U.S. DEPARTMENT OF ENERGY

National Nuclear Security Administration

Pit Production at Los Alamos National Laboratory

Report to Congress
May 2020

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National Nuclear Security Administration
United States Department of Energy
Washington, DC 20585

Message from the Administrator

The sole U.S. pit production capability is currently located in Los Alamos National Laboratory's Plutonium Facility-4, which will be more than 50 years old in 2030. As stated in the 2018 *Nuclear Posture Review*, "there now is no margin for further delay in recapitalizing the physical infrastructure needed to produce strategic materials and components for U.S. nuclear weapons." Plans to revitalize the Nation's pit production capability have been halted and delayed for decades. The requirement to produce no fewer than 80 pits per year during 2030 transcends Administrations, and in May 2018, the Department of Energy's National Nuclear Security Administration provided Congress with the recommended alternative to meet this national security imperative.

Pursuant to statutory requirements, this report is being provided to:

- **The Honorable Richard Shelby**
  Chairman, Senate Committee on Appropriations
- **The Honorable Patrick Leahy**
  Vice Chairman, Senate Committee on Appropriations
- **The Honorable Lamar Alexander**
  Chairman, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations
- **The Honorable Dianne Feinstein**
  Ranking Member, Subcommittee on Energy and Water Development
  Senate Committee on Appropriations
- **The Honorable Nita M. Lowey**
  Chairwoman, House Committee on Appropriations
- **The Honorable Kay Granger**
  Ranking Member, House Committee on Appropriations
- **The Honorable Marcy Kaptur**
  Chairwoman, Subcommittee on Energy and Water Development
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- **The Honorable Mike Simpson**
  Ranking Member, Subcommittee on Energy and Water Development
  House Committee on Appropriations
- **The Honorable James Inhofe**
  Chairman, Senate Committee on Armed Services
- **The Honorable Jack Reed**
  Ranking Member, Senate Committee on Armed Services

- **The Honorable Deb Fischer**
  Chairman, Subcommittee on Strategic Forces
  Senate Committee on Armed Services
- **The Honorable Martin Heinrich**
  Ranking Member, Subcommittee on Strategic Forces
  Senate Committee on Armed Services
- **The Honorable Adam Smith**
  Chairman, House Committee on Armed Services
- **The Honorable William "Mac" Thornberry**
  Ranking Member, House Committee on Armed Services
- **The Honorable Jim Cooper**
  Chairman, Subcommittee on Strategic Forces
  House Committee on Armed Services
- **The Honorable Michael Turner**
  Ranking Member, Subcommittee on Strategic Forces
  House Committee on Armed Services

If you have any questions or need additional information, please contact Ms. Nora Khalil, Associate Administrator for External Affairs, at (202) 586-7332, or Ms. Katie Donley, Deputy Director for External Coordination, Office of the Chief Financial Officer, at (202) 586-0176.

Sincerely,

Lisa E. Gordon-Hagerty
Under Secretary for Nuclear Security
Administrator, NNSA

Executive Summary

During the Cold War, the United States was capable of producing more than 1,000 pits per year (ppy) at the Department of Energy's (DOE) Rocky Flats Plant in Colorado. Since the closure of the Rocky Flats Plant in 1992, the United States has not had the ability to manufacture more than 10 ppy. As a result, a major initiative of the 2018 *Nuclear Posture Review* is to "provide the enduring capability and capacity to produce plutonium pits at a rate of no fewer than 80 ppy in 2030." In May 2018, DOE's National Nuclear Security Administration (DOE/NNSA) provided Congress with the recommended two site approach to produce no fewer than 80 ppy during 2030:

- Continue investing in capabilities at Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico to produce at least 30 war reserve ppy during 2026; and
- Repurpose the Mixed Oxide Fuel Fabrication Facility at the Savannah River Site (SRS) near Aiken, South Carolina to produce at least 50 war reserve ppy during 2030.

This two-site approach, which consists of continued investment in capabilities at LANL to produce at least 30 war reserve ppy during 2026, and repurposing of the Mixed Oxide Fuel Fabrication Facility at SRS to produce at least 50 war reserve ppy during 2030, was endorsed by the Nuclear Weapons Council in 2018. The two site path forward to meet pit production requirements at the proposed level of 80 ppy capacity provides both the required numbers per year and the resilience needed to mitigate against unplanned outages at a single site.

Recapitalizing the Nation's pit production capability and producing no fewer than 80 ppy during 2030 is driven by three major factors:

1. Ability to enhance warhead safety and security to meet Department of Defense and DOE/NNSA requirements;
2. Deliberate, methodical replacement of older existing plutonium pits with newly manufactured pits as risk mitigation against plutonium aging; and
3. Ability to respond to changes in the deterrent requirements driven by great power competition.

As requested in Section 3120(c) of the *John S. McCain National Defense Authorization Act for Fiscal Year 2019* (Public Law 115-232), this report provides an initial analysis of the staffing, equipment, and infrastructure necessary to establish the initial restart capability at LANL to produce a minimum of 30 ppy during 2026. The effort to sufficiently capture the necessary staffing, equipment, and infrastructure to establish this capability is on-going and continuous refinements and value engineering will be reflected in future program planning documents. The current schedule for the LANL-wide activities associated with the execution strategy, along with other figures and sensitive information deemed necessary to respond to the legislative

requirement, are in this report's classified addendum. This schedule continues to be updated as LANL refines requirements to achieve 30 ppy.

Costs listed within this report are preliminary, based on the best information and analysis to date, and will be updated as acquisition approaches are defined and designs mature. The design maturity of activities in this report varies, and consequently, cost estimates for specific efforts are dependent on the maturity of the activity. The cost estimates in this document range from as much as -50 percent to +100 percent, which is consistent with American Association of Cost Engineering International guidance for Class 5, rough-order-of-magnitude estimates. Estimates represent the high end of the cost range based on preliminary assumptions that have yet to be validated and approved, and DOE/NNSA is actively working to minimize both cost and scope necessary to support the mission.

Pit Production at Los Alamos National Laboratory

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I. Legislative Language

This report responds to legislative language set forth in Section 3120(c) of the *John S. McCain National Defense Authorization Act for Fiscal Year 2019* (Public Law 115-232) (FY 2019 NDAA), wherein it is stated:

> *… the Administrator shall submit to the congressional defense committees a report containing—(A) a detailed plan to produce 30 pits per year at Los Alamos National Laboratory by 2026, including—(i) equipment and other construction already planned at the Chemistry and Metallurgy Research Replacement Facility; (ii) additional equipment or labor necessary to produce such pits; and (iii) effects on and from other ongoing programs at Los Alamos National Laboratory; and (B) a detailed plan for designing and carrying out production of plutonium pits 31–80 at Los Alamos National Laboratory, in case the MOX facility is not operational and producing pits by 2030.*

II. Introduction

The United States has not manufactured a war reserve pit (plutonium subcomponent of the primary) since 2012 and has not had the ability to manufacture more than 10 pits per year (ppy) for nearly three decades, since the Department of Energy's (DOE) Rocky Flats Plant closed in 1992. As a result, a major initiative of the 2018 *Nuclear Posture Review* is to "provide the enduring capability and capacity to produce plutonium pits at a rate of no fewer than 80 ppy in 2030." In May 2018, DOE's National Nuclear Security Administration (DOE/NNSA) provided Congress with a two site approach to produce no fewer than 80 ppy during 2030.

DOE/NNSA's two-site approach to meet the Nation's pit production requirement will continue investment in the Los Alamos National Laboratory (LANL) in Los Alamos, New Mexico, and repurpose the Mixed Oxide Fuel Fabrication Facility at the Savannah River Site near Aiken, South Carolina to produce the full amount of pits required during 2030. This approach has been endorsed by the Nuclear Weapons Council, and is a prudent plan to meet pit production requirements at the proposed level of 80 ppy capacity, which provides the resilience needed to mitigate against unplanned outages at a single site.

