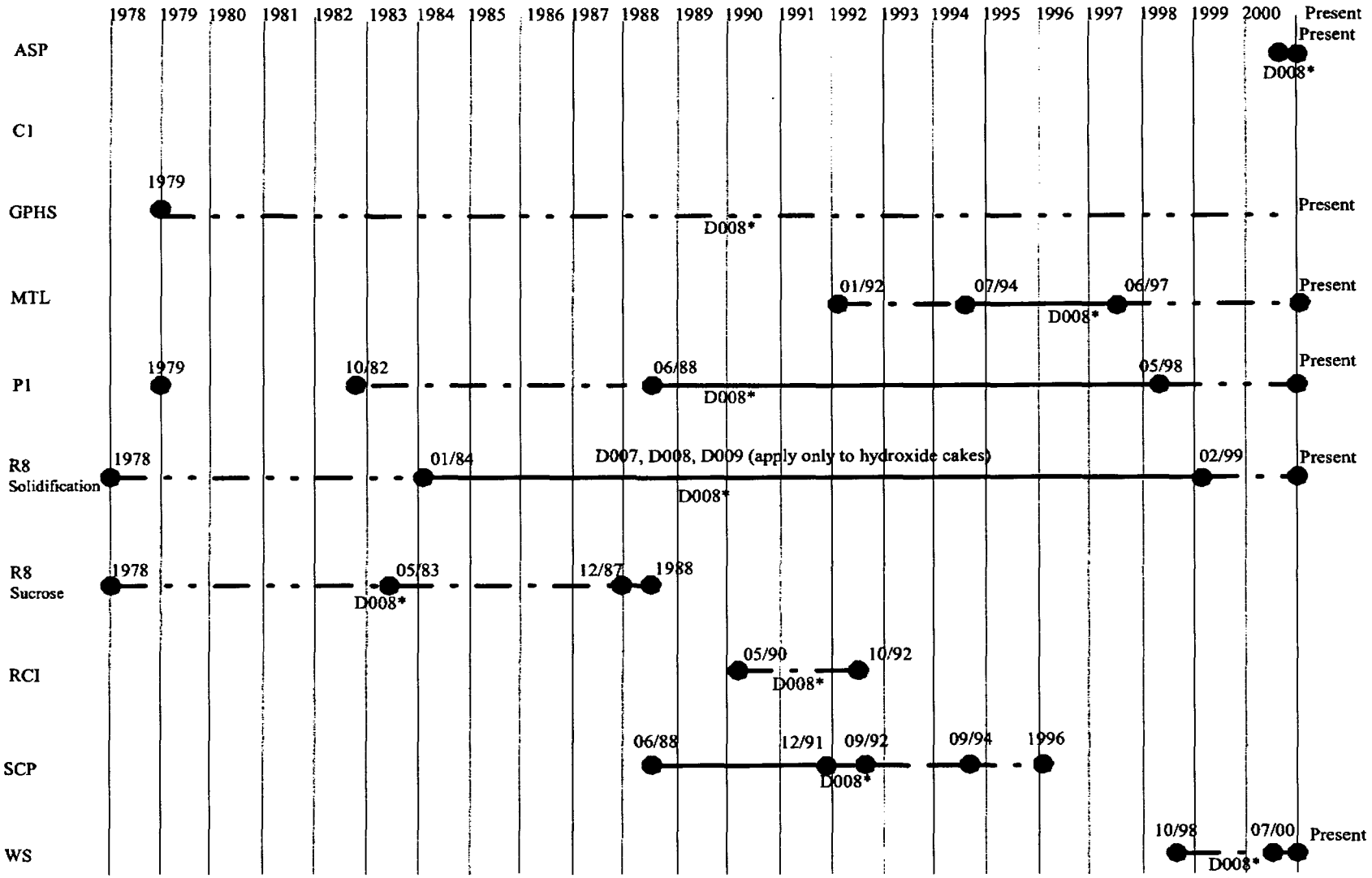

Technical Area Locations
TA-0 Unassigned Land Reserve
TA-2 Omega Site
TA-3 South Mesa Site
TA-5 Beta Site
TA-6 Two Mile Mesa Site
TA-8 Anchor Site West
TA-9 Anchor Site East
TA-11 K-Site
TA-14 Q-Site
TA-15 R-Site
TA-16 S-Site
TA-18 Pajarito Laboratory
TA-21 DP-Site
TA-22 TD-Site
TA-28 Magazine Area A
TA-33 HP-Site
TA-35 Ten Site
TA-36 Kappa Site
TA-37 Magazine Area C
TA-39 Ancho Canyon Site
TA-40 DF-Site
TA-41 W-Site
TA-43 Health Research Lab & DOE Headquarters
TA-46 WA-Site
TA-48 Radiochemistry Site
TA-49 Frijoles Mesa Site
TA-50 Waste Management Site
TA-51 Radiation Exposure Facility
TA-52 Reactor Development Site
TA-53 Meson Physics Facility
TA-54 Waste Disposal Site
TA-55 Plutonium Facility Site
TA-57 Fenton Hill Site
TA-58 Two Mile North Site
TA-59 OH-Site
To Santa Fe
DOE Boundary
State Rd. 502
Tsankawi Indian Ruins
State Rd. 4
White Rock
Pajarito Rd.
Barranca Mesa
North Mesa
Los Alamos Airport
North Community
Los Alamos
Western Area
State Rd. 501
To Ski Area
DOE Boundary
State Rd. 4

## MAP OF TA-55

**Note:** The Plutonium Facility, Building PF-4, is labeled PF-4 on this map.



## TIMELINE FOR Pu-238 PROCESSES




*Prior to 1987, leaded gloves were not segregated from combustible debris. Between 1987 and May 1992, they were segregated and discarded in the metal debris waste stream. Since May 1992, they have been routinely segregated and assigned to a leaded glove waste stream, still under the originating P/S code (TWCP-4166).

## TIMELINE EXPLANATION



The P/S code is established either in the P/S diagrams or in both (or all) revisions of the procedures designating the start and end dates (e.g., Rev. 0 to Rev. 1 or Rev. 0 to Rev. 5.



The P/S code is not identified in the procedure, but the process description matches the P/S code and the description in previous or later revisions of the same procedure.



Extrapolate out two (2) years beyond the last revision date for the procedure to the next possible review date.



Time period based on subject matter expert comments.

## PROCESS INPUTS AND OUTPUTS

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| ASP | Aqueous Scrap Processing | Scrap items, oxide | Nitirc acid, sodium hydroxide, sodium oxalate | Plutonium oxalate, plutonium hydroxide | Debris | *D008 | TWCP-5600 |
| GPHS | General Purpose Heat Source | Pu-238 oxide | Yttrium metal, UCAR C-34 cement | Heat sources | Debris | *D008 | P238-01<br>P238-07<br>P238-08 |
| MTL | Metallography | Samples from P1 | Epoxy mounting resin, aluminum oxide, diamond powder, hydrobromic acid, hydrochloric acid, hydrofluoric acid | Polished samples (archived in glovebox line) | Aqueous abrasive slurries to P/S code R8, debris | *D008 | P238-10<br>P238-20 |
| P1 | Heat Source Production | Pu-238 oxide | Yttrium metal, UCAR C-34 cement | Heat sources | Debris | *D008 | P238-01<br>P238-07<br>P238-08 |
| R8 | Waste Solidification | Analytical solutions from CHM-1, CLS-1, NMT-1, C-AAC; metallography; heat source production, and plutonium decontamination operations | Sodium hydroxide, ferric nitrate, phenolphthalien, ethanol, | No product | Hydroxide cakes, debris | HWNs apply only to hydroxide cakes D006, D007, D008, *D008 D009, D011 | P238-02<br>P238-14<br>P238-15<br>P238-16<br>P238-17<br>P238-18<br>P238-20<br>P238-21 |

| P/S Code | P/S Title | Process Inputs | | Process Outputs | | EPA Codes[2] | References[3] |
|---|---|---|---|---|---|---|---|
| | | Feed Stream(s) | Chemicals/Reagents | Product | Waste Stream[1] | | |
| R8 | Recovery of Pu-238 from Sucrose Solutions | Sucrose solutions (containing sodium pyrophosphate and sucrose) used in particle size analysis of $^{238}PuO_2$ | None | calcined $^{238}PuO_2$ for reprocessing (if above DL) | Calcined residue of sucrose. Solid debris waste including stainless steel, ceramic, glassware, Tygon tubing, filter paper | *D008 | P238-02<br>P238-19 |
| RCI | Pu-238 Recovery from Iridium | Iridium contaminated with Pu-238 oxide | Magnesium chloride, nitric acid, hydrochloric acid, sulfuric acid | Cleaned iridium metal | Debris, magnesium oxide crucibles | *D008 | P238-13<br>P238-14<br>P238-20 |
| SCP | Scrap Processing | Pu-238 oxide | Physical process – no chemicals used | Pu-238 oxide | Debris | *D008 | P238-11<br>P238-12 |
| WS | Pu-238 Direct Oxide Reduction | plutonium oxide (high purity) | Calcium metal, oxygen gas, chlorine gas, calcium chloride, calcium fluoride | plutonium metal | Calcium chloride salt, magnesia crucibles, calcium oxide, calcium metal, debris | *D008 | TWCP-5706<br>TWCP-5707 |

