

**National Nuclear Security Administration**  
**Report to Congressional Defense Committees**  
**on**  
**“An Enhanced Schedule for the Modern Pit Facility”**

**Requested by The United States Senate in**  
**Senate Report 108-46, Pages 457-458**

**Report Submitted by:**

**The Secretary of Energy**

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**February 2004**

**Abstract**

In response to a request in Senate Report (108-46) accompanying S. 1050, “National Defense Authorization Act for Fiscal Year 2004,” this report on pit manufacturing addresses: (1) options for an enhanced schedule for a Modern Pit Facility (MPF) design and construction if the Secretary of Energy decides to proceed with an MPF, (2) an evaluation of technical expertise and protection of institutional knowledge required for pit production, (3) a proposed plan for ensuring production agility and facility flexibility, and (4) a planning approach to ensure that if the MPF is constructed, it is appropriately sized based on a requirement by pit type by year.

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## Executive Summary

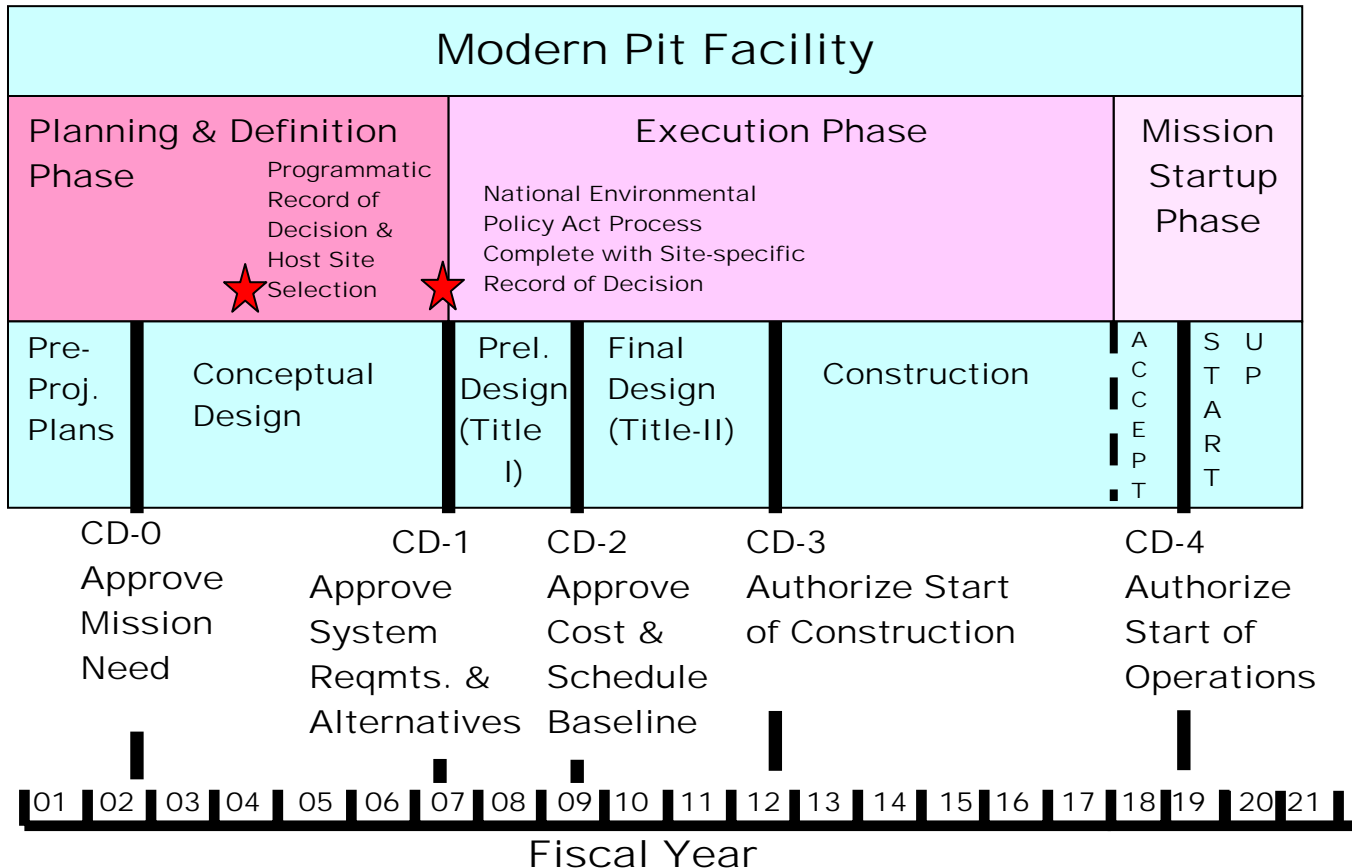
This report responds to a request in Senate Report 108-46 accompanying S. 1050, “National Defense Authorization Act for Fiscal Year 2004,” that the Secretary submit a report to the congressional defense committees on the Department of Energy’s (DOE) evaluation of ways to accelerate the modern pit facility (MPF) option for pit manufacturing, should the Secretary decide to proceed with the MPF option, and on other issues pertaining to pit manufacturing.