LANL developed an integrated schedule, aligned with DOE/NNSA Office of Defense Programs priorities set forth by the Pit Product Realization Team (PRT) established in 2013, for activities needed to reach 30 ppy. These activities include pit production operations, pit production equipment installations, Pit PRT activities, line item construction projects, staffing recruitment and training, and maintenance and security investments. The current schedule for the LANL-wide activities associated with the execution strategy, along with other figures and sensitive information deemed necessary to respond to the legislative requirement, are contained in the classified addendum. This schedule will continue to be updated as LANL refines its requirements.

In 2019 LANL conducted an extensive staffing analysis to better understand both the highly skilled personnel required to produce pits and the supporting personnel (e.g., security forces, Radiological Control Technicians, maintenance staff) across the site. As a result of this analysis, LANL identified infrastructure needs that were previously unplanned, including office and parking structures and security enhancements to Technical Area-55 (TA-55); NNSA is currently evaluating these proposed infrastructure investments. LANL is also evaluating interim solutions to address gaps between when proposed staffing levels will increase and be sufficient to support the mission, and when the additional infrastructure and physical security necessary will be available. This information will continue to be refined.

DOE/NNSA also established a Plutonium Pit Production Matrixed Execution Team (MET) that is a cross-functional body of senior level DOE/NNSA executives that support the effort to achieve the pit production mission. The MET is chaired by DOE/NNSA's Office of Defense Programs and includes membership from the supporting program and functional offices, DOE/NNSA field offices, and management and operating partners. The primary focus of the MET is to resolve conflicts that arise from resource limitations or other technical and schedule issues.

For major construction activities, DOE/NNSA establishes a mission need, program requirements, and funding profile for new facilities and significant upgrades. The Office of Defense Programs works with the DOE/NNSA Office of Acquisition and Program Management (APM) to deliver modernization activities following DOE Order 413.3B. To facilitate effective project coordination, DOE/NNSA established a process to stand up a Senior Management Team (SMT), also led by the Office of Defense Programs, for each major project. The SMT is composed of senior executive service members from APM, the supporting program and functional offices, and respective field offices to monitor the design and acquisition process and resolve issues for appropriate program requirements decisions.

The majority of this report responds to the first part of Section 3120(c) including providing (i) equipment and other construction already planned at the Chemistry and Metallurgy Research Replacement (CMRR) Facility; (ii) additional equipment or labor necessary to produce such pits, and; (iii) effects on and from other ongoing programs at LANL. The second part of Section 3120(c) of the FY 2019 NDAA, regarding a detailed plan for designing and carrying out production of plutonium pits 31-80 at LANL, is addressed in Section VIII.

III. Enduring Production Activities

3.1 Pit Product Realization Team

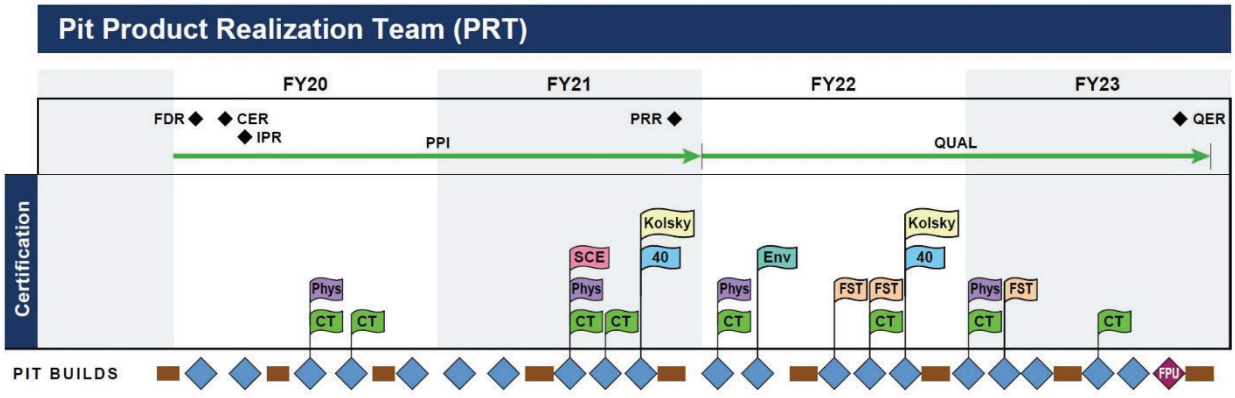
In 2013, the Pit PRT, led by Lawrence Livermore National Laboratory (LLNL) in Livermore, California as the design agency with participation from LANL and the Kansas City National Security Campus (KCNSC) in Kansas City, Missouri production agencies, was initiated to focus on the next pit type for production. In addition to manufacturing the first war reserve pit during

2023, the Pit PRT scope includes achieving 10 war reserve ppy during 2024, 20 war reserve ppy during 2025, and an ongoing rate production of 30 war reserve ppy during 2026.

The Pit PRT established a baseline schedule to produce the first war reserve pit, or first production unit (FPU), during 2023. This integrated schedule covers the scope required to achieve 30 war reserve ppy during 2026. Pit builds must be manufactured to meet the criteria of the three phases of product realization – Development (DEV), Process Prove-in (PPI), and Qualification Evaluation (QE) – before they can be deemed war reserve, or ready for insertion into the stockpile. LANL and KCNSC as the production agencies have the responsibility of producing all DEV, PPI, QE, and war reserve components. LLNL as the design agency is responsible for the design meeting military requirements. LLNL has unique fabrication, material recovery, component and assembly test competencies, and analytic capabilities required to certify the functional performance of war reserve pits.

The Pit PRT identifies, tracks, trends, and reports progress towards achieving FPU, as illustrated in Figure 1, and ultimately 30 war reserve ppy. As LANL executes pit production activities, LANL has to concurrently complete equipment installations and infrastructure investments, hire and train an expanded skilled workforce, and improve production-related business operations.

Figure 1. Pit PRT FPU Summary-level Schedule



Legend			
40	40 mm Gas Gun	Phys	LLNL Physics Tests
CER	Complete Engineering Release	PPI	Process Prove-In
CT	Computed Tomography	PRR	Production Readiness Review
ENV	Environmental Testing	QER	Qualification Evaluation Release
FDR	Final Design Review	QUAL	Qualification
FPU	First Production Unit	SCE	Subcritical Experiments
FST	Full Scale Test		MC&A Inventory
IPR	Interlaboratory Peer Review		Pit Builds
Kolsky	Kolsky Bar Tests		First Production Unit

3.2 Staffing

The success of the pit production mission at LANL requires an enduring skilled workforce to perform pit fabrication, attainment and maintenance of a reliable facility for continuous operations at PF-4, ongoing waste management activities, and provisions for safety and security. Additional staff must be hired years in advance of when needed for production, in order to meet the necessary time to obtain a DOE Q clearance, be certified in the Human Reliability Program, and to complete mandatory training to work in high-hazard nuclear facilities. In addition to pit production personnel, craft, oversight, and project engineers are needed to execute the construction of new support infrastructure, which may include office buildings, parking lots, cafeterias, training locations, and access portals.

LANL developed a pit production staffing proposal to identify and manage the staffing requirements needed to achieve 30 ppy. This staffing proposal focuses on requirements to:

- Produce pits;
- Maintain nuclear and hazardous facilities and infrastructure;
- Manage environmental protection, safety, quality, and security programs and requirements;
- Provide business support services; and,
- Manage DOE/NNSA newly-generated transuranic (TRU) waste.