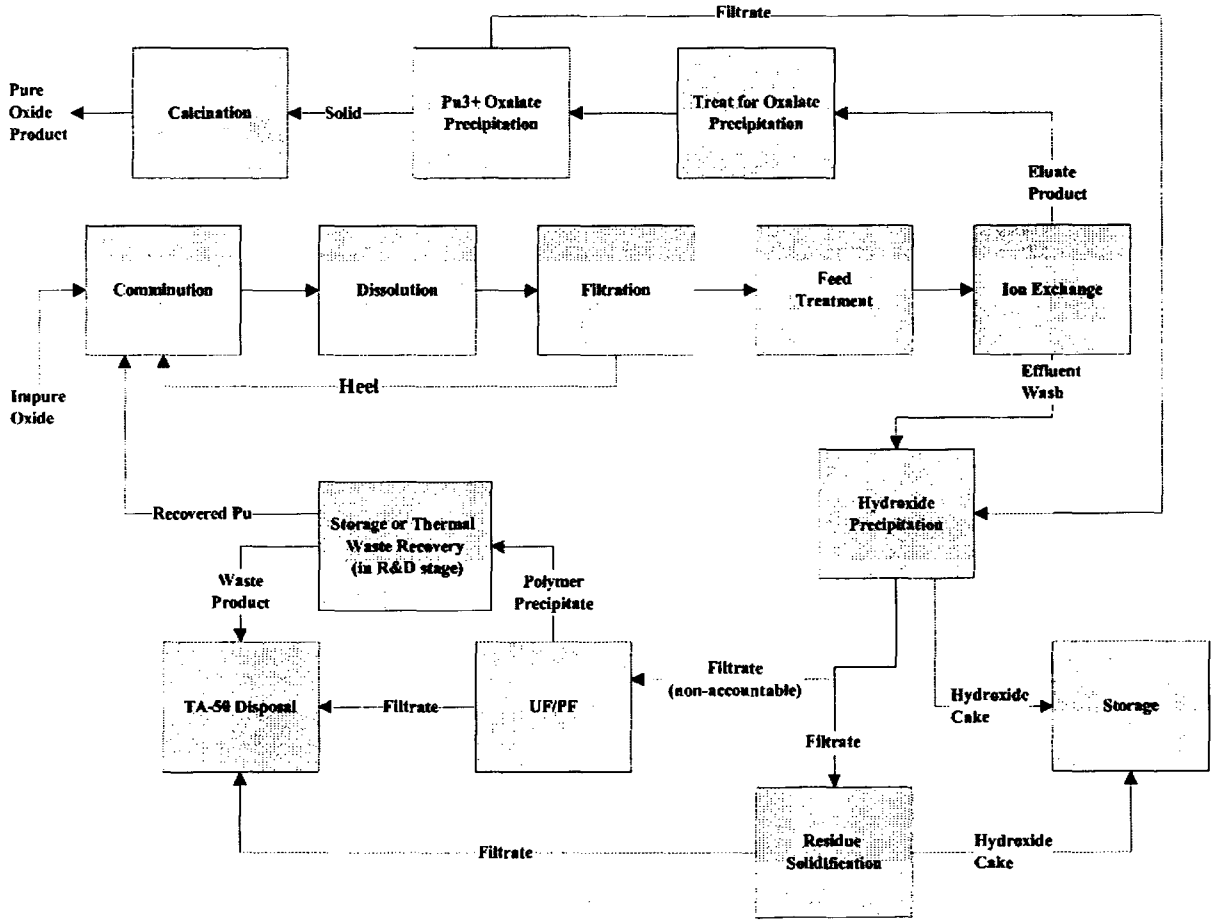
[1] All P/S codes generate routine laboratory debris waste consisting of glassware, plastics, ceramic materials, paper, rags, HEPA filters, metal containers, brushes, and small tools. Leaded gloves may also be generated and are segregated.

[2] See discussion in Section 4.0 for details on the applicability of the RCRA codes listed in this column. The RCRA hazardous waste codes listed apply to the solid TRU waste only and not to any other waste forms that may undergo further treatment or processing (e.g., evaporation or cement fixation). The resulting treated waste stream is evaluated for hazardous waste constituents and assigned the applicable EPA hazardous waste codes. All P/S codes have the potential to generate leaded gloves. The gloves are segregated from other metal debris waste and are assigned EPA hazardous waste code D008 under the originating P/S code.

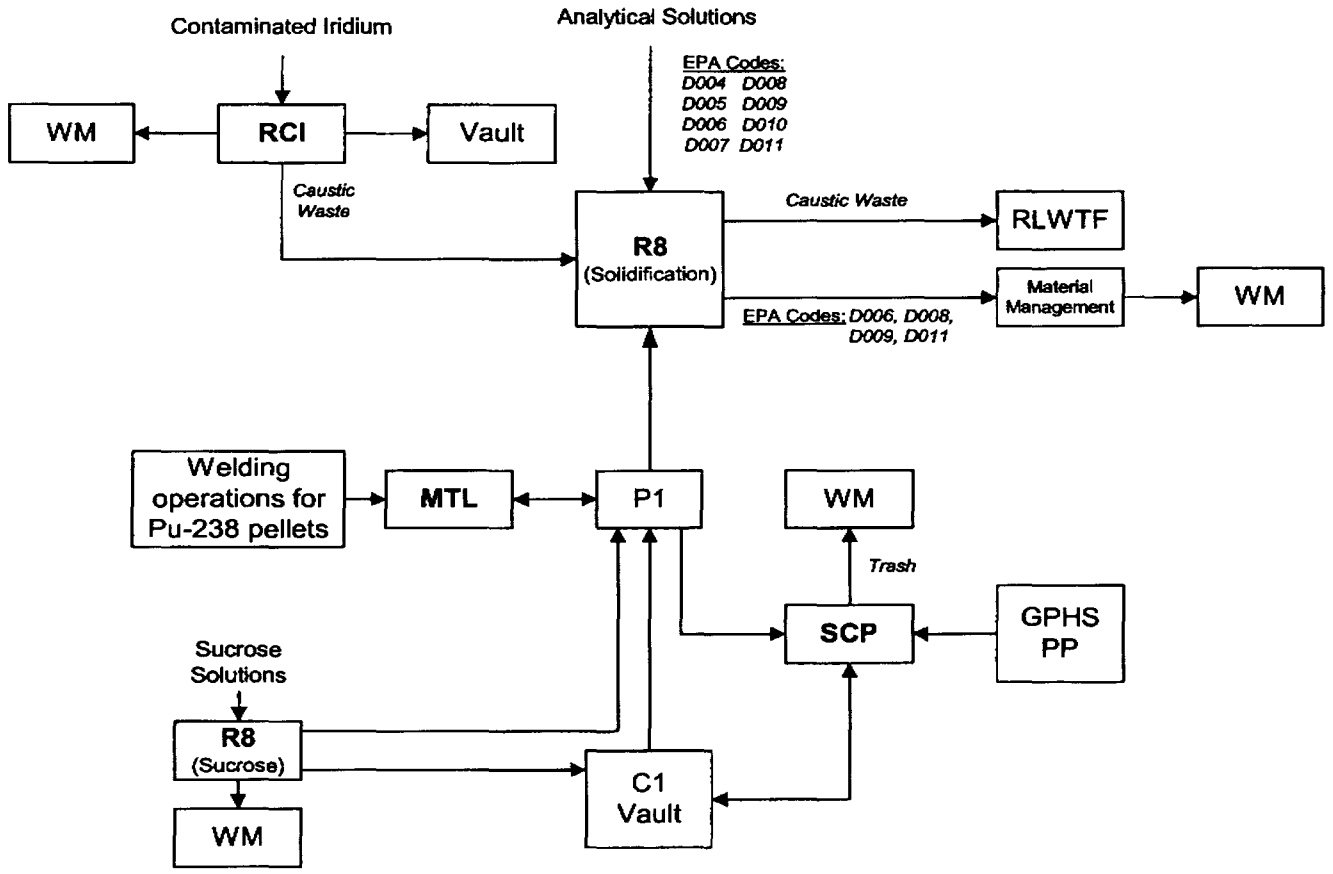
[3] Refer to the Acceptable Knowledge Roadmap in Attachment 1. References listed as P238-*nn* (where *nn* is a 2-digit number) are in TWCP-3545.

