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Los Alamos
NATIONAL LABORATORY

Weapons Production Directorate Overview

Dave Eyler
ALD Weapons Production

updated May 2021

LA-UR #

Overview

- Associate Laboratory Directorate for Weapons Production (ALDWP) Overview
- Plutonium Center and Science
- Detonators
- Hydro program
- ALDWP Today

Who do we serve?

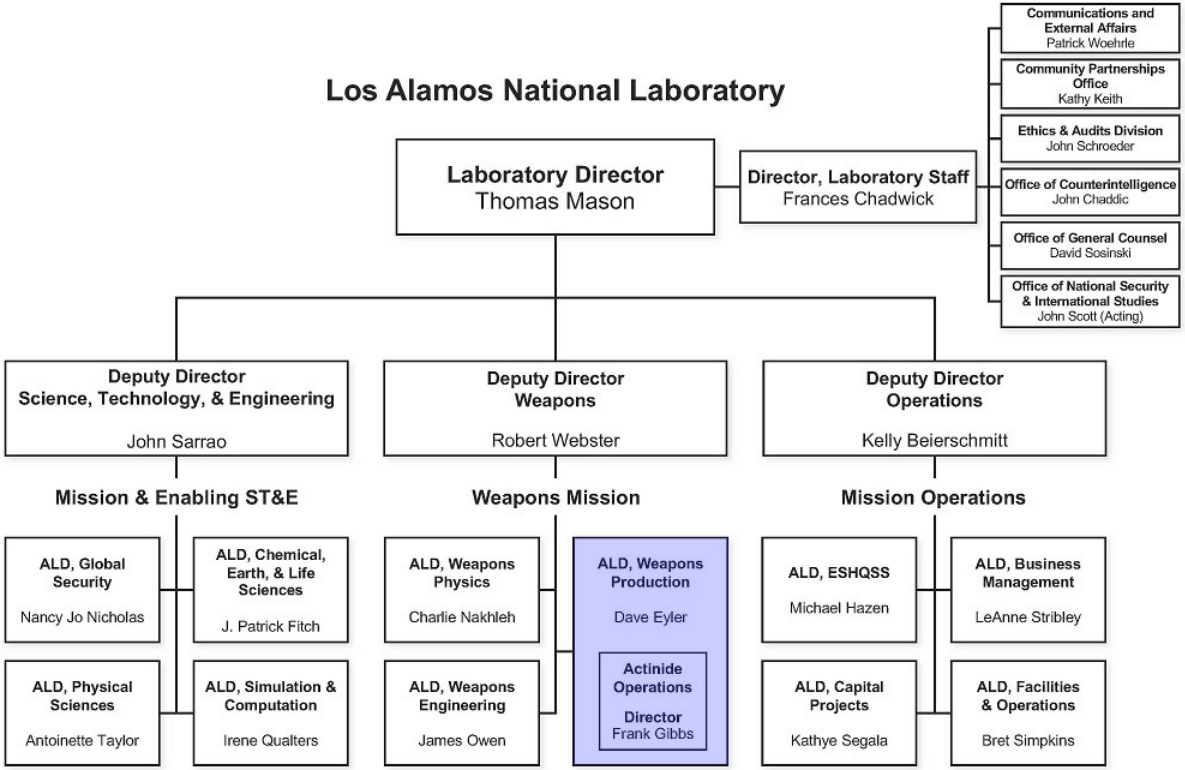
Nuclear Deterrence

Energy and Space

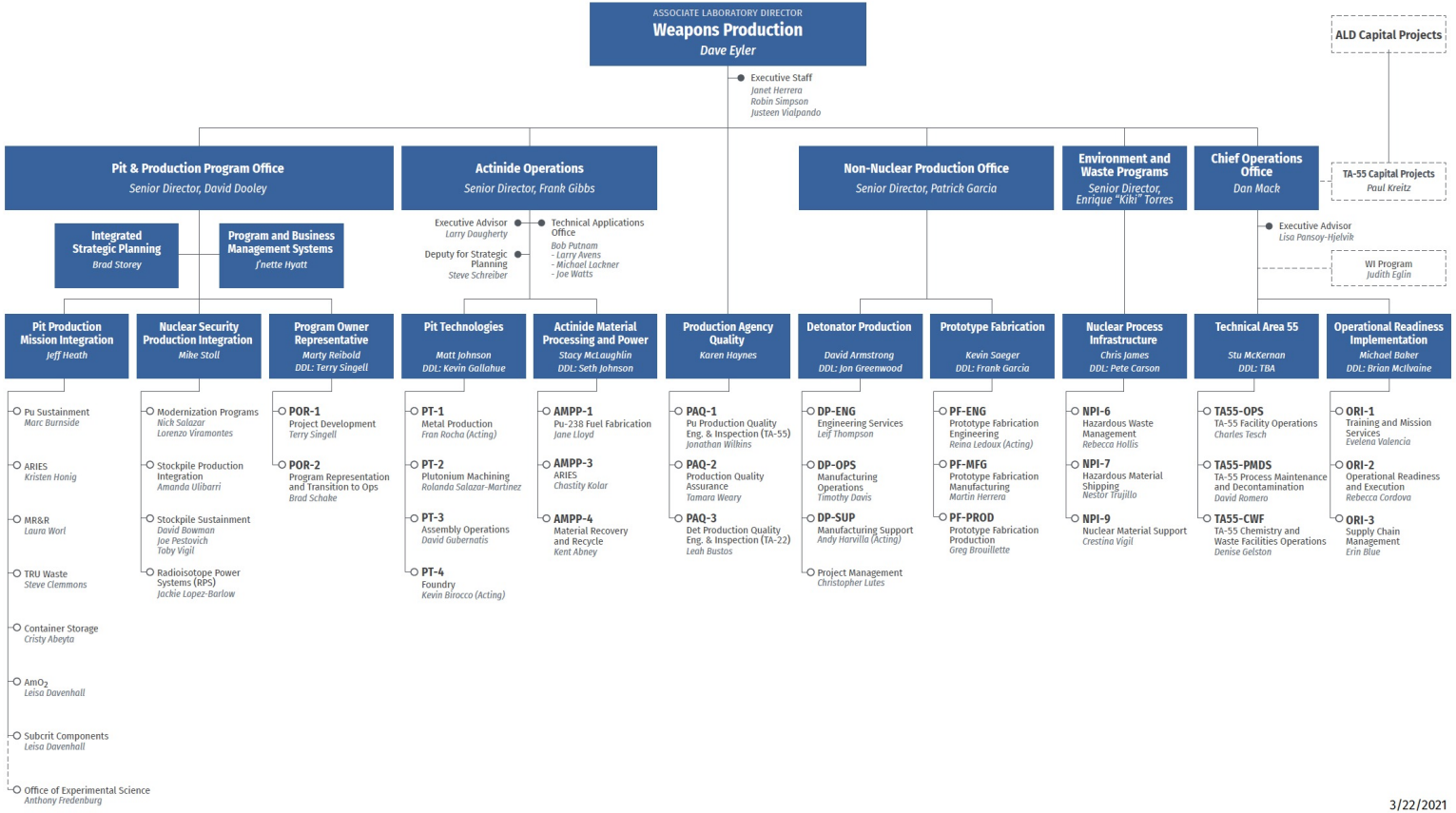
