APPENDIX B
FACILITIES DESCRIPTION

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This appendix presents information about the facilities at the Savannah River Site (SRS) near Aiken, South Carolina, Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico, the Waste Isolation Pilot Plant (WIPP) near Carlsbad, New Mexico, and the two Tennessee Valley Authority (TVA) nuclear power reactor sites (Browns Ferry Nuclear Plant and Sequoyah Nuclear Plant) that may be involved in surplus plutonium disposition as evaluated in this *Final Surplus Plutonium Disposition Supplemental Environmental Impact Statement* (*SPD Supplemental EIS*). **Figure B–1** shows the locations of these facilities.

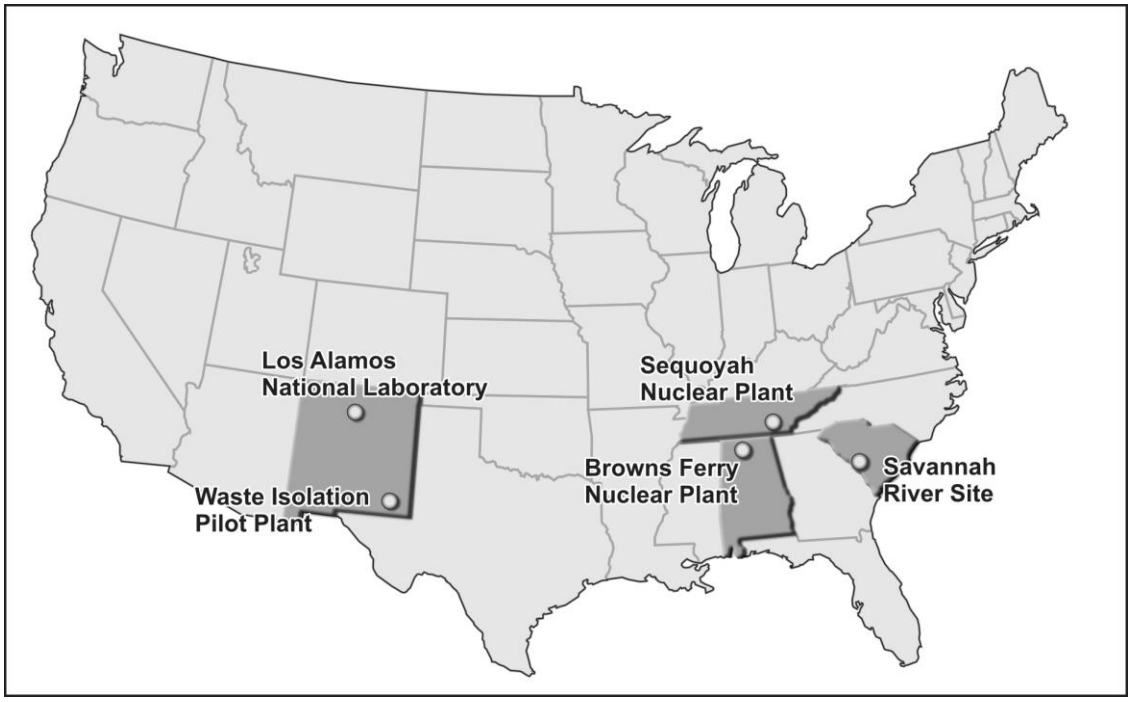


Figure B–1 Locations of Major Facilities Evaluated in this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement*

Figure B–2 shows the principal areas at SRS and highlights the areas at which the facilities evaluated in this *SPD Supplemental EIS* are located:

- F-Area, the location of the Mixed Oxide Fuel Fabrication Facility (MFFF) (under construction), the F/H-Laboratory, and the Waste Solidification Building (WSB) (under construction), and the proposed location of the Pit Disassembly and Conversion Facility (PDCF)
- K-Area, the location of the K-Area Complex, which houses the existing K-Area plutonium storage and K-Area Interim Surveillance (KIS) capabilities, and the proposed location for the plutonium immobilization capability and the K-Area Pit Disassembly and Conversion Project (PDC)
- H-Area, the location of H-Canyon/HB-Line
- S-Area, the location of the Defense Waste Processing Facility (DWPF) and Glass Waste Storage Buildings (GWSBs)
- E-Area, the location of waste management operations

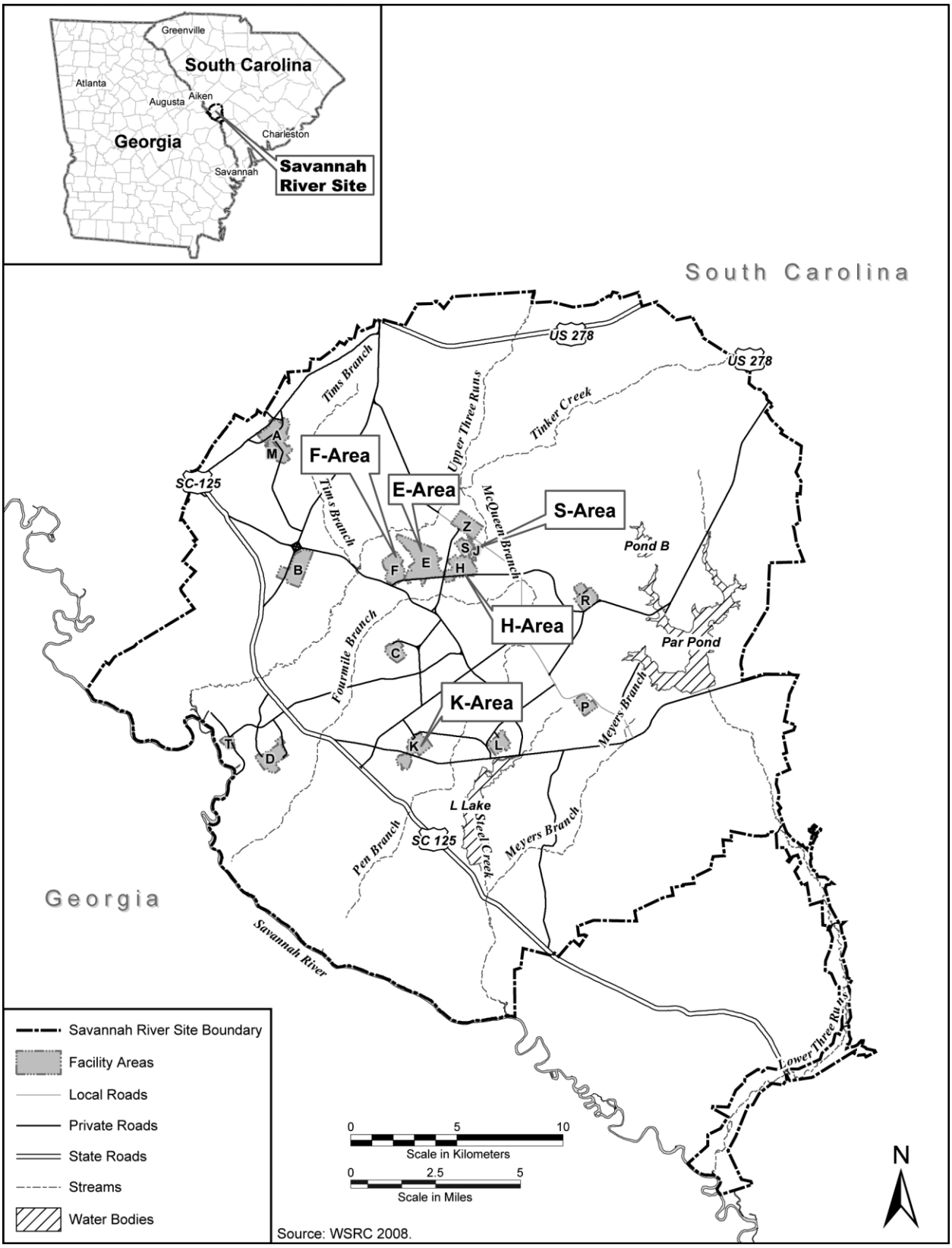


Figure B–2 Savannah River Site Location and Operations Areas

This *SPD Supplemental EIS* evaluates alternatives involving combinations of these SRS facilities to:

- Disassemble and convert to an oxide from 27.5 to 35 metric tons (30.3 to 38.6 tons) of surplus pit plutonium
- Convert 4 metric tons (4.4 tons) of surplus non-pit plutonium to an oxide
- Fabricate from 34 to 45.1 metric tons (37.5 to 49.7 tons) of surplus pit and non-pit plutonium into mixed oxide (MOX) fuel, with subsequent irradiation in domestic commercial nuclear reactors
- Prepare 7.1 metric tons (7.8 tons) of surplus pit plutonium and 6 metric tons (6.6 tons) of surplus non-pit plutonium for disposal at WIPP, with subsequent transport to WIPP
- Immobilize 13.1 metric tons (14.4 tons) of surplus pit and non-pit plutonium, with subsequent onsite storage
- Vitrify 6 metric tons (6.6 tons) of surplus non-pit plutonium with high-level radioactive waste, with subsequent onsite storage

Currently, about 2 metric tons (2.2 tons) of plutonium oxide are being prepared for MOX feed through the Advanced Recovery and Integrated Extraction System Program (ARIES) in the Plutonium Facility (PF-4) at Technical Area 55 (TA-55) at LANL. The U.S. Department of Energy (DOE) is analyzing the impacts of these activities in this *SPD Supplemental EIS* as well as expansion of activities at PF-4 to enable disassembly and conversion of 35 metric tons (38.6 tons) of surplus pit plutonium. In addition, this *SPD Supplemental EIS* includes a qualitative analysis to evaluate the option (under the WIPP Alternative) of using LANL facilities in TA-55 to prepare 7.1 metric tons (7.8 tons) of surplus pit plutonium for potential disposal at WIPP.[1] **Figure B–3** shows the locations of LANL and TA-55 at LANL and **Figure B–4** shows the location of PF-4 at TA-55.

Table B–1 summarizes the construction and facility modifications that may be required, depending on the *SPD Supplemental EIS* alternative and the pit disassembly and conversion option. **Table B–2** shows the analyzed duration of construction and operations of the facilities under each of the alternatives. Chapter 4 of this *SPD Supplemental EIS* presents the impacts of the five surplus plutonium disposition alternatives, consisting of four action alternatives and the No Action Alternative. The alternatives are composed of pit disassembly and conversion options (Appendix F) and disposition options (Appendix G). **Table B–3** shows the maximum annual and the total surplus plutonium throughput analyzed for each of the affected facilities under each of the alternatives.

B.1 Savannah River Site

B.1.1 F-Area Facilities

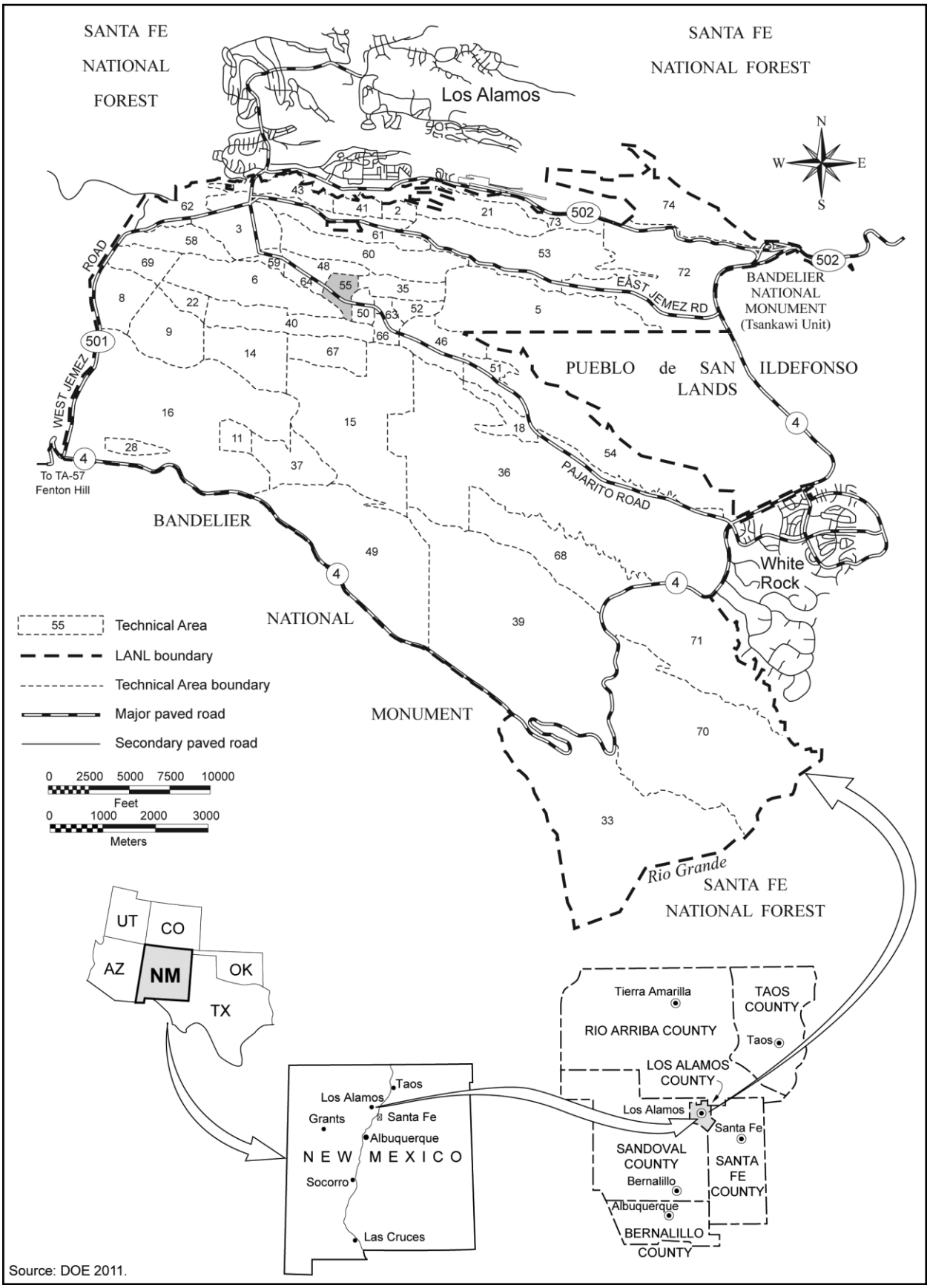
F-Area at SRS is where PDCF would be built should DOE reaffirm its January 11, 2000, decision to construct this facility (65 FR 1608). F-Area facilities also include MFFF and WSB, both of which are under construction.

B.1.1.1 Pit Disassembly and Conversion Facility

A stand-alone PDCF would be built on a 50-acre (20-hectare) parcel near MFFF and WSB at F-Area. Once completed, PDCF would encompass less than 23 acres (9.3 hectares). The primary mission of PDCF would be to: (1) receive surplus weapons-usable plutonium in the form of pits and other plutonium metals, (2) convert the plutonium metal to plutonium oxide, and (3) remove any residual classified attributes through blending of the converted plutonium oxide. Once the plutonium oxide is blended, it would be sealed in DOE-STD-3013 containers[2] for transfer to other SRS facilities for disposition (e.g., fabrication into MOX fuel, immobilization, or blending and packaging for potential disposal as contact-handled transuranic [CH-TRU] waste at WIPP).

[1] *Use of LANL facilities to prepare pit plutonium for potential disposal at WIPP may require additional NEPA analysis.*

[2] *DOE-STD-3013 containers are containers that meet the specifications in DOE Standard 3013,* Stabilization, Packaging, and Storage of Plutonium-Bearing Materials, *DOE-STD-3013-2012 (DOE 2012a).*



Source: DOE 2011.