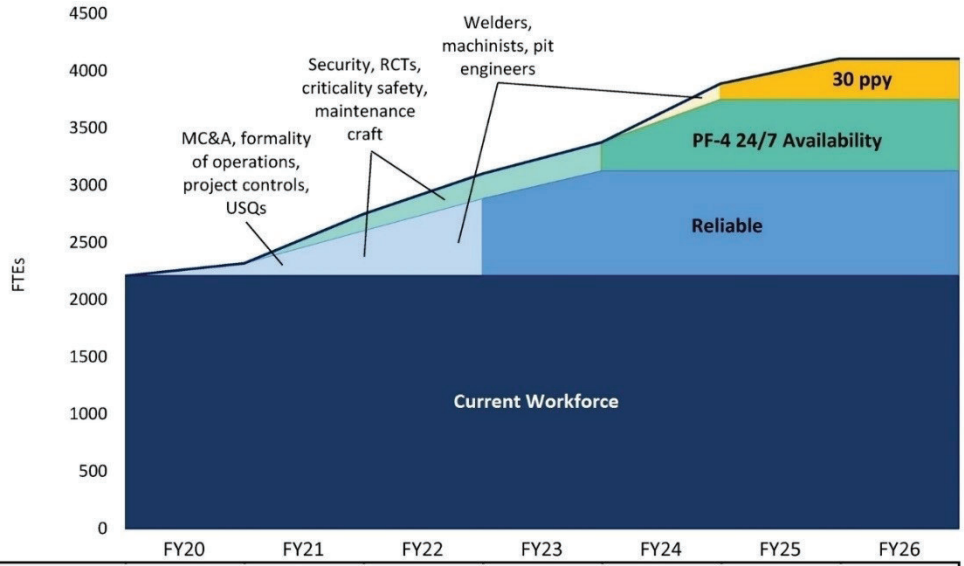
As part of planning, LANL interviewed managers from 42 divisions (including 11 of the 12 Associate Laboratory Directorates) associated with pit production to inform the development of the staffing proposal. LANL's staffing estimate include an approximate range of proposed staffing requirements that will continue to be refined, for both pit production personnel and supporting staff across LANL. The staffing analysis also includes data gathered to support infrastructure requirements for the additional workforce.

As LANL continues to refine the staffing estimates and assess potential operational efficiencies, the required staffing level is subject to change.

Figure 2 illustrates the increase in the current workforce as it relates to three overlapping objectives:

- Objective 1: Reliably operate and maintain LANL's plutonium enterprise and to produce 20 ppy in 2025;
- Objective 2: 24/7 operation of TA-55 PF-4; and
- Objective 3: Increase the pit production staffing to the level required to support a sustained 30 ppy production rate at an annual confidence level of 90 percent and on a single production shift.

Figure 2. LANL's Estimate of Enduring Staffing to Reliably Produce 30 ppy during 2026



	FY20	FY21	FY22	FY23	FY24	FY25	FY26
Total FTEs*	***2,316***	***2,746***	***3,099***	***3,373***	***3,887***	***4,105***	***4,105***
FTEs by Staffing Objective							
Current Workforce	2,207	2,207	2,207	2,207	2,207	2,207	2,207
Reliable	109	393	673	917	917	917	917
24/7		146	218	249	623	623	623
30 ppy					139	357	357
FTEs by Funding Source							
NA-10 Total FTEs	1,028	1,251	1,431	1,595	1,844	1,987	1,987
NA-50 Total FTEs	698	827	930	1,049	1,200	1,270	1,270
NA-70 Total FTEs	591	667	738	730	843	848	848

* FTEs, due to rounding, may not add up to exact totals

Objectives 1 and 2 provide the staff to perform craft maintenance work, equipment installation, and construction during off-shifts while delivering on all current plutonium missions during the day shift. The staffing increases associated with objectives 1 and 2 from FY 2020 through FY 2024 are required to produce 20 ppy during 2025. The full-time equivalents (FTEs) in Figure 2 are grouped into five employment categories:

- Research and Development (R&D) Professionals – Scientists and Engineers directly engaged in R&D activities;
- Professionals – Employees engaged in non-R&D, professional activities;
- Technicians – Employees engaged in the technical support of R&D or facility operational activities;
- Support – Employees engaged in administrative-type support activities; and
- Craft – Employees engaged in manual activities requiring various skill levels in precision, production, or repair.

3.3 Operations and Maintenance

Facilities and infrastructure must be operated and maintained so that facility downtime will not interfere with pit production. Maintenance projects and routines will be designed and executed to meet regulatory requirements, provide functional redundancy, increase reliability, and address challenges posed by aging facilities. Maintenance activities that could affect production will be performed during planned outages that are scheduled to maximize the number of maintenance activities performed to minimize associated downtime. Critical facilities and functions necessary to support the pit production mission include:

- TA-55 PF-4 (and related support facilities at TA-55);
  - Operations control center
  - Safety basis
  - Criticality safety
  - Radiation protection
  - Nondestructive Assay (NDA) and Material Control and Accountability (MC&A)
  - Formality of operations
  - Facility training
  - Decontamination and waste management
  - Design, configuration, and system support
  - Area and project controls
  - Document control, procedure writing, and regulatory compliance
  - Industrial and glovebox safety, health, and regulatory compliance
  - Addressing unresolved safety questions for the TA-55 Authorization Basis
- TA-55 Radiological Laboratory Utility Office Building (RLUOB);
- TA-50 Radioactive Liquid Waste Treatment Facility (RLWTF);
- TA-50 Low-level (radioactive) Liquid Waste (LLW);
- TA-50 Transuranic Liquid Waste (TLW) (after start-up);
- TA-54 Radioactive Assay Nondestructive Testing (RANT);
- TA-63 Transuranic Waste Facility (TWF);
- TA-03 Chemistry and Metallurgy Research (CMR) (until operations are transferred to RLUOB); and
- TA-03 Main Shops.

Ongoing LANL infrastructure modernization efforts are improving the condition of TA-55 PF-4 and supporting facilities. A significant increase in staffing and maintenance projects is required for these facilities to support a reliable pit production program, which is included in the FY 2021-2025 Future-Years Nuclear Security Program (FYNSP). LANL will perform maintenance activities during the off-shifts as TA-55 PF-4 expands to 24/7 availability. Optimal use of staff for extended shift and 24/7 operations is in the process of being determined. Infrastructure and operations staff must be available to meet regulatory requirements to meet continuity of

operations with sufficient supervision and oversight to manage issues and events to meet needed operational tempo. Staffing proposals are being updated to incorporate the transition to 24/7 availability of TA-55 PF-4 no later than 2024.

Additional LANL efforts to increase efficiency and balance available resources include:

- Developing and maintaining a staffing pipeline to hire, train, and certify staff for critical facility operations and maintenance functions;
- Implementing pay and benefits incentives for critical skills, such as mechanical engineers, pipefitters, electricians, and craft;
- Improved schedule integration for maintenance and facility upgrades with program schedules for construction, Decontamination and Decommissioning (D&D), equipment installation, and production;
- Using other plutonium facilities (such as RANT, TWF, RLW, and RLUOB) to train workers prior to qualification for working in TA-55 PF-4; and
- Developing integrated acquisition teams to streamline procurements.

3.4 Waste Management

Waste management includes the characterization, processing, staging, and shipping of waste streams from multiple LANL facilities to offsite entities, such as the Waste Isolation Pilot Plant (WIPP) in Carlsbad, New Mexico, for final waste disposition. Due to nuclear material quantity limits of TA-55, pit production activities are highly dependent on continuous removal of nuclear waste. Effective waste management must reliably address all waste streams, from generation through final off-site disposition, and meet all regulatory requirements as mandated by facility, institutional, state, and federal procedures and policies.

Liquid wastes generated at TA-55 include acid, caustic, and industrial wastes. The RLW facilities support both low-level and TRU liquid processing. The existing facilities are undergoing modifications to modernize processing capabilities and to handle projected capacities. The recently completed construction of a new LLW facility, with a larger liquid storage capability for low-level liquid waste, and the new TLW facility currently in design, supports the projected processing throughput required for production of 30 ppy.

Solid waste generated at TA-55 consists of consumables (gloves, rags, plastics, wood, etc.), metal scrap from process equipment, gloveboxes removed from PF-4, process residuals (salt, ash, hydroxides, etc.) glass, ceramics, and tools that are contaminated. In FY 2020, the Material Recycle & Recovery program is funding expansion of the solid waste management capability at the Transuranic Waste Facility (TWF) to include drum characterization capabilities that will improve waste disposal throughput. After characterization and staging at TWF, the drums of waste are transferred to the RANT facility for packaging and shipment to WIPP. Prior to shipment, packaged solid TRU waste drums must be in compliance with the WIPP Waste Acceptance Criteria and certified through LANL's MC&A program. NNSA will explore waste

minimization techniques and technologies or other ways to minimize waste activities through laboratory directed or plant directed research projects for TRU waste shipped to WIPP, preserving this national asset's capacity.