Homeland Security

Industry

How the Lab is organized



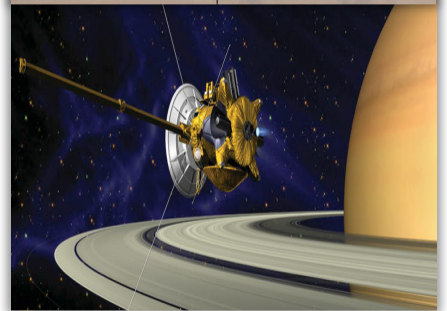
How ALDWP is organized



3/22/2021

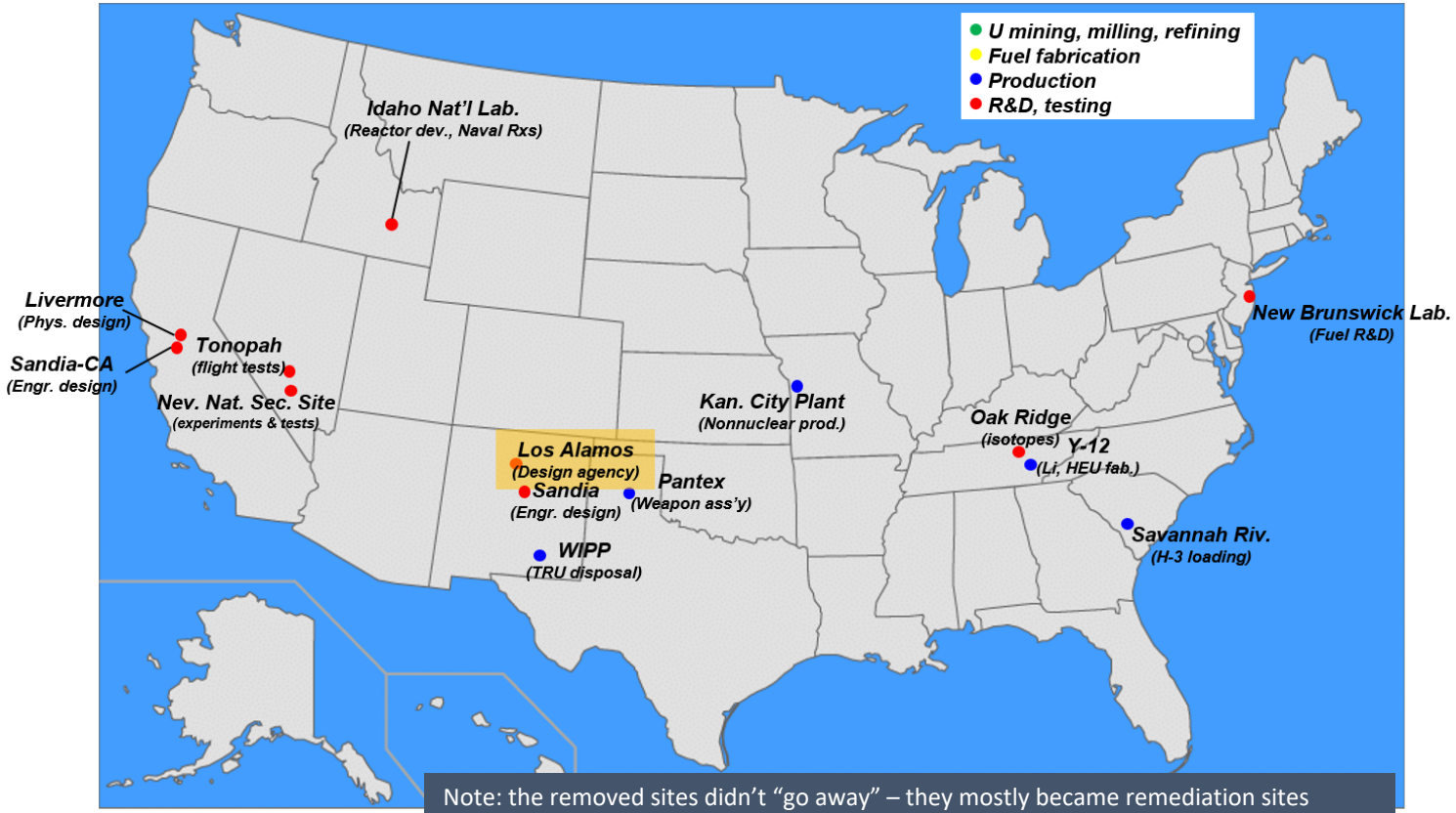
Supporting U.S. Nuclear Policy and Objectives