Figure B–3 Los Alamos National Laboratory Location and Technical Areas

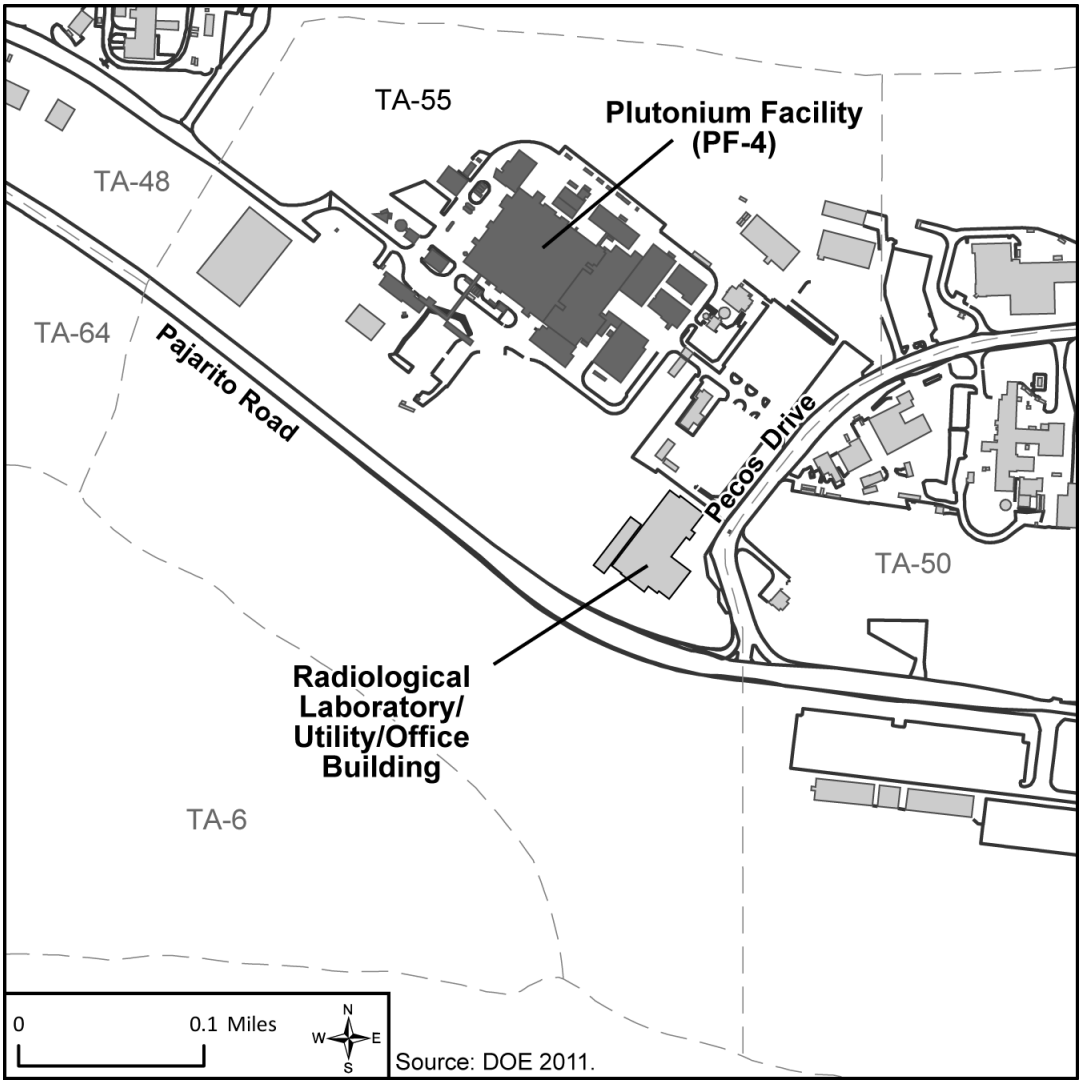


Figure B–4 Location of Facilities in Technical Area 55

Table B–1 Proposed Facility Construction and Modification Summary[a]

Facility	*Description*
Facility Construction	
PDCF at F-Area at SRS	New facility construction would disturb approximately 50 acres.
PDC at K-Area at SRS	New facility construction would disturb approximately 30 acres.
Immobilization capability in K-Area at SRS	New facility construction would disturb approximately 2 acres. Modifications to the K-Area Complex would occur to support plutonium immobilization.
Facility Modification	
MFFF at F-Area at SRS	Minor modification to support plutonium conversion using metal oxidation furnaces would be internal to MFFF, which is already under construction.
K-Area glovebox at SRS	Modifications of a glovebox would be conducted within an existing facility structure at the K-Area Complex to support pit disassembly activities.
H-Canyon/HB-Line (dissolution to DWPF)	Some tanks or piping in H-Canyon would be changed out or reconfigured to increase plutonium storage volume or capacity. The scrap recovery south line in HB-Line would be reactivated and additional equipment added to implement processes to minimize equipment corrosion and increase dissolution throughput rates.
H-Canyon/HB-Line (oxide production)	New equipment, including one new HB-Line glovebox, would be required to supply plutonium oxide feed for MFFF; H-Canyon might add new, or change out or reconfigure existing, tanks or piping to increase plutonium solutions storage and processing capabilities.
H-Canyon/HB-Line (preparation for WIPP)	Minor modifications would be conducted within existing structures for preparation of surplus plutonium for potential WIPP disposal, and interim storage of pipe overpack containers or criticality control overpacks.
DWPF at S-Area at SRS	Minor modifications to an existing structure to accommodate can-in-canisters from the plutonium immobilization capability would include new canister storage racks, a closed-circuit television system, a remote manipulator, and other modified equipment.
PF-4 at TA-55 at LANL	Modifications to the existing PF-4 would be made to support an enhanced pit disassembly and conversion capability; temporary disturbance of less than 2 acres would occur to accommodate a construction trailer and worker parking area. [b]
Domestic commercial nuclear power reactors	Use of MOX fuel is expected to require only minor modifications within existing structures.

DWPF = Defense Waste Processing Facility; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; SRS = Savannah River Site; TA = Technical Area; WIPP = Waste Isolation Pilot Plant.

[a] Different impacts of facility construction and modification activities may occur, depending on the particular alternative and pit disassembly and conversion option addressed in this *Surplus Plutonium Disposition Supplemental Environmental Impact Statement.*

[b] Additional modifications to TA-55 facilities may be required to support preparation of surplus pit plutonium for potential disposal at WIPP.

Note: To convert acres to hectares, multiply by 0.40469.

Source: DOE 1999; LANL 2013; SRNL 2013; SRNS 2012; WSRC 2008.

Table B–2 Analyzed Duration of Facility Construction and Operations (years)

Facility	Alternative				
	No Action	*Immobilization to DWPF*	*MOX Fuel*	*H-Canyon/ HB-Line to DWPF*	*WIPP*
Construction					
Immobilization	N/A	6	N/A	N/A	N/A
Metal Oxidation Furnaces in MFFF [a]	N/A	3.5	3.5	3.5	3.5
PDCF	13	13	13	13	13
PDC in K-Area	N/A	N/A	13	13	13
H-Canyon/HB-Line (pit conversion) [b]	N/A	2	2	2	2
H-Canyon/HB-Line (preparation for WIPP) [c]	N/A	N/A	< 2	N/A	2
PF-4 at LANL	N/A	8	8	8	8 [d]
Operations					
Pit Disassembly and Conversion					
PDCF	10	12	12	12	12
PDC in K-Area	N/A	N/A	12	12	12
H-Canyon/HB-Line [e]	N/A	14	14	14	14
Oxidation Furnaces in MFFF	N/A	20	20	20	20
PF-4 at LANL	7	7–22 [f]	7–22 [f]	7–22 [f]	7–22 [f]
Disposition					
MFFF	21	21	24	23	21
Immobilization	N/A	10	N/A	N/A	N/A
H-Canyon/HB-Line (dissolution to DWPF) [g]	N/A	N/A	N/A	13	N/A
H-Canyon/HB-Line [g] (oxide production)	N/A	N/A	6	N/A	N/A
H-Canyon/HB-Line [g] (preparation for WIPP)	N/A	N/A	10	N/A	13–25 [h]
DWPF [g]	N/A	10	6 [i]	13	N/A
TA-55 at LANL (preparation for WIPP)	N/A	N/A	N/A	N/A	~22 [j]
Support Facilities					
K-Area storage [k]	40	20	22	22	22
KIS [k]	40	15	7	10	7
WSB	21	21	24	23	21

DWPF = Defense Waste Processing Facility; Immobilization = K-Area plutonium immobilization capability; KIS = K-Area Interim Surveillance capability; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; TA = Technical Area; WIPP = Waste Isolation Pilot Plant; WSB = Waste Solidification Building.

[a] Installation of furnaces could take place during construction or operation of MFFF.

[b] In addition, modification of the K-Area Complex to enable pit disassembly is estimated to require 2 years.

[c] Modifications to support preparation of 13.1 metric tons of plutonium for potential WIPP disposal under the WIPP Alternative are expected to require 2 years; less construction time would be required to support preparation of 2 metric tons of non-pit plutonium for potential WIPP disposal under the MOX Fuel Alternative.

[d] Optional modification of TA-55 facilities for preparation of pit plutonium for potential WIPP disposal would occur concurrently with modification of PF-4 for an enhanced pit disassembly and conversion capability.

[e] Pits would be disassembled at PF-4 at LANL or at the K-Area Complex and plutonium would be converted to plutonium oxide at H-Canyon/HB-Line.

[f] Values are for processing 2 metric tons of plutonium metal and 35 metric tons of plutonium metal.

[g] The assumed operational period for H-Canyon/HB-Line and DWPF only reflects the years required to disposition surplus plutonium.

[h] The first value is for preparing 6 metric tons of non-pit plutonium at H-Canyon/HB-Line for potential WIPP disposal (the remaining 7.1 metric tons of pit plutonium would be prepared at TA-55 facilities at LANL for potential WIPP disposal); the second value is for preparing 13.1 metric tons of pit and non-pit plutonium at H-Canyon/HB-Line for potential WIPP disposal. The latter projected operational period would be reduced to the extent that pit plutonium was prepared at LANL for potential WIPP disposal rather than at SRS.

[i] Although oxide production at H-Canyon would generate a small volume of liquid radioactive waste that would be sent to the tank farm for storage over a period of approximately 6 years, vitrification of this waste at DWPF would result in the generation of approximately 2 additional canisters, an activity that takes 2 days to accomplish.

[j] Under the WIPP Alternative, preparation of pit plutonium at LANL for potential WIPP disposal could occur concurrently with disassembly and conversion of pit plutonium at PF-4, and could extend the Surplus Plutonium Disposition Program at LANL by a few years.

[k] The assumed operational periods are from 2012 forward.

Note: Values have been rounded. To convert metric tons to tons, multiply by 1.1023.

Source: LANL 2013; SRNL 2013; SRNS 2012.

Table B–3 Maximum Annual/Total Plutonium Throughput Analyzed (metric tons)

Facility	*Alternative*									
	No Action		*Immobilization to DWPF*		*MOX Fuel*		*H-Canyon/ HB-Line*		*WIPP*	
	Annual	*Total*	*Annual*	*Total*	*Annual*	*Total*	*Annual*	*Total*	*Annual*	*Total*
Pit Disassembly and Conversion										
PDCF	3.5	28	3.5	35	3.5	35	3.5	35	3.5	35
PDC in K-Area	N/A		N/A		3.5	35	3.5	35	3.5	35
MFFF Oxidation	N/A		3.5	35	3.5	35	3.5	35	3.5	35
H-Canyon/HB-Line [a]	N/A		1	10	1	10	1	10	1	10
PF-4 at LANL [b]	0.3	2	2.5	35	2.5	35	2.5	35	2.5	35
Disposition										
Immobilization	N/A		1.3	13.1	N/A		N/A		N/A	
MFFF Fabrication	3.5	34	3.5	34	3.5	45.1	3.5	41.1	3.5	34
H-Canyon/HB-Line (preparation for MFFF)	N/A		N/A		0.7	4	N/A		N/A	
H-Canyon/HB-Line (dissolution to DWPF)	N/A		N/A		N/A		0.5	6	N/A	
H-Canyon/HB-Line (preparation for WIPP)	N/A		N/A		0.2	2	N/A		0.6/0.6 [c]	6/13.1 [c]
DWPF	N/A		1.3	13.1	– [d]		0.5	6	– [d]	
TA-55 at LANL (preparation for WIPP)	N/A		N/A		N/A		N/A		0.3	7.1

DWPF = Defense Waste Processing Facility; Immobilization = K-Area plutonium immobilization capability; LANL = Los Alamos National Laboratory; MFFF = Mixed Oxide Fuel Fabrication Facility; MOX = mixed oxide; N/A = not applicable; PDC = Pit Disassembly and Conversion Project; PDCF = Pit Disassembly and Conversion Facility; PF-4 = Plutonium Facility; TA = Technical Area; WIPP = Waste Isolation Pilot Plant.

[a] Pits would be disassembled at PF-4 at LANL or at the K-Area Complex and plutonium would be converted to plutonium oxide at H-Canyon/HB-Line.

[b] The maximum annual and total throughputs for expanded pit disassembly and conversion at LANL are 2.5 and 35 metric tons of plutonium, respectively; the maximum annual and total throughputs for the No Action Alternative and other options where LANL is not considered for expanded pit disassembly and conversion are 0.3 and 2 metric tons of plutonium, respectively. Production of 2 metric tons of plutonium oxide at LANL is part of the No Action Alternative and base program regardless of the option selected.

[c] The first value is for preparing 6 metric tons of non-pit plutonium at H-Canyon/HB-Line for potential WIPP disposal (the remaining 7.1 metric tons of pit plutonium would be prepared at TA-55 facilities at LANL for potential WIPP disposal); the second value is for preparing 13.1 metric tons of pit and non-pit plutonium at H-Canyon/HB-Line for potential WIPP disposal.

[d] No plutonium disposition using DWPF would occur, but operations at H-Canyon/HB-Line would generate waste resulting in a small number of high-level radioactive waste canisters.

Note: Values have been rounded. To convert metric tons to tons, multiply by 1.1023.

Since the issuance of previous National Environmental Policy Act (NEPA) analyses (DOE 1999, 2003), DOE has instituted several design enhancements (WSRC 2008):

- Added a 43,380-square-foot (4,030-square-meter) sand filter for final air treatment
- Added a metal oxidation step for metallic uranium, deleted a gallium removal system, deleted a tritium extraction furnace, changed the hydride-oxidation system to a hydride/dehydride system with additional high-efficiency particulate air (HEPA) filtration and a hydrogen generator, and repositioned some equipment
- Added sprinklers to gloveboxes operated in a non-inert atmosphere
- Added a grouting process for floor sweepings in the waste management area, glovebox sweepings, and lab-concentrated liquids
- Upgraded the security measures and design of the facility to minimize the opportunity for intruder access
- Deleted the unclassified vaults
- Reduced the Plutonium Processing Building area to 153,600 square feet (14,300 square meters); the Plutonium Processing Building includes a main process area plus loading dock, safe haven (a location that protects workers while simultaneously restricting potential intruder access), interstitial space, and firefighting water containment basin
- Increased the total support area to 155,400 square feet (14,400 square meters), including the Mechanical and Support Equipment Building, Utility Building, Fan House, Sand Filter Structure, Entry Control Facility, Diesel Storage Building, and Administration Building

Figure B–5 shows PDCF material flows and processes, with MOX fuel fabrication illustrated as the plutonium disposition pathway. Pits transported from the Pantex Plant near Amarillo, Texas, would be disassembled and the plutonium would be separated from other materials. Other byproducts from the disassembly process would be packaged, stored, and shipped to DOE sites. The plutonium metal that was bonded with highly enriched uranium (HEU) and other materials would be size-reduced, then chemically separated from these materials via a hydride/dehydride process. All mechanically and/or chemically separated plutonium from pits or plutonium metal would be converted within metal oxidation furnaces to plutonium oxide and used as feed for MFFF (SRNS 2012). The facility would be designed with a nominal throughput rate of 3.5 metric tons (3.9 tons) of plutonium metal per year. The plutonium oxide product would meet DOE-STD-3013 requirements (DOE 2012a) and would be stored in vaults and transported within the facility using DOE-STD-3013-compliant containers (WSRC 2008).

