Office of Material Management and Minimization (M^3)

MISSION NEED STATEMENT

Surplus Plutonium Disposition Project

Dilute and Dispose Approach

Not a Major System Acquisition

M3-SR-16-0013

Revision 0

August 25, 2016

PREPARED BY:

Virginia G. Kay, 9/16/16
Deputy Director, Office of Material Disposition — Date

CONCURRENCE:

William E. Kilmartin, 9/21/16
Director, Office of Material Disposition — Date

Sachiko W. McAlhany, 9/16/16
Senior Technical Advisor, Office of Material Management and Minimization — Date

Peter H. Hanlon, 9/16/2016
Assistant Deputy Administrator, Office of Material Management and Disposition — Date

FOR
Michael Thompson, 9/16/2016
Assistant Deputy Administrator for Major Modernization Programs — Date

Frank Marcinowski, 9/21/16
Associate Principal Deputy Assistant Secretary, Regulatory Policy Affairs — Date

Robert Raines, 16 Sept 16
Associate Administrator for Acquisition and Project Management — Date

APPROVAL:

Anne M. Harrington
Deputy Administrator for Defense Nuclear Nonproliferation

9/22/16
Date

CONFIGURATION CONTROL LOG

Revision	Date	Summary of Revision
0	August 25, 2016	Initial Issue

TABLE OF CONTENTS

LIST OF FIGURE(S)

1.0 STATEMENT OF MISSION NEED

1.1 Mission Need Statement

The mission of the Surplus Plutonium Disposition Dilute and Dispose approach is to provide processing, characterization, and storage capabilities to efficiently disposition and permanently dispose of 34 metric tons of weapons-useable plutonium to meet objectives of the United States nonproliferation policy for eliminating excess nuclear weapons materials and fulfill commitments to the international community.

1.2 Justification of Mission Need

The justification of mission need for the National Nuclear Security Administration (NNSA) Material Management and Minimization (M^3) Surplus Plutonium Disposition (SPD) Program and associated projects was approved in October 1997 as:

> "The end of the Cold War has created a legacy of surplus weapons-usable fissile materials both in the U.S. and the former Soviet Union. The global stockpiles of weapons-usable fissile materials pose a danger to national and international security in the form of potential proliferation of nuclear weapons and the potential for environmental, safety and health consequences if the materials are not properly safeguarded and managed.
>
> In September 1993, President Clinton issued a Nonproliferation and Export Control Policy in response to the growing threat of nuclear proliferation. The President's policy states 'the U.S. will seek to eliminate where possible the accumulation of stockpiles of highly enriched uranium or plutonium'... Furthermore, at the Moscow Nuclear Safety Summit, April 19-20, 1996, the President agreed to a statement including the following: 'we are determined to identify appropriate strategies for the management of fissile materials designated as no longer required for defense purposes…".

Since approval of the Mission Need, the U.S. and Russian governments signed the *Plutonium Management and Disposition Agreement*[1] (PMDA) in September 2000 that commits the U.S. and Russia to dispose of at least 34 metric tons (MT) of weapons-useable plutonium by irradiating as Mixed Oxide (MOX) fuel or by other methods "as may be agreed

[1] *The Agreement between the Government of the United States of America and the Government of the Russian Federation Concerning the Management and Disposition of Plutonium Designated as No Longer Required for Defense Purposes and Related Cooperation* was entered into force on July 13, 2011.

by the Parties." M^3 implements this mission by disposing of surplus weapons-useable plutonium in an environmentally sound manner, ensuring these materials can never again be readily used in nuclear weapons.

Additionally, there is a Departmental priority to remove certain inventories of plutonium from the State of South Carolina. Therefore, expediting removal of plutonium from SRS for final disposition is a key objective of the program.

The mission need, as previously approved, has not changed and remains valid; however, NNSA has decided to pursue a significantly less expensive and lower risk approach. The proposed Dilute and Dispose Approach would require a different capital asset, the Surplus Plutonium Disposition Project, to accomplish this mission.