- Preventing nuclear proliferation and nuclear terrorism
- Maintaining strategic deterrence and stability at reduced nuclear force levels
- Modernizing and refurbishing nuclear warhead to maintain their safety, security, and reliability
- Sustaining a safe, secure, and effective nuclear arsenal



The Historic Nuclear Weapons Complex

The Current Nuclear Weapons Complex



Note: the removed sites didn't "go away" – they mostly became remediation sites

We are the Nation's Plutonium Center of Excellence

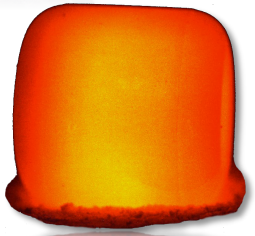
Pu Manufacturing

The Cornerstone: Plutonium Facility, PF-4
(Mission Operations and Supports)

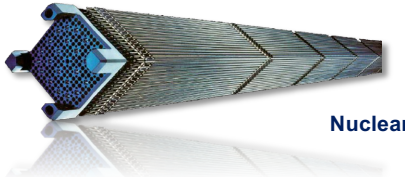
Materials Disposition

Pit Certification

Plutonium Storage



Pu-238



Nuclear Energy

We produce non-nuclear components for the U.S. Nuclear Stockpile

Detonator Production and **Prototype Fabrication** divisions serve a variety of organizations throughout the Laboratory and the nation by providing key non-nuclear components through excellence in on-site engineering, design, manufacturing, machining, and more.

We ensure nuclear weapon safety, security, and reliability

Trident Submarine-Launched Ballistic Missile (W76 and W88)

B61-12 Nuclear Bomb Test Assembly

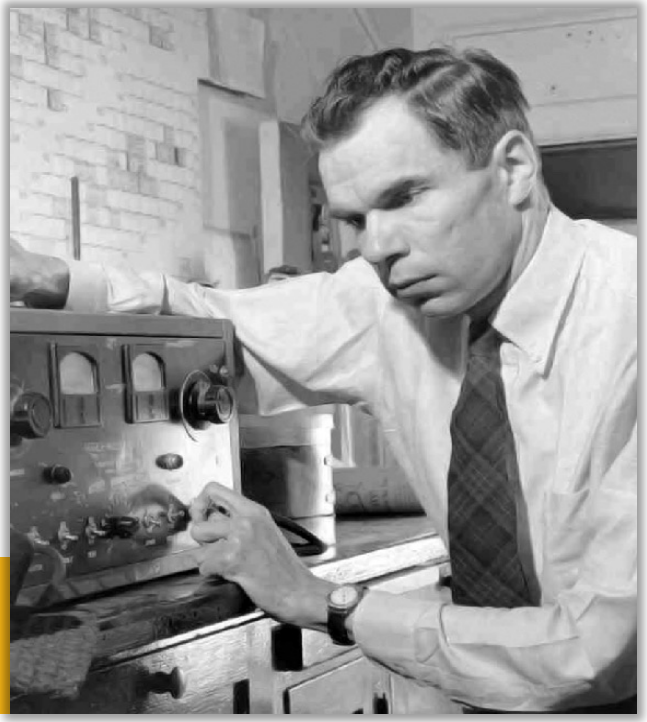
Multiple Independently-Targetable Reentry Vehicle

B61-12 Nuclear Bomb Flight Test

Minuteman III Intercontinental Ballistic Missile (W78 and W87)

What is plutonium?

