



U.S. DEPARTMENT OF
ENERGY

NNSASM
National Nuclear Security Administration

Pit Production Contingency Plans

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

Message from the Administrator

After considerable study, including all necessary activities under the *National Environmental Policy Act*, the Department of Energy's National Nuclear Security Administration (DOE/NNSA) concluded that a two-site approach using two existing facilities to reestablish pit production was the optimal way to proceed based on resiliency against unplanned outages, schedule to implement, and costs (both for implementation and life cycle). The two-site approach as initially envisioned enhances capabilities at the existing Los Alamos National Laboratory (LANL) Plutonium Facility 4 (PF-4), in Los Alamos, New Mexico (carried out through the line-item Los Alamos Plutonium Pit Production Project [LAP4]), to achieve a 30 war reserve (WR) pits per year (ppy) capacity in 2026 and repurposes the existing facility formerly known as the Mixed Oxide Fuel Fabrication Facility (MFFF) at the Savannah River Site (SRS), near Aiken, South Carolina, into the Savannah River Plutonium Processing Facility (SRPPF) to achieve a 50 WR ppy capacity in 2030.

Based on the latest subject matter expert-developed conceptual designs and cost and schedule ranges, meeting 30 WR ppy at LANL during 2026 is achievable, but meeting the full 80 ppy during 2030 is not achievable, as production at SRPPF will not yet be available. Following additional analysis and acquisition milestones, DOE/NNSA now assesses the additional 50 WR ppy from SRPPF, to reach the full 80 ppy capacity, is achievable in the 2032-2035 timeframe contingent upon the potential for both implementation and technical options to accelerate both project completion and transition to WR pit production. Producing no fewer than 80 WR ppy as close as possible to the 2030 date remains a high priority, particularly considering uncertainties associated with performance due to the aging of plutonium in existing pits and meeting new safety and security requirements. DOE/NNSA is working closely with the subject matter experts responsible for the LAP4 and SRPPF projects to identify and mitigate risks to completing these two projects on time and within budget. DOE/NNSA will also assess options to find project schedule efficiencies to enable returning the delivery date as close as possible to 2030 and/or surging pit production above 80 WR ppy for a period of time to recover delayed deliveries in the mid-2030s.


Pursuant to legislative requirements, this report is being provided to the following Members of Congress:

- **The Honorable Richard Shelby**
Chairman, Senate Committee on Appropriations
- **The Honorable Patrick Leahy**
Vice Chairman, Senate Committee on Appropriations
- **The Honorable Dianne Feinstein**
Chairman, Subcommittee on Energy and Water Development
Senate Committee on Appropriations

- **The Honorable John Kennedy**
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
House Committee on Appropriations
- **The Honorable Mike Simpson**
Ranking Member, Subcommittee on Energy and Water Development
House Committee on Appropriations

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

Sincerely,



Jill Hruby
Under Secretary for Nuclear Security
Administrator, NNSA

Executive Summary

The United States must reestablish the capability to produce plutonium pits as close to 2030 as possible to ensure the long-term effectiveness of the U.S. nuclear deterrent. The Department of Energy's National Nuclear Security Administration (DOE/NNSA) assesses that any delays would be an extremely high-risk approach. Though further research to improve understanding of plutonium and pit aging is necessary, this research must continue in parallel to pit production efforts. Waiting for research to yield greater fidelity in pit lifetime estimates gives time for plutonium aging risks to realize. This could result in significant issues for the stockpile and a loss of confidence in the U.S. nuclear deterrent for a considerable period.

DOE/NNSA identified the two-site approach to reestablishing pit production as the optimal way to proceed based on resiliency against unplanned outages, schedule to implement, and acquisition costs. The two-site approach includes enhancing pit production capabilities at the Los Alamos National Laboratory's (LANL) Plutonium Facility 4 (PF-4), in Los Alamos, New Mexico to produce 30 WR ppy during 2026 (carried out through the line-item Los Alamos Plutonium Pit Production Project [LAP4]) and repurposing the existing facility formerly known as Mixed Oxide Fuel Fabrication Facility (MFFF) into the Savannah River Plutonium Processing Facility (SRPPF) at the Savannah River Site (SRS), near Aiken, South Carolina to produce 50 WR ppy.