The primary PDCF buildings include the Plutonium Processing Building, Mechanical and Support Equipment Building, Utility Building, Fan House and Exhaust Stack, Sand Filter Structure, and Administration Building. The Plutonium Processing Building would house the activities needed to receive surplus weapons-usable plutonium, process pits and plutonium metal parts, and ship products to MFFF or other locations for disposition. Areas where plutonium would be processed or stored would be designed to survive natural phenomena hazard events and potential accidents. The Plutonium Processing Building would be a bermed underground Nuclear Material Hazard Category 2 reinforced-concrete structure with a total floorspace of 153,600 square feet (14,300 square meters) and more than 20 glovebox lines. The gloveboxes would be connected by an overhead trolley system, which would be used to transfer material between gloveboxes so that the material would remain within containment. The Plutonium Processing Building would house industrial lathes, metal oxidation furnaces, hydride reactors, robotic manipulators, oxide-blending equipment, and welding equipment.

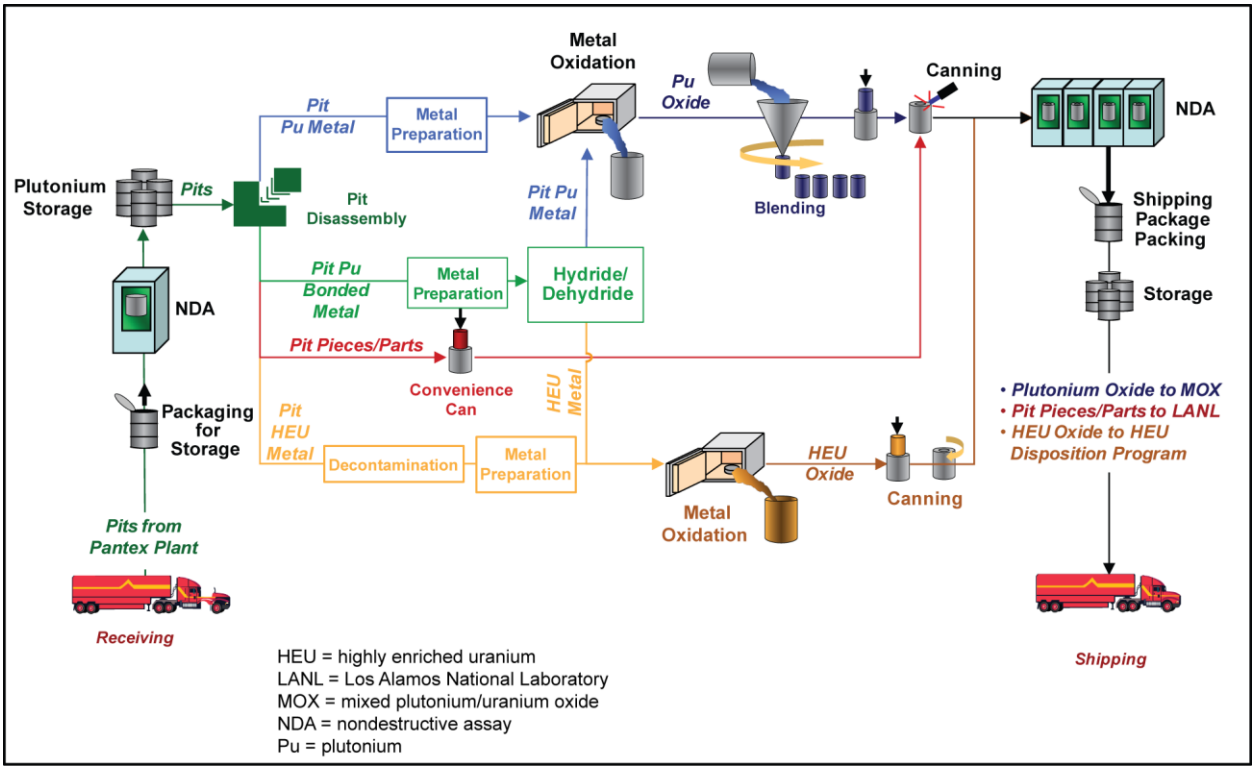


Figure B–5 Pit Disassembly and Conversion Capability in the Pit Disassembly and Conversion Facility in F-Area or the Pit Disassembly and Conversion Project in K-Area

The Mechanical and Support Equipment Building would house service functions to support operations that would occur at the Plutonium Processing Building, including heating, ventilating, and air conditioning (HVAC) equipment; mechanical, control and communications, and electrical power distribution equipment; uninterruptible power supplies; emergency generators; a facility control room; shower and locker areas; and offices.

The Utility Building would house the standby power supply system and other electrical and mechanical equipment for the PDCF complex. The Fan House would be designed to draw air from the Sand Filter and then exhaust through a stack. The Fan House would house fans, required ductwork, a control room, and a storage room. The Sand Filter would be a single-level, below-grade structure that would house sand filter functions and a limited amount of supporting mechanical equipment. The Pedestrian and Vehicle Portal would provide a security checkpoint for pedestrians and vehicles. The Administration Building would be located next to the Sand Filter.

Activities involving radioactive materials or externally contaminated containers of radioactive materials would be conducted within gloveboxes interconnected by a conveyor system to move materials between process steps. Gloveboxes would remain sealed and operate independently, except during material transfer, and would include inert atmospheres, where appropriate. Safety features would limit the temperature and pressure inside the gloveboxes and ensure that operations maintain criticality safety. The glovebox atmosphere would be kept at a lower pressure than surrounding areas, so that any leaks of gases or suspended particulates would be contained and filtered. The ventilation system would include HEPA filters and a sand filter and would be designed to preclude the spread of airborne radioactive particulates or hazardous chemicals within the facility or to the environment.

PDCF would be designed to minimize waste generation and effluent discharges. Radioactive solid wastes would be packaged in accordance with the acceptance criteria of the receiving disposal facility and sent to E-Area for any needed additional packaging before onsite or offsite disposal. Mixed radioactive and hazardous wastes would be sent to appropriate offsite treatment, storage, or disposal

facilities (WSRC 2008). Solid nonhazardous wastes would be sent to the Three Rivers Regional Landfill at SRS. Higher-activity laboratory wastes from PDCF would be transferred to WSB to be treated and solidified, while lower-activity liquid radioactive wastes would be combined with other low-activity liquid streams and piped to the Effluent Treatment Project (ETP) for processing.

Small quantities of radioactive isotopes, including plutonium isotopes, americium-241, and tritium gas, may be emitted to the atmosphere. Condensate and blowdown discharge would be routed to the SRS Central Sanitary Wastewater Treatment Facility. No direct releases of process liquids to surface water are expected.

B.1.1.2 Mixed Oxide Fuel Fabrication Facility

Currently under construction in F-Area, MFFF will produce completed MOX fuel assemblies containing plutonium and uranium oxides for irradiation in domestic commercial nuclear power reactors. MFFF will operate in accordance with decisions made by DOE and announced in the January 11, 2000, Record of Decision (ROD) for the *Surplus Plutonium Disposition Environmental Impact Statement (SPD EIS)* (65 FR 1608) and the April 24, 2003, amended ROD (68 FR 20134), and pursuant to the license, when issued by the U.S. Nuclear Regulatory Commission (NRC), which is based on analysis in the *Environmental Impact Statement on the Construction and Operation of a Proposed Mixed Oxide Fuel Fabrication Facility at the Savannah River Site, South Carolina* (*MFFF EIS*) (NRC 2005). DOE made an interim action determination in April 2011 (SRS 2011) regarding modifications to MFFF to provide the capability to manufacture fuel for pressurized-water reactors (PWRs), boiling-water reactors (BWRs), and next-generation light-water reactors.

Since issuance of the *SPD EIS* (DOE 1999), enhancements to the design of MFFF have occurred because of: (1) improvements recognized as part of the detailed design process, (2) changes in the amount of MOX fuel to be fabricated, and (3) the decision to accept certain non-pit plutonium with higher levels of impurities or different impurities than originally planned (alternate feedstock). Equipment has been added to process this alternate feedstock to produce a form suitable for use as feed for MFFF (DOE 2003). In addition, if DOE's National Nuclear Security Administration (NNSA) makes the decision to install a plutonium oxidation capability in MFFF, additional furnace gloveboxes and a storage glovebox would be installed within MFFF.

MFFF is being built on an 87-acre (35-hectare) site at F-Area. After construction, MFFF will occupy about 17 acres (6.9 hectares), and encompass about 440,000 square feet (41,000 square meters) of floor space (DOE 2003). MFFF will receive plutonium oxide from the K-Area storage capability, PDC in K-Area (in the event PDC is constructed), the nearby PDCF (in the event PDCF is constructed), PF-4 at LANL, and/or H-Canyon/HB-Line (if this option is selected), and send certain liquid wastes (i.e., high-alpha, stripped uranium) to WSB for processing. In addition, if a plutonium oxidation capability is installed in MFFF, plutonium metal may be shipped from LANL to MFFF. Also, MFFF will receive depleted uranium dioxide from Richland, Washington. Existing SRS infrastructure, security, emergency services, waste management, and environmental monitoring will support the MOX fuel fabrication mission.

MFFF's design includes the MOX Fuel Fabrication Building and support structures, including the Secured and Receiving Warehouses, the Administration Building, and the Technical Support and Reagents Processing Buildings. All buildings, except for the Administration Building and the Receiving Warehouse, will be enclosed within a double-fenced perimeter intrusion, detection, assessment system. This protected area will encompass about 14 acres (5.7 hectares) (NRC 2005).

The MOX Fuel Fabrication Building is designed to meet structural and safety standards for storing and processing special nuclear material. The walls, floors, and building roof will be built of reinforced concrete. Areas that will contain plutonium are designed to survive natural phenomenon hazards, such as earthquakes, extreme winds, floods, and tornadoes, as well as potential accidents (DOE 1999). The MOX Fuel Fabrication Building will have three major functional areas. The MOX Processing Area includes the blending and milling, pelletizing, sintering, grinding, fuel rod fabrication, fuel bundle

assembly, laboratory, and storage areas. The Aqueous Polishing Area houses processes to remove impurities from plutonium oxide feedstock. The Shipping and Receiving Area contains equipment and facilities to handle materials entering and exiting the MOX Processing and Aqueous Polishing Areas (NRC 2005). The MFFF design includes a ventilation system to maintain lower pressure in rooms with higher levels of contamination. Operations having the potential to release contamination will be performed in sealed gloveboxes. Airborne emissions from MFFF will pass through two HEPA filters in series before discharge from a continuously monitored 120-foot (37-meter) stack.

If NNSA makes the decision to use MFFF to convert plutonium metal to plutonium oxide for use in the MFFF, the MOX Fuel Fabrication Building would be modified with the installation of metal oxidation furnaces and associated gloveboxes. These modifications would not change the planned footprint of the building (SRNS 2012). No new structures would need to be constructed. Existing rooms would need only minor modification for the installation of oxidation equipment.[3]

The Secured Warehouse will receive and store most of the materials, supplies, and equipment needed for facility operations, while the Receiving Warehouse will receive and store materials not requiring special handling in the Secured Warehouse. The Technical Support Building will provide services such as health physics, electronics and mechanical maintenance, personnel locker rooms, and first aid. The Reagents Processing Building will contain chemical storage areas, partitioned to prevent inadvertent chemical interactions and equipped with spill containment systems and drip pads, and facilities for preparation of chemical solutions used mainly in the aqueous polishing process. Chemicals will be transferred to the Aqueous Polishing Area of the MOX Fuel Fabrication Building via piping within a below-grade concrete trench between the two buildings (NRC 2005).

Mixed Oxide Fuel Fabrication Process

Figure B–6 illustrates the MOX fuel fabrication process, which consists of two steps: feed material processing and fuel fabrication. The scope of subsequent processing operations for each batch of feed would depend on its isotopic, chemical, and impurity content. Most feed materials would begin with the aqueous polishing process to remove impurities, such as gallium, americium, aluminum, and fluorides. This process would include: (1) dissolution of plutonium oxide in nitric acid using a silver nitrate catalyst; (2) removal of impurities using a solvent extraction process; and (3) conversion of plutonium from a nitrate solution to an oxide powder using an oxalate precipitation, filtration, and drying process. A stripping step would separate and remove uranium from the plutonium solution, resulting in a stripped uranium waste stream that would be collected and ultimately sent to WSB. Calciner offgas (nitrogen oxide) would be routed through a treatment unit and HEPA filters before being discharged through an exhaust stack. Filtered oxalic mother liquors (i.e., oxalic acid remaining after reacting with oxidized plutonium to precipitate plutonium oxalate) would be concentrated, treated, and recycled. The plutonium oxide would be evaluated to ensure that it meets fabrication specifications and transferred, as needed, to the MOX fuel fabrication process (NRC 2005).

Since issuance of the *SPD EIS* in 1999, equipment has been added to the MFFF design to process some of the impure non-pit plutonium originally destined for immobilization and referred to as "alternate feedstock." Equipment has been added to crush, mill, and decrease the particle size; homogenize the alternate feedstock; characterize and determine impurity content; and remove additional impurities. As needed, chlorides would be removed as chlorine gas, which would be converted in a scrubber to a solution that would be disposed of after solidification as low-level radioactive waste (LLW). After this initial processing, the alternate feedstock would be sent to the plutonium polishing unit to be processed in the same manner as other plutonium oxide feed, and transferred as needed for MOX fuel fabrication (DOE 2003).

[3] *Installation of the oxidation furnaces could be performed during MFFF construction or operation.*

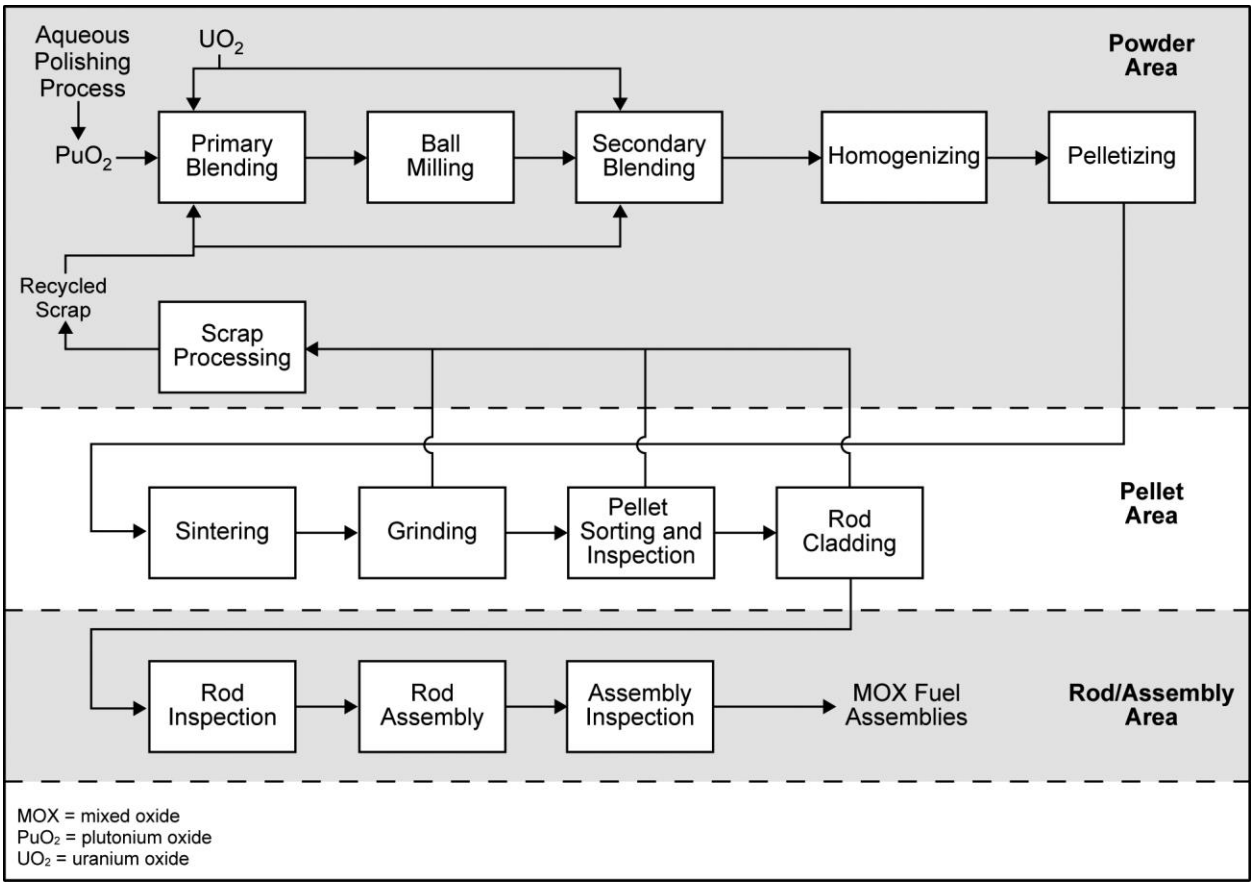


Figure B–6 Mixed Oxide Fuel Fabrication Process

Figure B–7 illustrates the plutonium oxidation process that would take place if NNSA decides to add this capability to MFFF. Metal feed from PF-4 at LANL would be stored in the K-Area Complex before being transported to MFFF for conversion into plutonium oxide. The plutonium oxide powder would be sent to the aqueous polishing process and transferred as needed for MOX fuel fabrication.