- Plutonium is the 94th element in the periodic table and was first separated by Glenn Seaborg and his team in 1941
- Primary applications
  - Use in nuclear explosives
  - Use as a fuel for nuclear reactors
- Any reactor that contains uranium will create plutonium as a byproduct

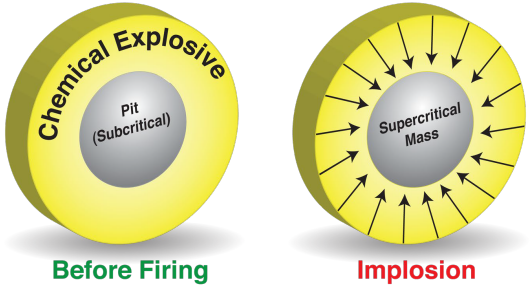


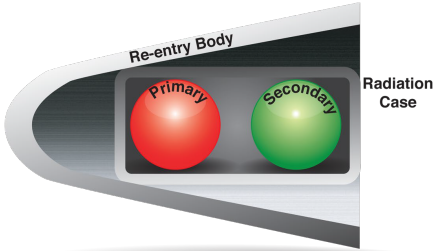
As long as nuclear explosives and nuclear reactor exist, the U.S. will need to maintain the capability to handle, store, process, and produce plutonium-bearing materials

Pits and weapons

- Energy from fissions in the pit drive the secondary, both of which produce the weapon's yield

Purified Pu Metal

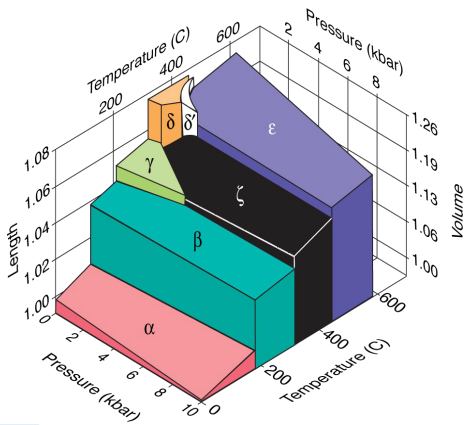




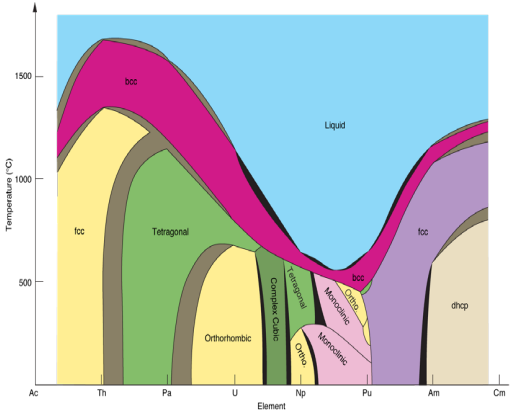
Plutonium science

- Plutonium is one of the most interesting materials known to mankind
  - Many crystal structures
  - Large variations in density and physical properties
  - Sensitive to small changes in pressure and temperature
- Because of its interesting properties, Pu materials must be well characterized to ensure
  - Safe handling
  - Material certification
  - Feedback of material information for models

Machine Tool Programming



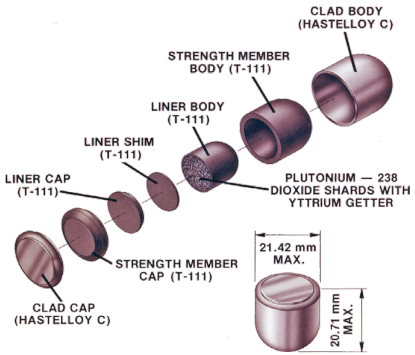
Phase Diagram
3- dimension



Phase Diagram 2- dimension

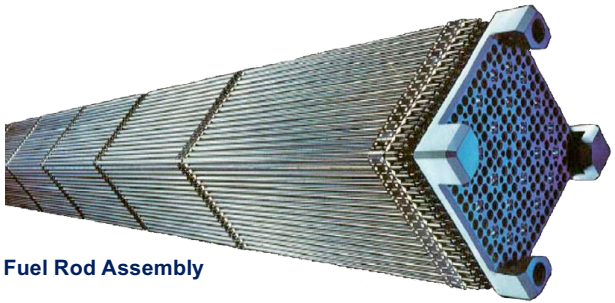
Global impacts of plutonium science

- Pu-238 power components in Cassini mission to Saturn and Mars Science Laboratory
- Mixed-oxide fuel test assemblies placed in Catawba reactor for characterization in preparation for disposing of weapons- usable plutonium in electricity-producing reactors (“swords to plowshares”)
- Material exchange programs for assessing detection and analysis capabilities
- Pu neutron sources used for oil-well logging
- Chemistry and material characterization capabilities provide forensic tools for global nuclear security