3.4.1 Waste Shipment Milestones

Actions necessary in the waste management program to support the enduring pit production mission are:

- Continue to ship NNSA Newly Generated (NGEN) TRU waste from RANT to WIPP prior to WIPP's planned maintenance outage currently projected for FY 2022. The outage is needed to start up and operate the newly constructed Safety Significant Confinement Ventilation System in the 2023 timeframe.
- Develop and implement an approved radioactive waste plan to effectively and efficiently manage NNSA NGEN TRU waste for the eventual disposition of 1,500 drums per year, with a surge capacity of 2,000 drums per year, by 2023.
    - Maintain the feed of WIPP-certifiable waste to the Central Characterization Project (CCP) at the rates described above to retain TRU waste characterization, certification, mobile loading and shipping resources throughout the pit production period.
    - Collaborate with DOE's Carlsbad Field Office to ensure compliance with the Waste Acceptance Criteria for planned TRU waste shipments from LANL to WIPP.
        - Verify and validate that "suspect containers" are made compliant with WIPP's Waste Acceptance Criteria prior to review by the CCP for characterization and shipment to WIPP.
    - To maintain programmatic requirements, develop contingency plans to address unexpected shipment delays due to operational pauses at WIPP.
- Minimize solid waste storage within the TA-55 protected area by relocation of LLW storage by 2023.
- Update the TRIAD Rad Waste Program Plan and backup plan in the event WIPP is shut down for an extended period of time.

IV. Pit Production Equipment

In FY 2019, DOE/NNSA and LANL successfully completed the installation of the equipment required to reach FPU during 2023. The requirement to ramp up production to 10 ppy during 2024, and a steady-state production of 30 ppy during 2026, requires additional equipment to expand capacity.

Activities related to process equipment and gloveboxes, some of which are major items of equipment projects, include the D&D of legacy process equipment, equipment and glovebox refurbishment, and installation of new processing equipment and gloveboxes in PF-4. Each

activity has a need date determined by assessing the Pit PRT and LANL Production Agency schedules, which specify equipment must be available for intended use. Most of these activities are required to have turnover to operations complete by March 2022 to support FPU during 2023, and by September 2024 to support the ramp-up to 30 ppy capacity production which begins in 2025.

A high-level schedule reflecting equipment infrastructure activities necessary to achieve the 30 ppy requirement is in Figure 1 of the Classified Addendum.

(b)(7)(F)

The recapitalization of pit manufacturing equipment focuses on three major areas:

- Replacement of aging, end-of-life equipment with modern equipment, reducing maintenance costs and increasing throughput;
- Reconfiguration within existing facilities to remove process constraints and to improve material process flow by simplifying part movement and reducing pit component handling and potential damage; and
- Reconfiguration to support removal of obsolete gloveboxes that pose safety concerns, are costly to maintain, and interfere with the recapitalization plan.

Pit manufacturing equipment investments to reach 10 ppy reliably will continue to be managed and executed as capital equipment investments within the Plutonium Sustainment/Los Alamos Plutonium Operations program.[1] The physical areas undergoing reconfiguration are within the current operational spaces performing product and pit process activities, and the schedule of activities and projects are integrated with the day-to-day operations in PF-4. These efforts are managed by a common process that includes design, procurement, installation, and operational startup. This process verifies that each new equipment capability undergoes proper configuration control, testing, and qualification prior to being included in the pit production flow sheet. Additional investments to increase PF-4's production capacity to 30 ppy and supporting infrastructure at Los Alamos will be part of a line item construction project, the Los Alamos Plutonium Pit Production Project (LAP4) created in the *Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act, 2019* (P.L. 115-244).

Pit production equipment installation lists are provided in Figure 4 through Figure 10 in the Classified Addendum, organized by processes and pit manufacturing area within PF-4.

[1] Los Alamos activities funded under Plutonium Sustainment Operations in FY 2020 and prior have been moved to Los Alamos Plutonium Operations under the Production Modernization program in NNSA's new budget structure proposed in the FY 2021-2025 FYNSP.

V. Pit Production Facilities and Supporting Infrastructure

DOE/NNSA will produce 30 ppy at PF-4 during 2026 as part of the two-site solution to meet the requirement for no fewer than 80 ppy during 2030. In support of this enduring mission, investments at LANL in supporting infrastructure may be necessary and may include: office spaces, parking, training space, and other functions, as well as:

- Construction of the new TLW facility;
- Upgrades to PF-4 including seismic reinforcement, fire protection, and ventilation systems;
- Implementation of a classified wireless network within PF-4 for data collection of equipment process data into electronic build books for DOE/NNSA Diamond Stamping, the procedure to determine mark quality of war reserve pits;
- Completion of the CMRR subprojects RLUOB Equipment Installation phase 2 (REI2) and PF-4 Equipment Installation phase 1 (PEI1) to fulfill the transition of analytical chemistry (AC) and material characterization processes out of the old CMR facility;
- Upgrading and reclassifying the RLUOB to a Hazard Category 3 facility to support increases in actinide AC capability; and
- Continue investments across six enduring buildings to meet requirements, while managing the risks and costs associated with increasing production rates and maintaining operations.

Producing 30 ppy during 2026 at LANL requires continued facility recapitalization and elimination of deferred maintenance of the major safety and process systems for safe, secure, and reliable operations at TA-55. LANL and DOE/NNSA are partnering to prioritize the infrastructure investments to improve facility availability for manufacturing operations, to include ongoing equipment installation and facility modifications to optimize the pit production processes.

In addition to the recapitalization and infrastructure investments described, physical security investments may include additional protective force posts, patrols, and canine teams; security systems infrastructure; personnel security functions; and MC&A support. Proposed supporting infrastructure investments are sub-divided into two primary groupings: line-item construction projects, and small infrastructure projects.

5.1 Line-Item Projects

LANL recently completed several line-item projects integral to the enduring plutonium missions. CMRR, LAP4, the TLW Facility, and the TA-55 Reinvestment Project, Phase III (TRP III) are active line-item construction projects. For projects that are not baselined, estimates represent the

high end of the cost range based on preliminary assumptions that have yet to be validated and approved, and DOE/NNSA is actively working to minimize both cost and scope necessary to support the mission.

5.1.1 Chemistry and Metallurgy Research Replacement Project

The CMRR project relocates and consolidates actinide AC, materials characterization (MC), and actinide research capabilities that support all plutonium programs – pit production, surveillance, certification, plutonium science, and other national security programs. The CMRR project is under the scope parameters established at Critical Decision (CD)-1, *Approve Alternative Selection and Cost Range*, (2014) to include the necessary infrastructure and equipment needed to support missions assigned to LANL with nuclear AC and MC operations and supporting capabilities. There are currently four active subprojects in CMRR—REI2, PEI1, PEI2, and Recategorization of RLUOB to Hazard Category 3 (RC3). REI2 and PEI1 subprojects were baselined on October 31, 2016 and both projects are executing construction ahead of plan and under budget with a baseline project completion (CD-4, *Approve Start of Operations or Project Completion*) in mid-FY 2022. The remaining PEI2 and RC3 subprojects are in the design stage. The current FY 2021 funding profile in support of CMRR is summarized in Table 1.

Table 1: FY 2021 CMRR Funding Profile in Thousands ($K)

	Prior years	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025	Out years	Total
	$1,853,326	$169,427	$238,123	$113,655	$275,841	$198,477	TBD	TBD

5.1.1.1 RLUOB Equipment Installation Phase 2

The REI2 subproject improves the use of RLUOB by reconfiguring existing laboratory space and equipping empty laboratories with AC and MC capabilities. The increased radiological limit for RLUOB to 38.6 g of plutonium-239 equivalent, consistent with the new limit established by DOE/NNSA Supplemental Guidance NA-1 SD G 1027, supports the justification to additionally equip the available laboratory space in this facility. Specific capabilities covered by the REI2 scope include:

- Coulometry
- X-ray fluorescence
- Sample preparation for the following analyses
  - Trace elements
  - Mass spectrometry
  - X-ray fluorescence
  - Radiochemistry counting laboratory
  - Oxide and metal

REI2 also supports installation of AC and MC capabilities for R&D, troubleshooting production processes, and other applications for LANL's role as the Nation's Plutonium Center of Excellence.