*D008 due to leaded gloves

## SIMPLIFIED Pu-238 PROCESS FLOW DIAGRAMS: AQUEOUS SCRAP PROCESSING (P/S code ASP) (TWCP-5600)



## SIMPLIFIED Pu-238 PROCESS FLOW DIAGRAMS: OTHER Pu-238 PROCESSES



## Decision/Discrepancy Resolution Documentation
### TA-55 Pu-238 Operations

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| WS | WS performed in 10/98 and 10/99 | TWCP-5707 | P/S WS--'75-'77 experimental work performed at DP site, waste not out of TA-55 | TWCP-3545/P238-2 | Process report describes activities as in TWCP-5707 | C—meeting with SMEs indicate work performed under P/S code WS in '75-'77 was at another site, not TA-55, so waste did not ever become TA-55 owned. See attached meeting notes. |
| MTL | The older metalography operations(before 1992) used solvent (e.g. trichloroethane) | TWCP-3545/P238-2 | Process report section 3.5 states Pu-238 processes at TA-55 used no organic solvents. | Process Report | Process report does not list any solvents. | C—meeting with SMEs indicated P/S code MTL did not begin until after 1992, so no trichloroethane would be in the waste post 1992. See attached meeting notes. |
| PTS | Indicates that P/S code PTS was associated with R and D research studies with Pu-238. | TWCP-3545/P238-2 | Process report does not describe PTS | Process Report | PTS code not included in process report. | C—Pu-238 PTS operations were performed in another glovebox, therefore this waste would be in under another P/S code per John Musgrave. PTS is Pretreatment studies on LANL and RFETS material, it would be under nitrate operations. See attached meeting notes. |
| PI | P/S Code PI should be taken from Pu-238 report and added to another report (report not referenced). Also indicates time line back to 1978 | TWCP-3545/P238-20 | PI still discussed in this summary report<br><br>Report timeline goes back to 1979. | Summary report | PI P/S code is very similar to CHS and LWRHU and the waste streams would be the same. Therefore the PI information should be moved to another report. | C—in meeting with SMEs, this statement meant that this information was in a previous Pu-238 draft report and needed to be included in this current report which it is. See attached meeting notes. |

| Item Identification* | AK No. 1 | Source No. 1 | AK No. 2 | Source No. 2 | Decision/Discrepancy | Rationale** |
|---|---|---|---|---|---|---|
| All | Leaded gloves were always separated | TWCP-3545/P238-2 | Process report says prior to May 1992, lead gloves were discarded as metal debris and were not segregated from other metal wastes | Process Report, section 3.6.1 | | A—Process report is correct. The first statement is not correct per meeting with SMEs. See attached meeting notes. |
| General | Only lead contaminated debris is lead-lined gloves | TWCP-3545/P238-20 | Cd, Cr, and Pb are typical impurity in Pu Oxide product | TWCP-1044 | Process report, section 3.5 refers to 1044 stating there are no RCRA constituents. Questions remain if analytical data indicates they are below TCLP limits. | B—Gloves segregated after 1992 per Jim Foxx, but apply waste code to all P/S codes. See attached meeting notes. Analytical data in TWCP-2102 indicate below TCLP limits. |
| All | Two issues need to be resolved by R. Glenn—needing more info regarding electrode and electrode solutions; generators signing data package to confirm certain materials were not in the waste | TWCP-3545-P238-20 | No discussion of either of these issues in the Process report | Process report | | C—At the time TWCP-3545-P238-20 was documented, the P/S code was unknown. SMEs said that the correct P/S code was RSI and this refers to decontamination operations, which could have been performed two ways, using dilute mineral acid, or electrolyte ($MgCl_2$). No RCRA constituents. Issues are resolved. See attached meeting notes. |

Sandy Wonder — Evaluator (Print Name)
AK Investigator — Title
Sandy Wonder — Signature
2/25/02 — Date

Pamela Rogers — SPM Review (Print Name)
Pamela Rogers — Signature
2/26/02 — Date

* Item identification can be PS Code, waste stream, drum ID, item ID, or other identification of items affected.
** Rationale code: [A=Professional Judgment; B=Most Conservative Decision; C=Other (specify)]



Source: TWCP-07907

# TWCP/WRR
# Document Modification/Review Cycle

Print Date: 3/27/2002

## Step 7 - Preparation for Document Control

☐ Revision
☒ Interim Change

Document ID: TWCP-AK-2.1-009 New Rev/IC: R.0/IC1

Preparer: Sandy Wander

Document Title:
Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55

Blank entries are Not Applicable items.

☒ Procedure number verified
☒ Procedure Title verified
☒ Procedure Revision/ AK-009 effective date 3/21/02 - posted to web on 3/28/02, delay in posting was due to pending response from CBFO per Jim Bailey.
☒ Pagination verified
☒ Document Header v
☒ Attachment Header
☐ Hazard Summary v RMDC 3/28/02
☒ Effective/Review Date/LAUR# on cover page
☐ Copy of final to Training/Signature Copies

☒ Signatures and Dates typed on cover page
☒ Revision History table reflect changes and effective date
s have been marked as SAMPLE, if applicable
s extracted for Web publishing
onic files archived
tte Prepared for Document Control
☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 3/27/2002 Signed Initials: JJD

## Step 8 - Document Control - Tracking and Web Conversion

Date Received: 3/28/02

☑ Verify Signatures
☑ Verify Effective Date cover/history
☑ Verify IC added to document (if applicable)
☑ Log into Database/Make Assignment
☑ Print Receipts/Cover sheets

☑ Copy document: 2
☑ Control Stations Updated - Date: 3/28/02
☑ Master Index Updated - Date: 3/28/02
NA Archive old revision (Record)

☑ Capture Document: __ Word ✓ PDF
NA Forms: __ Yes __ No
☑ Transfer to Web Server
☑ Quality check to Original
☑ Verify Signatures ✓ Signature Dates ✓
☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date

☑ Web Page TOC: ✓ No/Rev ✓ Effective Date ✓ LAUR ✓ Title ✓ Link ✓ Test
☑ On-line test: ✓ Open Doc
☑ Electronic Notification: ✓ Sent ✓ Printed
NA CBFO: __ Electronic Copy __ Printed
☑ Change Control Notification ____Sent ____Printed ✓ NA

Date Completed: 3/28/02 Signed Initials: CBK

# TWCP/WRR
# Document Modification/Review Cycle

Print Date: 3/27/2002

## Step 1: Receipt Document

Status: ○ Open ◉ Closed ☐ Revision ☒ Interim Change

Date Received: 3/21/2002

Current Rev/IC: R.0

Document ID: TWCP-AK-2.1-009

Rev/IC: R.0/IC1

Document Title:

Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55

Preparer: Sandy Wander Date to DP Team: 3/21/2002

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

03/27/02: Prepared document for transmittal to Document Control

## Step 3: Preliminary Review Cycle

☒ IC - Not Applicable

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

If pages are separated match to Document: TWCP-AK-2.1-009

# TWCP/WRR
# Document Modification/Review Cycle

## Step 4: Comment Reconciliation Cycle ☒ IC - Not Applicable (enter action in comments section)

| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

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Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
| Change Control | G M Polley | 3/21/2002 | 3/25/2002 | NA |
| | | | | |
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Comments

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: Procedure Notification
Cc: fabi,bailey, lpc
Bcc:
Attached:

The following are revised AK reports.

**Effective Date: 3/21/02**

**TWCP-AK-2.1-004,R.2/IC1 -** Process Acceptable Knowledge Report for Miscellaneous Operations at TA-55 (LA-UR-02-1714)

**TWCP-AK-2.1-005,R.2/IC1 -** Process Acceptable Knowledge Report for Nitrate Operations at TA-55 (LA-UR-02-1715)

**TWCP-AK-2.1-006,R.2/IC1** - Process Acceptable Knowledge Report for Pyrochemical Processes at TA-55 (LA-UR-02-1713)

**TWCP-AK-2.1-007,R.2/IC1** - Process Acceptable Knowledge Report for Special Processing at TA-55 (LA-UR-02-1712)

**TWCP-AK-2.1-009,R.0/IC1** - Process Acceptable Knowledge Report for Plutonium-238 Operations at TA-55 (LA-UR-02-1709)

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

***Patricia G. Patton***

Los Alamos National Laboratory
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TWCP-AK-2.1-009,R.0/IC1

**Effective Date** [redacted] **Doc_Source** TWCP **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE REPORT FOR PLUTONIUM-238 OPERATIONS AT TA-55 (LA-UR-02-1709)

**Document Comments**

| Work Stations | ID_No | Name | MS | Organization | Copy |
|---|---|---|---|---|---|
| ☒ RMDC | N/A | ? | ? | ? | |
| ☐ WCRRF | | | | | |
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| ☐ RANT | | | | | |
| ☐ DECON | | | | | |
| ☒ QA | | | | | |

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# TWCP/WRR
# Document Modification/Review Cycle

Print Date: 8/7/2001

## Step 1: Preparation for Document Control

☒ Revision ☐ Interim Change

Document ID: TWCP-AK-2.1-009 New Rev/IC: R.0

Preparer: John Musgrave

Document Title:

Process Acceptable Knowledge Summary Report for Plutonium-238 Operations at TA-55

Blank entries are Not Applicable items.