This report identifies ways to mitigate warhead deliverable risk and assumes both LAP4 and SRPPF move forward as currently planned. However, delays in demonstrating the required rates of 30 WR ppy at LANL and 50 WR ppy at SRS are possible. This report assumes a capacity for 80 WR ppy is achieved no later than 2035.

Producing no fewer than 80 WR ppy as close as possible to the 2030 date remains a high priority for DOE/NNSA, particularly considering uncertainties associated with performance due to the aging of plutonium in existing pits and meeting new safety and security requirements. DOE/NNSA is working closely with the subject matter experts responsible for pit production projects at both LANL and SRS to identify and mitigate risks to completing these two projects on time and within budget. DOE/NNSA is also coordinating with the Department of Defense to identify options to mitigate against risks to required warhead deliverables during this period until 80 WR ppy is established.



Pit Production Contingency Plans

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I. Legislative Language

This report responds to legislative language set forth in House Report 116-449 accompanying the *Consolidated Appropriations Act, 2021* (P.L. 116-260), wherein it states:

“The NNSA is directed to develop, in coordination with the Department of Defense, a contingency plan to meet the needs of the nuclear deterrent that do not solely rely on the current need dates for pit production. This plan shall be submitted to the Committee not later than 120 days after enactment of this Act, and updated and submitted each year thereafter with the budget request. The plan shall include options to ramp up pit production that extend the current need dates for pit production; how the hedge and fielded stockpile could be configured to serve as an interim solution; and an estimate of how many years current pit production need dates could be extended by advancing pit reuse concepts.”

II. Introduction

The United States must reestablish the capability to produce plutonium pits as close to 2030 as possible to ensure the long-term effectiveness of the U.S. nuclear deterrent. The Department of Energy’s National Nuclear Security Administration (DOE/NNSA) assesses that any delays would be an extremely high-risk approach. Though further research to improve understanding of plutonium and pit aging is necessary, this research must continue in parallel with pit production efforts. Waiting for research to yield greater fidelity in pit lifetime estimates gives time for plutonium aging risks to realize. This could result in significant issues for the stockpile and a loss of confidence in the U.S. nuclear deterrent for a considerable period.

A second JASON’s study¹ of the plutonium aging/pit lifetime question recently concluded:

Finally, we urge that pit manufacturing be re-established as expeditiously as possible in parallel with the focused program to understand Pu aging, to mitigate against potential risks posed by Pu aging on the stockpile. The reuse of aged pits in rebuilt primaries can address certain issues but cannot change the aged pits themselves. A significant period will be required to recreate the facilities and expertise needed to manufacture Pu pits. Given the number and age distribution of weapons in the stockpile, it will then include some eighty-year-old pits, even under most favorable circumstances.

Deviating from the Department of Defense’s (DoD) 2030 requirement could increase operational risk. Implementing a pit manufacturing capability of no fewer than 80 War Reserve (WR) pits per year (ppy) in the 2032-2035 timeframe provides the ability to:

- Address plutonium/pit aging concerns by methodically replacing older pits;

¹ (U) JASON Letter Report response to the 2019 Pit Aging JASON Summer Study, JASON, November 23, 2019.

- Meet new military requirements to include enhanced safety and security as required;
- Respond to potential challenges to our deterrent based on renewed peer competition; and
- Maintain capacity balance with other existing and planned warhead component manufacturing capabilities.