5.1.1.2 PF-4 Equipment Installation Phase 1

The PEI1 subproject is the consolidation of existing PF-4 processes, reusing existing gloveboxes for new processes, D&D of old gloveboxes and equipment in PF-4, and installation of new gloveboxes and equipment. PEI1 will support the AC and MC capabilities for the processing of larger amounts of nuclear material into small samples prior to analysis in RLUOB.

Specific capabilities covered by the PEI1 scope include:

- Small-sample fabrication and preparation for AC;
- Surface science; and,
- Physical property measurements.

Prior to the *Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act, 2019* (P.L. 115-244), there were two additional subprojects in the CMRR project – PEI2 and RC3. House Report 115-929 accompanying FY 2019 appropriations directed these two subprojects to be removed from the CMRR project and placed into LAP4. As directed in House Report 116-83 accompanying the *Energy and Water Development and Related Agencies Appropriations Bill, 2020*, the PEI2 and RC3 subprojects are again funded in the CMRR line-item for FY 2020. NNSA's FY 2021 FYNSP includes funding for these subprojects in the CMRR line-item.

A high-level schedule for AC and MC equipment infrastructure planned for the CMRR project is in Figure 11 of the Classified Addendum.

5.1.1.3 PF-4 Equipment Installation Phase 2

The PEI2 subproject will establish advanced MC capabilities to support all plutonium missions and maintain LANL as the Nation's Plutonium Center of Excellence. This subproject consolidates MC capabilities in TA-55 PF-4 relocating existing capabilities, replacing existing equipment, installing gloveboxes and equipment, D&D of legacy equipment, and infrastructure.

Table 2 provides a summary of proposed projects where the maturity and cost estimate rigor varies depending on the activity. The estimates may include contingency of up to +100 percent.[2]

[2] Such approximation is consistent with American Association of Cost Engineering International (AACEI) guidance for Class 5, rough-order-of-magnitude (ROM) estimates.

Table 2. LANL Proposed TA-55 General Infrastructure Projects under CMRR

Project	Proposed Need Date	High-end of the Estimated Cost Range (K)
TA-55 PF-4 Post 118 Expansion	2022	$43,000
TA-55 PF-4 Post 116 Expansion	2024	$29,000
TA-55 PF-3 Change Room Expansion	2022	$35,000
TA-55 West Vehicle Access Upgrade	2023	$35,000
TA-55 Warehouse	2024	$26,000
TA-55 (Vicinity) Office Building and Parking	2024	$106,000[3]

5.1.1.3.1 TA-55 PF-4 Post 118 and Post 116 Expansion

The increase in programmatic activity in PF-4 is creating the need for increased capacity and efficiency for ingress and egress of the workforce. Pre-conceptual design work was completed during an earlier evaluation of this scope. Once final configuration and capacity requirements are defined, the cost, scope, and schedule estimates will be revised accordingly. The larger cost for Post 118 is due to common scope necessary for both Post expansion projects, if executed.

(b)(3) UCNI

5.1.1.3.3 TA-55 West Vehicle Access Upgrade

Similar to the capacity issues outlined above, increased vehicle access for shipments and supporting activities are also needed. The TA-55 West Vehicle Access cost estimate is based on similar scope from the Nuclear Material Safeguards and Security Upgrade Project Phase 2 (NMSSUP II) project. Scenarios being evaluated for both vehicle access portals will require upgraded access points through the existing Perimeter Intrusion Detection and Assessment System (PIDAS). Once final configuration and requirements are defined, the cost, scope, and schedule estimates will be revised accordingly.

5.1.1.3.4 TA-55 Warehouse

Projected storage capacity of existing warehouse space is inadequate and an additional warehouse is required to support TA-55 activities. The basis of the warehouse estimate is the

[3] NNSA continues to refine requirements for office and parking space associated with the pit production mission. While all cost estimates for general infrastructure are preliminary, this estimate in particular is a very rough order of magnitude and is currently under evaluation. NNSA will continue to value engineer office and parking facilities to increase affordability.

new warehouse (30,000 sq. ft.) being built at TA-46. Given scope uncertainty, a 60,000 sq. ft. structure has been priced. Once final configuration and requirements are defined, the cost, scope, and schedule estimates will be revised accordingly.

5.1.1.4 RLUOB Hazard Category 3

The RC3 subproject completes the build-out of AC and MC characterization equipment in RLUOB. This project includes the installation of gloveboxes, open-front hoods, and standalone equipment for AC and MC operations. This subproject will be completed after the elevation of RLUOB to a Hazard Category 3 Nuclear Facility (limited to 400 g of plutonium-239 equivalent). This increase in the material at risk (MAR) limit to 400 g will further improve the RLUOB to support the AC and MC requirements for all plutonium missions.

5.1.2 Transuranic Liquid Waste Facility

The TLW facility project replaces the obsolete TRU liquid waste treatment capability required for all plutonium missions at TA-55. The existing TRU liquid waste capability is part of RLWTF at TA-50 that was constructed in 1963. The replacement for LLW treatment capability was completed in November 2018. The proposed TLW capability will be housed in an independent Hazard Category 3 nuclear facility that is designed to treat at least 29,000 liters of liquid TRU waste per year. The design capacity is based on supporting all plutonium-related missions in PF-4, including pit production at 30 ppy. This project is in the design stage and forecast to be baselined in the first quarter of FY 2021.

5.1.3 TA-55 Reinvestment Project, Phase III

The TRP III project replaces the obsolete fire alarm control panel, detection system, initiating devices, monitoring modules, addressable relay modules, and notification system that services TA-55 PF-4 and other structures at TA-55. The existing system was installed when the facility was constructed in the mid-1970s. The current panel and the associated existing fire detection, control, and evacuation devices are not National Fire Protection Association or *Americans with Disabilities Act* compliant. Repair and replacement parts are not available and the system continues to be under frequent maintenance. The fire alarm control panel represents a single-point vulnerability for TA-55 PF-4.

TRP III attained CD-0, *Approve Mission Need,* approval. The execution strategy will request CD-1/2/3 approval in 2021 with a goal of CD-4 completion in 2026.[4]

5.1.4 Los Alamos Plutonium Pit Production Project

The *Energy and Water, Legislative Branch, and Military Construction and Veterans Affairs Appropriations Act, 2019* (P.L. 115-244) created a new line item construction project to increase

[4] CD-1: Approve Alternative Selection and Cost Range; CD-2: Approve Performance Baseline; CD-3: Approve Start of Construction or Execution; CD-4: Approve Start of Operations or Project Completion.

PF-4's production capacity and provide additional infrastructure for pit production at LANL. Scope proposed for this project includes pit production equipment needed to increase PF-4's production capacity from 10 ppy to 30 ppy during 2026 as well as several, to be determined infrastructure investments. The FY 2021 LAP4 funding request of $226 million supports development of design documentation, long-lead procurements, and conduct of facility and site preparation at PF-4. This project is in the conceptual design phase and additional detail will be provided to Congress in future budget requests. Table 3 provides a summary of infrastructure subprojects that LANL has proposed that DOE/NNSA has yet to approve. The estimates may include contingency of up to +100 percent due to the lack of scope definition.

Table 3. LANL Proposed TA-55 General Infrastructure Projects under LAP4

Project	Need Date	High-end of the Estimated Cost Range (K)
TA-48 Plutonium Training, Support, and Development Center	2024	$490,000
TA-48 Office Building and Parking Structure	2024	$368,000
TA-55 West Entry Control Facility	2023	$119,000
TA-55 East Vehicle Access Upgrade	2024	$35,000
Building for Office and Parking for Security Workforce	2024	$90,000

5.1.4.1 Equipment

The installation of pit production equipment needed to increase PF-4's capacity beyond 10 pits per year reliably to achieve a production rate of 30 ppy during 2026 is a critical component of LAP4.