- ☒ Procedure number verified
- ☒ Procedure Title verified
- ☒ Procedure Revision/IC verified
- ☒ Pagination verified
- ☒ Document Header verified
- ☒ Attachment Header verified
- ☐ Hazard Summary verified (if applicable)
- ☒ Effective/Review Date/LAUR# on cover page
- ☐ Copy of final to Training/Signature Copies
- ☒ Signatures and Dates typed on cover page
- ☒ Revision History table reflect changes and effective date
- ☐ Forms have been marked as SAMPLE
- ☐ Forms extracted for Web publishing
- ☒ Electronic files archived
- ☒ Diskette Prepared for Document Control
- ☒ Document Control packet contains signed original, diskette, DRR/Redline, review documentation

Document Tracking Closed ○ Open ◉ Closed Date to DC: 8/7/2001 Signed Initials: JSB

## Step 2: Document Control - Tracking and Web Conversion

Date Received: 8/7/01

- ☑ Verify Signatures
- ☑ Verify Effective Date cover/history
- ☑ N/A Verify IC added to document (if applicable)
- ☑ Log into Database/Make Assignment
- ☑ Print Receipts/Cover sheets
- ☑ Copy document: 2
- ☑ Control Stations Updated - Date: 8/7/01
- ☑ Master Index Updated - Date: 8/7/01
- ☑ N/A Archive old revision (Record)

- ☑ Capture Document: __ Word ✓ PDF
- ☑ Forms: __ Yes ✓ No
- ☑ Transfer to Web Server
- ☑ Quality check to Original
- ☑ Verify Signatures ✓ Signature Dates ✓
- ☑ Dates: ✓ Cover ✓ Rev. History ✓ Review Date
- ☑ N/A Add: Controlled Document Original Signatures on File at the RMDC
- ☑ N/A Security Set for: ____ Read Only
- ☑ Web Page TOC: ✓ No/Rev ✓ Effective Date N/A LAUR ✓ Title ✓ Link ✓ Test
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If pages are separated match to Document: TWCP-AK-2.1-009

# TWCP/WRR
# Document Modification/Review Cycle

Print Date: 8/7/2001

## Step 4: Comment Reconciliation Cycle ☐ IC - Not Applicable (enter action if requirements applicable)

| | | Comments: |
|---|---|---|
| Reviewer Comments Incorporated: | | |
| Redline/DRR Given to Preparer: | | |
| Reconciled Comments Returned: | | |
| Modifications Made to Document: | | |
| Preparer Review of Modifications: | | |
| Signed/Release for Final Signature: | | |

## Step 5: Final Signature Cycle ☐ IC - Not Applicable (enter action if requirements applicable)

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|---|---|---|---|---|
| J. Fabryka-Martin | Technical | 7/3/2001 | 7/3/2001 | Independent Technical Reviewer/Editor |
| M. Lin | SPM | 7/18/2001 | 7/18/2001 | Site Project Manager |
| B. Humphrey | QA | 7/18/2001 | 7/19/2001 | Waste Certification Official |
| M. Gavett | QA | 7/19/2001 | 7/27/2001 | Site Project QA Officer |
| A. Montoya | Fac Mgr | 7/3/2001 | 7/18/2001 | Facility Representative |
| | | | | |
| | | | | |
| | | | | |

Comments:

## Step 6: External Review Cycle

| Organization | Contact | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments

**TWCP/WRR**

Print Date: 8/7/2001

# Document Modification/Review Cycle

## Step 1: Receipt of Document

Status: ○ Open ◉ Closed ☒ Revision ☐ Interim Change

Date Received: 12/1/2000

Current Rev/IC: -

Document ID: TWCP-AK-2.1-009

Rev/IC: R.0

Document Title:

Process Acceptable Knowledge Summary Report for Plutonium-238 Operations at TA-55

Preparer: John Musgrave Date to DP Team: 12/1/2000

## Step 2: Modification Cycle

Technical Reviewer: (QA and Preparer)

Release for Review:

Comments:

## Step 3: Preliminary Review Cycle

☐ IC - Not Applicable (Information in Comments Section)

| Reviewer | Name | Sent Out | Returned | Comments |
|---|---|---|---|---|
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Comments:

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X-Sender: 102484@mail-48.lanl.gov
Date: Mon, 6 Aug 2001 09:17:30 -0600
To: "James D. Bailey" <bailey@lanl.gov>
From: John Musgrave <jmusgrave@lanl.gov>
Subject: LA-UR
X-RCPT-TO: <154344@empo.lanl.gov>

Jim,
The LA-UR Number for the Pu-238 Process Report is LA-UR-01-4200.

John

To: rubyannf@lanl.gov, mlgarcia@lanl.gov
From: Patricia G Patton <pgp@lanl.gov>
Subject: For Training Distribution
Cc: fabi@lanl.gov
Bcc:
Attached:

The following is a new procedure.

**TWCP-AK-2.1-009,R.0** - Process Acceptable Knowledge Summary Report for Plutonium-238 Operations at TA-55

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

***Patricia G. Patton***

**Los Alamos National Laboratory**
**E-ET**
**Records Management / Document Control**
**( RMDC )**
**TA-0**
**557 Oppenheimer Building 764**
**Phone: (505) 667-2071**
**Email: pgp@lanl.gov**

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To: wipp.notify@wipp.carlsbad.nm.us
From: Patricia G Patton <pgp@lanl.gov>
Subject: [Procedure]
Cc: Tammy.Bowden@wipp.carlsbad.nm.us
Bcc: fl@lanl.gov
Attached: \\twcp-web\Pages\twcp\RMDC\AK\TWCP-AK-2.1-009\TWCP-AK-2.1-009R0.pdf;

The following is a new procedure.

**TWCP-AK-2.1-009,R.0** - Process Acceptable Knowledge Summary Report for Plutonium-238 Operations at TA-55

**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**~~**

***Patricia G. Patton***

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TWCP-AK-2.1-009,R.0

**Effective Date** 8-7-2001 **Doc_Source** AK **Doc_Status** FINAL **Entry No**

**Document Title** PROCESS ACCEPTABLE KNOWLEDGE SUMMARY REPORT FOR PLUTONIUM-238 OPERATIONS AT TA-55 (LA-UR-01-4200)

**Document Comments**

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| Code | Description* |
|---|---|
| LA 116G | Waste is packaged in a 55-gallon drum, an SWB, or a TDOP within plastic bags that have been breached upon repackaging. The punctured bags are not considered to be part of the packaging; therefore, there are no layers of confinement.<br><br>Oversized waste items may be wrapped in plastic and placed in an SWB or a TDOP. No closed liner bags are used in the SWB or TDOP. |
| LA 216H | Waste is packaged in a maximum of three layers of inner plastic bags. Bagged out items are placed in a 55-gallon drum lined with a maximum of two polyethylene liner bags. All bag closures are by the twist and tape method, or the twist, tie, and tape method. |

*If drums are overpacked in an SWB or in a TDOP, no closed liner bags are used in the SWB or TDOP.

Specific waste packaging configurations for the codes and corresponding shipping categories are shown in the following table:

## WASTE PACKAGING CONFIGURATION TABLE

| Code | Layers of Confinement | Hydrogen Diffusivity of Filter on Primary Payload Container* (mol/s/mol fraction) ($\times 10^{-6}$) | Shipping Category | | | |
|---|---|---|---|---|---|---|
| | | | Drum | SWB Overpack | SWB | Direct Load TDOP |
| LA 116A<br>LA 216A | Maximum of 4 plastic bag layers, two of which are liner bags | 1.9 | 30 0340 0528 | 30 0340 0568 | N/A | N/A |
| | | 3.7 | 30 0340 0502 | 30 0340 0542 | N/A | N/A |
| LA 116B<br>LA 216B | Maximum of 2 filtered plastic bag layers, both of which are inner bags | 1.9 | 30 0340 0145 | --- | N/A | N/A |
| | | 3.7 | 30 0340 0120 | — | N/A | N/A |
| LA 116C<br>LA 216C | Maximum of 1 plastic bag layer, which is an inner bag | 1.9 | 30 0340 0306 | 30 0340 0346 | N/A | N/A |
| | | 3.7 | 30 0340 0280 | 30 0340 0320 | N/A | N/A |
| LA 116D<br>LA 216D | Maximum of 2 plastic bag layers, both of which are inner bags | 1.9 | 30 0340 0485 | 30 0340 0525 | N/A | N/A |
| | | 3.7 | 30 0340 0459 | 30 0340 0499 | N/A | N/A |
| LA 116E<br>LA 216E | Maximum of 1 filtered plastic bag layer, which is an inner bag | 1.9 | 30 0340 0136 | --- | N/A | N/A |
| | | 3.7 | 30 0340 0110 | — | N/A | N/A |

| Code | Layers of Confinement | Hydrogen Diffusivity of Filter on Primary Payload Container* (mol/s/mol fraction) ($\times 10^{-6}$) | Shipping Category | | | |
|---|---|---|---|---|---|---|
| | | | Drum | SWB Overpack | SWB | Direct Load TDOP |
| LA 116F LA 216F | Maximum of 1 filtered plastic bag layer, which is a liner bag | 1.9 | 30 0340 0133 | — | N/A | N/A |
| | | 3.7 | 30 0340 0108 | — | 30 0340 0034 | N/A |
| LA 116G | No layers of confinement | 1.9 | 30 0340 0127 | 30 0340 0166 | N/A | N/A |
| | | 3.7 | 30 0340 0101 | 30 0340 0141 | 30 0340 0028 | 30 0340 0013 |
| LA 216H | Maximum of 5 plastic bag layers, two of which are liner bags | 1.9 | 30 0340 0707 | 30 0340 0747 | N/A | N/A |
| | | 3.7 | 30 0340 0681 | 30 0340 0721 | N/A | N/A |

* See Introduction for explanation of hydrogen diffusivity of filter on primary payload container.
N/A Not Applicable
--- Not Used

ASSAY: Drums are assayed by means of a neutron or gamma counter according to written procedures. The instrument used depends on the matrix and nuclide content of the drum. SWBs and TDOPs are assayed by means of portable nondestructive assay hold-up system according to written procedures. The results of the assay are expressed in terms of grams of each radionuclide present. Assay results are used to calculate Pu-239 fissile gram equivalent (plus 2 times the error), plutonium equivalent curies (plus error), and decay heat (plus error).

FREE LIQUIDS: Visual inspections of each waste item for free liquids are performed in accordance with written procedures. Special emphasis during waste inspection is always applied to containers such as bottles and cans. Real-time radiography (RTR) examination of a sample of these drums may be performed to verify that free liquids are not present.