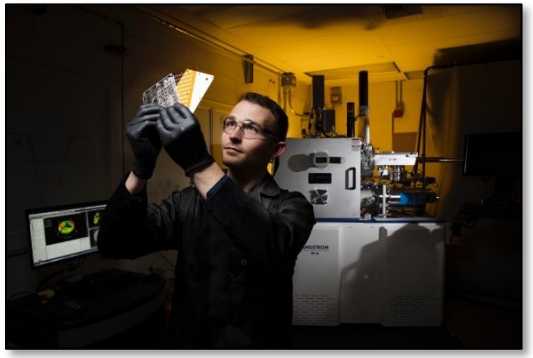
Milliwatt Generator Heat Source

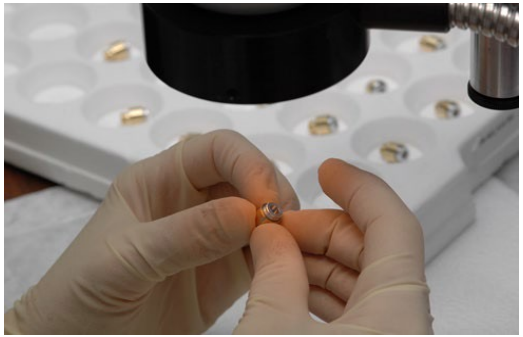
Heat Source Assembly



Fuel Rod Assembly

We produce detonators for the U.S. nuclear stockpile

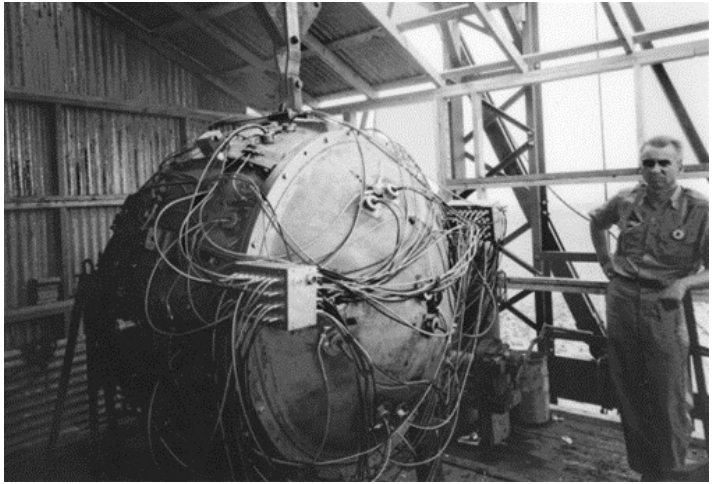




Detonator Production Complex at Technical Area 22

LANL's history with detonators begins with Fat Man

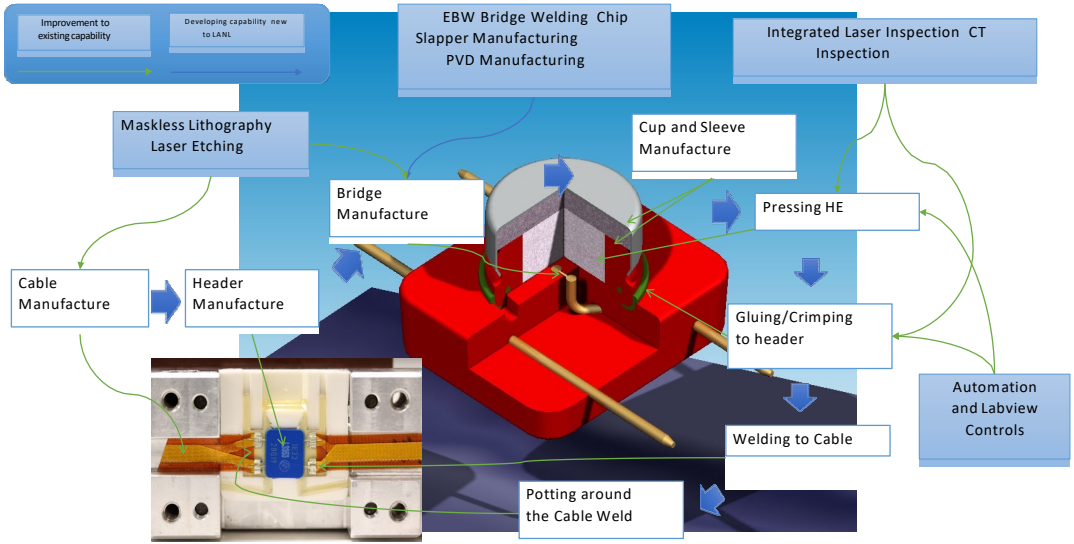
- "Fat Man" was the codename for the first implosion style atomic bomb
- Fat Man was built by scientists and engineers at Los Alamos during the Manhattan Project
- Two more bombs similar to Fat Man were detonated during the Operation Crossroads nuclear tests at Bikini Atoll in 1946
