NNSA Pit Production Efforts

The Need for Pit Production

An important component in U.S. nuclear weapons is the "pit," which contains plutonium. During the Cold War, the United States could manufacture hundreds of pits per year at the Rocky Flats Plant in Colorado, but this plant stopped manufacturing pits in 1989 and was subsequently dismantled. NNSA is developing the capability to manufacture plutonium pits at the rate of at least 80 war-reserve (WR) pits per year.

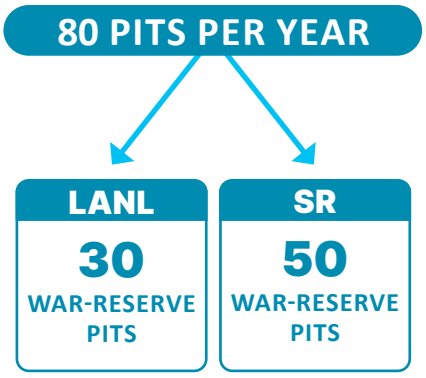
Why Are We Doing This Today?

A question that often arises is why we are doing this today, given the common view that pits have long lifetimes.

Here are some facts:

- **Pit performance does degrade over time. The damage caused by the decay of Pu-239 atoms does change material properties. It is difficult to quantify how much the properties will change over time, and even more difficult to quantify how much those changes will affect weapon performance under all relevant conditions.**
- **How long a pit will meet requirements depends on details of warhead design and environmental conditions. Some designs and conditions tolerate age-related degradation better than others.**
- **Estimating how long a given pit type will meet requirements, in a given weapon system and environment, is an extrapolatory exercise involving considerable uncertainty. We must extrapolate in time, because pits do not exist today that are as old as the ages of interest, and we must extrapolate from behavior in subcritical experiments to performance in nuclear explosions.**
- **As delivery systems change, warhead requirements change. The old pits that are available for reuse might not be well suited to new requirements.**
- **NNSA must prepare to deliver safe, secure, reliable warheads under a variety of possible future scenarios. We are not preparing well if we are not developing the ability to manufacture every component that goes into nuclear warheads.**
- **Because the development of new capabilities in nuclear facilities takes a long time, we must begin development of a needed capability long before it is actually needed.**

Two-site Solution



The Los Alamos capability is being developed in building PF-4, an operating facility that has made approximately 30 WR pits since 2000 and is making development pits today. The Savannah River capability will go into a building that was constructed for a different purpose and is not in use today.

Shipping and Receiving

Pit Quality Acceptance

Our Approach

We will not reach the capability to produce 80 WR pits per year by 2030, which was the original target date, but NNSA is working with LANL and SR to achieve this production rate as soon as possible. Today's predictions of how many WR pits we will produce per year for the next 15 years have large uncertainties, because many factors that affect schedule are not knowable at this time.

We work closely and continuously with our DoD colleagues to account for many uncertainties, including pit-production timeline uncertainties, as we jointly ensure that our nuclear deterrent will remain effective into the future.

Flexible and Resilient

Reliable rate production requires:

- **Sufficiently manufacturable pit design**
- **Sufficiently mature manufacturing process**
- **Sufficiently equipped and staffed**

Los Alamos Pit-Production Status and Plans

Plutonium Facility at Los Alamos

The first pit to be manufactured at LANL is for the W87-1 warhead, slated to sit atop the Sentinel ICBM, which is under development and will replace the Minuteman III ICBMs. Lawrence Livermore National Laboratory (LLNL) is responsible for the pit design, and Kansas City National Security Campus (KCNSC) is responsible for manufacturing non-Plutonium components, which are shipped to LANL PF-4 for assembly into pits.

Decontamination and removal of old equipment is ongoing at PF-4, clearing space for the new equipment that is being designed, manufactured, and installed. Decontamination, removal, and installation usually occur during second and third shifts, in the same rooms where pit production and other work occurs during the day.

Design of W87-1 Pit

Based on experience with development builds, the NNSA-LANL-LLNL-KCNSC team decided in fall 2022 on a design change that improves manufacturability of the W87-1 pit. The change was made possible when a potential military requirement was removed a few years ago, and the decision was made once the development work provided data on the costs and benefits of the change. The change will delay the first production unit (FPU), largely because of the time required for Kansas City to produce certified "war reserve" versions of newly designed components. We expect to "diamond stamp" the first fully qualified WR pit (the "first production unit," or FPU) in the second half of CY 2024.

Even with the FPU delay, the improved manufacturability of the new design will enable production of more WR pits on the time scales that matter.

Process Maturation at LANL PF-4 and KC NSC
Manufacturing processes continue to be exercised and matured at LANL and KC. More than 40 development pits have been built, the build rate is increasing, build-failure mechanisms are increasingly well understood, and build quality is increasing.