### How did the Nation get here and what are future requirements?

Plutonium pits for the nuclear weapons stockpile were manufactured at the DOE Rocky Flats Plant (RFP) in Golden, Colorado, from 1952-1989. In December 1989, the Rocky Flats plant was shut down due to environmental and safety concerns. Today, the United States is the only nuclear weapons power without sufficient capability to manufacture stockpile-certified plutonium pits required to sustain its nuclear arsenal. In December 2001, the Department of Defense (DoD) transmitted to the Congress the *Nuclear Posture Review (NPR)* in response to a request in the FY2001 National Defense Authorization Act. The NPR outlined a U.S. goal of reducing the nuclear weapons stockpile to 1700 - 2200 operationally deployed strategic nuclear weapons by 2012 that became a U.S. commitment in the 2003 Strategic Offensive Nuclear Reduction Treaty (Moscow Treaty).

### Can NNSA accelerate the current planning schedule?

If the Secretary of Energy decides to proceed with an MPF, the schedule below will be consistent with the NNSA Future-Years Nuclear Security Program (FYNSP).



This schedule can potentially be accelerated by 3-4 years by implementing options to: (1) complete the National Environmental Policy Act (NEPA) process for MPF, (2) minimize transitions between conceptual, preliminary, and final design, (3) accelerate the design schedule, (4) shorten the procurement time for construction services, (5) initiate specific construction actions (e.g., support buildings and site preparation) before final design completion, (6) select facility design features that optimize the construction schedule, and (7) select a more aggressive construction workday schedule.

Implementation of these options would require both an increase in early year budgets and tradeoffs consistent with the FYNSP. Current MPF planning balances competing demands for funds, long-term pit manufacturing capability requirements, and timing of information (e.g., stockpile size and pit lifetimes) required for quality decisions.

### **How will NNSA maintain pit manufacturing expertise with a planning date of 2021 for a MPF start?**

Since the early 1990's, Los Alamos National Laboratory (LANL) has served as the U.S. focal point for pit manufacturing development activities and now employs many former Rocky Flats personnel who have helped transfer and maintain the technical expertise necessary to manufacture stockpile-certified pits. In April 2003, the first W88 pit was manufactured at LANL marking a U.S. milestone for hands-on pit manufacturing capability; however, completion of engineering and physics tests required for W88 stockpile-certification is now scheduled for 2007.

In the near-term, NNSA will rely on an interim pit manufacturing capability at LANL and technology development work at U.S. plutonium facilities (LANL, Lawrence Livermore National Laboratory (LLNL), and the Savannah River Site (SRS)) to maintain the Nation's pit manufacturing expertise.

### **How will NNSA ensure facility flexibility?**

Long-term pit manufacturing calls for a facility with flexible capabilities to meet changing military requirements and to keep the production program agile. The MPF option includes (1) design requirements to ensure production agility in a small, flexible MPF, (2) manufacturing process equipment placed in modules, (3) modular facility configuration that provides contingency and new process development floor-space to support the use of new technologies, and (4) planning based on modern manufacturing and model-based design practices. By following this approach, different MPF design options can be used without impacting the construction schedule.