MOX fuel fabrication begins with blending and milling plutonium oxide powder to ensure consistency in isotopic concentration. Then, depleted uranium oxide and plutonium oxide powders are blended and milled to ensure uniform distribution of plutonium oxide in the MOX fuel, and to adjust the particle size of the MOX powder. The MOX powder is pressed into pellets, sintered (i.e., baked at high temperature), and ground to proper dimensions. Materials and pellets would be inspected at each stage, and rejected materials would be recycled through the process. Most operations would be performed within sealed gloveboxes with inert atmospheres. Sintering furnaces would be sealed, and offgases would be filtered and monitored before release to the atmosphere (DOE 1999).

Finished pellets would be loaded into empty fuel rods at the fuel rod fabrication area, sealed, inspected, decontaminated, and bundled into fuel assemblies (**Figure B–8**). Fuel assemblies could be prepared for PWRs, BWRs, or next-generation light-water reactors. Fuel assemblies could consist entirely of MOX fuel rods or a mixture of MOX and low-enriched uranium (LEU) fuel rods. For the latter design, LEU rods would be fabricated at a commercial facility and brought to MFFF for assembly with MOX fuel rods. Rejected fuel assemblies would be disassembled and the materials recycled. Completed fuel assemblies would be stored pending shipment to existing domestic commercial nuclear power reactors using NNSA's Secure Transportation Asset (DOE 1999).

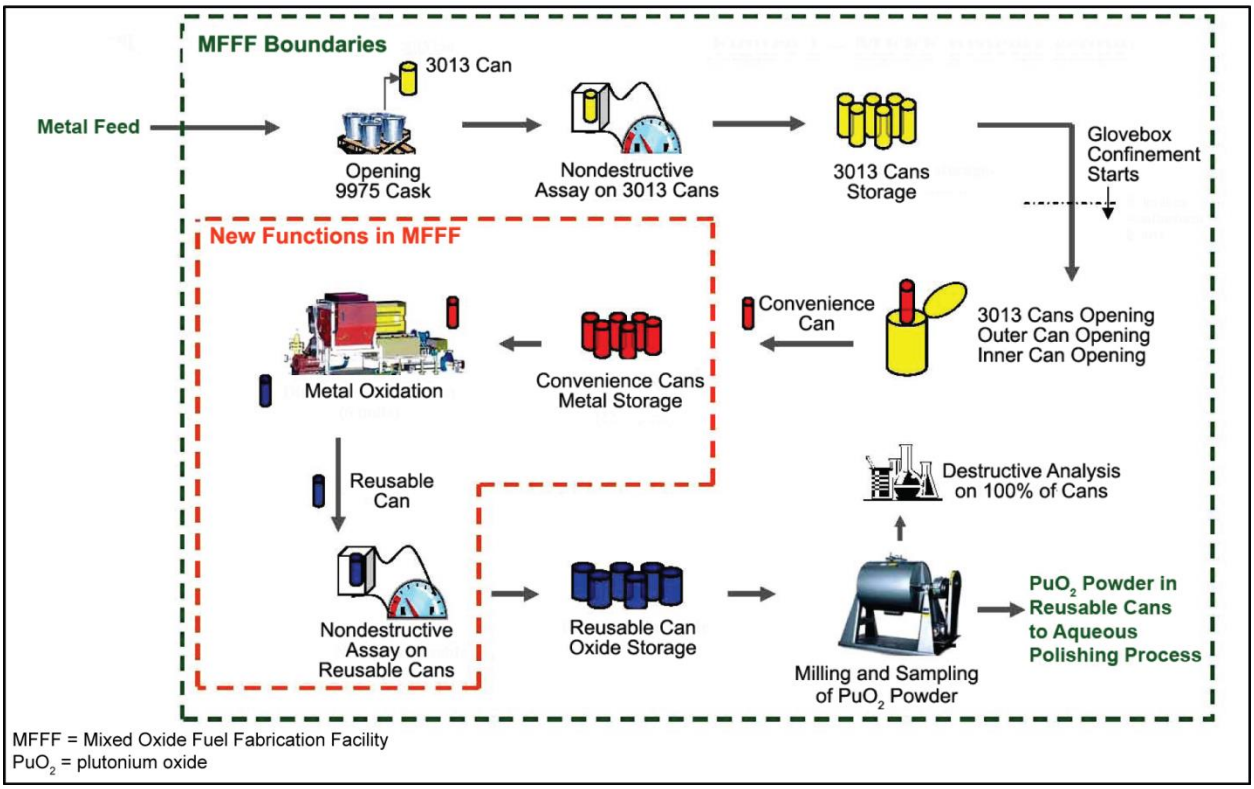


Figure B–7 Metal Oxidation Process

A liquid americium waste stream generated by the aqueous polishing process would be combined with an excess acid stream from the nitric acid recovery process and an alkaline wash stream into a high-alpha activity process stream to be piped to WSB, where it would be treated and solidified for potential disposal at WIPP as CH-TRU waste. Stripped uranium from the aqueous polishing process would be diluted with depleted uranyl nitrate hexahydrate and transferred to WSB for further treatment. An LLW stream would be piped to the onsite ETP for further treatment and disposal (NRC 2005).

Solid wastes from MFFF are expected to include glovebox gloves, equipment, tools, wipes, and glovebox and HEPA filters. These materials would be transferred to a waste packaging glovebox to remove residual plutonium. The plutonium would be recycled and the waste materials packaged, assayed, and disposed of as CH-TRU waste or LLW, as appropriate (DOE 1999). CH-TRU waste would be transferred to E-Area for staging and subsequent shipment to WIPP for disposal. LLW would be disposed of at onsite or offsite DOE or commercial disposal facilities.

B.1.1.3 Waste Solidification Building

WSB is under construction on a 15-acre (6.1-hectare) site at F-Area next to the proposed PDCF site to process two liquid waste streams from MFFF and one from PDCF operations at F-Area or PDC operations at K-Area, assuming either of these latter two facilities is constructed.[4] A stand-alone WSB was not evaluated in the *SPD EIS*, but was evaluated by NRC in the *MFFF EIS* (NRC 2005), and by DOE in the *Storage and Disposition of Weapons-Usable Fissile Materials Final Programmatic Environmental Impact Statement (Storage and Disposition PEIS)* (DOE 1996) and in a supplement analysis to the *SPD EIS* (DOE 2008b).

[4] *WSB was originally proposed to treat five MFFF and PDCF waste streams, but an evaluation of options to use existing SRS waste management facilities showed that treating minimally contaminated wastewater from MFFF and PDCF at ETP rather than at WSB would be optimal (Cantey 2008).*

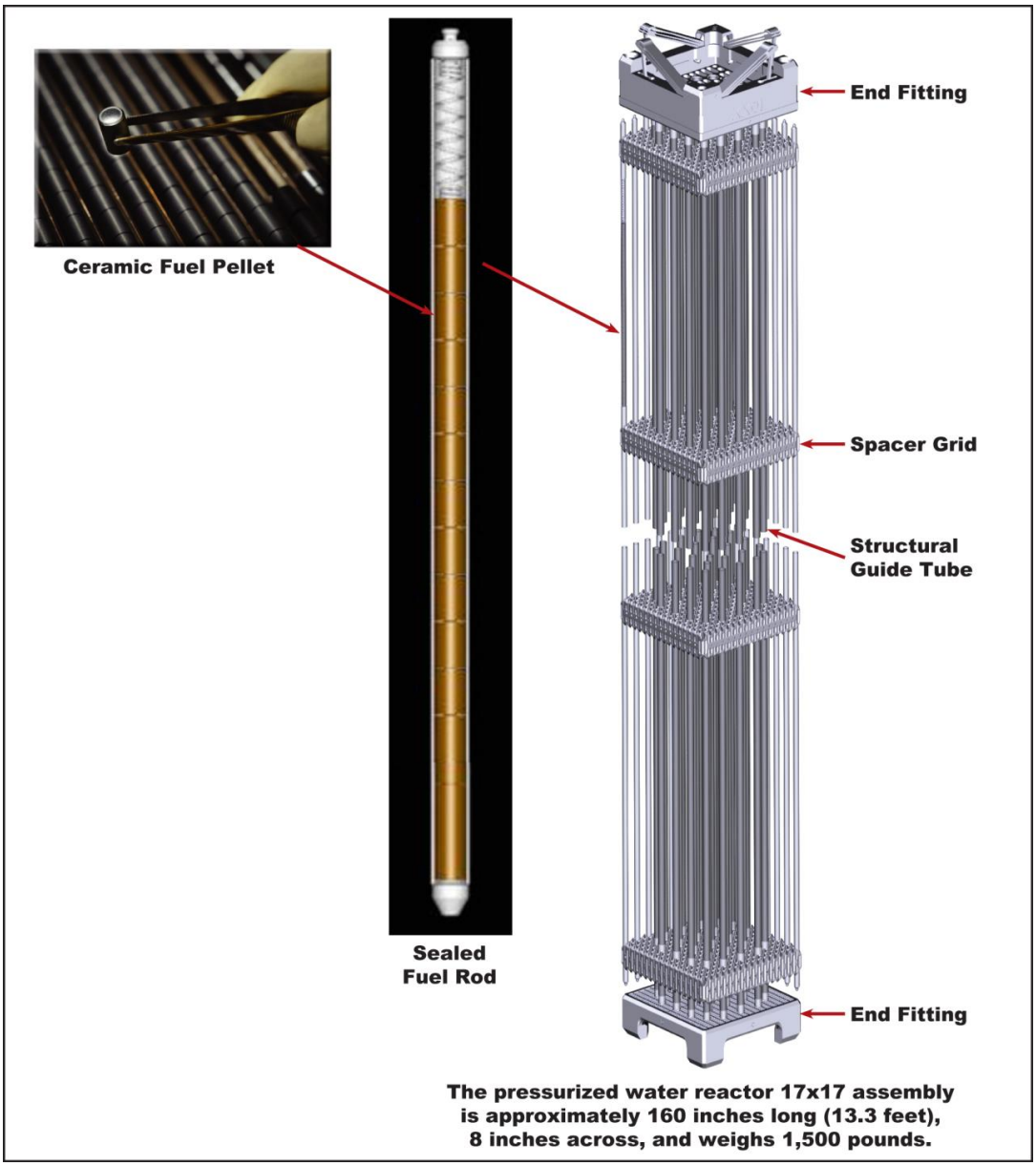


Figure B–8 Typical Reactor Fuel Assembly

WSB will occupy about 9 acres (3.6 hectares). The WSB design includes a Process Building; a covered staging area for interim storage of waste containers; an exhaust stack; and additional support facilities, including office trailers, a truck unloading area, a caustic and acid tank area, and a diesel generator. The Process Building will be a two-story reinforced-concrete structure, with a first level covering about 33,000 square feet (3,100 square meters) and a total floorspace of about 38,000 square feet (3,500 square meters). The Process Building will be located at grade and contain waste concentration and cementation equipment for processing low-activity and high-activity liquid waste, an analytical laboratory, control room, and some plant services. Liquid wastes will be solidified directly in drums inside dedicated enclosures. Secondary containment features, such as dikes, tanks, sumps, and jackets with associated leak detection or monitoring equipment, will be provided for areas with the potential for spills. Non-shielded areas will be dedicated to cold chemical feeds, steam generation, administration, electrical feeds, diesel electrical generation, the exhaust stack, floor drain collection, and drum receipt and storage (DOE 2008b).

WSB will receive two waste streams transferred from MFFF through underground, double-walled stainless steel lines: a high-activity (high-alpha) waste stream and a low-activity (stripped uranium) waste stream. WSB may also receive a low-activity laboratory waste stream either transferred through underground, double-walled stainless steel lines from PDCF or shipped in trucks from PDC. Waste streams will be stored at WSB in tanks pending subsequent treatment, including neutralization, volume reduction by evaporation, and cementation. Condensed overheads from the evaporators will be either transferred through a lift station and piping to ETP if the overheads meet the waste acceptance criteria for that facility or routed back through WSB processes for further treatment prior to discharge through a permitted outfall (DOE 2008b).

Waste acceptance criteria are being developed for incoming liquid waste, including strict requirements on contaminants of concern, to ensure that these contaminants would not pose a hazard to WSB workers or necessitate additional treatment processes to meet waste acceptance criteria of subsequent treatment or disposal facilities. Liquid waste streams will be processed in WSB into solid LLW and CH-TRU waste forms acceptable for disposal. Solid TRU wastes will be shipped to WIPP. Solid LLW will be sent to onsite disposal facilities such as the E-Area facilities, or to offsite Federal or commercial disposal facilities. Any mixed low-level radioactive waste (MLLW) will be disposed of at offsite facilities. Sanitary wastewater from WSB will be transferred to the SRS Central Sanitary Waste Water Treatment System (DOE 2008b).

Major pieces of process equipment include tanks, pipes, evaporators, cementation equipment, agitators, and pumps. The WSB design includes a ventilation system to maintain lower pressure in rooms that have the potential for higher levels of contamination. Air exhausted from different process areas, gloveboxes, and certain process vessels would be routed through HEPA filters before being discharged from the WSB stack. The 50-foot- (15-meter-) high stack would have an internal diameter of about 5 feet (1.5 meters) and carry an exhaust flow of about 60,000 cubic feet (1,700 cubic meters) per minute. WSB is designed to provide radiation shielding for workers and confinement of airborne contamination, in accordance with appropriate natural phenomenon and other hazard criteria (e.g., high-activity process piping and vessels would be isolated by automatic values should a seismic event be detected). The process facility includes fire detection and alarm systems, as well as an automatic fire suppression system. A standby diesel generator provides backup power, if needed (DOE 2008b).

Minor design changes to WSB would be needed if DOE decides, following completion of this *SPD Supplemental EIS*, to proceed with construction of PDC at K-Area. Rather than constructing a pipeline to carry laboratory waste from PDCF, DOE would construct and operate the capability needed at WSB to receive and store liquid waste delivered in trucks from PDC operations.

B.1.1.4 F/H-Laboratory

The F/H-Laboratory at SRS is a large complex designed to accommodate a variety of missions. The facility was designed to be flexible and adaptable to changing needs and missions, and would provide an analytical support capability for new facilities, such as PDC if it is constructed, as well as continue to provide analytical support services for currently operating SRS facilities, such as H-Canyon/HB-Line. Minor modifications may be needed at F/H-Laboratory if PDC is constructed and operated or if H-Canyon/HB-Line is used to support conversion of pit plutonium to plutonium oxide. Samples analyzed at the F/H-Laboratory in support of plutonium management activities would account for only a small fraction of the overall activities performed there (SRNL 2013; SRNS 2012).