- To overcome the difficulty of synchronizing multiple detonations, Luis Alvarez and Lawrence Johnston invented exploding bridgewire detonators to replace the less precise primacord detonation system

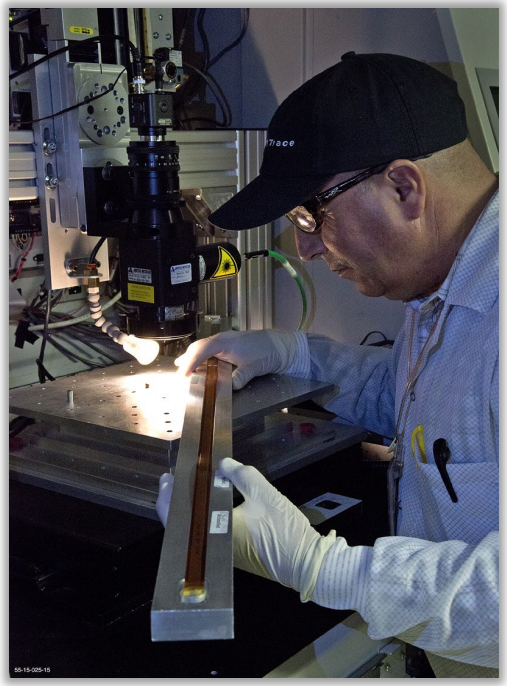


"About one week before Trinity, the 1773 EBW detonator was declared to be the best of the competing detonator types. The 1773 EBW detonators were used on the weapon tested at Trinity and subsequently on the weapon dropped at Nagasaki."

-Tucker Detonator History

Anatomy of an exploding bridge wire detonator





Detonator Cable Welding

Prototype Fabrication's Hydro program

Design Review / Job Initiation
- Physics
- Weapons Engineers
- Prototype Fabrication Division