5.1.4.2 TA-48 Office Building and Parking Structure

The current use rate of office space in and around TA-55 is near capacity for current operations. The growth in staff illustrated in Figure 2 necessitates office space and parking near TA-55. The size and capacity for additional office space and parking for the additional staff is under evaluation and is part of conceptual design efforts.

5.1.4.3 TA-48 Plutonium Training, Support, and Development Center

Preparing for the new workforce and sustainment of long-term operations requires additional training facilities. LANL has proposed and NNSA is evaluating the expansion of training areas, development classrooms and laboratories, associated support office space (approximately 300 workstations), conference rooms, and a cafeteria. As with office and parking facilities, NNSA will aggressively value engineer any investments to increase affordability.

5.1.4.4 TA-55 West Entry Control Facility

Infrastructure expansion for the workforce on the west side of TA-55 will introduce a need for increased throughput of personnel beyond the current capacity. The addition of a West Entry Control Facility (ECF) is projected to meet capacity requirements and realize efficiencies. The scope of the TA-55 West ECF is based on the existing TA-55 East ECF (building, PPIV booths, etc.). The estimate is based on the actual cost for similar work performed on the NMSSUP II project and adjusted for escalation accordingly.

5.1.4.5 TA-55 East Vehicle Access Upgrade

Increased vehicle access for production related shipments and supporting activities and current scenarios are being evaluated for both vehicle access portals and will require cutting into the existing PIDAS. Once final configuration and requirements are defined the cost, scope, and schedule estimates will be revised accordingly.

5.1.4.6 Building for Office and Parking for Security Workforce

Additional capacity and capability is needed for the proposed increase in the security force. Pre-conceptual information is being developed for the Security Complex with exact location still under development. The initial estimate is that 50–75 offices, muster rooms for an additional 250–300 security subcontractors, locker room, weapons equipment issue room, computer lab, etc., are needed and serve as the basis of the preliminary estimate developed for this scope and are priced based on historical pricing from similar work.

5.2 Small Projects

There are numerous smaller projects in TA-55 PF-4, RLUOB, the nuclear waste facilities, and supporting infrastructure that are necessary to support all plutonium missions. The small projects cover a wide range of needs (e.g., office buildings, seismic upgrades, fire water loop replacement, boiler system upgrades, etc.). Small projects are intended to make facilities reliably available for programmatic work, address Defense Nuclear Facility Safety Board concerns, and meet the State of New Mexico Environment Department requirements. As illustrated in Table 4 through Table 8 below, the completion dates of the small projects range from 2019 to 2028. Additional planning resources will be required needed for scheduled integration and project execution.

5.2.1 Recapitalization

The Recapitalization: Infrastructure & Safety program, led by DOE/NNSA's Office of Safety, Infrastructure, and Operations, is responsible for small projects to revitalize infrastructure in TA-55. These projects represent a set of facility-based projects that include items such as the TA-55 fire water loop and the TA-55 PF-4 fire penetrations, ventilation, wet vacuum, and seismic switch upgrades for the electrical power distribution system, are delineated in Table 4.

Table 4. Proposed Recapitalization Projects

Recapitalization Project	Required By	TPC (K)
PF-4 High Risk Variable Frequency Drive Fan Safety Upgrades	2020	$5,400
PF-4 Medium Risk Variable Frequency Drive Fan Safety Upgrades	2020	$1,700
PF-4 Fire Wall Upgrades	2020	$5,500
PF-4 Zone 1 Damper Controls and Actuators Safety Upgrades	2022	$7,000
RLWTF Tank Removal and Ground Water Monitoring Well Replacement	2021	$6,600
PF-4 Fire Suppression System 2 Over 1 Issues Upgrade	2022	$10,400
PF-4 Secondary Lift Installation	2022	$1,430
RLUOB Secondary Fire Pump Installation	2021	$6,143
PF-4 Public Address System Upgrade	2021	$3,036
RLWTF Clarifier Number 1 Stabilization	2021	$4,850
PF-4 Power and Communications Systems Upgrade	2021	$15,966
PF-4 High Pressure Feed Separation	2023	$10,300
RLWTF Clarifier Number 2 Stabilization	2023	$5,000
RLWTF Two Concrete Effluent Storage Tanks Stabilization (N25K and S25K)	2025	$6,112
PF-4 Fire Water Loop Component Replacement (Pumps and Boilers)	2021	$8,700
RLWTF Concrete Gravity Filter Stabilization	2023	$6,000
PF-4 Controls Systems Upgrade	2025	$6,500
PF-4 Health Physics Vacuum Refurbishment	2023	$6,000
(b)(7)(F)	2023	$6,400
PF-4 Generator and Power Supply Upgrades	2024	$11,000
PF-4 North Fire Suppression Cast Iron Fittings Refurbishment	2024	$4,750
PF-4 South Fire Suppression Cast Iron Fittings Refurbishment	2024	$4,750
RLUOB Robust Safety Management Programs (SMP): SNM Handling	2025	$5,770
RLUOB Robust SMP: Radiological Control and Industrial Hygiene	2025	$7,811
RLUOB Robust SMP: Configuration Management and Engineering	2025	$6,925
PF-4 Respirator Distribution and Health Facility Upgrades	2025	$9,000
RANT Crane and Lift Equipment Infrastructure Replacement	2024	$5,500
Environmentally Protect the 480 West Pad at TA-55	2024	$3,500
PF-4 Plenum Component Refurbishment	2024	$5,500
PF-4 Non-Seismic Building Separation	2024	$6,350
PF-4 Boiler System Upgrade	2026	$6,384
PF-4 Zone 1 Exhaust Fan Replacement	2025	$4,000
PF-4 Compressed Gas Infrastructure	2024	$9,000
PF-4 Zone 2 Bleed Off Fans Replacement	2025	$2,900
Utilize West Access to PF-4 for Drum and Commodities Movement	2025	$11,000
Facility Wet Vacuum Replacement (Balance of plant)	2025	$16,000
(b)(7)(F)		

Recapitalization Project	Required By	TPC (K)
PF-4 Uninterruptable Power Supply Revitalization	2025	$5,000
TA-55 Outland Ventilation Control System Refurbishment	2024	$6,500
Total		**$261,277**

5.2.2 Maintenance

The Facility Maintenance program is responsible for TA-55 PF-4 facility maintenance small projects. These projects are focused on radiological instrumentation, motor control center revitalization, glovebox fire suppression, instrument air system modernization, fire pumps, Documented Safety Analysis implementation, etc. These facility systems support all programmatic operations in the plutonium enterprise and are essential for ongoing operations, and are listed in Table 5.

Table 5. Proposed Maintenance Projects and Activities

Small Project or Activity	Required By	TPC (K)
Column Capital Testing	2022	$2,000
D&D Halon System in PF-4 Operations Center	2026	$350
Instrument Air System Modernization	2022	$300
New vault room or relocation of the water baths	2024	$6,500
Relocate Vault Administration Area	2022	$2,333
Replace Halon system in PF-4 Operations Center	2022	$2,500
SAFER Structural Modifications for SS and SSCs	2022	$6,000
TWF: High-Efficiency Neutron Counter, Real Time Radiography, and Flammable Gas Stand-Up	2022	$2,300
Upgrades to the Weather Stations for Safety Basis	2022	$7,400
Total		**$29,683**

5.2.3 LANL Site Support

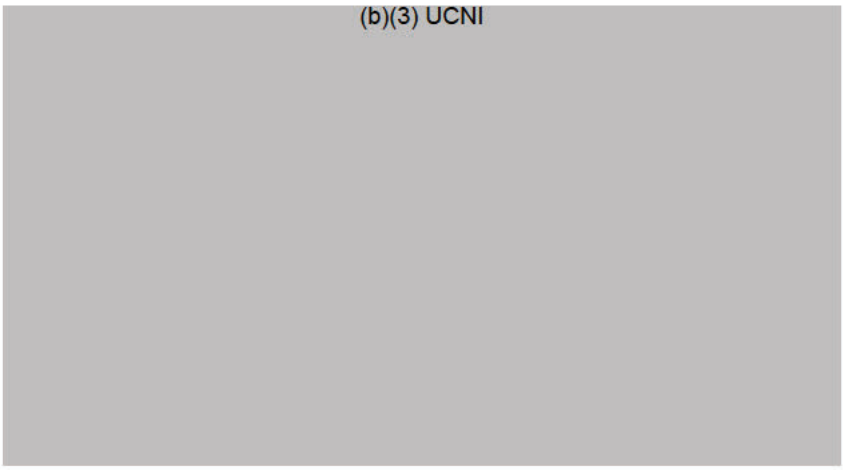
The LANL site support program will address institutional office and parking needs through institutional general plant projects and other non-line-item actions, as indicated in Table 6.