DOE/NNSA identified the two-site approach to reestablishing pit production as the optimal way to proceed based on resiliency against unplanned outages, schedule to implement, and acquisition costs. The two-site approach initially included enhancing pit production capabilities at the Los Alamos National Laboratory's (LANL) Plutonium Facility 4 (PF-4), in Los Alamos, New Mexico to produce 30 WR ppy during 2026 and repurposing the existing facility formerly known as Mixed Oxide Fuel Fabrication Facility (MFFF) into the Savannah River Plutonium Processing Facility (SRPPF) at the Savannah River Site (SRS), near Aiken, South Carolina to produce 50 WR ppy during 2030.

DOE/NNSA continues to follow its formal and rigorous capital asset acquisition process for both the LAP4 and SRPPF projects. Critical Decision (CD)-1, *Approve Alternative Selection and Cost Range*, for LAP4 was achieved in April of 2021 and CD-1 for SRPPF was achieved in June 2021. Based on the latest conceptual designs and the cost and schedule ranges developed by subject matter experts, producing 30 WR ppy at the LANL in 2026 is achievable; however, DOE/NNSA determined that the required 50 WR ppy production rate at SRS will not be achieved in 2030.

CD-1 achievement enables DOE/NNSA to proceed to 90 percent design and refine schedules and costs in support of CD-2, *Approve Performance Baseline*, for each project. Further design activities conducted in support of SRPPF's CD-2 will identify multiple opportunities to accelerate achieving the required production capacity. As part of the CD-2 90 percent design development, DOE/NNSA is working with subject matter experts from across the nuclear security enterprise to identify and mitigate risks to completing these projects on time. Establishing required SRPPF pit production capacity as close as possible to 2030 remains a high priority and is required for sustaining the effectiveness of the Nation's nuclear deterrent.

III. Progress Toward 80 PPY

Producing WR pits at full rate requires the achievement of three key efforts for each pit production facility project. These include: (1) completing construction and receiving startup authorization (CD-4, *Approve Start of Operations or Project Completion*); (2) demonstrating a WR-quality pit manufacturing capability; and (3) demonstrating the ability to manufacture at full rate capacity while maintaining WR quality control. The total time duration for achieving steps two and three above is several years based on past and current experience.

At LANL, PF-4 is already conducting plutonium operations, so to a large extent, these three efforts are overlapping in time. At SRS, SRPPF must undergo commissioning to start plutonium operations, so the three key efforts to achieve 50 WR ppy will occur sequentially.

LAP4 and SRPPF are in and of themselves complex projects and achieving WR at full rate production requires demonstrating that the pits produced meet stringent requirements. As a result, delays to meeting the 30 WR ppy and 50 WR ppy targets, respectively, are possible. DOE/NNSA continues to work with DoD to identify options to mitigate risks associated with meeting warhead deliverables through the mid-2030s.

In assessing the impact of delays to pit production, several delay scenarios must be considered. The first scenario is for both LAP4 and SRPPF to achieve project completion as currently planned but not achieve full WR rate production on planned timelines; the second scenario sees LAP4 move forward as planned but SRPPF implementation delayed; and the third scenario is both LAP4 and SRPPF are halted.

It is DOE/NNSA's assessment that scenarios two and three would result in a significant impact to current DoD stockpile planning. If a decision to implement SRPPF or LAP4 is delayed to the extent that the teams working on these projects are forced to disband, it could take 15 years from the date of the decision to resume WR pit production before WR pits could begin to be produced, assuming a cold restart of the project after a long delay. Moving forward with LAP4 while delaying SRPPF would achieve a 30 ppy rate, which is too low a rate for the current stockpile size. This would require greater pit production (and other warhead component) capacity to make up for delays; and/or accepting growing risks to the effectiveness of the deterrent with no timely way to address issues should those risks be realized.

This report identifies ways to mitigate warhead deliverable risk and assumes both LAP4 and SRPPF move forward as currently planned. However, delays in demonstrating the required rates of 30 WR ppy at LANL and 50 WR ppy at SRS are possible. This report assumes a capacity for 80 WR ppy is achieved no later than 2035.