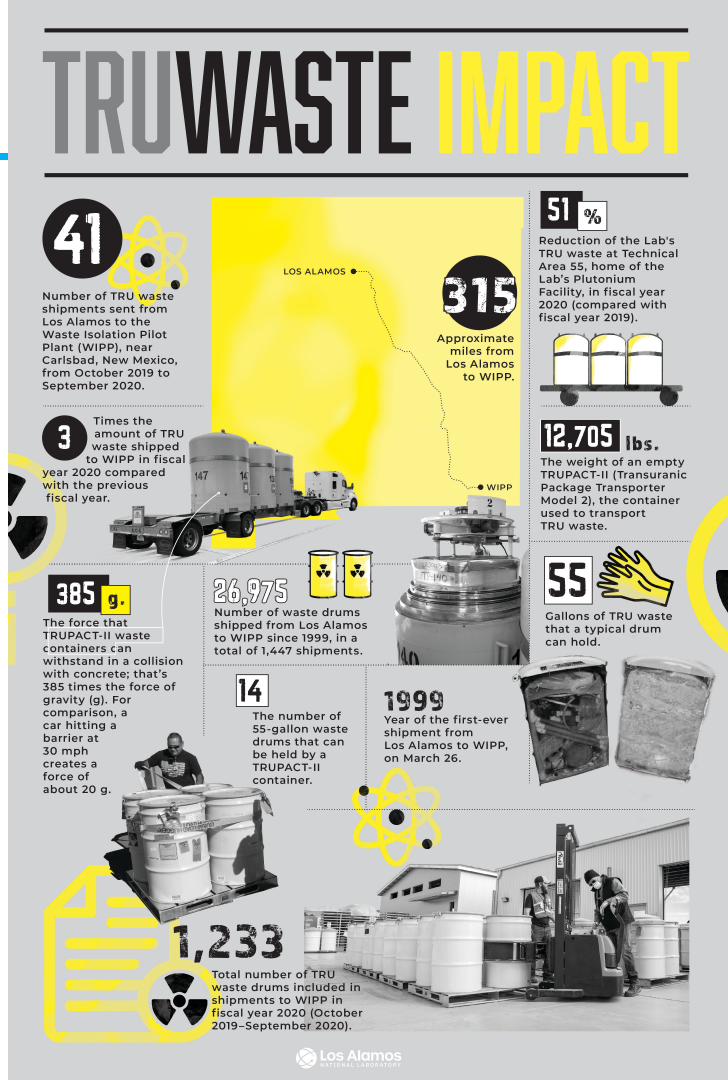
Fabrication
- Material Procurement
- Programming
- Machining
- Welding

Dimensional Inspection
- Ultra-High Precision Data Collection
- Inspection meta data provided to customer

Delivery
Address any NCRs

FY20 accomplishments, examples

- 1,233 TRU waste drums were included in 41 shipments to WIPP in Carlsbad, New Mexico.
- Facility upgrades made throughout PF-4, such as upgrading the aging trolley system, which helps to move materials
- Doubled the number of qualified Radiological Control Technicians
- Kicked off New Employee Training Academy
- Implemented and trained on COVID-19 protocols; kept production moving despite challenges
- Heat source final assemblies made record-breaking sale
- Upgraded and acquired new equipment such as Thermo Neutron Counter updates, new lathes in Prototype Fabrication
- Achieved milestones for uranium and legacy material operations



FY21 Lab agenda – ALDWP role

Execute LANL's manufacturing mission to deliver 30 plutonium pits per year

- Support first production unit (FPU)
- Develop PF-4 requirements
- Integrated schedule
- Production goals
- Enhance quality of work environment
- Expand the workforce
- Execute TRU waste plan
- Support analytical chemistry
- Support SRS pit production

Implement an integrated initiative for plutonium & actinide missions based on FY20 strategy

- Establish actinide operations and pit program strategy team
- Develop real-time capability for measurements for crit safety and safety basis
- Institute nuclear enterprise science and technology program

Current needs for pit production

- Expanding the workforce
- Needed capital improvements (e.g. parking garage, office space, etc.)
- Transuranic (TRU) waste processes
- Supporting programs like Advanced Recovery and Integrated Extraction System (ARIES), Material Recovery & Recycle (MR&R), Surveillance, Certification - necessary to the pit mission

The ALDWP vision, values & behaviors

Our vision

- To achieve both the program's and the nation's objectives, now and in the future
- To realize the potential of individuals and the organization

Our values and behaviors

VALUES

- COMMITMENT
- RESPECT
- INTEGRITY
- DEALING WITH PROBLEMS
- TAKING CARE OF PEOPLE
- PRECISION IN LANGUAGE

BEHAVIORS

- PERSONAL RESPONSIBILITY
- VALUE THE LEGACY
- RAISE THE CONCERNS
- CONTINUOUS LEARNING
- CONTINUOUS IMPROVEMENT