Table 6. Proposed Site Support Projects and Activities

Small Project or Activity	Required By	TPC (K)
General Purpose Office Building in Pajarito Corridor	2022	$19,000
Increase PPIV booth capacity at East ECF	2022	$7,000
Parking Structure in the Pajarito Corridor	2021	$17,500
Total		**$43,500**

5.2.4 Material Recycle and Recovery

The Material Recycle and Recovery (MR&R) program, led by DOE/NNSA's Office of Defense Programs, is responsible for activities related to PF-4 glovebox upgrades and the testing of fire-rated containers, and are listed in Table 7. For instance, MR&R identified 13 gloveboxes in the PF-4 facility to be repurposed and upgraded to process newly generated residues and dispose legacy materials from the PF-4 vault.



5.2.5 Capability Based Investments

Capability Based Investments (CBI), led by DOE/NNSA's Office of Defense Programs, is responsible for activities that will replace or upgrade the material conveyance system, glovebox stands, inert gas distribution, and the dry vacuum system. These facility systems support all programmatic operations in the plutonium enterprise and are essential for ongoing operations, and are listed in Table 8.

Table 8. Proposed CBI Projects and Activities

Small Project or Activity	Required By	TPC (K)
Trolley Replacements – Bucket Operations	2022	$5,000
Trolley Replacements – Controllers	2022	$4,254
Trolley Replacements – Bus Bar	2022	$18,060
PF-4 Refurbishment of Oxygen Monitoring	2022	$3,000
Modifications to Inert Gas Distribution System	2024	$20,000
Total		**$50,314**

VI. Funding Sources and Cost Summary

DOE/NNSA program and functional offices responsible for developing and requesting funding in support of the 30 ppy activities include the Office of Defense Programs, the Office of Safety, Infrastructure and Operations, and the Office of Defense Nuclear Security. Funding sources and cost summaries for the initial LANL proposal for pit production equipment, general infrastructure, and small projects necessary to establish the capability to produce 30 ppy are enumerated in this section. Costs listed within this report are estimates for planning purposes. The maturity and cost estimate rigor varies depending on the maturity of the activity, with cost estimate ranges varying from -50 percent to +100 percent.

DOE/NNSA and LANL continue to install the equipment needed to produce 10 ppy at 90 percent confidence in PF-4 funded under the Plutonium Sustainment Program, managed within the Office of Defense Programs through FY 2020 and beyond. Pit production equipment and other supporting infrastructure is being installed to increase PF-4's capacity from 10 ppy to 30 ppy reliably (at 90 percent confidence) as a line-item construction project in FY 2021 and beyond. The estimates for specific pieces of equipment in this document represent data available at the time, and are estimated under acquisition as individual items of capital equipment; these estimates will be revised to reflect acquisition through a line-item construction project as the design matures.

In FY 2019, Plutonium Sustainment funded activities at approximately $45 million to install the equipment needed to produce 10 ppy. Starting in FY 2020, funding for these activities through Plutonium Sustainment/Los Alamos Plutonium Operations will increase to $80 – $100 million, subject to availability of appropriations, and continue at that level through 2023, subject to appropriations. The funding request for the line item construction project to install the equipment and associated infrastructure to reach 30 ppy reliably, summarized in Table 9, is under evaluation.

Table 9. FY 2021 30 ppy Funding Profile in Thousands ($K)

	FY 2021	FY 2022	FY 2023	FY 2024	FY 2025
LANL Pu Operations	$610,599	$635,280	$733,217	$810,188	$842,549
LAP4	$226,000	$350,000	$500,000	$450,000	$200,000
Enterprise Pu Support	$90,782	$88,913	$67,969	$67,330	$77,004

The cost summary for pit production equipment installation rolled-up by processes are captured in Table 10.

Table 10. Pit Manufacturing Equipment List Cost Summary

Pit Manufacturing Equipment List	Cost (K)
Metal Preparation Process	$97,100
Foundry Process	$52,800
Machining Process	$140,600
Welding Process	$18,700
Assembly Process	$106,700
Inspection Process	$40,200
Metallography Process	$14,900
Support Infrastructure Process	$22,300
Total	**$493,300**

General Infrastructure investments, rolled-up in Table 11, may include upgrades in PF-4 and RLUOB, construction of new facilities in and around TA-55, and modifications to existing facilities and utilities along LANL's Pajarito Corridor. The amount listed below is the high end of the cost range based on preliminary assumptions that have yet to be validated and approved. DOE/NNSA is actively working to minimize both cost and scope necessary to support the mission.

Table 11. General Infrastructure Cost Summary

General Infrastructure	Cost (K)
TA-55 General Infrastructure Projects	$1,376,000
Total	**$1,376,000**

NNSA's FY 2021-2025 FYNSP includes funding to support small projects, rolled-up in Table 12, to install, modify, or upgrade equipment; upgrade and maintain facilities and associated utilities; and build new facilities. These small projects are funded by Recapitalization, Maintenance, LANL Site Support, MR&R, and CBI programs. As NNSA refines requirements and matures designs, out year plans may change.

Table 12. Small Projects Cost Summary

Small Projects	Cost (K)
Recapitalization	$261,267
Maintenance	$29,683
LANL Site Support	$43,500
Material Recycle and Recovery	$33,092
Capability Based Investments	$50,314
Total	**$417,866**

6.1 Plutonium Sustainment Equipment Cost and Performance Summary

Determining actual costs for completed Plutonium Sustainment equipment investment activities, cost, and performance to schedule is achieved by using initial estimates and actual execution data. To date, pit production equipment installation activities have been managed as discrete capital equipment efforts funded through the Plutonium Sustainment program. Under this approach, early estimates are developed based on qualitative assessments of equipment and enclosure complexity. These estimates are updated based on input from the design team and bids for specific items of equipment. Contingency and Management Reserve funding are held at the program level, rather than at the specific site level to balance risk between ongoing operations and equipment installation since both activities are limited by operator and facility availability.

Mindful of past cost overruns, LANL is working to understand what factors have led to cost growth in the past and is working with DOE/NNSA to correct those factors and refine cost estimating procedures. Specific examples of lessons from prior projects that are being applied to cost estimates include:

- Fabricating mock-up glovebox enclosures using plywood in cold environments to ensure the enclosure design support operations and maintenance procedures;
- Fabricating of enclosures and testing equipment in cold environments, prior to moving them to operating nuclear facilities;
- Estimating cost and schedule accounting for the extensive modification of equipment for operations in challenging glovebox environments; and
- Involving pit production operators and equipment technicians extensively throughout the initiation, design, procurement, fabrication and installation of new equipment and gloveboxes.

VII. Interactions with Other Programs

Programs aside from pit production that occupy space in PF-4 rely on the base infrastructure at TA-55, including TA-55 shipping and receiving, storage, NDA, and waste management capabilities. DOE/NNSA is developing a document for all the requirements for any program that is dependent on PF-4 to codify each program and establish a change control methodology. The goal of this document is to prevent individual programs from making changes without evaluating the effects on other programs that depend on PF-4. Key programs and the associated interfaces are discussed in this section.

