Engineering Assessment Overview

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Introduction

The Engineering Analysis (EA) refines recommendations from the Plutonium Pit Production Analysis of Alternatives (AoA) to support selection of a single preferred alternative for conceptual design:

- Repurposing the Mixed Oxide Fuel Fabrication Facilities (MFFF) at the Savannah River Site (SRS) to produce 50 Weapons Reserve (WR) pits per year (ppy) (complementary to the enduring 30 WR ppy mission at Los Alamos National Laboratory)

The EA was completed by an independent Architectural & Engineering firm, PARSONS, with plutonium expertise provided by a team of subject matter experts

The EA provides analysis related to:

- Engineering Feasibility
- Cost
- Schedule
- Risk
Engineering Feasibility

- MFFF was designed and constructed to meet Nuclear Regulatory Commission requirements for nuclear safety and DOE requirements for material control and accountability (MC&A) and for safeguards and security.

- The safety strategy is to conservatively assume that all the passive and active engineering controls credited for the Los Alamos National Laboratory Plutonium Facility.

- Because MFFF is an existing structure, design for the 50 ppy project would be limited to designing process and support systems and the minor modifications to the building.

- Modifying MFFF does include the addition of a significant and somewhat complex conveyance system.

- There is more than sufficient room for process equipment, support areas, and utility systems for the production of 50 ppy at high confidence.

- The existing Technical Support Building has more than sufficient room to house the operational staff needed.

Provides a fully independent and self-contained 50 ppy capability.
Construction Scope

- **Mixed Oxide Fuel Fabrication Facility**
  - Removing the existing fuel manufacturing equipment previously installed in the areas that are being used for pit production
  - Installation of gloveboxes and process equipment
  - Installing an analytical chemistry laboratory
  - Installation of process support and building utility systems
  - Commodity routing and final system connections

- **Technical Support Building**
  - Modifications to provide Entry Control Facility and Office and Support Space

- **Waste Solidification Building**
  - Testing and repairing or replacing the existing equipment

- **Security Upgrades**
  - Installation Perimeter Intrusion Detection and Assessment System (PIDAS)
Equipment and Process Space

- Process Equipment List
  - 117 Manufacturing
  - 36 Aqueous

<table>
<thead>
<tr>
<th>Process Area</th>
<th>Room(s) Size (ft²)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Disassembly and Metal Preparation</td>
<td>6,084</td>
</tr>
<tr>
<td>Foundry</td>
<td>5,919</td>
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<tr>
<td>Machining</td>
<td>8,942</td>
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<tr>
<td>Subassembly and Assembly</td>
<td>8,322</td>
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<tr>
<td>Post Assembly</td>
<td>1,581</td>
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<tr>
<td>Material Management</td>
<td>2,055</td>
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<tr>
<td>Material Characterization</td>
<td>1,920</td>
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<tr>
<td>Sample Preparation and Analytical Laboratory</td>
<td>19,960</td>
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<tr>
<td>Aqueous Recovery</td>
<td>6,838</td>
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<tr>
<td>High Energy Radiography</td>
<td>4,100</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>65,721</strong></td>
</tr>
</tbody>
</table>
Pre-Conceptual Equipment Layouts
1st Floor Plan

(b)(3)
Pre-Conceptual Equipment Layout
2nd Floor Plan

(b)(3)
Pre-conceptual Equipment Layout
3rd Floor Plan
(b)(3)
Cost and Schedule Estimates

Cost Estimate Range - $1.83 - $4.58 B

Point Estimate - $2.29 B

Schedule
- Start Conceptual Design – Oct 2018
- CD-1 Approval – Dec 2019
- CD-3A Approval – Feb 2021
- CD-2/3 Approval – Sep 2022
- Construction Completion – Jul 2025
- CD-4 Approval – Jan 2028

The cost estimate and schedule is a rough-order-of-magnitude estimate (Class 5 in accordance with DOE Cost Estimating Guide estimate classification) and is intended to provide a means of comparing relative costs to support the decision-making process.

Estimates and schedule are not intended for budgeting purposes.
Qualitative Risk Assessment

**Threats**
- MFFF ongoing construction leads to increased costs for modifications or facility retrofit
- Difficulties closing out the MOX project and contract result in schedule delays
- Facility configuration results in increased safety and security requirements and associated lifecycle costs

**Opportunities**
- Some work required for pit production at MFFF can be completed as part of MFFF closeout
- Analytical capability will be located in existing HC-2 Security Category 1 space
- Improved operational efficiency using lessons learned and best practices with SMEs from separate sites
- Separate sites each with production capabilities can ensure continuing mission support
- Additional HC-2 space is available to support other NNSA programs.
- Opportunity to make use of purchase and stored commodities from the MOX project
- Remove walls for construction and operations
- MFFF would not have to be safety class due to distance from the site boundary
- Use of F/H analytical laboratory
Process Overview

Main flow of product

- Receipt and Packaging
  - Receive and unpack pits from, and pack and ship pits to, the Pantex Plant near Amarillo, TX

- Storage
  - Securely store plutonium-bearing items, including residues, oxides, metals, components, and pits

- Pit Disassembly
  - Disassemble old pits to “mine” the plutonium to feed new pit manufacturing because no new plutonium is available from US reactors
  - Remove both stable impurities and those that grow in to the plutonium because it is radioactive to produce purified and “new” metal

- Metal Preparation
  - Spec Metal
  - Old Metal

- Foundry
  - Machine cast plutonium to precise dimensions and inspect using radiography, dimensional inspection, and density

- Machining and Inspection
  - Assemble plutonium shells into a pit along with non-nuclear parts that can be welded to seal the pit against the environment
  - Post Assembly NDT
  - Perform final inspection and non-destructive testing of the pit, including radiography and dimensional inspection

- Analytical Chemistry
  - Analyze plutonium metal and pit-derived samples for physical properties such as grain size, surface chemistry, strength, etc., validate results from key manufacturing steps, esp. welding and joining, and support process troubleshooting

- Nitrate & Chloride Recovery
  - Dissolve plutonium by-products and residues in acid to recover plutonium from the residue stream

- Analytical Chemistry
  - Analyze plutonium samples to ensure they contain the appropriate amount and concentration of plutonium, and that impurities are below specified limits

- Solid Waste Management
  - Stage, characterize, and ship radioactive solid waste (both low-level and transuranic) to the appropriate disposal site
  - Remove radioactive elements from liquid waste streams so that effluent can be discharged to the environment

- Liquid Waste Management
  - Remove both stable impurities and those that grow in to the plutonium because it is radioactive to produce purified and “new” metal
  - Disassemble old pits to “mine” the plutonium to feed new pit manufacturing because no new plutonium is available from US reactors

- Materials Characterization
  - Analyze plutonium metal and pit-derived samples for physical properties such as grain size, surface chemistry, strength, etc., validate results from key manufacturing steps, esp. welding and joining, and support process troubleshooting

- Assembly & Joining
  - Melt, alloy, cast, and heat treat pure plutonium into a blank for machining

- Post Assembly NDT
  - Assembly & Joining
  - Finished Assemblies

- WR Assemblies
  - Receive and unpack from, and ship to Pantex WR Assemblies

- Pit Quality Acceptance
  - Ensure all documentation is in order to document that the pit was fabricated appropriately and meets all requirements so that it can be used in a Stockpile weapon

- Solid Waste Management
  - Dissolve plutonium by-products and residues in acid to recover plutonium from the residue stream

- Liquid Waste Management
  - Wildcat key manufacturing steps, esp. welding and joining, and support process troubleshooting

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