B.1.2 K-Area Complex

K-Reactor was constructed in the 1950s in K-Area to produce tritium and plutonium. K-Reactor was initially shut down in 1988 and then underwent seismic and structural upgrades for its restart in 1991. K-Reactor was operated for the last time in 1992, placed in a cold-standby condition in 1993, shut down in 1996, and subsequently deactivated. Nuclear fuel and equipment needed for reactor operation were removed, as were irradiated materials stored in the Disassembly Basin (deinventoried in 2002). The building was later modified for nuclear material storage (DNFSB 2003).

Structures and security at the K-Area Complex have been upgraded to house plutonium storage and surveillance capabilities, including K-Area storage and KIS. The physical security protection strategy for the K-Area Complex is based on a graded and layered approach supported by a guard force trained to detect, deter, and neutralize adversary activities. Facilities are protected by staffed and automated access control systems, barriers, surveillance systems, and intrusion detection systems (DOE 2007b).

B.1.2.1 Immobilization Capability

The immobilization capability proposed under the Immobilization to DWPF Alternative would convert surplus plutonium to an oxide form, as needed, and then immobilize the plutonium oxide within a glass matrix. The immobilized plutonium would be sealed in cans, loaded into magazines, placed inside DWPF canisters (**Figure B–9**), and transferred to DWPF to be filled with vitrified HLW. The filled canisters would be sealed and transferred to S-Area at SRS for storage pending final disposition.

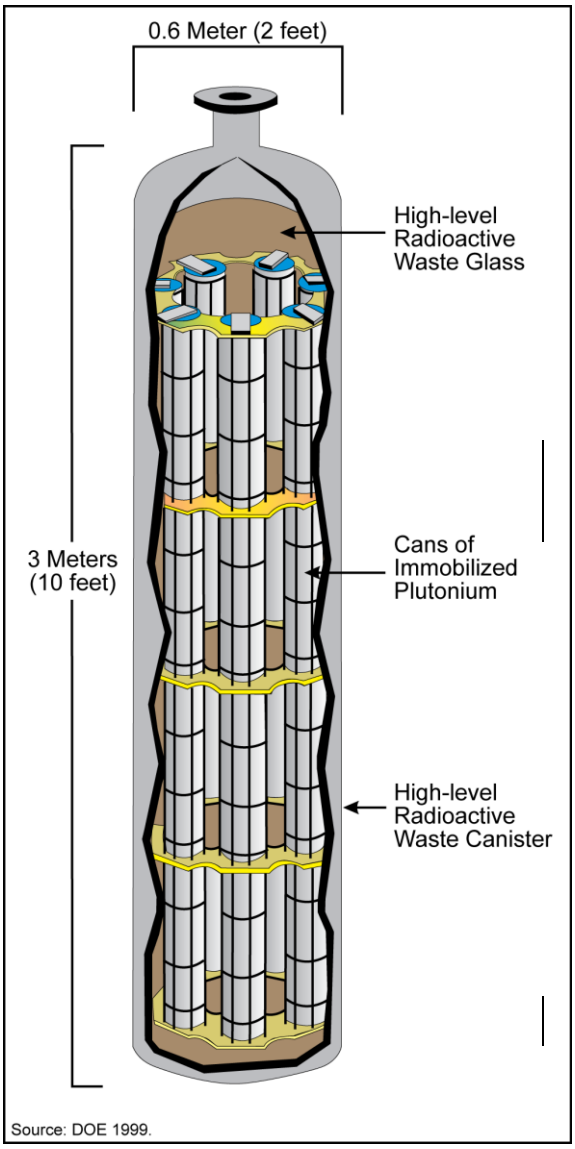


Figure B–9 Cutaway of Can-in-Canister

Immobilization Capability Construction

An immobilization capability would be constructed in K-Area. Existing equipment and piping currently installed in several areas at K-Area would be removed to accommodate the new facility, decontaminated as necessary, and properly recycled or disposed of. As needed to minimize the potential for airborne emissions, work would be performed within a temporary enclosure, with exhaust routed to the reactor building ventilation system and main stack discharge. In addition, the Cooling Water Reservoir would be drained and the remaining sludge removed and disposed of, and the Cooling Water Pumphouse would be removed. Solid radioactive wastes are expected to include LLW and MLLW. Some hazardous, polychlorinated biphenyl (PCB), and asbestos wastes may be generated, as well as some radioactive and nonradioactive liquid wastes (SRS 2006; WSRC 2008).

Support operations would be housed at K-Area in existing adjacent buildings or in new construction. Approximately 2 acres (0.8 hectares) of land in previously disturbed portions of K-Area would be disturbed during construction.

Plutonium conversion and immobilization operations would be carried out in a series of gloveboxes; confinement barriers would separate the immobilization capability into zones to control the spread of possible airborne contamination. As needed, operations within gloveboxes would be conducted in inert atmospheres. The exhaust from gloveboxes would be passed through HEPA filters and a sand filter before discharge to the stack. A fire protection system with automatic fire detection and suppression capability would be included in gloveboxes (except for gloveboxes with inert atmospheres). General area coverage would be provided by an automatic fire detection and sprinkler system, with the locations and depths of possible standing water controlled to ensure criticality safety. Fire-rated walls would be constructed to ensure personnel safety. An HVAC system would be installed, as would compressed gas systems providing dry, breathing, and instrument air; and helium, argon, and other gases. Public address and telecommunications systems and health and

safety monitoring systems, such as nuclear incident and continuous air monitors, would be installed. An uninterruptible power supply and standby generators would provide backup power to ensure that critical systems would remain operational during any power interruptions. New domestic, process, cooling water, and sanitary sewer lines would be installed and supported by existing infrastructure at K-Area (DOE 1999; SRS 2007b, 2007c, 2007k, 2007l, 2007m, 2007n, 2007o; WSRC 2008).

Site work would include investigation of site conditions; temporary and permanent erosion and sedimentation controls; site preparation, excavation, and backfill; installation of access walkways, driveways, and parking areas; installation of utilities (i.e., process water, domestic water, sanitary sewer, electrical); and final grading and provision of stormwater drainage and ground cover. Some existing utility lines would require removal or relocation (SRS 2007j).

Immobilization Capability Operations

Figure B–10 shows a flow diagram of the glass can-in-canister immobilization capability. As indicated in the figure, immobilization activities would occur at both the K-Area immobilization capability and DWPF. The immobilization capability would generate about 82 can-in-canisters per year, with each canister assumed to contain about 16 kilograms (35 pounds) of immobilized plutonium in 28 cans. This would result in an annual plutonium throughput of about 1.3 metric tons (1.4 tons).

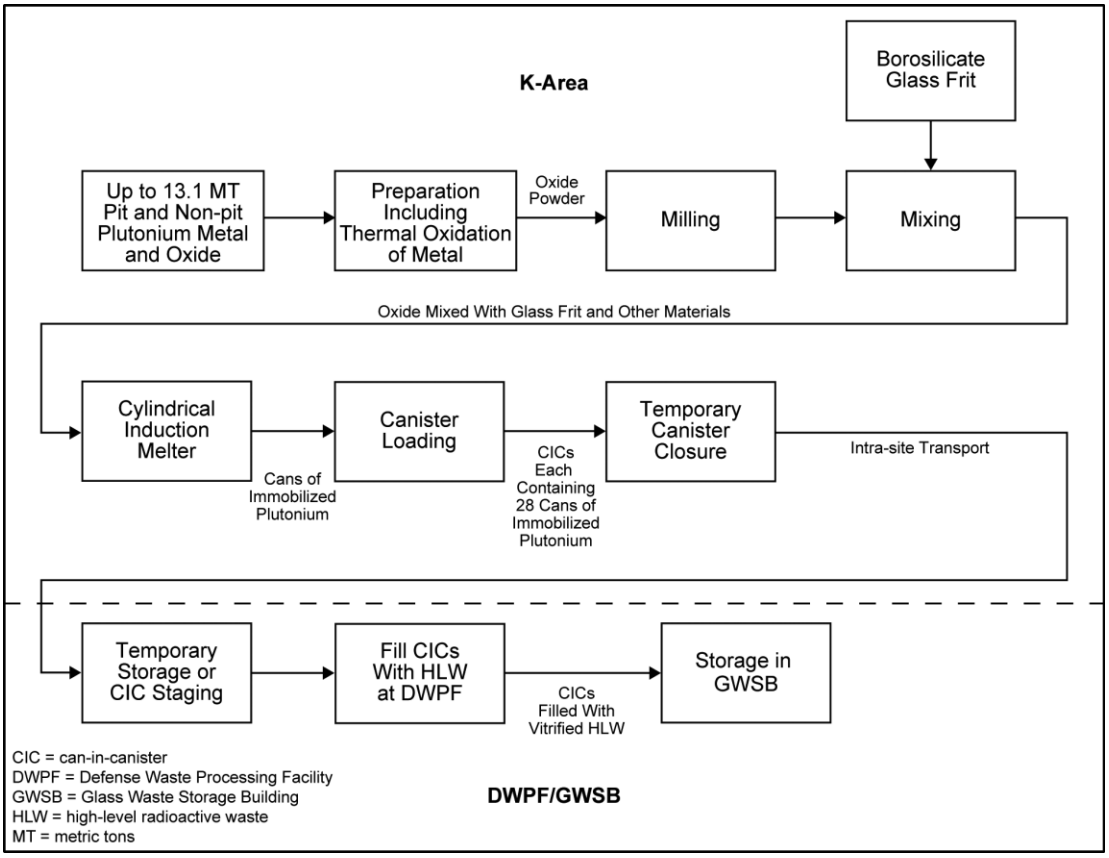


Figure B–10 Immobilization Capability

Non-pit plutonium would be brought to the immobilization capability from K-Area storage, while pit plutonium in oxide form would be brought to the immobilization capability from PDCF, H-Canyon/HB-Line, or LANL. Plutonium oxide would be removed from the Type B shipping packages and transferred to a glovebox for inspection. Clean oxides not requiring conversion would be stored pending immobilization. Metals and alloys would be converted to oxide in one of two metal oxidation furnaces housed within gloveboxes. The cladding from the Fast Flux Test Facility (FFTF) fuel would be removed and the fuel pellets sorted according to fissile material content. Pellets containing plutonium or

enriched uranium would be ground to an acceptable particle size for proper mixing with glass frit (small glass particles) (DOE 1999, 2007a; SRS 2007d, 2007h, 2007p).

Plutonium oxide feed would be prepared to produce individual batches with the desired composition, and then milled to reduce the size of the oxide powder to achieve faster and more-uniform distribution during the subsequent melting process. The milled oxide would be blended with borosilicate glass frit containing neutron absorbers (e.g., gadolinium, boron, hafnium). The mixture would be melted in a platinum/rhodium melter vessel and drained into stainless steel cans. The cans would be sealed, leak-tested, assayed, and transferred out of the immobilization system within bagless cans using a bagless transfer system.[5] The cans may be temporarily stored or placed directly into magazines that would be inserted through the throat of the DWPF HLW canister and locked into a framework inside the canister. A temporary closure plug would be installed in the opening in the top of the canister and, following leak testing, the canister would be loaded into a shielded transportation box for transport in a specialized vehicle, the Shielded Canister Transporter, to DWPF (DOE 1999, 2007a; SRS 2007a, 2007e, 2007f, 2007g). The loaded DWPF canisters could be temporarily stored at the GWSBs pending collection of a sufficient number for a campaign at DWPF.

Immobilization operations are expected to generate CH-TRU waste, LLW, MLLW, hazardous waste, and nonhazardous solid waste. Waste would be generated, staged, assayed, packaged, and temporarily stored in several rooms located throughout the facility. CH-TRU waste could include metal cladding from fuel elements, spent filters, contaminated beryllium pieces and cuttings, used containers and equipment, paper and cloth wipes, analytical and quality-control samples, and solidified inorganic solutions. CH-TRU waste would be treated, packaged, and certified as compliant with WIPP waste acceptance criteria before shipment. LLW would be disposed of in onsite or offsite disposal facilities, while MLLW and hazardous wastes would be sent off site for appropriate treatment before disposal in permitted offsite facilities. Solid nonhazardous wastes would be sent to the Three Rivers Regional Landfill at SRS. DOE does not expect that liquid LLW would be generated during normal operations (DOE 1999; SRS 2006).

Immobilization operations would result in airborne emissions of small quantities of nonradioactive pollutants, such as fluorides, hydrochloric acid, nickel and nickel oxides, beryllium and beryllium oxides, nitrogen oxides, volatile organic compounds, or particulate matter. Small quantities of uranium, plutonium, neptunium, and americium isotopes could also be released (WSRC 2008). The exceedingly small emissions from facility gloveboxes would pass through HEPA filters and a sand filter before being discharged from the stack (SRS 2007k).

B.1.2.2 Pit Disassembly and Conversion Project at K-Area

PDC may be constructed and operated in K-Area at SRS. Pits would be disassembled and pit plutonium would be processed into physical and chemical forms suitable for disposition by MOX fuel fabrication. Pit disassembly and conversion processes at PDC would be similar to those described for PDCF (Section B.1.1.1). The analysis for PDC in this *SPD Supplemental EIS* includes the impacts from possible operations where surplus plutonium would be prepared for MOX fuel fabrication at MFFF or prepared for potential disposal as CH-TRU waste at WIPP, using the same processes as those described for H-Canyon/HB-Line (Section B.1.3). Preparation of plutonium for potential WIPP disposal could also occur using the K-Area Interim Surveillance capability (see Section B.1.2.4).

Gloveboxes and other equipment required for safe pit disassembly and conversion would be installed within the K-Area Complex following removal of unneeded equipment, rerouting of piping, and any needed decontamination. Some support systems, such as a fanhouse, exhaust tunnel, stack, and diesel generator building, would be constructed within K-Area. Approximately 30 acres (12 hectares) of land would be disturbed. PDC operations would require the provision of additional support systems in the project area, including filtered ventilation systems independent of existing building ventilation. The

[5] *The bagless transfer system allows for contamination-free removal of the filled cans from the immobilization system without compromising the integrity of the glovebox.*

ventilation systems would be seismically qualified with emergency diesel generators and redundantly designed to maintain process areas at a negative air pressure relative to the atmosphere. Exhaust from the process gloveboxes would be routed through HEPA filtration and then through the main building exhaust system.

A storage capability for pit and non-pit plutonium may be provided at PDC, including container storage racks and drum storage. Oxidation, material stabilization, and packaging would include equipment such as a can puncture device, multi-can cutter, furnace, material weighing and transfer equipment, a bagless transfer system, and an outer can welder with leak detection capability.

The process for preparation of pit plutonium would be essentially the same as that described in Section B.1.1.1 for PDCF (see Figure B–5). The plutonium pits would be disassembled and the plutonium and other materials recovered, with the plutonium being converted to a plutonium oxide powder for subsequent disposition (e.g., fabrication into MOX fuel or blending and packaging for potential disposal as CH-TRU waste at WIPP). In addition, non-pit plutonium would be prepared for subsequent disposition using the same processes as those described for H-Canyon/HB-Line (Section B.1.3).

Pit plutonium would be processed at a design throughput of 3.5 metric tons (3.9 tons) of plutonium per year. The process would be designed to minimize waste generation and effluents. Construction activities may generate LLW and MLLW; TRU waste; hazardous and nonhazardous waste; and asbestos, PCB, and mixed PCB wastes. Radioactive wastes, asbestos, and PCB wastes would be generated during removal of old facilities and equipment and decontamination of building surfaces. LLW would be packaged in accordance with the acceptance criteria of the receiving disposal facility and sent to E-Area for any needed additional packaging before onsite or offsite disposal. Mixed radioactive and hazardous wastes would be sent to appropriate offsite treatment, storage, and disposal facilities (WSRC 2008). Some liquid waste may be sent to WSB for treatment. Toxic Substances Control Act (TSCA) and mixed TSCA wastes would be sent to offsite facilities for treatment and disposal. Solid nonhazardous wastes would be sent to the Three Rivers Regional Landfill at SRS.

