ARIES Oxide Production Program at LANL

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Outline

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Background: ARIES Oxide Production Program

Program Objectives

- Disassemble pits from stockpile-return units identified as excess by NA-23 and convert metal to oxide.
- Current mission - Obtain Pu from disassembly to produce 2MT of Pu oxide, certify it for use in mixed-oxide (MOX) fuel production.
- Maintain and upgrade capabilities, including certifying existing oxide lots to MOX standards and installing new equipment to eliminate single-point failures. Examples include new pit disassembly and packaging equipment.
- Assess programmatic legacy material, equipment, and informational assets and develop disposition pathways for excess items and material.
- Program primarily operates in LANL PF-4 facility with cold laboratory space at TA-46 and TA-3.

Funding Profile

<table>
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<th>Budget ($M New BA)</th>
<th>FY 15</th>
<th>FY 16</th>
<th>FY 17</th>
<th>FY 18</th>
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<td>FY 18</td>
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57 FTE 63 FTE 58 FTE 69 FTE (Planned)

Robotic Lathe in PF-4
Fissile Material Disposition

To meet US commitments for disposition of surplus weapons-grade Plutonium (Pu), LANL was tasked to develop a methodology to dispose of the excess plutonium – resulting in the Advanced Recovery and Integrated Extraction System (ARIES).

The ARIES program began in 1998 and shortly demonstrated:

- pit disassembly,
- conversion of Pu metal to oxide, and
- packaging for long-term storage.
ARIES Program History

- Operational at LANL in July 1999 with disassembly of four pits.
- Three Demonstration efforts from 1999 - 2012 for “proof-of-principle” testing of pit disassembly and conversion
  - 1st demonstration identified issues with pit bisector, worker dose, and mechanical separations.
  - 2nd Demonstration - disassembled and processed all “pit classes” in the surplus inventory and identified lathe as the best tool for disassembly
  - 3rd Demonstration – validated functionality of prototypical equipment and verified use with special nuclear material.
ARIES Program History (continued)

- FY09 - Transition from design and testing to production of unpolished Plutonium Oxide (PuO$_2$) (ARIES baseline mission-of-record).

- January 2012 – Alternative facility in South Carolina, PDCF, cancelled. LANL directed to use ARIES capability to support a limited (2MT) oxide production campaign as feed for the MOX Fuel Fabrication Facility (MFFF) at a nominal annual rate.

- April 2013 - NNSA begins assessing alternative Pu disposition strategies, slows down the MFFF project and production of certified PuO$_2$ feed at LANL.

- FY15 to present day – NNSA objective for LANS - maintain core ARIES production capability, produce at least 100 kg certified PuO$_2$ annually.
Los Alamos Plutonium Facility is Central to U.S. Excess Fissile Material Disposition

Weapons from the DoD

Pantex Plant (Weapon Disassembly)

Pantex Plant (Interim Pit Storage)

WIPP

LANL PF4

TA-55 Pu Processing

Y-12 U Processing

SRS H-Canyon

Pu, U Processing

Commerical Reactors

Fuel Irradiation

SRS MFFF

Purification and Fuel Fabrication

SRS Other Oxide Sources

Commercial Fuel Fab

Multiple materials/forms
Pu oxide
U oxide

UNCLASSIFIED
Program maintains gloveboxes for disassembly, oxidation, milling, blending, sieving, sampling, storage, characterization, and packaging
ARIES Process Overview
Pit Receiving

Empty FL shipping containers at LANL awaiting return to sender.

Program is installing new cranes to handle MD-2 containers by 2020
Pit Disassembly

- Manual lathe was used in early demonstrations for Plutonium pit disassembly
- More complex tools were developed to accommodate many different pit types
- Automation with robotic lathe was developed to support PDCF
- Photo shows manipulator and wrist moving a chuck that would hold parts for disassembly
- Control system replaced in 2015
New Simple Pit Cutter

Addresses current single point failure in flowsheet
Pu Conversion

- Two types of furnaces now used for Pu metal-to-oxide conversion: Direct Metal Oxidation (DMO) and muffle furnaces
Pu Conversion

- The DMO-3 Furnace and FY18 oxide product
- DMO-3 and muffle furnaces were first used for production under normal operating conditions in FY18 and FY17, respectively
- Muffle Furnace and FY17 oxide product
Oxide Processing

- Rod mill used to mill the DMO oxide product to meet particle size requirements
- Terbula Blender (similar to paint shaker) used to blend oxide in a homogeneous batch
- Plutonium oxide before and after milling
Packaging for Long-Term Storage

3013 Can Set for 50-year storage - outer, inner, and Cogema convenience cans

UNCLASSIFIED
3013 Packaging

- Welding required for Inner and Outer 3013 containers
- Cans must be electrically decontaminated between inner and outer can welding
- Redundant automated welder station (RIPS) installed for inner can welding
- Packaging demonstrated for 50-year storage effectiveness
- 100% credit for MAR minimization
Electrolytic Decontamination

- Similar to electropolishing
- Contaminants and stainless steel removed as precipitates
- Electrolyte is recycled
- Uniform surface removal
- pH Control System
Nondestructive Assay (NDA)

- Program currently uses facility NDA capability in PF-4 basement
- NDA Table installed in ARIES main room will be capable of completing MC&A-required measurements
- NDA Table awaiting criticality safety analysis, expected in FY18; robot and analytical equipment are being maintained
- Security cage installed in 2015
Storage

Fire-rated Diebold safes

Storage Case in Basement

Vault Storage
Other Capabilities

- Sieving
- Homogeneous sampling
- Surface area and particle size analyses
- TGA for moisture content measurement
- Supporting resumption of Uranium electrode decontamination operations
- Packaging in SAVY containers also used