Given this timeline, risk mitigations will be discussed for the B61-12 Life Extension Program (LEP), the W88 Alteration (Alt) 370, the W80-4 LEP, the W87-1 Modification (Mod) Program, and the W93 Warhead Program.

III. Contingency Plans for Department of Defense Warhead Deliverables through the Mid-2030s

Contingency or risk mitigation plans fall into three broad categories:

1. Exercising surge capacity once pit production has been established;
2. Incorporation of some amount of pit reuse; and
3. Changes to the warhead delivery schedule (rate).

1. Exercising Surge Capacity

Temporarily surging beyond the planned production rate of 30 WR ppy at LANL after 2026 while SRS establishes 50 WR ppy capacity represents the largest single contingency opportunity. Production rates are based on single-shift operations. DOE/NNSA is working with the sites to better define contingency options related to multiple-shift production operations. Other

contingency options being evaluated include modifications to specifications, product manufacturability, and WR pit certification.

2. Incorporation of Pit Reuse

Incorporation of pit reuse can be implemented in two ways. The first is to carry out the entire production build with reused pits. The second is to incorporate newly manufactured pits in the warheads slated for deployment while employing pit reuse in the warheads slated for the hedge.² A mixed pit deployment, however, may have both negative operational and logistical implications and would need to be coordinated with DoD.

Additionally, pit reuse may not meet all military requirements, would increase performance uncertainty,^{3,4} and increase lifetime uncertainty due to risks associated with plutonium aging. Plutonium is radioactive and continuously decays, resulting in changes to the pit over time. As pits age, predictions show warhead performance decreases and the uncertainty in the rate of this decrease grows over time.

In 2030, the average age of the pits in the stockpile will be approximately 50 years-old, with a relatively tight distribution around the mean. Given first production unit (FPU) and last production unit (LPU) dates of systems coupled with the required service life of the warhead, plutonium pits would be between 80-100 years old at the end of their life cycle if or when they are reused. DOE/NNSA continues to research the operational life expectancy of plutonium pits; however, this is a problem that will require many years to research and further understand.

3. Modifications to Warhead Delivery Rate

A third option to mitigate risk is to work with DoD to explore adjustments to the warhead delivery schedule to accommodate delays in pit production. This approach, however, will not only delay the W87-1 and W93 programs but will also likely defer future projected modernization activities to replace legacy warheads before they expire. Further delays not only extend the bow wave of deferred stockpile work but also reduce our ability to respond to new threats as we continue to rely on Cold War-era designed and produced pits.

IV. Warhead Delivery Risk Mitigations by Modernization Program – Present through 2035

DOE/NNSA has multiple nuclear weapons modernization programs currently underway, and several do not rely on the current need dates for pit production. The B61-12 LEP, W88 Alt 370,

² Hedge weapons represent a portion of the stockpile retained to manage technological risks and geopolitical developments.

³ Implementing nuclear-tested and stockpile life-proven safety and security technologies normally results in the requirement to use insensitive high explosive (IHE) main charges. Reuse with IHE is possible, but performance margins can be low without removing some of the required security features.

⁴ (U) *W87-1 Modification Program Warhead Design Update*, March 2020 report to Congress (delivered in May 2020 due to COVID-19 operational restrictions).

and W80-4 LEP are not impacted by any changes in pit production capacity as these programs have either already been designed or based on pit reuse or their nuclear explosive packages are not being significantly modified, as detailed below. However, the W87-1, W93, and any future modernization efforts that are not yet programs of record may be impacted by delays in pit production. These warheads may benefit from such contingency plans and mitigation efforts.

1. B61-12 LEP

The B61-12 LEP is being designed for a 20-year life and is based on pit reuse. Using the currently planned FPU and LPU dates and the currently planned 20-year service life, B61-12 pits will be replaced before they enter the 80+ years old age range. However, for many reasons, including an abundance of caution to mitigate against yet unknown plutonium aging risks, the LANL Design Agency has taken steps to improve the performance margins of the primary. These changes, coupled with the planned 20-year service life, provide confidence in the certification of this LEP for use in the stockpile.