As directed by Congress, NNSA will continue construction of the MOX facility, while in parallel furthering planning and design for the proposed Dilute and Dispose Approach for surplus plutonium disposition. The decision to implement the Dilute and Dispose Approach would be made pursuant to NEPA.

2.0 ALIGNMENT

The mission need for the SPD Program (hereafter called the Program) is directly aligned with the U.S. Department of Energy (DOE) and the NNSA M^3 mission and strategic plan to reduce the threat of nuclear weapons proliferation worldwide by managing and disposing of excess weapons-usable nuclear material. The current U.S. approach for surplus plutonium disposition is production of MOX fuel for irradiation in commercial nuclear power reactors, (i.e., the MOX Fuel approach).

In FY 2013, the Secretary of Energy chartered the Plutonium Disposition Working Group (PWG) to evaluate alternate options for surplus plutonium disposition. The PWG evaluated five approaches for plutonium disposition, including the MOX Fuel approach and an alternate approach known as Dilute and Dispose. The Dilute and Dispose approach involves the dilution of plutonium oxide with inhibitor materials, packaging it into approved containers, and shipping the diluted plutonium to a geologic repository for permanent disposal. *The Report of the Plutonium Disposition Working Group: Analysis of Surplus Weapon-Grade Plutonium Disposition Options* was issued in April 2014, which documents the comparative analysis of these options.

In FY 2015, Congress directed NNSA to task a Federally Funded Research and Development Center to conduct an independent review of the Plutonium Disposition Working Group report. The Aerospace Corporation performed an independent review and addressed the MOX Fuel and Dilute and Dispose approaches in a report issued in April 2015, *Plutonium Disposition*

Study Options Independent Assessment Phase 1 Report, Option 1: MOX Fuel, Option 4: Down-blend. In addition, the Secretary of Energy chartered a Plutonium Disposition Program Red Team to provide an assessment of surplus plutonium disposition approaches and to recommend a best path forward. The Red Team was challenged to address the MOX Fuel approach, the Dilute and Dispose approach, and any other approaches deemed feasible. The Red Team issued its *Final Report of the Plutonium Disposition Red Team* in August 2015.

These evaluations repeatedly conclude that the proposed Dilute and Dispose approach to surplus plutonium disposition is significantly less expensive and has far lower risks than the MOX Fuel approach.

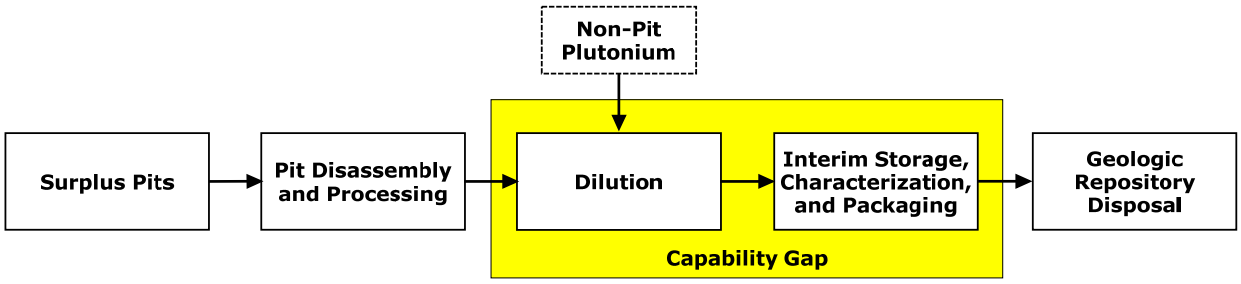
The Explanatory Statement for the Consolidated Appropriations Act, 2016, Public Law 114-113, provides funding for "advance planning, to resolve regulatory and other issues, to complete conceptual design activities for the dilute and dispose alternative to the Mixed Oxide (MOX) Fuel Fabrication Facility, and to develop and submit to the Committee on Appropriations of both Houses of Congress a report that includes an evaluation of program risks and a lifecycle cost estimate and schedule for the alternative."