### **How will NNSA planning meet MPF capacity requirements?**

The NNSA has evaluated capacity requirements for an MPF based on the following parameters: (1) size of the future stockpile (2) numbers and types of weapons in the stockpile, (3) pit lifetime, (4) start date for quantity production, and (5) length of time between shutdown of Rocky Flats and start of new production. A general conclusion from these analyses is that if the number of weapons in the U.S. stockpile is consistent with NPR/Moscow Treaty with pit lifetimes of about 60 years, the Nation will need an operational production capacity of some 125 pits per year around 2021. These classified analyses also confirm the need for a 125 pits per year capacity independent of the composition (specific numbers by pit type by year) of a 1700 – 2200 stockpile. The current consensus opinion of NNSA physics laboratories is that minimum pit lifetime is 45 to 60 years; however, NNSA's planning for an MPF is based on a 60-year pit lifetime.

Because of uncertainty in parameters that define the required capacity for an MPF, the NNSA must: (1) include major decision points prior to start of construction that allow for adjustments to plant capacity and start date of construction, or provide a choice to end planning, and (2) complete periodic revalidations of the required MPF capacity based on changing stockpile size and numbers of pit types from DoD and pit lifetime estimates from NNSA physics laboratories.

### **Should MPF planning continue even with pit capability at LANL?**

A small interim manufacturing capability of 10 to 20 pits per year at LANL is scheduled for 2007 in Technical Area 55 (TA-55). However, based on pit lifetimes of 45-60 years and a Moscow Treaty stockpile requirement of 1700-2200 deployed, strategic weapons by 2012, this interim capability will not meet requirements. An upgrade to TA-55 would not provide a capability to support a Moscow Treaty stockpile requirement and, most importantly, would not provide NNSA with opportunities to minimize risks to the environment and radiation exposures to workers. As with most major systems acquisition projects, MPF planning activities prior to construction start will consume 20 percent or less of the estimated total project cost but take more than 50 percent of the total project duration. Thus, MPF planning provides opportunities for significant schedule readiness at a low relative cost if continued without interruption.

### **Summary**

NNSA has the responsibility to manage risks and uncertainties for long-term pit manufacturing based on known and anticipated requirements. The NNSA will meet this responsibility through a planning process for a modular pit manufacturing capability based on a stockpile consistent with the Moscow Treaty, a 60-year pit lifetime, and an on-line production capability in place by 2021 which is a few years before current pits reach a minimum lifetime of 45 years. Periodic reviews of pit lifetimes and weapon requirements will enable NNSA to manage the risk to national security and to plan for an MPF because:

- The lack of a U.S. pit manufacturing infrastructure capable of supporting future stockpiles is a serious national security deficiency.
- A responsive production infrastructure is required to permit reductions in the nuclear arsenal and manage risks to national security.
- Impacts of pit aging are likely to remain uncertain, thereby resulting in risk to stockpile performance if there is not sufficient capability to manufacture replacements.
- A steady MPF planning course will enable NNSA to meet long-term national security needs for pits in a manner that meets modern safety and environmental goals while utilizing state-of-the-art manufacturing methods that minimize risks to the environment and manufacturing workers.
- MPF planning provides an opportunity to more effectively address evolving physical security requirements relative to pit manufacturing.

## Section 1: Request for Report

In the Senate Report (108-46) accompanying S. 1050, “National Defense Authorization Act for Fiscal Year 2004”, the U.S. Senate requested the Secretary of Energy to submit a report to the congressional defense committees on several topics relative to a proposed modern pit facility (MPF). The specific request is:

### *Need for an enhanced schedule for the modern pit facility*

*The committee urges that the Department of Energy (DOE) evaluate options for the acceleration of modern pit facility (MPF) design and construction. Considerations for a modern pit facility should include consolidation of design and environmental review activities, the effect of different MPF designs on construction schedules, and the potential compression of proposed construction schedules. The Department should also evaluate the loss of technical expertise in pit production due to the closure of Rocky Flats, and assess options to ensure that the Nation’s experience in this area is not further degraded until the MPF becomes operational. Finally, the Department should indicate how their plan for keeping the production program agile and how their engineering design will create a flexible facility to meet ever changing military requirements in a world fraught with emerging threats.*

*The committee directs the Secretary to submit a report detailing its findings, and the steps it is taking to accelerate the MPF and protect its institutional knowledge of production processes, to the congressional defense committees together with the fiscal year 2005 budget request. The report should also include a schedule to establish a requirement by pit type by year, and any other requirements. The DOE must have a requirement established to ensure that the MPF is appropriately sized.*