EXPLOSIVE/COMPRESSED GASES: Explosives are prohibited at TA-03-29, TA-48, and TA-50-1; and in TA-55 waste. Only used pressure vessels or spray cans could potentially contain gases under pressure and they are blocked open, punctured, completely flattened, or cut in half in accordance with written procedures.

PYROPHORIC: No pyrophoric materials will be present as determined by visual inspection of each waste item in accordance with written procedures.

CORROSIVES: Visual inspections of each waste item for corrosive materials are performed in accordance with written procedures. Corrosive materials identified during this inspection are either neutralized or diverted from the waste stream.

CHEMICAL COMPATIBILITY: A chemical compatibility study has been performed on this content code, and all waste is chemically compatible for materials in greater than trace (>1% weight) quantities. The chemicals found in this content code are attached and are restricted to the allowable chemical lists for each waste material type found in Appendix 1.3.7 of the SAR.

# TA-55-21/22 Low Wattage Drums
## with Characterization Complete
## as of 7/9/2001

| | A | B | C | D | E | F | G | H | I | J | K | L | M | N | O |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Drum ID | BDRs Complete | Waste Stream | Package Date | RTR Data Package | FRAM Data Package | Assay Data Package | HGAS Data Package | Process Status Codes | RTR Layers of Packaging | TRUCON Determination | Shipping Category | TRUCON Wattage Limit | Shipping Wattage | Over Wattage? |
| 2 | 52463 | 4 | TA-55-22 | 9/15/1989 | LA00-RTR-023 | LA01-FRAM-001 | LA01-HENC-001 | LA01-HGAS-003 | COD | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00703 | ok |
| 3 | 52975 | 4 | TA-55-21 | 6/22/1990 | LA00-RTR-024 | LA01-FRAM-001 | LA01-HENC-001 | LA01-HGAS-006 | WM | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00336 | ok |
| 4 | 54307 | 4 | TA-55-21 | 1/31/1991 | LA00-RTR-023 | LA01-FRAM-005 | LA01-HENC-005 | LA01-HGAS-009 | RR | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00621 | ok |
| 5 | 54494 | 4 | TA-55-21 | 5/30/1991 | LA00-RTR-028 | LA01-FRAM-002 | LA01-HENC-001 | LA01-HGAS-006 | X0 | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00074 | ok |
| 6 | 54571 | 4 | TA-55-21 | 9/18/1991 | LA01-RTR-001 | LA01-FRAM-002 | LA01-HENC-001 | LA01-HGAS-006 | SO | Indeterminate | LA117D | 20 0170 0459 | .0618 | 0.00153 | ok |
| 7 | 54582 | 4 | TA-55-21 | 9/23/1991 | LA01-RTR-001 | LA01-FRAM-002 | LA01-HENC-001 | LA01-HGAS-006 | CV | Indeterminate | LA117D | 20 0170 0459 | .0618 | 0.00790 | ok |
| 8 | 54677 | 4 | TA-55-21 | 5/11/1992 | LA01-RTR-001 | LA01-FRAM-002 | LA01-HENC-001 | LA01-HGAS-006 | VUL | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00333 | ok |
| 9 | 54703 | 4 | TA-55-21 | 10/24/1991 | LA01-RTR-002 | LA01-FRAM-002 | LA01-HENC-001 | LA01-HGAS-006 | LR | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00189 | ok |
| 10 | 54737 | 4 | TA-55-21 | 1/29/1992 | LA01-RTR-002 | LA01-FRAM-002 | LA01-HENC-001 | LA01-HGAS-006 | NC | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00672 | ok |
| 11 | 54754 | 4 | TA-55-21 | 2/6/1992 | LA01-RTR-001 | LA01-FRAM-002 | LA01-HENC-001 | LA01-HGAS-006 | X0 | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.01366 | ok |
| 12 | | | | | | | | | NC | | | | | | |
| 13 | 54824 | 4 | TA-55-21 | 11/5/1990 | LA00-RTR-023 | LA01-FRAM-005 | LA01-HENC-004 | LA01-HGAS-009 | RR | 1 | LA117B | 20 0170 0280 | .1014 | 0.00559 | ok |
| 14 | 54959 | 4 | TA-55-21 | 12/6/1990 | LA00-RTR-026 | LA01-FRAM-003 | LA01-HENC-002 | LA01-HGAS-008 | CX | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00176 | ok |
| 15 | 52039 | 3 | TA-55-21 | 10/7/1992 | LA01-RTR-008 | LA01-FRAM-011 | LA01-HENC-008 | LA01-HGAS-022 | WM | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00304 | ok |
| 16 | 52193 | 3 | TA-55-21 | 3/27/1989 | LA01-RTR-010 | LA01-FRAM-007 | LA01-HENC-006 | LA01-HGAS-017 | X0 | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00528 | ok |
| 17 | 52320 | 3 | TA-55-21 | 1/25/1990 | LA01-RTR-009 | LA01-FRAM-007 | LA01-HENC-006 | LA01-HGAS-017 | unk | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00301 | ok |
| 18 | | | | | | | | | CX | | | | | | |
| 19 | 52344 | 3 | TA-55-21 | 2/16/1990 | LA01-RTR-010 | LA01-FRAM-007 | LA01-HENC-006 | LA01-HGAS-017 | WM | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.01200 | ok |
| 20 | | | | | | | | | CSE | | | | | | |
| 21 | 52383 | 3 | TA-55-21 | 3/28/1989 | LA01-RTR-010 | LA01-FRAM-007 | LA01-HENC-006 | LA01-HGAS-017 | X0 | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00653 | ok |
| 22 | 52566 | 3 | TA-55-21 | 8/14/1989 | LA01-RTR-008 | LA01-FRAM-011 | LA01-HENC-009 | LA01-HGAS-027 | WM | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.01288 | ok |
| 23 | | | | | | | | | unk | | | | | | |
| 24 | | | | | | | | | RCM | | | | | | |
| 25 | | | | | | | | | NC | | | | | | |
| 26 | | | | | | | | | MP | | | | | | |
| 27 | | | | | | | | | LR | | | | | | |
| 28 | | | | | | | | | EV | | | | | | |
| 29 | | | | | | | | | CW | | | | | | |
| 30 | 53548 | 3 | TA-55-21 | 12/8/1988 | LA01-RTR-010 | LA01-FRAM-007 | LA01-HENC-006 | LA01-HGAS-027 | NC | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00707 | ok |
| 31 | | | | | | | | | LR | | | | | | |
| 32 | 54125 | 3 | TA-55-21 | 8/21/1990 | LA00-RTR-024 | LA01-FRAM-005 | LA01-HENC-004 | LA01-HGAS-017 | CSE | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00629 | ok |
| 33 | 54132 | 3 | TA-55-21 | 8/21/1990 | LA01-RTR-003 | LA01-FRAM-016 | LA01-HENC-014 | LA01-HGAS-025 | ML | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.01884 | ok |
| 34 | | | | | | | | | EV | | | | | | |
| 35 | | | | | | | | | CSE | | | | | | |
| 36 | 54365 | 3 | TA-55-21 | 4/24/1991 | LA00-RTR-028 | LA01-FRAM-015 | LA01-HENC-013 | LA01-HGAS-025 | fE | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00060 | ok |
| 37 | 54441 | 3 | TA-55-21 | 5/28/1991 | LA01-RTR-003 | LA01-FRAM-016 | LA01-HENC-014 | LA01-HGAS-026 | WM | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00417 | ok |
| 38 | 54444 | 3 | TA-55-21 | 5/28/1991 | LA01-RTR-002 | LA01-FRAM-016 | LA01-HENC-014 | LA01-HGAS-027 | WM | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00140 | ok |
| 39 | | | | | | | | | unk | | | | | | |
| 40 | 54466 | 3 | TA-55-21 | 2/1/1990 | LA00-RTR-026 | LA01-FRAM-015 | LA01-HENC-013 | LA01-HGAS-025 | X0 | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00745 | ok |
| 41 | | | | | | | | | unk | | | | | | |
| 42 | 54471 | 3 | TA-55-21 | 5/23/1991 | LA01-RTR-002 | LA01-FRAM-016 | LA01-HENC-014 | LA01-HGAS-021 | X0 | Indeterminate | LA117H | 20 0170 0681 | .0417 | 0.00349 | ok |
| 43 | 54714 | 3 | TA-55-21 | 12/2/1991 | LA01-RTR-001 | LA01-FRAM-015 | LA01-HENC-013 | LA01-HGAS-027 | EV | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00105 | ok |
| 44 | 54757 | 3 | TA-55-21 | 2/13/1992 | LA00-RTR-026 | LA01-FRAM-015 | LA01-HENC-013 | LA01-HGAS-025 | X0 | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00750 | ok |
| 45 | 54780 | 3 | TA-55-21 | 10/7/1992 | LA00-RTR-024 | LA01-FRAM-005 | LA01-HENC-004 | LA01-HGAS-018 | X0 | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.01121 | ok |
| 46 | 54814 | 3 | TA-55-21 | 11/5/1990 | LA00-RTR-024 | LA01-FRAM-004 | LA01-HENC-004 | LA01-HGAS-016 | RR | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00668 | ok |
| 47 | 54915 | 3 | TA-55-22 | 11/19/1990 | LA00-RTR-025 | LA01-FRAM-004 | LA01-HENC-004 | LA01-HGAS-018 | RCM | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00332 | ok |
| 48 | 54966 | 3 | TA-55-22 | 12/6/1990 | LA00-RTR-023 | LA01-FRAM-005 | LA01-HENC-004 | LA01-HGAS-017 | RCM | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00449 | ok |
| 49 | 54967 | 3 | TA-55-21 | 12/6/1990 | LA00-RTR-024 | LA01-FRAM-005 | LA01-HENC-004 | LA01-HGAS-028 | CX | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00037 | ok |
| 50 | 54968 | 3 | TA-55-21 | 1/9/1991 | LA00-RTR-023 | LA01-FRAM-005 | LA01-HENC-004 | LA01-HGAS-017 | RR | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00089 | ok |
| 51 | 55179 | 3 | TA-55-22 | 2/3/1994 | LA01-RTR-010 | LA01-FRAM-014 | LA01-HENC-012 | LA01-HGAS-022 | MAG | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00407 | ok |
| 52 | 55208 | 3 | TA-55-21 | 4/29/1993 | LA00-RTR-024 | LA01-FRAM-015 | LA01-HENC-014 | LA01-HGAS-028 | CX | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00798 | ok |
| 53 | 55436 | 3 | TA-55-21 | 7/7/1994 | LA01-RTR-012 | LA01-FRAM-015 | LA01-HENC-013 | LA01-HGAS-026 | EV | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00048 | ok |
| 54 | 55487 | 3 | TA-55-21 | 11/30/1994 | LA01-RTR-012 | LA01-FRAM-012 | LA01-HENC-010 | LA01-HGAS-015 | X0 | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00133 | ok |
| 55 | 55541 | 3 | TA-55-21 | 6/19/1994 | LA01-RTR-013 | LA01-FRAM-012 | LA01-HENC-009 | LA01-HGAS-017 | ME | 2 or Fewer | LA117D | 20 0170 0459 | .0618 | 0.00095 | ok |
| 56 | 55572 | 3 | TA-55-21 | 11/30/1994 | LA01-RTR-013 | LA01-FRAM-012 | LA01-HENC-009 | LA01-HGAS-028 | EV | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00468 | ok |
| 57 | 55633 | 3 | TA-55-21 | 2/22/1995 | LA01-RTR-008 | LA01-FRAM-011 | LA01-HENC-008 | LA01-HGAS-026 | X0 | 0 | LA117B | 20 0170 0280 | .1014 | 0.00193 | ok |
| 58 | 55657 | 3 | TA-55-21 | 2/22/1995 | LA01-RTR-010 | LA01-FRAM-014 | LA01-HENC-012 | LA01-HGAS-022 | X0 | 0 | LA117B | 20 0170 0280 | .1014 | 0.00106 | ok |
| 59 | 56013 | 3 | TA-55-21 | 4/25/1996 | LA01-RTR-012 | LA01-FRAM-013 | LA01-HENC-010 | LA01-HGAS-017 | CF | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00650 | ok |
| 60 | 56025 | 3 | TA-55-21 | 5/1/1996 | LA01-RTR-012 | LA01-FRAM-013 | LA01-HENC-010 | LA01-HGAS-014 | EV | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.01935 | ok |
| 61 | 56826 | 3 | TA-55-21 | 2/25/1996 | LA01-RTR-015 | LA01-FRAM-015 | LA01-HENC-013 | LA01-HGAS-024 | EV | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.01471 | ok |
| 62 | 56826 | 3 | TA-55-21 | 2/16/1996 | LA01-RTR-015 | LA01-FRAM-010 | LA01-HENC-008 | LA01-HGAS-029 | SL | 3 or Fewer | LA117H | 20 0170 0681 | .0417 | 0.00249 | ok |