7.1 Pit Surveillance

The equipment and workforce used for pit surveillance are also used to inspect and destructively evaluate newly fabricated pits. (b)(7)(F)

7.2 Plutonium Science and Subcritical Experiments

Plutonium Science and Subcritical Experiments Programs rely on most of the elements of the pit manufacturing process, as well as on a skilled workforce, to make plutonium experimental components and evaluate the components before and after experiments. Equipment and process interfaces include electrorefining, casting, machining, assembly, coring, metallography, AC, and MC. Experimental activities will not interfere with manufacturing operations, although could interfere with pit certification and pit surveillance activities, as all three share the resources (equipment and staff) for pit disassembly, sample extraction and preparation, and MC. While plutonium science and pit production may share resources, there are also benefits to co-locating this work. Scientific work is often more challenging than production work, requiring a deeper understanding of the equipment used. Fabrication of experimental components is challenging, necessitating continuous improvement in both understanding of basic science and skill at troubleshooting and resolving fabrication issues. The opportunity for staff to work on unique experiments improves workforce skills supports improved proficiency on equipment that is shared with pit production, and facilitates experienced staff to train and educate newly hired staff.

7.3 Pit Disassembly and Conversion

Please reference the Classified Addendum for more details on pit disassembly and conversion.

7.4 Plutonium-238

The plutonium-238 operations team is examining options for removing some material from the PF-4 vault to free up additional vault space for other programs, including pit manufacturing. Plutonium-238 operations use a large fraction of the PF-4 MAR. MAR is the quantity of material that can be released and cause adverse health consequences to workers and the public under postulated accident scenarios. PF-4 limits the total amount of MAR that can be present in operational areas and plutonium-238 activities use a large fraction of the MAR permitted in PF-4.

If expansion of pit production operations results in using more of MAR than permitted, there could be conflicts between plutonium-238 and other programs for the available MAR. LANL is mitigating this potential issue by establishing safety-credited containers for material not in process, reducing the contribution to the MAR in PF-4 from plutonium-238 materials.

As the only operating Hazard Category 2, Security Category 1 plutonium science facility in the Nation, PF-4's activities go beyond the pit manufacturing mission and other DOE/NNSA missions. Recognizing the importance of this facility and the increased demand from pit production in the future, DOE/NNSA is assessing the requirements for the various DOE/NNSA missions that rely on PF-4. After codifying the requirements for the missions in PF-4, DOE/NNSA and LANL will develop a change control process to validate that future changes to requirements for PF-4 are prioritized, reviewed, and approved at the appropriate level. This approach will provide a way to evaluate effects to other programs within the facility, improving the ability to balance PF-4 resources and identify potential issues early.

VIII. Production of Pits 31-80 at Los Alamos National Laboratory

Section 3120(c) of the FY 2019 NDAA also requested a detailed plan for designing and carrying out production of plutonium pits 31-80 at LANL. As part of the 2018 Plutonium Pit Production Engineering Assessment (EA), a team of subject matter experts and Enterprise Construction Management Services contractors evaluated pre-conceptual design drawings for an option to achieve 80 ppy in PF-4 in tandem with new production module construction. Please refer to the EA, delivered to Congress in May 2018, for additional details on the layout drawing and equipment needed.

The EA concluded that a strategy to produce 80 ppy at LANL in PF-4 or newly constructed production modules had the highest risk of all options examined and installation of additional equipment in PF-4 to achieve 80 ppy could disrupt ongoing operations to achieve 30 ppy. In addition, in response to another portion of Section 3120 of the FY 2019 NDAA, the Institute for Defense Analyses (IDA) found the proposal to install additional equipment in PF-4 to reach an 80 ppy production rate was a "very high risk" approach. DOE/NNSA accepts both the EA results and IDA's statement regarding attempting to reach 80 ppy in PF-4 as PF-4 currently hosts the sole U.S. pit production capability, as well as other missions, and will reach its assumed 50-year design life before 2030. Although DOE/NNSA continues to invest in facility sustainment projects to extend the life of the facility and reduce public and operations safety risks, any long-term commitment to achieve 80 ppy at LANL would either require future investments in PF-4, and/or in a new facility to address the eventual need to replace PF-4.

IX. Conclusion

Throughout 2019, LANL and DOE/NNSA teams worked together to refine the understanding of the infrastructure and resources needed to reach and sustain a 30 ppy production capacity mission. While prior efforts focused mainly on the pit production equipment necessary to produce 30 ppy, these recent efforts have expanded to evaluate staffing needs beyond pit production personnel, infrastructure beyond PF-4, and other supporting capabilities.

The Plutonium Program Office, within DOE/NNSA's Office of Defense Programs, provides the management and oversight of the mission requirements and investments needed to restore the capability to manufacture no less than 80 ppy during 2030. The Plutonium Program Office provides the programmatic direction and funding to DOE/NNSA's national laboratories, plants, and sites to hire and train the workforce, modernize equipment and infrastructure, and deliver plutonium pits for the nuclear security enterprise.

LANL will continue to refine input to support the mission while minimizing costs. The FY 2021 President's Budget Request reflects the programmatic, infrastructure, and security needs at LANL to meet 30 ppy during 2026.

Glossary

40	40 mm Gas Gun
AACEI	American Association of Cost Engineering International
AC	Analytical Chemistry
AoA	Analysis of Alternatives
CBI	Capability Based Investments
CD	Critical Decision
CMR	Chemistry and Metallurgy Research
CMRR	Chemistry and Metallurgy Research Replacement
D&D	Decontamination and Decommissioning
DEV	Development
DOE/NNSA	Department of Energy's National Nuclear Security Administration
EA	Engineering Assessment
ECF	Entry Control Facility
ENV	Environmental Testing
FDR	Final Design Review
FPU	First Production Unit
FST	Full Scale Test
FY	Fiscal year
FYNSP	Future Years Nuclear Security Program
IDA	Institute for Defense Analyses
IPR	Interlaboratory Peer Review
IPT	Integrated Project Team
KCNSC	Kansas City National Security Campus
Kolsky	Kolsky Bar Tests
LANL	Los Alamos National Laboratory
LLNL	Lawrence Livermore National Laboratory
LLW	Low-level (radioactive) Liquid Waste
MAR	Material at risk
MC	Materials Characterization
MD	Material Disposition
MC&A	Material Control and Accountability
MFFF	Mixed Oxide Fuel Fabrication Facility
MOX	Mixed Oxide
NDA	Nondestructive Assay
NDAA	National Defense Authorization Act
NMSSUP II	Nuclear Material Safeguards and Security Upgrade Project Phase 2
PEI1	PF-4 Equipment Installation Phase 1
PEI2	PF-4 Equipment Installation Phase 2
PF	Plutonium Facility
Phys	LLNL Physics Tests

PIDAS	Perimeter Intrusion Detection and Assessment System
PIGMA	Pressurized Inert Gas Metal-Arc
PPI	Process-Prove-In
PPIV	Positive Personnel Identification and Verification
ppy	pits per year
PRR	Production Readiness Review
PRT	Product Realization Team
QE	Qualification Evaluation
QER	Qualification Evaluation Release
QUAL	Qualification
RANT	Radioactive Assay Nondestructive Testing
RC3	Recategorization of RLUOB to Hazard Category 3
REI2	RLUOB Equipment Installation phase 2
RLUOB	Radiological Laboratory Utility Office Building
RLW	Radioactive Liquid Waste
RLWTF	Radioactive Liquid Waste Treatment Facility
ROM	Rough-order-of-magnitude
SAFER	LANL Document Code
SCE	Subcritical Experiments
SMP	Safety Management Program
SNM	Special Nuclear Material
SRPPF	Savannah River Plutonium Processing Facility
SRS	Savannah River Site
SS	Structures and Systems
SSC	Structures, Systems, and Components
TA	Technical Area
TEM	Transmission Electron Microscopy
TLW	Transuranic Liquid Waste
TPC	Total Project Cost
TRP III	TA-55 Reinvestment Project III
TRU	Transuranic
TWF	Transuranic Waste Facility
WIPP	Waste Isolation Pilot Plant