As part of this planning, NNSA has completed pre-conceptual design for a Surplus Plutonium Disposition Project to support the necessary capability, and is planning to conduct an associated programmatic Analysis of Alternatives (AoA) for implementing the Dilute and Dispose approach.

3.0 CAPABILITY GAP

The basic technical approach for disposition of surplus weapons-usable plutonium utilizing the Dilute and Dispose approach involves production of plutonium oxide followed by dilution of the oxide with inhibitor materials, packaging the oxide into approved containers, and shipping the diluted plutonium oxide to a geologic repository (presumed to be the Waste Isolation Pilot Plant) for permanent disposal. Figure 1 illustrates a simplified process flow diagram for the Dilute and Dispose approach and highlights the areas where capability gaps exist and the need for the Surplus Plutonium Disposition Project.

Figure 1: Dilute and Dispose Approach Simplified Process Flow Diagram



Many of the programmatic capabilities required to execute the Dilute and Dispose approach currently exist at Pantex, the Los Alamos National Laboratory (LANL), the Savannah River Site (SRS), and the Waste Isolation Pilot Plant (WIPP). As the primary site for assembly and disassembly of nuclear weapons, Pantex provides management of the surplus pit inventory, including pit surveillance, monitoring, and packaging capabilities. Pantex will package and ship surplus plutonium to LANL, which currently has the capability to disassemble all pit types in the surplus pit inventory and to produce oxide from the pit plutonium. SRS, under the DOE Environmental Management (DOE-EM) program, has the capability to blend plutonium oxide with an adulterant for future disposal at WIPP.

However, in order to achieve the 34 MT mission in a timely manner, additional capacity is required to dilute the plutonium oxide powder with an inhibitor material, and to package and characterize the material to ensure compliance with the repository waste acceptance criteria. Additionally, sufficient lag storage of the waste product is required until eventual shipment and disposal at WIPP.

4.0 APPROACH

4.1 Requirements and Safety Basis Strategy

Execution of the Program using the Dilute and Dispose approach will fulfill U.S. and DOE/NNSA nuclear nonproliferation policy objectives, including the PMDA, and mission need requirements consistent with federal directives and standards, as well as various practices and guidance used in the DOE/NNSA Complex. The *Surplus Plutonium Disposition Program Requirements Document for the Dilute and Dispose Approach*, M3-SR-16-0009, provides a more comprehensive list of mission and program requirements.

The safety basis for the project will comply with all applicable federal codes, and DOE Orders, Standards and Guides. The project will comply with DOE Order 420.1C, *Facility*

Safety, and employ appropriate methods described in DOE-STD-1189, *Integration of Safety into the Design Process*.

The dilution capability will be installed in existing plutonium facilities. The safety basis will be developed such that the SPD Project will pose no unacceptable hazards to the offsite public, site workers or the environment and will be developed and integrated with the existing facility safety basis. The safety basis will be supported by evaluation of hazards and events involving facility operations, external events, and natural phenomenon. Engineered and administrative controls will be developed to prevent or mitigate hazard events that pose unacceptable risks. Priority will be given to passive engineered controls with emphasis on physical structures and barriers. As a general practice, safety controls for individual accident scenarios based on engineered Structures, Systems, and Components (SSCs) are preferred to administrative controls because they are usually more reliable and more predictable. In cases where an administrative control by itself is justified to reduce the frequency or consequence of an event, attributes of the administrative control will be identified in the form of a Specific Administrative Control (SAC).

The hazards associated with the project will require analysis to determine whether unmitigated consequences challenge existing facility Design Basis Accidents (DBAs). Hazards associated with fire, explosion, loss of confinement, direct radiation, criticality, external, and natural phenomenon events will be evaluated to determine potential consequences and appropriate controls. For current facilities, existing hazards analyses are already available that represent a significant starting point for safety basis development for these options. In all cases, the hazards analysis process will be performed. Functional classification of SSCs will be consistent with DOE-STD-3009, *Preparation of Nonreactor Nuclear Facility Documented Safety Analysis*. Safety Class (SC) functional classification will be based on 25 rem Total Effective Dose Equivalent (TEDE) Evaluation Guideline (EG) or greater to the public. Radiological consequences of 5 rem TEDE but less than 25 rem TEDE will be considered as potentially challenging the EG. In this range, Safety Class SSC classifications will be considered.