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## Attachment 3 - Acceptable Knowledge Source Document Summary

| Site(s): Los Alamos National Laboratory | Source Document Tracking Number: DR036 |
|---|---|

Waste Stream Number(s): LA-CIN01.001, LA-MHD01.001, LA-MIN02-V.001, LA-MIN04-S.001

(Applicable only when site library is not in use)

| Acceptable Knowledge Documentation Type: | Category: |
|---|---|
| ☑ TRU Waste Management Program Information | ☐ C - Correspondence |
| ☑ Waste Stream-Specific Information | ☐ D - Documents |
| ☐ Additional Information | ☐ M - Miscellaneous |
| | ☐ P - Procedures |
| | ☑ DR - Discrepancy Resolution |
| | ☐ U - Unpublished Documents |

Title or Description of Source Document [a]: Suspected Nitrate Salt Containers

Source Document Reference Information (author(s), document and revision number, date, publisher): Randy Fitzgerald, NA, Rev. NA, 01/03/2013, P2010-3381

| AK # [b] | Source Doc. Page # [c] | AK Information Summary |
|---|---|---|
| PR6, WS1, WS3 | Throughout | As a result of new AK information received from the waste generated, 48 containers that were on the June 22, 2009 AK Tracking spreadsheet (AKTSS) were placed on HOLD because it was suspected that these 48 containers were non-cemented nitrate salts that might warrant re-assignment to another waste stream. Based on the potential changes to the AK waste stream of these containers, an NCR was written. In 2012, LANL provided CCP AK with an updated list with 291 suspected nitrate salt containers. Resolution: All 291 container and/or their repackaged daughters, as appropriate, will be re-evaluated and re-assigned to waste stream LA-MIN02-V.001 (absorbed waste). These 291 container will be further processed by LANL prior to characterization and shipment to WIPP. |

Source Document Data Limitations (If any):

1. None.

Acceptable Knowlege Expert:

Amy Johns Amy Johns Date: 1/22/2013
Print /Sign

[a] Provide description for non-titled information (i.e., container paperwork, MSDS sheets, etc)
[b] Obtain from Acceptable Knowledge Documentation Checklist
[c] For microfilm or microfiche, identify box, tape, reel number and location.

CCP RECORDS ORIGINAL
DATE REC'D 2-4-2013

## Attachment 11 – Acceptable Knowledge Source Document Discrepancy Resolution

P2010 - 3381
Page 1 of 2

**Waste Stream Number(s):** LA-MHD01.001, LA-CIN01.001, LA-MIN02-V.001, LA-MIN04-S.001 (CCP-AK-LANL-006)

**Waste Stream Descriptions:** Heterogeneous Debris, Cemented TRU Waste, Absorbed Waste, Salt Waste

**AK Source Document Discrepancy Form Tracking Number:** AK6 DR036 – Suspected Nitrate Salt Containers

| Tracking # | Category[a] | Title | Document/Rev# | Author | Date | Publisher | Page # |
|---|---|---|---|---|---|---|---|
| | Pub. | CCP AK Summary Report for LANL TA-55 Mixed TRU Waste | CCP-AK-LANL-006, Rev. 12 | M. Ramirez | 12/12/2012 | CCP | ALL |
| | Unpub. | CCP Non-Conformance Report | NCR-LANL-0509-09, Rev. 0 | R. Fitzgerald | 6/22/2009 | CCP | ALL |
| | | | | | | | |

**NATURE OF DISCREPANCY:**

As a result of new AK information received from the waste generator (i.e., TA-55 Cement Fixation Group), forty-eight (48) containers that were on the June 22, 2009 AK Tracking Spreadsheet (AKTSS) were placed on HOLD because it was suspected that these 48 containers were non-cemented nitrate salts that might warrant re-assignment to another waste stream. Based on the potential changes to the AK waste stream of these containers, an NCR was written in accordance with CCP-TP-005, Sec. 4.8.1, Rev. 18. In 2012, LANL provided CCP AK with an updated list with two-hundred and ninety-one (291) suspected nitrate salt containers.

**RESOLUTION: See Attachment 1, Summary/History of Suspected Nitrate Salt Containers**

Initially, 48 containers were assigned to NCR-LANL-0509-09, R.0. These 48 containers were removed from the AKTSS and returned to LANL for further evaluation; and the NCR was closed. In 2012, after a thorough review of the LANL Engineering database, which CCP AK does not have access to due to potentially sensitive information; LANL provided a list of 291 suspected nitrate salt containers – See Attachment 1. These containers were originally assigned to CCP-AK-LANL-006 waste streams LA-MHD01.001, LA-CIN01.001 and LA-MIN04-S.001 based on information from the TRU Waste Storage Records (TWSRs) and TA-54 database. In addition, repackaged containers and the associated repackage dates are indicated on Attachment 1.

Forty (40) of the original 48 included in NCR-LANL-0509-09, R.0 were also included in the LANL list of 291; and the remaining eight (8) containers were NOT included in the LANL list of 291 nitrate salt containers. These 8 containers were evaluated by LANL and LANL determined they should remain in their existing waste streams (i.e., they didn't contain nitrate salts). In addition to the 40 nitrate salt containers that were included in NCR-LANL-0509-09, R.0, two hundred and fifty-one (251) additional containers were identified by LANL as nitrate salt containers.

All 291 containers and/or their repackaged daughters, as appropriate, will be re-evaluated and re-assigned to waste stream LA-MIN02-V.001 (absorbed waste). These 291 containers will be further processed by LANL prior to characterization and shipment to WIPP.

CCP RECORDS ORIGINAL
DATE REC'D 2/4/2013

| | | | |
|---|---|---|---|
| Discrepancy Resolved: | [X] Yes [ ] No | | |
| Acceptable Knowledge Expert: | Randy Fitzgerald (Print) | Amy Johns for Randy Fitzgerald (Sign) | Date: 1/3/2013 |
| Site Project Manager: | Terri-Anne Groover (Print) | T A Groover (Sign) | Date: ~~1/3/2013~~ 1/10/13 1/10/13 |

[a]Published Document or Controlled Database (Pub.); Unpublished Data (Unpub.); Internal Procedure or Note (Proc.); Correspondence (Corr.) or Discrepancy (Disc.)