PDC would provide for filtration and monitoring of the ventilation exhaust to minimize releases of radioactive isotopes to the atmosphere. Sanitary wastewater would be routed to the Central Sanitary Wastewater Treatment Facility at G-Area for processing before discharge from a permitted outfall. No direct releases of process liquids to surface water are expected (SRNS 2012).

B.1.2.3 K-Area Storage

The principal SRS facility for plutonium storage is located in the K-Area Complex.[6] The former reactor confinement area and adjacent areas were modified to form a large warehouse called the K-Area Material Storage Area (MSA). The K-Area MSA consists of two structurally independent buildings: the Process Building and the Stack Building. These buildings and adjacent buildings are separated by expansion joints that allow independent movement and would minimize the interaction of structures during a seismic event. Plutonium is stored in the K-Area MSA in DOE-STD-3013 or other approved containers nested within Type B transportation packages. This is a robust packaging configuration that serves as confinement against possible release of contamination during transportation and storage (DNFSB 2003; DOE 2002). The K-Area MSA is also used for receiving and storing plutonium in DOE-STD-3013 containers from offsite locations, including plutonium oxide produced at LANL to provide feed to MFFF.

B.1.2.4 K-Area Interim Surveillance

Operating since 2007, KIS provides the capability for destructive and nondestructive examination of stored plutonium materials. Nondestructive examination capabilities include weight verification, visual inspections, digital radiography, and gamma ray analysis, while destructive capabilities include can

[6] *In a September 11, 2007, amended ROD, DOE announced its decision to consolidate storage of surplus plutonium from several DOE sites at the K-Area MSA, then called the K-Area Material Storage facility, or KAMS (72 FR 51807).*

puncturing and can cutting for oxide sampling. Interim repackaging capabilities are available for safe storage of the material pending eventual disposition. Building modifications made to accommodate KIS included installation of a glovebox and associated equipment; upgrades of ventilation, filtration, and fire protection systems; and the addition of backup power capability (DOE 2005c).

KIS gloveboxes may also be used to prepare surplus plutonium for potential disposal as CH-TRU waste at WIPP. Plutonium would be prepared for potential WIPP disposal as CH-TRU waste using the same processes as those described for H-Canyon/HB-Line (Section B.1.3). Minor modifications to the K-Area Complex may be needed to provide this capability.

B.1.2.5 K-Area Pit Disassembly Glovebox

If DOE/NNSA decides to use H-Canyon/HB-Line for processing pit plutonium, the existing KIS glovebox, or a similar existing or new glovebox, would be modified or installed within the K-Area Complex to be used for pit disassembly. Equipment for opening pits and size-reducing pit materials would be installed in the glovebox. A nuclear incident monitoring system and control access system upgrades would be installed in the facility (SRNL 2013). After disassembly, pit components would be size-reduced, packaged into dissolvable containers, and shipped to H-Area (see **Figure B–11**).

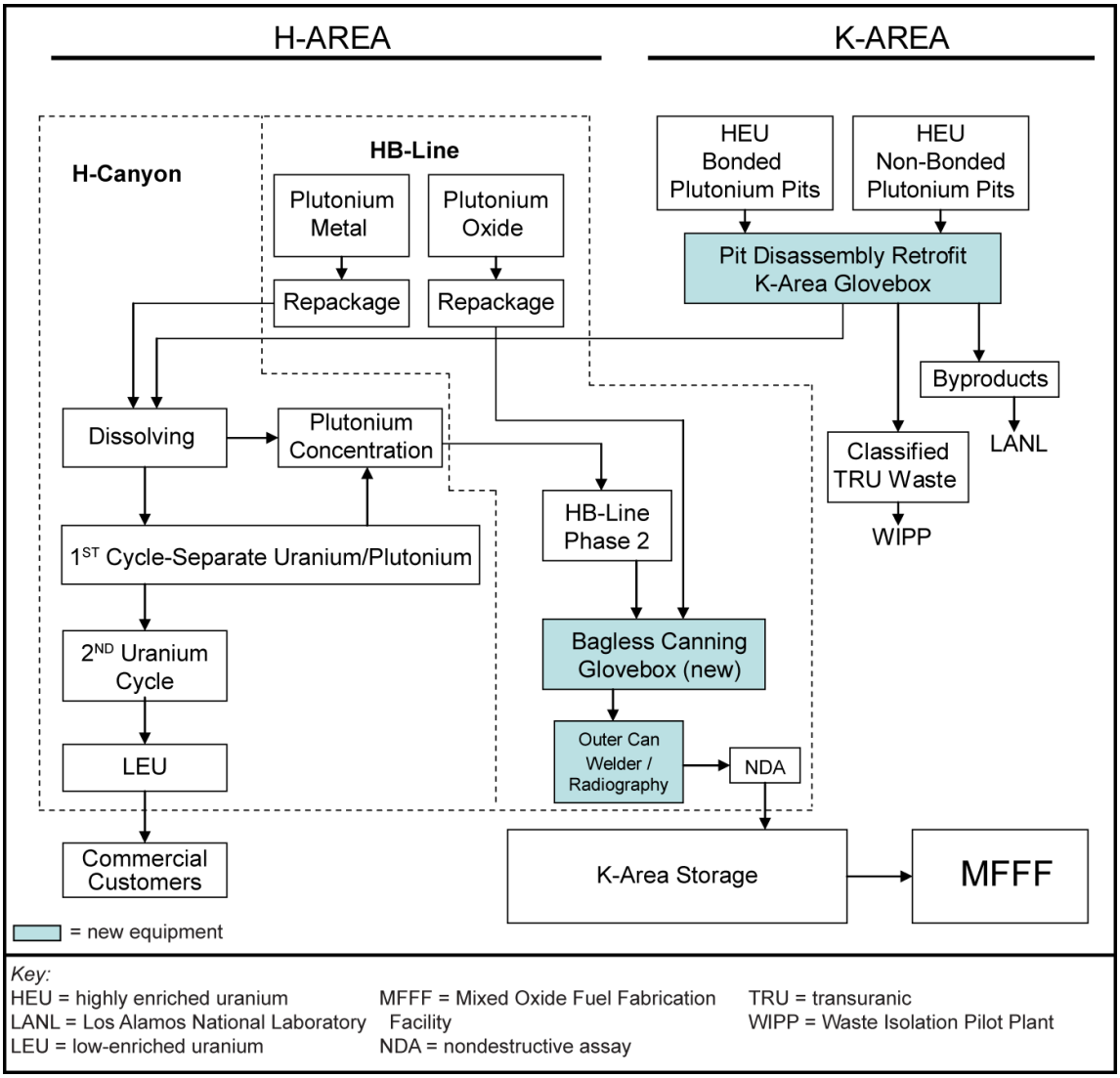


Figure B–11 H-Canyon/HB-Line Plutonium Processing for Mixed Oxide Fuel

B.1.3 H-Area Facilities – H-Canyon/HB-Line

H-Area is the location of H-Canyon/HB-Line, which is being evaluated in this *SPD Supplemental EIS* for processing pit and non-pit plutonium for disposition. H-Canyon was built in the 1950s and has been operating since 1955, using a solvent extraction process for recovery of uranium from used nuclear fuel (also known as spent nuclear fuel) primarily from SRS nuclear reactors, although several modifications were made to recover other strategic materials. HB-Line, located on top of H-Canyon, was built in the early 1980s to support production of plutonium-238 for deep space missions and to recover legacy materials stored at H-Canyon. In 1992, DOE decided to phase out chemical processing for defense purposes at H-Canyon/HB-Line, and the H-Canyon/HB-Line mission transitioned to stabilization of nuclear materials, including nuclear reactor fuels, plutonium-238 and neptunium-237, and plutonium-239 solutions (WSRC 2007b).

H-Canyon is a large, reinforced-concrete structure named for the two parallel processing areas (i.e., canyons) in the structure that house the series of tanks, process vessels, and other equipment used in the chemical separations process. The canyons are 560 feet (170 meters) long, an average of 20 feet (6.1 meters) wide, and 66 feet (20 meters) high. Processing operations involving high radiation levels occur in the hot canyon, and processing operations involving lower radiation levels occur in the warm canyon. A center section between the canyons houses offices, a control room, and support equipment (e.g., HVAC equipment). H-Canyon/HB-Line operations use steam to heat process vessels in H-Canyon and to transfer solutions through process cycles, electricity for powering lights and equipment and heating HB-Line dissolvers and process vessels, compressed air to provide pressure for process monitoring systems and to power some control systems, and process water for process cooling and other purposes (DOE 1995b). These operations are supported by several additional H-Area facilities, including a building for receipt, storage, and distribution of bulk chemicals; acid recovery; water and solvent handling; and liquid evaporation.

Material processed in H-Canyon is dissolved in nitric acid before entering the solvent extraction process. Process preparation includes removal of solid impurities and chemical adjustment. The first cycle of the solvent extraction process separates the solution into a product stream and a raffinate stream. The product stream from the first cycle is sent to subsequent solvent extraction cycles for further purification. A solvent recovery operation washes the solvent to remove impurities, which are treated as a low-activity waste stream, and to recover and recycle the solvent. Liquids from these processes are reduced in volume and eventually neutralized for rejection as waste to the H-Area liquid radioactive waste tanks.

Separate ventilation systems serve areas in H-Canyon/HB-Line that contain radioactive processing equipment. These systems maintain the air pressure at levels below the pressure of the outside air or areas occupied by workers so that air always flows into the process areas. Air from the process areas is treated and filtered before being released to the atmosphere through a 200-foot- (61-meter-) tall stack (DOE 1995b). Offgases from the H-Canyon dissolvers are passed through condensers and a silver nitrate reactor to remove iodine before further filtration by fiberglass filters and discharge through the stack. Emissions from other H-Canyon areas may be passed through HEPA or fiberglass filters before discharge to the sand filters and stack, while air from liquid process areas in the Support Building is sent to the sand filter and discharged from the stack. The original sand filters for H-Canyon are 100-foot- (30-meter-) long by 240-foot- (73-meter-) wide by 25-foot- (7.6-meter-) deep concrete structures with 8-foot- (2.4-meter-) deep beds made of coarse stone and succeeding layers of increasingly finer gravel and sand. Newer sand filters constructed in 1976 operate in parallel with the original filters and are similarly constructed, but have design enhancements (ERDA 1977).

The separations process generates high-activity (high-alpha) aqueous acid waste streams containing most of the radioactive decay products and chemical salts used in processing, plus several low-activity aqueous waste streams. These waste streams are sent to evaporators to reduce their volumes. The feed to the evaporators in the hot canyon originates from the primary separation process. The evaporator overheads, containing most of the water and acid and very little of the radioactive decay products and chemicals, are transferred to tanks for acid recovery and recycling. The fission products and chemicals in the evaporator

concentrate are neutralized and sent to the H-Area liquid radioactive waste tanks for storage pending vitrification in DWPF (DOE 1995b).

Solid LLW and CH-TRU waste streams generated from H-Canyon/HB-Line operations are treated and packaged for disposal. LLW may be shipped to onsite or offsite disposal facilities; CH-TRU waste is disposed of at WIPP.

There are two primary pathways for liquid effluents (DOE 1995a). In the first pathway, condensates from evaporators containing low levels of radionuclides flow to ETP for further treatment, if necessary, before discharge through a permitted outfall. In the second pathway, canyon cooling water passes through coils inside the vessels, flows back out of the canyon, and is cooled and recirculated or released to a permitted outfall. If radioactivity is detected in this cooling water, it is diverted to retention basins, then treated/cleaned by ETP prior to release through a permitted outfall.

For processing pit plutonium (Figure B–11), dissolvable cans containing plutonium metal would be received at H-Canyon from HB-Line or the K-Area Complex and discharged into a canyon dissolver. The dissolved solutions would be transferred to the separations process, during which any uranium present in the material would be recovered or discarded to the high-level waste system. Dissolved plutonium solution would be converted to plutonium oxide in HB-Line, packaged, and sent to the K-Area Complex for storage until processing for disposition by immobilization or through MFFF.

H-Canyon/HB-Line is being considered for processing surplus non-pit plutonium into plutonium oxide for MOX fuel fabrication at MFFF. Plutonium processing in H-Canyon/HB-Line would start with dissolution of the majority of the material that is in oxide form in HB-Line, and dissolution of most of the metals in H-Canyon. If required, treatment at H-Canyon/HB-Line using vacuum salt distillation and sodium peroxide fusion would separate plutonium from chloride and fluoride salts. The dissolved solutions would then be transferred to the separations process, during which any uranium present in the material would be recovered or discarded to the high-level waste system. Plutonium would be converted to plutonium oxide at HB-Line, packaged, and sent to the K-Area Complex for storage until processing for disposition at MFFF.

H-Canyon/HB-Line is also being considered for disposition of non-pit plutonium via dissolution followed by transfer to DWPF for vitrification with HLW. Dissolution of plutonium oxide at H-Canyon/HB-Line may include treatment using vacuum salt distillation and sodium peroxide fusion. The plutonium solutions would be transferred primarily to the DWPF sludge feed tank in the liquid radioactive waste tank farm pending vitrification at DWPF. Administrative and engineered controls defined in the safety basis documentation and Technical Safety Requirements for H-Canyon/HB-Line would ensure subcritical nuclear conditions during all processing operations.

H-Canyon/HB-Line could also be used to prepare surplus plutonium for potential disposal at WIPP. **Figure B–12** illustrates the process that would be used for non-pit plutonium. Transportation packages (e.g., 9975 packages) containing DOE-STD-3013 containers would be transferred from K-Area storage to HB-Line, where the containers would be cut open in an existing glovebox. Metals would be converted to an oxide using an existing or new furnace. Oxide would be repackaged into suitable containers, mixed/blended with inert material as part of termination of safeguards requirements, and loaded into pipe overpack containers (POCs) or criticality control overpacks (CCOs), where CCOs may contain more nuclear material than POCs.[7] The inert material would be added to reduce the plutonium content to less than 10 percent by weight and inhibit plutonium material recovery and could include dry mixtures of commercially available materials. Loaded POCs or CCOs would then be transferred to E-Area, where WIPP characterization activities would be performed. These characterization activities include

[7] *POCs are limited to 200 fissile gram equivalents (FGEs) per container, while CCOs are limited to 380 FGEs per container. Because of material characterization uncertainties, it is expected that less material would be shipped per POC or CCO than authorized. For purposes of analyses in this* SPD Supplemental EIS, *it was assumed each POC would contain 150 FGEs and each CCO would contain 350 FGEs.*

nondestructive assay and digital radiography for each POC or CCO to be shipped to WIPP. Once POCs or CCOs have successfully passed the characterization process and meet WIPP waste acceptance criteria they would be shipped to WIPP in Transuranic Package Transporter Model 2 (TRUPACT-II) transportation packages.