Equipment at PF-4
Equipment is being designed, manufactured, procured, and installed under several different projects, the largest of which is the Los Alamos Plutonium Pit Production Project (LAP4). LAP4 itself has several subprojects, with overlapping schedules and different completion dates. The choreography of decontamination, demolition, removal, procurement, and installation of equipment, across myriad projects and subprojects—all taking place at night in the same rooms where pit production occurs during the day—must constantly adapt as the realities of an operational facility, with old equipment and systems, can interrupt well-laid plans.

PF-4 will continue to build pits throughout the equipment removal and installation processes. Capacity and resilience will grow steadily over time as each piece of equipment is installed and turned over to operations—there are no step functions at the end of the big equipment projects and subprojects.

Los Alamos National Laboratory expects the first WR pit (FPU) in 2024, and we expect an increasing number of WR pits to be produced each subsequent year. Exact production rates will depend on:

- how quickly processes mature to the point that a high percentage of build attempts yield WR pits;
- the numbers and types of facility and equipment failures that occur over time; and
- the rate at which new equipment is delivered and installed.

At this time, it appears that equipment installation will not happen quickly enough to support 30 WR pits per year by 2026. For example, in January, 2023, the "30 Base Equipment" subproject of LAP4 reached Critical Decisions 2 and 3, with a schedule that showed completion between late 2027 and August of 2030. This was based on continued relegation of equipment work to 2nd and 3rd shifts, and the later date includes significant schedule contingency.

Efforts are underway to improve equipment installation schedules, mainly by allowing equipment work to occur 24/7 in carefully chosen spaces and time periods. We expect that this increase in facility time for equipment work will improve equipment installation rates, minimize the use of schedule contingency, and still provide enough process-maturity time to allow PF-4 to achieve 30 WR pits per year sooner than it otherwise would have.

Impacts on the Stockpile
NNSA continues to communicate pit-production schedule estimates and uncertainties to DoD and military partners, who continue to work with NNSA to plan for a safe, secure, reliable, and effective nuclear deterrent force in the face of these uncertainties.

Assembly and Joining

Machining and Inspection

Savannah River Plutonium Processing Facility Status and Plans

Savannah River Plutonium Processing Facility

Design efforts are currently underway for the process equipment, the gloveboxes that surround the equipment, and the many systems that connect to the gloveboxes in the "main process building" (MPB, originally built for the MOX mission) at SRPPF. SRPPF also includes many supporting facilities outside the MPB, which are also being designed at this time.

Cost and schedule for SRPPF remains uncertain at this time, largely because the design of the systems in the MPB has not reached a high enough level of maturity to lend itself to detailed cost and schedule estimates, and partly because construction efforts in this country are currently experiencing major headwinds, the duration of which is difficult to predict.

Construction projects across the U.S. are suffering from supply-chain delays, labor shortages, inflation rates much higher than in other sectors, and disappointing productivity. NNSA's construction projects, including those that are mainly focused on installing specialized equipment in existing buildings, are no exception. Experience has taught us how to mitigate the cost and schedule impacts of these realities to some extent, and we are applying these lessons to SRPPF.

Examples include placing early procurement contracts for materials and equipment that will likely have long lead times, starting some portions of construction as early as possible while other portions await further design maturity, and spreading labor demands across time as much as possible. To facilitate this within the formal DOE process (order 413.3B), we have divided SRPPF into 6 subprojects and have planned 12 procurement and work packages that can be executed before "Critical Decision 2" is reached.

We are also tackling the important challenges surrounding procurement of specialized gloveboxes, working with industry to increase manufacturing capacity while coordinating procurements across multiple sites and organizations (including those outside of NNSA) to spread the demand over time. We are grateful to Congress for appropriating funds in FY2023 that help us execute these important strategies.

Removal of old material and equipment from the MPB has begun. Site preparation and construction of some supporting facilities, notably including a massive sand filter, will begin before equipment installation gets underway in the MPB.

The end of construction of SRPPF will not be the beginning of production of 50 WR pits per year. Historically it has taken several years for a newly constructed facility of this type to complete the testing and adjustment of its many systems, gain approval of operating procedures, enter "hot" operations, and gain formal qualification of the many processes that must work as designed to produce a formally qualified WR component. Ramping up from the first production unit to full rate production also takes time.

A great deal of effort and planning has been devoted to minimizing the time from construction completion at SRPPF to production of at least 50 WR pits per year. Ingredients in the plan include a High-Fidelity Training and Operations Center (a subproject of SRPPF) that will be operational before construction is complete in the MPB, and an extensive knowledge exchange program with LANL.

National Nuclear Security Administration