Attachment 1
LANL List of 291 Nitrate Salt Containers
NCR-LANL-0509-09, R.0
AK6 DR036

| | PKG_ID | Original ID | Container Type | Waste Stream | Container History | RPKGD DAUGHTERS | RPKGD DATE |
|---|---|---|---|---|---|---|---|
| 1 | **S841239** | S841239 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **W+A1ILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 2 | **S841240** | S841240 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 3 | **S841251** | S841251 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 4 | **S841314** | S841314 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 5 | **S841320** | S841320 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 6 | **S841627** | S841627 | 85-GAL | LA-CIN01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 7 | **S842213** | S842213 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 8 | **S842463** | S842463 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 9 | **S842526** | S842526 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 10 | **S842528** | S842528 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 11 | **S843528** | S843528 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 12 | **S843593** | S843593 | 55-GAL | LA-CIN01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 13 | **S843594** | S843594 | 55-GAL | LA-CIN01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 14 | **S843672** | S843672 | 85-GAL | LA-CIN01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 15 | **S843673** | S843673 | 85-GAL | LA-CIN01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 16 | **90875** | S844213 | POC | LA-MHD01.001 | PARENT INCLUDED in NCR-LANL-0509-09, R.0 AND DAUGHTER **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | 92147, 92148 | 10/2/2012 |
| 17 | **S844215** | S844215 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 18 | **S844253** | S844253 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 19 | **S844573** | S844573 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 20 | **S844602** | S844602 | 85-GAL | LA-CIN01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 21 | **S844684** | S844684 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 22 | **S844689** | S844689 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 23 | **S845031** | S845031 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 24 | **S845072** | S845072 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 25 | **S845104** | S845104 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 26 | **90892** | S845201 | 55-GAL | LA-MHD01.001 | PARENT INCLUDED in NCR-LANL-0509-09, R.0 AND DAUGHTER **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | 92241 | 10/24/2012 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 27 | **S845338** | S845338 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 28 | **S846037** | S846037 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 29 | **S846055** | S846055 | 55-GAL | LA-CIN01.001-Cans | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 30 | **S846088** | S846088 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 31 | **S846096** | S846096 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 32 | **S846107** | S846107 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 33 | **S846132** | S846132 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 34 | **S846168** | S846168 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 35 | **S846172** | S846172 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 36 | **S846195** | S846195 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 37 | **S846660** | S846660 | 55-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 38 | **S851415** | S851415 | 85-GAL | LA-CIN01.001-Cans | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 39 | **S851418** | S851418 | 85-GAL | LA-CIN01.001-Cans | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 40 | **S851436** | S851436 | 85-GAL | LA-MHD01.001 | INCLUDED in NCR-LANL-0509-09, R.0 AND **WILL BE RE-EVALUATED AND RE-ASSIGNED** TO LA-MIN02-V.001 **because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 41 | S841295 | S841295 | 55-GAL | LA-MIN02-V.001 | **INCLUDED** in NCR-LANL-0509-09, R.0, but REMOVED FROM SUSPECT NITRATE SALTS LIST because it was NOT included in LANL List of 291 Nitrate Salt Containers; and **remained in existing waste stream**. | N/A | N/A |
| 42 | S844608 | S844608 | 85-GAL | LA-CIN01.001 | **INCLUDED** in NCR-LANL-0509-09, R.0, but REMOVED FROM SUSPECT NITRATE SALTS LIST because it was NOT included in LANL List of 291 Nitrate Salt Containers; and **remained in existing waste stream**. | N/A | N/A |
| 43 | S845135 | S845135 | 85-GAL | LA-CIN01.001 | **INCLUDED** in NCR-LANL-0509-09, R.0, but REMOVED FROM SUSPECT NITRATE SALTS LIST because it was NOT included in LANL List of 291 Nitrate Salt Containers; and **remained in existing waste stream**. | N/A | N/A |
| 44 | S845194 | S845194 | 55-GAL | LA-MHD01.001 | **INCLUDED** in NCR-LANL-0509-09, R.0, but REMOVED FROM SUSPECT NITRATE SALTS LIST because it was NOT included in LANL List of 291 Nitrate Salt Containers; and **remained in existing waste stream**. | N/A | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 45 | S851430 | S851430 | 85-GAL | LA-MHD01.001 | **INCLUDED** in NCR-LANL-0509-09, R.0, but REMOVED FROM SUSPECT NITRATE SALTS LIST because it was NOT included in LANL List of 291 Nitrate Salt Containers; and **remained in existing waste stream**. | N/A | N/A |
| 46 | S851525 | S851525 | 85-GAL | LA-CIN01.001 | **INCLUDED** in NCR-LANL-0509-09, R.0, but REMOVED FROM SUSPECT NITRATE SALTS LIST because it was NOT included in LANL List of 291 Nitrate Salt Containers; and **remained in existing waste stream**. | N/A | N/A |
| 47 | S852596 | S852596 | 85-GAL | LA-CIN01.001 | **INCLUDED** in NCR-LANL-0509-09, R.0, but REMOVED FROM SUSPECT NITRATE SALTS LIST because it was NOT included in LANL List of 291 Nitrate Salt Containers; and **remained in existing waste stream**. | N/A | N/A |
| 48 | S852971 | S852971 | 85-GAL | LA-CIN01.001 | **INCLUDED** in NCR-LANL-0509-09, R.0, but REMOVED FROM SUSPECT NITRATE SALTS LIST because it was NOT included in LANL List of 291 Nitrate Salt Containers; and **remained in existing waste stream**. | N/A | N/A |
| 49 | 88957 | S824181 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 50 | **90316** | S910171 | POC | LA-MIN04-S.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92459 | 12/11/2012 |
| 51 | **90317** | S910171 | POC | LA-MIN04-S.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92472 | 12/17/2012 |
| 52 | **90318** | S910171 | POC | LA-MIN04-S.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92461 | 12/12/2012 |
| 53 | **90323** | S910172 | 55-GAL | LA-MIN04-S.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 54 | **90324** | S910172 | POC | LA-MIN04-S.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92466 | 12/17/2012 |
| 55 | **90713** | S832340 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92463 | 12/13/2012 |
| 56 | **90718** | S824551 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 468, 92469, 924 | 12/17/2012 |
| 57 | **90719** | S824551 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92481, 92482 | 12/18/2012 |
| 58 | **90720** | S824551 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92476, 92477 | 12/18/2012 |
| 59 | **90721** | S824551 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92479 | 12/18/2012 |
| 60 | **90722** | S824551 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92484 | 12/18/2012 |
| 61 | **90723** | S824551 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92488, 92489 | 12/18/2012 |
| 62 | **90724** | S824551 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 494, 92495, 924 | 12/19/2012 |

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| 63 | **90725** | S824551 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92492 | 12/19/2012 |
| 64 | **90727** | S832147 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92210 92211, 92212, 92213 | 10/17/2012 |
| 65 | **90728** | S832147 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92486 | 12/18/2012 |
| 66 | **90755** | S825639 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92158 | 10/3/2012 |
| 67 | **90756** | S825639 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92136 | 10/2/2012 |
| 68 | **90757** | S825639 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 69 | **90758** | S825639 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 70 | **90759** | S825639 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92162 | 10/4/2012 |
| 71 | **90760** | S825639 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92154 | 10/3/2012 |

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| 72 | **90802** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92126, 92127 | 10/1/2012 |
| 73 | **90803** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92121, 92122 | 10/1/2012 |
| 74 | **90804** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92124 | 10/1/2012 |
| 75 | **90805** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 76 | **90806** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92160 | 10/3/2012 |
| 77 | **90807** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92173 | 10/4/2012 |
| 78 | **90808** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92169 | 10/4/2012 |
| 79 | **90809** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 80 | **90810** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92144, 92145 | 10/2/2012 |

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| 81 | **90811** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92131 | 10/2/2012 |
| 82 | **90812** | S822838 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 83 | **90817** | S832448 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 84 | **90818** | S832448 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92171 | 10/4/2012 |
| 85 | **90819** | S832448 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 86 | **90820** | S832448 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92150 | 10/3/2012 |
| 87 | **90821** | S832448 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92164 | 10/4/2012 |
| 88 | **90822** | S832448 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92156 | 10/3/2012 |
| 89 | **90823** | S832448 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 90 | **90836** | S832156 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 91 | **90837** | S832156 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 92 | **90838** | S832156 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92347 | 11/8/2012 |
| 93 | **90841** | S832040 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92190 | 10/9/2012 |
| 94 | **90842** | S832040 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92186 | 10/9/2012 |
| 95 | **90843** | S832040 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92139, 92140 | 10/2/2012 |
| 96 | **90848** | S832149 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92181 | 10/9/2012 |
| 97 | **90849** | S832149 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 98 | **90850** | S832149 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92290 | 11/2/2012 |

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|---|---|---|---|---|---|---|---|
| 99 | **90851** | S832149 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 100 | **90852** | S832149 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 101 | **90853** | S832149 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92294 | 11/10/2012 |
| 102 | **90855** | S834539 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 103 | **90858** | S834539 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92292 | 11/1/2012 |
| 104 | **90859** | S834539 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92133, 92134 | 10/2/2012 |
| 105 | **90860** | S834539 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92183, 92184 | 10/9/2012 |
| 106 | **90861** | S834539 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92188 | 10/9/2012 |
| 107 | **90862** | S834539 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92195 | 10/11/2012 |