2. W88 Alt 370

The W88 Alt 370 is replacing the high explosive main charge but otherwise not significantly modifying the original nuclear explosive package design. LANL has extensively analyzed the W88 over many years and will continue to assess it annually to provide confidence in the alteration for use in the stockpile.

3. W80-4 LEP

The W80-4 LEP is being designed for a 30-year life and relies on pit reuse. This is the first warhead acquisition program where, based on the current planned service life, pit ages will begin to be over 80 years old near end of service life. The Lawrence Livermore National Laboratory, in Livermore, California, has taken steps to improve the performance of the primary for several reasons to include mitigating against plutonium aging concerns near the end of the warheads' service life, and providing confidence in the certification of this LEP for use in the stockpile.

4. W87-1 Modification Program

In September 2018, the Nuclear Weapons Council (NWC) authorized restart of the W78 replacement warhead program and established the name of the replacement warhead as the W87-1. To meet DoD safety and security requirements, the W87-1 will require an IHE main charge primary. This requirement for an IHE main charge, along with potential plutonium aging issues if accomplished solely through pit reuse, means that newly manufactured pits will be required to ensure confidence in the warhead's performance over its planned 30-year service life.

Based on current planning, the pits produced at LANL are key to supporting the W87-1 Mod. The first WR pit for the W87-1 is scheduled for production in FY 2023, seven years before the warhead's FPU in FY 2030. This seven-year margin in the schedule provides the W87-1 Mod with early indication of progress towards pit production capability and capacity plans and

provides a prebuilt stockpile of pits before 2030, prior to the projected build of the first W87-1 units.

If delays to the LANL pit production rate occur, DOE/NNSA, in coordination with DoD, will explore the three-risk mitigation options introduced in the previous section. If the delays are significant enough to drive the program to pit reuse, the pits would be greater than 80 years old when removed from service (using the same assumptions above of FPU, LPU, and current average pit service life timelines). Application of pit reuse for this system could come with exceptions to the service life and eliminating required security features for warheads incorporating reuse.

5. W93 Program

In September 2018, the NWC also directed establishment of a U.S. Navy warhead Project Officers Group, or POG, for a new Sea-launched Ballistic Missile (SLBM) warhead. This warhead has been designated the W93 and is in early stages of Phase 1, *Concept Development*, of the Joint DoD-DOE/NNSA Nuclear Weapons Lifecycle Process. Given all existing SLBM pits are already in use, the W93 will require either a newly manufactured pit or legacy pit repurposed from another weapon system.

Any delay in pit production will constrain W93 design options to pit reuse, limit the service life of the warhead from the currently planned 30 years, and could also impact operational requirements. Additional delays in pit production not only have the potential to slow final deliveries of the existing programs of record set to rely on new pits but would also likely delay future projected modernization activities to replace legacy warheads before they expire. Further delays not only extend the bow wave of deferred stockpile work but also reduces our ability to respond to new threats as we continue to rely on Cold War-era designed and produced pits.

VII. Conclusion

Reestablishing a U.S. pit production capability to meet stockpile and military requirements is a high priority. Pits are a key component of nuclear weapons, and the need to sustain a viable pit manufacturing capability for deterrence transcends Administrations; the current needed production capacities were identified in 2008. Any further delay in establishing this capability will result in the need for a larger pit production (and other warhead component) capacity and/or an acceptance of growing risks to the effectiveness of the deterrent for which there would be no timely mitigations should those risks be realized.

Implementing a minimum of 80 WR ppy capability as soon as possible represents a prudent approach for the United States to maintain confidence in the nuclear deterrent in the long-term. Such production would also allow for improvements in warhead safety and security in response to new military requirements and enable the United States to respond to possible challenges to the U.S. nuclear deterrent based on renewed peer competition.