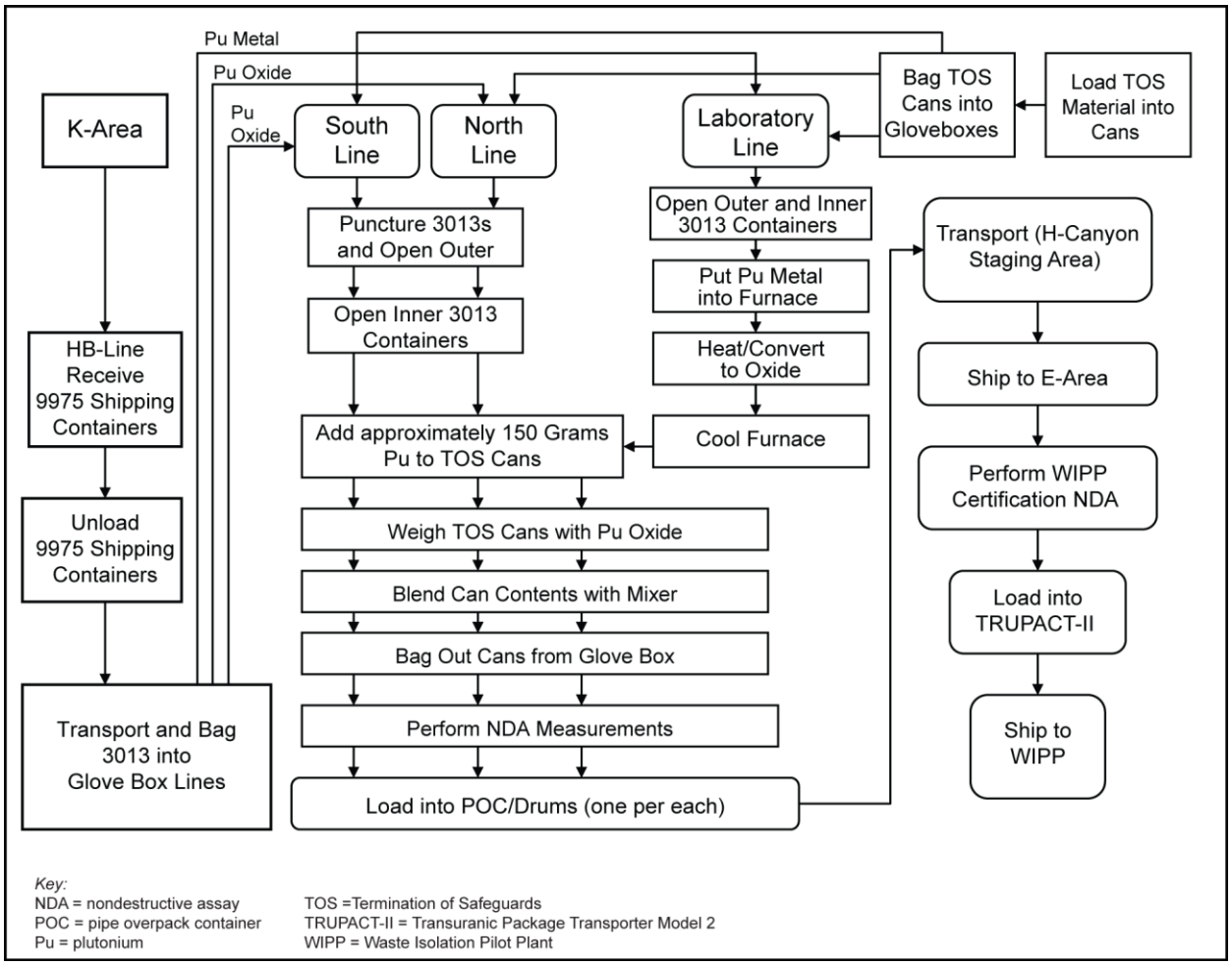


Figure B–12 HB-Line Repackaging of Non-Pit Plutonium for Waste Isolation Pilot Plant Disposal

The process for pit plutonium would be similar to that shown in Figure B–12 for non-pit plutonium except that the pit plutonium would be transferred as an oxide, rather than a potential mixture of metal and oxide, to HB-Line for preparation for WIPP disposal in POCs or CCOs.

If unirradiated FFTF fuel cannot be disposed of by direct disposal to WIPP, the unirradiated FFTF fuel would be disassembled and could be prepared for disposal through H-Canyon/HB-Line and vitrification at DWPF or disposal at WIPP. Disposition of unirradiated FFTF materials through H-Canyon/HB-Line to DWPF would require disassembly of the fuel pins and repackaging into carbon steel containers suitable for dissolution in H-Canyon. The WIPP Disposal Option would require installation of an additional glovebox or laboratory-type hood to remove the fuel pellets from the fuel pins and load them into suitable transfer containers. Gloveboxes in HB-Line could be used to house operations to crush the pellets into a powder, load the powder into suitable cans, mix/blend with inert material, assay, package the loaded cans into POCs or CCOs, and transfer to E-Area before shipment to WIPP.

Minor upgrades are being considered that would enhance processing of surplus pit and non-pit plutonium in H-Canyon/HB-Line. These upgrades may include changeout or reconfiguration of some existing tanks and/or piping in H-Canyon plus an additional glovebox and some additional equipment in HB-Line.[8] For purposes of analysis in this *SPD Supplemental EIS*, it was assumed that H-Canyon/HB-Line would operate through 2021 to support the MOX Fuel Alternative, through 2026 to support the H-Canyon/HB-Line to DWPF Alternative or to convert pit plutonium to an oxide for MOX fuel fabrication, or through approximately 2037 to prepare 13.1 metric tons (14.4 tons) of surplus plutonium for potential WIPP disposal.

B.1.4 S-Area Facilities

B.1.4.1 Defense Waste Processing Facility

DWPF was built in S-Area to vitrify several million gallons of liquid HLW stored in large underground tanks. Canister filling, the final process step of both the proposed immobilization and H-Canyon/HB-Line dissolution processes, would occur at DWPF. The DWPF complex consists of the Vitrification Facility and support structures, including GWSBs.

Liquid wastes from the SRS separations facilities are stored in tank farms where the liquids are processed to reduce the volume of the waste and separate it into sludge and salt components. These processing steps generate a low-activity liquid waste stream that is treated at ETP before being discharged to the environment through a permitted outfall. Before vitrification in DWPF, sludge and salt components go through separate pretreatment steps that, in the case of salt waste, produce a high-activity (high-alpha) stream that is vitrified at DWPF, and a low-activity stream that is disposed of in the Saltstone Facility adjacent to DWPF. Within the Vitrification Facility, sludge from the Extended Sludge Washing Facility is treated with nitric acid, and any mercury in the sludge is recovered (WSRC 2008). The sludge is mixed with borosilicate glass frit and used as feed for the melter, where the mixture is heated to form molten glass. Canisters of vitrified waste from DWPF are transferred to GWSBs.

Until recently, the HLW vitrified in DWPF consisted of sludge waste pretreated in the Extended Waste Processing Facility. The current waste feed vitrified in DWPF is composed of treated sludge and slurry from a salt pretreatment process. Salt pretreatment includes an actinide removal process and modular caustic-side solvent extraction system that separates the salt waste into a high-activity (high-alpha) stream for vitrification in DWPF and a low-activity stream to be processed at the Saltstone Facility. DOE also plans to augment the current pretreatment system using a newly constructed Salt Waste Processing Facility (DOE 2007c; SRR 2009; SRS 2007i; 71 FR 3834). As discussed in the description of the Immobilization to DWPF Alternative in Chapter 2, Section 2.3.2, of this *SPD Supplemental EIS*, any plutonium going to DWPF must be received in accordance with DOE's program for HLW vitrification.

Vitrification of Plutonium with High-Level Radioactive Waste in Standard Canisters

Vitrification and canister-filling operations at DWPF would be the same for plutonium-bearing solutions processed through H-Canyon/HB-Line (see Section B.1.3) as operations for the other HLW sludge vitrified at DWPF. Upon receipt at DWPF, empty canisters are moved individually through an inspection area to the melt cell. Borosilicate glass frit is mixed with liquid waste and the mixture is sent to the melter, where the mixture is heated until it is molten. The molten glass waste mixture is slowly poured into the canisters, requiring about a day to fill each canister. Any contamination on the outside surface of the canister is removed, and the canister is plugged, welded closed, and inspected. A Shielded Canister Transporter moves each filled and sealed canister to a nearby GWSB for storage (DOE 1999; WSRC 2007a). Canisters measure about 2 feet (0.6 meters) in diameter by 10 feet (3 meters) long (Figure B–9). Individual canisters weigh about 1,000 pounds (450 kilograms) when empty and about 5,000 pounds (2,300 kilograms) when filled with vitrified HLW.

[8] *A third dissolver will be installed at H-Canyon independent of surplus plutonium processing (SRNL 2013).*

Processing surplus plutonium through H-Canyon/HB-Line would increase the number of HLW canisters to be generated and stored. The number of additional HLW canisters would depend on the quantity of surplus plutonium processed through H-Canyon/HB-Line and DWPF and on the plutonium concentration within the feed material. Processing 6 metric tons (6.6 tons) of surplus plutonium is estimated to generate 20 to 48 additional canisters. A range in the number of additional canisters is contemplated because DOE is developing options for increasing the plutonium loading from the current level of 897 grams of plutonium per cubic meter (0.06 pounds per cubic foot) to approximately 6,000 grams of plutonium per cubic meter (0.37 pounds per cubic foot) (SRNL 2013). The addition of gadolinium in the plutonium stream to absorb neutrons, thus ensuring criticality safety during DWPF processing, would minimize the plutonium waste mass and HLW canister generation (SRNL 2013).

Minor modifications, such as installation of a dedicated transfer line, may be made to the H-Area tank farm to support the quantity of non-pit plutonium being considered under the H-Canyon/HB-Line to DWPF Alternative (SRNL 2013).

Vitrification of Immobilized Plutonium Can-in-Canisters

Canister-filling operations in DWPF for can-in-canisters containing immobilized plutonium from the K-Area immobilization capability (see Section B.1.2.1) would be essentially the same as those for canisters that would be filled with the plutonium processed through H-Canyon/HB-Line, as described above. The canisters from the K-Area immobilization capability would be heavier than the empty canisters usually processed in DWPF, and would have higher radiation fields (DOE 1999, 2007a:11). To minimize the physical and radiological impacts on facility operation, these canisters would be transferred to the melter through the normal exit route for the poured canisters. Minor modifications to DWPF to accommodate these canisters would include new canister storage racks, a closed-circuit television system, a remote manipulator, and other modified equipment (WSRC 2008).

Each filled can-in-canister would weigh approximately 6,120 pounds (2,800 kilograms), about 1,100 pounds (500 kilograms) heavier than a standard HLW canister (WSRC 2008). The number of canisters to be generated and stored at S-Area would depend on the amount of surplus plutonium processed and the amount of plutonium per can. About 12 percent of the glass can-in-canister volume would be taken up by the cans of immobilized plutonium and structural internals. Because the cans of immobilized plutonium and internals would displace a similar volume of vitrified HLW, implementing the Immobilization to DWPF Alternative would increase the number of HLW canisters to be generated and stored by about 95 HLW canisters.

B.1.4.2 Glass Waste Storage Buildings

The *Defense Waste Processing Facility Supplemental Environmental Impact Statement* (DOE 1994) addressed the environmental impacts associated with constructing one or more GWSBs with a total capacity of 10,000 HLW canisters. To date, two GWSBs have been constructed and are operating in S-Area. The first storage building is a below-grade, seismically qualified vault containing vertical storage. The vault is equipped with forced ventilation cooling to remove radioactive decay heat from the canisters. An industrial-steel-frame building encloses the operating area directly above the storage vault, and a 5-foot- (1.5-meter-) thick concrete floor separates the storage vault from the operating area. The second storage building is 200 by 200 feet (61 by 61 meters) and is similar in design to the first storage building, but, among other differences, does not require forced ventilation for canister cooling (DOE 2006; SRS CAB 2004). The estimated storage capacity for the two storage buildings is approximately 4,590 canisters (SRR 2013). DOE is planning for additional canister storage capacity. This additional capacity could entail use of dry storage casks on an S-Area pad.

Filled containers of vitrified waste would be transported from DWPF, one canister at a time, using the Shielded Canister Transporter, to one of the GWSBs (DOE 2005a). At the storage building, the shielding plug of a storage vault would be removed, the waste canister would be lowered from the Shielded Canister Transporter to the storage vault, and the shielding plug replaced. The GWSBs may also be used for temporary storage of can-in-canisters of immobilized plutonium from K-Area pending collection of a

sufficient number for a vitrification campaign in DWPF. Canisters would be stored until a disposition path for HLW is determined.

B.1.5 E-Area Waste Management Facilities

Existing facilities in E-Area at SRS would be used for storage, staging, and shipping of CH-TRU waste, LLW, and MLLW generated by surplus plutonium disposition activities. E-Area is located in the Industrial Core Management Area between F-Area and H-Area (see Figure B–2). It consists of approximately 330 acres (134 hectares) and includes the TRU Waste Storage Pads, LLW Disposal Vaults, Low-Activity Waste Vaults, Intermediate-Level Waste Vaults, Engineered Trenches, and Very-Low-Activity Waste Disposal Trenches (slit trenches) (DOE 2005b; WSRC 2004). The TRU Waste Storage Pads would be used for accumulation of TRU waste, MLLW, and hazardous waste before shipment offsite for disposal.

Because the CH-TRU waste would be certified to be in compliance with WIPP waste acceptance criteria at the generating facilities, additional extensive pre-shipment characterization would generally not be required at E-Area. CH-TRU waste would be loaded into TRUPACT-II (**Figure B–13**) or HalfPACT transportation packages. These packagings are NRC-licensed Type B casks designed specifically for the transport of TRU waste. They have undergone extensive testing to demonstrate the ability to provide safe containment of TRU waste. The TRUPACT-II cask is 8 feet (2.4 meters) wide and 10 feet (3.0 meters) high and can hold up to fourteen 55-gallon drums or two standard waste boxes, each having a capacity of 1.8 cubic meters (63 cubic feet) (DOE 2012b). The HalfPACT cask is 8 feet (2.4 meters) wide and 7.5 feet (2.3 meters) high and can hold up to seven drums (DOE 2012b). Up to three TRUPACT-II packages could be loaded on a truck; however, shipments must meet weight restrictions and some shipments use a smaller cask. Each truck would be tracked by emergency response and law enforcement officials via the satellite TRANSCOM, DOE's unclassified Tracking and Communications System (DOE 2013).

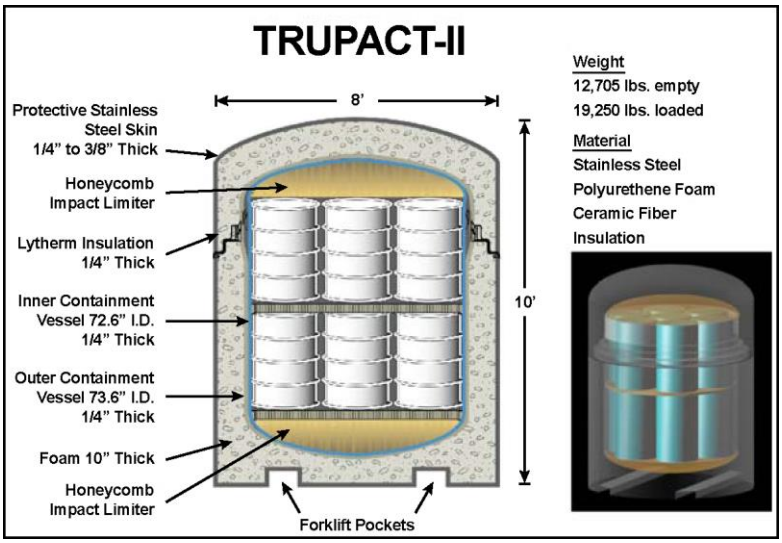


Figure B–13 Transuranic Package Transporter Model 2

LLW may be disposed of at E-Area in the Low-Activity Waste Vaults, Intermediate-Level Waste Vaults, Engineered Trenches, or Very-Low-Activity Waste Disposal Trenches (slit trenches). LLW may also be shipped off site for disposal at Federal or commercial disposal facilities, as would all MLLW. Shipments would use licensed commercial carriers and would be performed in compliance with applicable Federal and state regulations. Hazardous waste could be shipped off site for treatment and disposal directly from the generating facility if it is logistically advantageous to do so instead of first transporting it to E-Area. Nonhazardous waste would be shipped directly from the generating facility to onsite disposal facilities. Appendix E provides additional information on transportation of waste to disposal facilities.

B.2 Los Alamos National Laboratory

B.2.1 Plutonium Facility

DOE/NNSA proposes to use PF-4 at LANL for disassembly and conversion of some or all plutonium pits addressed in this *SPD Supplemental EIS*. LANL was originally established in 1943 as "Project Y" of the Manhattan Project in northern New Mexico, within what is now the Incorporated County of Los Alamos. Project Y had a single national defense mission—to build the world's first nuclear weapon. After World War II ended, Project Y was designated a permanent research and development laboratory, the Los Alamos Scientific Laboratory. It was renamed LANL in the 1980s, when its mission was expanded from defense and related research and development to incorporate a wide variety of new assignments in support of Federal Government and private sector programs. LANL is now a multidisciplinary, multipurpose institution primarily engaged in theoretical and experimental research and development.