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| 108 | **90863** | S834539 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92197 | 10/11/2012 |
| 109 | **90865** | S832464 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 215, 92216, 922 | 10/18/2012 |
| 110 | **90866** | S832464 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92296 | 11/1/2012 |
| 111 | **90867** | S832464 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92341 | 11/8/2012 |
| 112 | **90868** | S832464 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92345 | 11/8/2012 |
| 113 | **90869** | S832464 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92339 | 11/8/2012 |
| 114 | **90870** | S832464 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92142 | 10/2/2012 |
| 115 | **90876** | S844213 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92343 | 11/8/2012 |
| 116 | **90877** | S844213 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92202 | 10/15/2012 |

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| 117 | **90878** | S844213 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92349 | 11/8/2012 |
| 118 | **90880** | S843962 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 219, 92220, 922 | 10/18/2012 |
| 119 | **90881** | S843962 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 120 | **90884** | S833261 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92355 | 11/13/2012 |
| 121 | **90885** | S833261 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 122 | **90886** | S833261 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 123 | **90888** | S823194 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92229 | 10/23/2012 |
| 124 | **90890** | S823194 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92360 | 11/13/2012 |
| 125 | **90893** | S845201 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 126 | **90895** | S832155 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92237 | 10/23/2012 |
| 127 | **90896** | S832155 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 128 | **90897** | S832155 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92362 | 11/13/2012 |
| 129 | **90899** | S823187 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92245, 92246 | 10/25/2012 |
| 130 | **90900** | S823187 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 131 | **90925** | S862411 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92239 | 10/24/2012 |
| 132 | **90929** | S860096 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 133 | **90932** | S863696 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 134 | **90933** | S863696 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92374 | 11/14/2012 |

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| 135 | **90934** | S863696 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 136 | **90936** | S871844 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92251, 92252 | 10/25/2012 |
| 137 | **90937** | S871844 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92351 | 11/8/2012 |
| 138 | **90939** | S863788 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92233 | 10/23/2012 |
| 139 | **90941** | S863788 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92357 | 11/13/2012 |
| 140 | **90942** | S863788 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 141 | **90953** | S863787 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92227 | 10/22/2012 |
| 142 | **90955** | S863787 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92129 | 10/2/2012 |
| 143 | **90956** | S863787 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92192 | 10/9/2012 |

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| 144 | **90957** | S863787 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 145 | **90965** | S883130 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92235 | 10/23/2012 |
| 146 | **90966** | S883130 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92152 | 10/3/2012 |
| 147 | **90968** | S883130 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92204 | 10/15/2012 |
| 148 | **90969** | S883130 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 149 | **90972** | S881608 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92364 | 11/13/2012 |
| 150 | **90973** | S881608 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 151 | **90974** | S881608 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92366 | 11/13/2012 |
| 152 | **90986** | S881569 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 153 | **90987** | S881569 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 154 | **90988** | S881569 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 155 | **90989** | S881569 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 156 | **90990** | S881569 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 157 | **90991** | S881569 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 158 | **90993** | S851432 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92231 | 10/23/2012 |
| 159 | **90995** | S851432 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 160 | **90996** | S851432 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 161 | **90997** | S851432 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 162 | **91000** | S881562 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92206 | 10/15/2012 |
| 163 | **91001** | S881562 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92378 | 11/14/2012 |
| 164 | **91002** | S881562 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 165 | **91003** | S881562 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 166 | **91004** | S881562 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92166 | 10/4/2012 |
| 167 | **91007** | S881563 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 168 | **91008** | S881563 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92175 | 10/4/2012 |
| 169 | **91009** | S881563 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 170 | **91010** | S881563 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 171 | **91011** | S881563 | POC | LA-MHD01.001 | **NOT INCLUDED in NCR-LANL-0509-09, R.0, but WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001 because it was included on the LANL list of 291 nitrate salt containers.** | N/A | N/A |
| 172 | **91013** | S851506 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | 92248, 92249 | 10/25/2012 |
| 173 | **91017** | S851506 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 174 | **91018** | S851506 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 175 | **91019** | S851506 | POC | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 176 | **S793450** | S793450 | 85-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 177 | **S802701** | S802701 | 85-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 178 | **S803613** | S803613 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 179 | **S804989** | S804989 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 180 | **S811692** | S811692 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 181 | **S813471** | S813471 | 85-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 182 | **S813676** | S813676 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 183 | **S816692** | S816692 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 184 | **S816768** | S816768 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 185 | **S816837** | S816837 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 186 | **S816890** | S816890 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 187 | **S818255** | S818255 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 188 | **S818382** | S818382 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 189 | **S818412** | S818412 | 85-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 190 | **S818449** | S818449 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 191 | **S821203** | S821203 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 192 | **S822679** | S822679 | 85-GAL | LA-CIN01.001-Cans | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 193 | **S822876** | S822876 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 194 | **S822952** | S822952 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 195 | **S823004** | S823004 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 196 | **S823016** | S823016 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 197 | **S823127** | S823127 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 198 | **S823166** | S823166 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 199 | **S823221** | S823221 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 200 | **S823229** | S823229 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 201 | **S823276** | S823276 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 202 | **S824184** | S824184 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 203 | **S824187** | S824187 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 204 | **S824188** | S824188 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 205 | **S824208** | S824208 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 206 | **S824508** | S824508 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 207 | **S824541** | S824541 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 208 | **S824660** | S824660 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 209 | **S824967** | S824967 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 210 | **S825020** | S825020 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 211 | **S825021** | S825021 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 212 | **S825730** | S825730 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 213 | **S825810** | S825810 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 214 | **S825902** | S825902 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 215 | **S832140** | S832140 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 216 | **S832141** | S832141 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 217 | **S832143** | S832143 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 218 | **S832144** | S832144 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 219 | **S832145** | S832145 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 220 | **S832148** | S832148 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 221 | **S832150** | S832150 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 222 | **S832241** | S832241 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 223 | **S832320** | S832320 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 224 | **S832499** | S832499 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 225 | **S833037** | S833037 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 226 | **S833409** | S833409 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 227 | **S833481** | S833481 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 228 | **S833846** | S833846 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 229 | **S833937** | S833937 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 230 | **S834406** | S834406 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 231 | **S834633** | S834633 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 232 | **S835283** | S835283 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 233 | **S841292** | S841292 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 234 | **S842181** | S842181 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 235 | **S842234** | S842234 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 236 | **S851416** | S851416 | 85-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 237 | **S851426** | S851426 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 238 | **S851682** | S851682 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 239 | **S851739** | S851739 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 240 | **S851752** | S851752 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 241 | **S851764** | S851764 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 242 | **S851772** | S851772 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 243 | **S852513** | S852513 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 244 | **S852530** | S852530 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 245 | **S852588** | S852588 | 55-GAL | LA-CIN01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 246 | **S852590** | S852590 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 247 | **S852592** | S852592 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 248 | **S852593** | S852593 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 249 | **S852883** | S852883 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 250 | **S852895** | S852895 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 251 | **S852923** | S852923 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 252 | **S852931** | S852931 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 253 | **S853006** | S853006 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 254 | **S853279** | S853279 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 255 | **S853326** | S853326 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 256 | **S853492** | S853492 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 257 | **S853641** | S853641 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 258 | **S853771** | S853771 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 259 | **S853898** | S853898 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 260 | **S853899** | S853899 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 261 | **S854616** | S854616 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 262 | **S855126** | S855126 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 263 | **S855139** | S855139 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 264 | **S855216** | S855216 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 265 | **S855240** | S855240 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 266 | **S855290** | S855290 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 267 | **S855566** | S855566 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 268 | **S855677** | S855677 | 55-GAL | LA-CIN01.001-Cans | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 269 | **S855793** | S855793 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 270 | S855943 | S855943 | 55-GAL | LA-MIN04-S.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 271 | **S860014** | S860014 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 272 | **S860093** | S860093 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 273 | **S860095** | S860095 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 274 | **S861975** | S861975 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 275 | **S861976** | S861976 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 276 | **S861980** | S861980 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 277 | **S861995** | S861995 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 278 | **S862241** | S862241 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 279 | **S862255** | S862255 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 280 | **S863789** | S863789 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 281 | **S864662** | S864662 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 282 | **S864663** | S864663 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 283 | **S864694** | S864694 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 284 | **S870065** | S870065 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 285 | **S870213** | S870213 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 286 | **S870338** | S870338 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 287 | **S870381** | S870381 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 288 | **S870475** | S870475 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 289 | **S870478** | S870478 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 290 | **S873554** | S873554 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 291 | **S881570** | S881570 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 292 | **S881607** | S881607 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 293 | **S891279** | S891279 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 294 | **S891387** | S891387 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 295 | **S891513** | S891513 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 296 | **S892963** | S892963 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |

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| 297 | **S900215** | S900215 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 298 | **S901114** | S901114 | 85-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |
| 299 | **S910170** | S910170 | 55-GAL | LA-MHD01.001 | **NOT INCLUDED** in NCR-LANL-0509-09, R.0, but **WILL BE RE-EVALUATED AND RE-ASSIGNED TO LA-MIN02-V.001** because it was included on the LANL list of 291 nitrate salt containers. | N/A | N/A |