It is anticipated that new Active Confinement Ventilation Systems, Fire Protection Systems, Building Structure and associated Power Supply Systems will require functional classification. It is assumed that the new SSCs will be functionally classified as Safety Class pending completion of the Consolidated Hazard Analysis (CHA) process. The CHA process may also identify the need for additional SSCs to be classified at the Safety Significant (SS) level in order to protect the Co-located Worker (CW) and Facility Worker (FW). Finalization of all functional classifications will be completed once the designs are finalized and the final CHA report is issued.

Major Modification Screening and Evaluations will be performed for the process, storage and characterization areas selected. The SPD Project will likely involve at least some facility changes that would constitute a major modification. Consequently, Conceptual Safety Design Reports (CSDRs), Preliminary Safety Design Reports (PSDRs) and Preliminary Documented Safety Analyses (PDSAs) will be developed. The SPD Project will also include Fire Hazards Analyses (FHA) and revisions to CHAs, Documented Safety Analyses (DSA) and Technical Safety Requirements (TSRs). Safety basis documentation for the selected process location and for interim storage, characterization and packaging will be developed in a coordinated manner under the SPD Project.

The hazards and accident analysis process will begin with CHA meetings to evaluate potential events associated with SPD activities using preliminary design information. These meetings will support an evaluation of risks based on events that could result in significant consequences to the CW and Maximally-exposed Offsite Individual (MOI) as well as an evaluation of risk reduction provided by new and existing SSCs. Preliminary controls, including functional classifications and safety functions, will be identified which will be factored into the overall design process. Additional CHAs will be performed and documented in later phases of the project as the design matures for the specific option selected. These later CHA iterations will involve more definitive evaluations of risk to the MOI and also include FW.

The CHA process will be used to support the development of the Preliminary Documented Safety Analysis and revisions to the facility Documented Safety Analysis, and Technical Safety Requirements during later SPD Project phases. The SPD Project will include additional integrated safety documentation including Safety Design Strategy (SDS) and CSDR deliverables during the conceptual design phase and PSDR documentation during the preliminary design phase. The table below summarizes integrated safety documentation by project phase based on the assumption that the SPD Project constitutes a major modification regardless of the final option chosen.

Table 1: SPD Integrated Safety Documentation by Project Phase

CD	Project Phase	Integrated Safety Documentation
N/A	Pre-conceptual Design	Safety Basis Strategy Summary and Pre-conceptual Integrated Safety Documentation
CD-1	Conceptual Design	SDS, Preliminary CHA and CSDR
CD-2	Preliminary Design	CHA and PSDR
CD-3	Final Design	PDSA
CD-4	Construction Completed	CHA, DSA and TSR Revision

4.2 Program Alternatives

4.2.1 No-Action Alternative

A no-action alternative does not meet the objectives and requirements that have been established by the United States or DOE/NNSA for management and disposition of surplus weapons-usable plutonium. Therefore, the no-action alternative was not considered further.

4.2.2 Execute the Dilute and Dispose Approach

The Dilute and Dispose approach takes advantage of existing DOE facilities, infrastructure, and processes to meet the objectives and requirements that have been established by the United States and the DOE/NNSA for management and disposition of surplus weapons-usable plutonium. While execution of the Program utilizing the Dilute and Dispose approach will take advantage of existing assets, additional capability and/or capacity is required for dilution of the plutonium oxide feed and interim storage, characterization, and packaging.

4.2.3 Programmatic Analysis of Alternatives

The Dilute and Dispose approach is not required to be executed at a single site and/or facility. There are multiple potential locations at LANL and/or SRS suitable for the implementation of the project needed to add capability for dilution of the plutonium oxide and interim storage, characterization, and packaging of the diluted product.