LANL occupies about 40 square miles (104 square kilometers) of land on the eastern flank of the Jemez Mountains along the area known as the Pajarito Plateau. The terrain in the LANL area consists of mesa tops and canyon bottoms that trend in a west-to-east manner, with the canyons intersecting the Rio Grande to the east of LANL. LANL operations occur within numerous facilities located over 47 designated technical areas within the LANL boundaries and at other leased properties situated near LANL (see Figure B–3). PF-4 is located in TA-55, in the west-central portion of LANL, approximately 1.1 miles (1.8 kilometers) south of the Los Alamos townsite. TA-55 facilities provide research and applications in chemical and metallurgical processes for recovering, purifying, and converting plutonium and other actinides into many compounds and forms, as well as research into material properties and fabrication of parts for research and stockpile applications. A perimeter intrusion, detection, assessment and delay system (PIDADS) surrounds all nuclear facilities in TA-55.

The ARIES line at PF-4 is operating at demonstration capacity (based on single-shift operation) to produce 2 metric tons (2.2 tons) of plutonium oxide as early feed material for MFFF. These operations would continue under all alternatives analyzed in the *SPD Supplemental EIS*. Under some of the pit disassembly and conversion options under the action alternatives, the LANL ARIES program could be expanded to produce 35 metric tons (38.6 tons) of plutonium feed for MFFF.

Upgrades are currently being implemented at the existing ARIES Program and are included in the 2008 *Final Site-Wide Environmental Impact Statement for the Continued Operation of the Los Alamos National Laboratory, Los Alamos, New Mexico* (DOE 2008a). These upgrades include:

- Modifications to a pit disassembly lathe, already operating in PF-4, that will be used by LANL's existing ARIES program
- Installation of hydride/dehydride equipment
- Acquisition and installation of a second plutonium metal oxidation furnace
- Installation of a second mill/blend machine
- Installation of four new safes in the basement
- Installation of new storage boxes in two gloveboxes

If DOE decides to expand the ARIES capabilities, PF-4 would be equipped with the capability to handle full production of plutonium metal and plutonium oxide. The projected increased production rate would require additional modifications to PF-4, including modifications and reconfigurations of rooms, vaults, and gloveboxes where pit disassembly and conversion equipment and operations would be placed. Twenty gloveboxes would be decontaminated and decommissioned, 18 gloveboxes modified, and 18 new gloveboxes installed. The current ARIES program uses about 4,500 square feet (420 square meters) and the expansion would require another 3,000 square feet (280 square meters) for a total of 7,500 square feet (700 square meters). Construction work would last approximately 8 years. A double-wide construction

trailer and temporary parking for up to 60 employees would be required. The total disturbed area outside PF-4 would be less than 2 acres (0.8 hectares) (LANL 2013).

The pit disassembly and conversion capability at PF-4 would be similar to the capability at SRS illustrated in Figure B–5. Pits would be shipped from the Pantex Plant to PF-4. After disassembly and processing, the plutonium oxide and plutonium metal may be shipped to SRS (also see below). Plutonium oxide would be directly available for disposition (e.g., fabrication into MOX fuel, immobilization, or blending and packaging for disposition as CH-TRU waste at WIPP), while metallic plutonium would be converted to plutonium oxide at H-Canyon/HB-Line or in oxidation furnaces installed at MFFF. This plutonium oxide would then be available for disposition.

Under the WIPP Alternative, rather than shipping 7.1 metric tons (7.8 tons) of pit plutonium to SRS for preparation at H-Canyon/HB-Line for potential WIPP disposal, some or all of this pit plutonium could be prepared at LANL for potential WIPP disposal. The process for preparation of pit plutonium at LANL for potential WIPP disposal would be the same as that described in Section B.1.3 for H-Canyon/HB-Line. Plutonium in oxide form would be blended with inert material, placed within POCs or CCOs, and transferred to TA-54 or TA-63 for staging for shipment to WIPP for disposal (see Section B.2.2). The process steps required to blend and package plutonium are well understood and currently being performed at LANL on a smaller scale in support of other programs, but some changes would be necessary to expand the capabilities to accommodate a larger volume. It is expected that these changes or modifications would occur within the footprint of existing TA-55 facilities such as PF-4, and concurrently with those required for an enhanced pit disassembly and conversion capability at PF-4. Activities to prepare pit plutonium for potential WIPP disposal could occur concurrently with pit disassembly and conversion operations at PF-4, and could extend the Surplus Plutonium Disposition Program at LANL by a few years.

There is minimal storage capacity for wastes at TA-55, so timely management of wastes generated by TA-55 activities is essential for maintaining facility capacity. Before a new activity or change to an existing activity can be performed in PF-4, it must be vetted through an approval process that considers its potential impact on waste management, including the types and volumes of waste to be generated. Before any waste can be generated, the waste originator must work with the TA-55 Waste Management Coordinator to plan the life cycle for the wastes. The TA-55 Waste Management Coordinator works with waste originators to complete documentation that characterizes all waste streams to ensure compliance with treatment, storage, and disposal facility waste acceptance criteria. Waste management sites throughout TA-55, including treatment and storage sites, produce waste packages that meet LANL, state, and Federal criteria for handling and storage, and ensure waste items or packages meet TA-54 LLW disposal and offsite waste acceptance criteria. Radioactive liquid waste discharges would be piped to the TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF). Solid LLW may be disposed of on site, shipped directly to an offsite permitted disposal site, or sent to TA-54 for staging before shipment off site. MLLW and hazardous waste would be transported to TA-54 for staging before shipment off site for treatment and disposal. TRU waste would be characterized, certified for WIPP disposal, and staged for shipment to WIPP (see Section B.2.2) (LANL 2013).

B.2.2 Los Alamos National Laboratory Support Facilities

Pit disassembly and conversion work at PF-4 would be supported by laboratory analyses at the Chemistry and Metallurgy Research Building[9] in TA-3 (Figure B–3) and the Radiological Laboratory/Utility/Office Building (RLUOB) at TA-55 (Figure B–4) (LANL 2013:031512). The Chemistry and Metallurgy Research Building is a nuclear facility that was constructed as an actinide chemistry and metallurgy research facility between 1949 and 1952. Its current missions include analytical chemistry and materials characterization, destructive and nondestructive analyses, and actinide

[9] *DOE has developed a strategy for transferring analytical chemistry and materials characterization capabilities to existing space in RLUOB and PF-4. Implementation of the strategy supports plans to cease programmatic operations in the old Chemistry and Metallurgy Research Building by about 2019.*

research and processing. RLUOB is a newly constructed administrative and support function building adjacent to PF-4. In addition to office space, utilities, and training classrooms, RLUOB contains radiological laboratory space (DOE 2011:2-6, 2-9).

The principal facility for treating radioactive liquid waste at LANL is RLWTF, located in TA-50. RLWTF consists of the treatment facility, support buildings, and liquid and chemical storage tanks, and receives liquid waste from various sites across LANL. Several upgrades to RLWTF have been implemented in recent years to upgrade the tank farm, install new ultrafiltration and reverse osmosis equipment, and install new nitrate reduction equipment. RLWTF Outfall Number 051 discharges into Mortandad Canyon. RLWTF is slated for replacement with a new facility in accordance with the 2008 *Final Site-Wide Environmental Impact Statement for Continued Operation of Los Alamos National Laboratory, Los Alamos, New Mexico* (*LANL SWEIS*) ROD (73 FR 55833); this new facility is being planned with an evaporation unit to eliminate liquid discharges into the environment (DOE 2011:3-66).

TA-54 is the location of most of LANL's solid radioactive waste and chemical waste capabilities. LLW generated at LANL may be disposed at Area G in TA-54 or staged therein before being shipped off site. Other waste types such as MLLW and hazardous waste are staged at Area G for offsite treatment and/or disposal. TRU waste is currently characterized at Area G before it is transported to the Radioassay and Nondestructive Testing Facility (RANT), also located in TA-54, and loaded into TRUPACT packages for shipment to WIPP (LANL 2013).

Because of the requirements in a 2005 Compliance Order on Consent between DOE/NNSA and the New Mexico Environment Department (DOE 2008a:2-9), the waste management capabilities in Area G are being transitioned to other locations along the Pajarito Road corridor (i.e., other locations on the same mesa as TA-54). Consequently, it is expected that characterization of TRU waste from pit disassembly and conversion activities at PF-4 would shift from G Area to the RANT facility where TRUPACT-II loading would also occur. After it becomes operational, management of TRU waste from pit disassembly and conversion activities could also occur at the new TRU Waste Facility planned for construction in TA-63. LLW, MLLW, and hazardous waste management capabilities would be transitioned to other locations in TA-54. DOE decided to transition the waste management capabilities at LANL (73 FR 55833), including construction of the new TRU Waste Facility in TA-63, based on the analysis in the *LANL SWEIS* (DOE 2008a).

As discussed in Section B.2.1, under the WIPP Alternative, some pit plutonium could be prepared at LANL for potential disposal at WIPP, rather than being shipped to SRS for preparation for potential WIPP disposal. In this event, the TRU Waste Facility to be constructed in TA-63 may require additional equipment or additional storage capacity, as well as additional staffing. Loading operations at RANT might require additional staffing or shifts to accommodate the additional shipments to WIPP.

B.3 Waste Isolation Pilot Plant

WIPP, near Carlsbad, New Mexico, is the only facility authorized to dispose of TRU waste generated by defense activities. The WIPP repository is located in thick, stable, and ancient salt beds, 2,150 feet (655 meters) below the ground surface. The Waste Isolation Pilot Plant Land Withdrawal Act (Public Law No. 102-579) authorized the disposal of up to 175,600 cubic meters (6.2 million cubic feet) of TRU waste generated by the Nation's atomic energy defense activities. TRU waste is waste that contains alpha particle-emitting radionuclides with atomic numbers greater than uranium (92) and half-lives greater than 20 years in concentrations greater than 100 nanocuries per gram of waste.

In 1997, DOE issued the *Waste Isolation Pilot Plant Disposal Phase Final Supplemental Environmental Impact Statement* (*WIPP SEIS-II*) (DOE 1997), which addressed the management of TRU waste at DOE sites and the management and disposal of TRU waste at WIPP. The January 23, 1998, ROD (63 FR 3624) for the *WIPP SEIS-II* announced DOE's decision to dispose of up to 175,600 cubic meters (6.2 million cubic feet) of TRU waste generated by defense activities at WIPP after preparation to meet the WIPP waste acceptance criteria. This waste included TRU waste generated since 1970 and TRU waste that DOE would generate over the next 35 years. DOE's total TRU waste inventory at its sites

(stored TRU waste and projected generation of TRU waste through 2033) in the *WIPP SEIS-II* was 170,000 cubic meters (6 million cubic feet). This inventory is referred to as the basic inventory. DOE recognized that additional TRU waste not included in the *WIPP SEIS-II* site inventory might be identified that would be suitable for disposal at WIPP. For that reason, DOE assumed an additional 5,600 cubic meters (198,000 cubic feet) of projected TRU waste and analyzed the transportation and disposal of 175,600 cubic meters (6.2 million cubic feet) of TRU waste under the Proposed Action in the *WIPP SEIS-II*. DOE also analyzed a larger quantity of waste taking into account other sources of waste such as TRU waste that was not generated from defense activities (DOE 1997).

The 1996 *Storage and Disposition PEIS* (DOE 1996) considered, but dismissed, an option that would have allowed for the disposal of the Nation's entire inventory, at the time estimated at 50 metric tons (55 tons), of surplus plutonium at WIPP. The *Storage and Disposition PEIS* stated that this option would exceed WIPP's capacity. It also stated that this option would likely require amendment of the Waste Isolation Pilot Plant Land Withdrawal Act, associated regulations, draft or pending regulatory compliance documents, and the planning basis for WIPP waste acceptance criteria, among other things (DOE 1996). Because a much smaller amount of surplus plutonium (13.1 metric tons [14.4 tons]) is now being considered for potential disposal at WIPP, DOE now considers this to be a reasonable alternative that should be evaluated in this *SPD Supplemental EIS*.

For disposition of surplus plutonium by disposal at WIPP, the volumes and corresponding numbers of shipments of TRU waste transported to WIPP would depend on the quantity of surplus plutonium contained within the disposal containers (the POCs or CCOs). POCs are limited to 200 fissile gram equivalents per container, while CCOs are limited to 380 fissile gram equivalents per container. The larger limit within CCOs would approximately halve the volumes of TRU waste generated from processing the surplus plutonium, and halve the number of waste shipments to WIPP (also see Footnote 6). For the purposes of this *SPD Supplemental EIS*, both POCs and CCOs are analyzed (Appendix E). In addition, shipping FFTF fuel directly in its current packaging (Hanford Unirradiated Fuel Package, or HUFP), instead of repackaging the fuel into POCs or CCOs, would reduce the number of containers and the number of shipments.

B.4 Reactor Sites Using Mixed Oxide Fuel

Most commercial nuclear power reactors currently operating in the United States could use MOX fuel. It is not expected that a reactor's operations would need to change significantly to allow it to use MOX fuel. Prior to being allowed to use MOX fuel, the reactor operator would be required to obtain a license amendment from NRC. Assuming a reactor operator is granted such a license amendment by NRC to allow it to use MOX fuel in one or more of its reactors, MOX fuel would be shipped from SRS to the reactor sites using NNSA's Secure Transportation Asset. After an acceptance inspection at the reactor site, the MOX fuel would be stored in a secure location at the reactor site until it was loaded into the reactor during one of its standard refueling outages. Fresh MOX fuel presents a slightly higher risk of higher doses to workers due to the presence of plutonium and other actinides compared to LEU fuel. Worker doses would be required to continue to meet Federal regulatory dose limits and any reactor proposing to use MOX fuel would be required by NRC to take steps within its as low as reasonably achievable (ALARA) program to limit any increase in doses to workers that may occur from use of MOX fuel.

From the storage location, both MOX and LEU fuel assemblies would be loaded into the reactor. This *SPD Supplemental EIS* analyzes the use of a reactor core with 40 percent MOX fuel. MOX fuel assemblies would remain in the reactor in accordance with the utility's operating plan. When the MOX fuel completes its fuel cycle, it would be withdrawn from the reactor in accordance with the reactor's refueling procedures and placed in the reactor's used fuel storage pool for cooling alongside other used fuel. No major changes are expected in the reactor's used fuel storage plans to accommodate the used MOX fuel. After sufficient cooling, the used fuel may be transferred to dry cask storage, a storage configuration requiring no water to cool the used fuel. The amount of decay heat would be slightly higher

in used MOX fuel rods than in LEU used fuel rods and this small difference would be expected to be managed using standard used fuel pool and dry cask practices.

The TVA reactors evaluated in this *SPD Supplemental EIS* are licensed to store used nuclear fuel in dry storage casks (NRC 2012). As of January 2013, 40 casks had been filled and placed in storage at the Browns Ferry Nuclear Plant and 32 casks had been filled and placed in storage at the Sequoyah Nuclear Plant. TVA plans to transfer additional used fuel to dry storage casks over the operating lives of these plants, taking into account lessons learned from the accident at the Fukushima Dai-ichi Nuclear Plant in Japan (TVA 2013) (see Appendix J, Section J.3.3.3).

Appendix I, Section I.1, of this *SPD Supplemental EIS*, discusses the potential environmental impacts associated with using MOX fuel in reactors at TVA's Browns Ferry and Sequoyah Nuclear Plants, in Alabama and Tennessee, respectively. Section I.2 discusses the potential environmental impacts associated with using MOX fuel in other commercial nuclear power reactors at other locations in the United States (generic reactors). Appendix J presents a discussion of the impacts of postulated accidents in commercial reactors operating with a partial MOX core compared to the impacts with an LEU core.

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