A programmatic AoA will be performed to identify alternatives and provide the analytical basis for the selection of a preferred alternative, which is the facility or combination of facilities, for installation of the additional dilution, interim storage, characterization, and packaging capability.

4.3 Assumptions and Constraints

Assumptions and constraints for execution of the Program utilizing the Dilute and Dispose approach are defined in the Program Requirements Document (Reference 2).

4.4 Organizational Approach

The Program is managed and executed by the NNSA Office of Material Disposition (NA-233) within the M^3 organization. Because execution of the Program requires use of facilities managed by other DOE organizations (e.g., DOE-EM and NNSA-Defense Programs), close coordination with these other organizational entities is essential to ensure efficient and cost effective execution of the Dilute and Dispose approach to meet programmatic requirements. The programmatic AoA will consider ongoing and planned missions in the facilities managed by other DOE organizations to assess impacts and/or synergy with facility operations.

An Integrated Program Team composed of federal staff and Management and Operating contractor representatives at affected sites has been created to mature the detailed execution planning of the Program utilizing the Dilute and Dispose approach.

5.0 RESOURCE AND SCHEDULE FORECAST

The cost range for the project to provide the capabilities to dilute the plutonium oxide and provide interim storage, characterization, and packaging of the diluted product is $200 to $500 million and was developed as follows:

- The basis of this range is rough order-of-magnitude (ROM) estimates for options utilizing existing Hazard Category 2 facilities with plutonium oxide processing capabilities and the required security infrastructure for Category 1 quantities of plutonium.
- The contractor initially developed AACE Class 5 estimates which informed a conservatively bounding range for existing Pu facilities with sufficient space.
- The cost range was then evaluated against other established benchmarks such as the Department of Defense Cost Assessment and Program Evaluation (CAPE) and the Office of Project Management Oversight and Assessments (PM) Cost Estimating and

Scheduling Initiative (CESI) recommended cost per square foot data for nuclear process construction;

- This range does not include Mixed Oxide Fuel Fabrication Facility project closeout.

The project initiation is planned for the 2nd quarter FY2017 with the schedule range for CD-4 approval estimated to be 2nd quarter FY2026 to 4th quarter FY2027. This is a bounding schedule range developed from low and high schedule estimates based on judgement and experience with similar work within potential facilities.

Following selection of the location for the project through the AoA process, a conceptual design will establish preliminary project cost and schedule ranges and a funding profile. A tailored CD-1/3A strategy is planned to allow preparation of the conceptual design package to include specification and procurement of long-lead equipment. The estimated cost for preparation of the conceptual design package is $8M and $20M is estimated for procurement of the long-lead equipment.

6.0 IMPACT OF NON APPROVAL OF MISSION NEED

If the Mission Need for the Program and associated projects is not approved, the objectives and requirements established by the United States and the DOE/NNSA for management and disposition of surplus weapons-usable plutonium would not be met, including the U.S.-Russian PMDA commitments. This would erode the United States' position as a world-leader in nuclear nonproliferation policy, and would not achieve permanent threat reduction from the disposition of nuclear materials that are surplus to the needs of the nation. Additionally, the commitments to remove plutonium from the state of South Carolina would not be met.

In addition, there are significant mission impacts at DOE sites. Long term continued staging of surplus pits at Pantex would create additional storage and security infrastructure needs, and could constipate the activities to continue nuclear weapons dismantlement and long term stockpile management. This would also create the need for a long term extension of Category 1 material storage of plutonium at SRS at a cost of at least $120M annually.

7.0 REFERENCES

1. DOE Memorandum, Tavares and Canter to File, *Critical Decision 1 – Pit Disassembly and Conversion Facility, Immobilization and Processing Facility, and Mixed Oxide Fuel Fabrication Facility*, October 31, 1997.

2. NNSA, *Surplus Plutonium Disposition Program Requirements Document for the Proposed Dilute and Dispose Approach*, M3-SR-16-0009, Revision 0, August 30, 2016.