*The Department’s current schedule does not envision operations at the proposed MPF until the year 2020. While the Department expects to conduct limited pit production at the Los Alamos National Laboratory in the interim, the expected production levels at this laboratory will be of limited value in maintaining the Nation’s strategic arsenal. As the Department has not had a viable pit production facility since the closure of Rocky Flats in 1989, the committee is concerned with a proposed 2020 operations starting date for the new MPF.*

*(Senate Report 108-46, at pp. 457-458)*

This report addresses the issues identified by the Congress. It should also be noted that the Conference Report to accompany H.R. 2754, the Fiscal Year 2004 Energy and Water Appropriations Bill, states “...until the Congress reviews the revised future Stockpile plan it is premature to pursue further decisions regarding the Modern Pit Facility.”

## Section 2: Background

Plutonium pits for the nuclear weapons stockpile were manufactured at the Department of Energy (DOE) Rocky Flats Plant (RFP) in Golden, Colorado, from 1952-1989. In December 1989, DOE shut down production at Rocky Flats due to environmental and safety concerns. Consequently, stockpile-certified pits have not been manufactured in the United States (U.S.) since that date. Today, the U.S. is the only nuclear weapons power without sufficient capability to manufacture plutonium pits suitable for use in the nuclear weapons stockpile required to sustain the nuclear deterrent.

During the mid-1990s, DOE conducted a comprehensive analysis of the capability and capacity needs for the entire Nuclear Weapons Complex (NWC) and evaluated alternatives for maintaining the Nation's nuclear stockpile in the *Final Programmatic Environmental Impact Statement for Stockpile Stewardship and Management* (SSM-PEIS) (DOE/EIS-0236) (DOE 1996b). Issued in September 1996, the SSM PEIS assessed future stockpile requirements and pit manufacturing capability and capacity needs. The SSM-PEIS evaluated reasonable alternatives for re-establishing interim pit production capability on a small scale. A larger pit production capacity—in line with the capacity planned for other National Nuclear Security Administration (NNSA) manufacturing functions—was not evaluated in the SSM PEIS “because of the small current demand for the fabrication of replacement pits, and the significant, but currently undefined, time period before additional capacity may be needed.” In the SSM-PEIS Record of Decision (ROD) (61 FR 68014) on December 26, 1996, the Secretary of Energy decided to re-establish an interim pit fabrication capability, with a small capacity, at Los Alamos National Laboratory (LANL). That 1996 decision limited pit fabrication to a facility “sized to meet programmatic requirements over the next ten or more years.” In the ROD, DOE committed to “performing development and demonstration work at its operating plutonium facilities over the next several years to study alternative facility concepts for larger capacity.”

Subsequent to the issuance of the SSM-PEIS ROD, a number of citizen groups filed suit challenging the adequacy of the SSM-PEIS. In August 1998, the SSM-PEIS litigation was resolved. As a result of that litigation, DOE agreed to entry of a court order that required, “prior to taking any action that would commit DOE resources to detailed engineering design, testing, procurement, or installment of pit production capability for a capacity in excess of the level that has been analyzed in the SSM-PEIS (50 pits per year under routine conditions, 80 pits per year under multiple-shift operations), DOE shall prepare and circulate a supplemental Programmatic Environmental Impact Statement (PEIS), in accordance with DOE National Environmental Policy Act (NEPA) Regulation 10 CFR 1021.314, analyzing the reasonably foreseeable environmental impacts of and alternatives to operating such an enhanced capacity, and shall issue a ROD based thereon.”

Consistent with the 1996 SSM-PEIS ROD, NNSA is establishing a small manufacturing capability for W88 pits at LANL. In April 2003, LANL completed manufacture of the first W88 pit certifiable for use in the nuclear weapons stockpile. However, engineering tests and physics experiments required to certify LANL-manufactured pits are scheduled for completion in 2007. An interim manufacturing capacity of 10-20 W88 pits per year is also scheduled at LANL by the end of 2007.

Also consistent with the 1996 SSM-PEIS ROD, NNSA is completing development and demonstration work to study alternative facility concepts with capacities in excess of those in the

SSM-PEIS. Since November 2000, a team consisting of NNSA, plant, and laboratory personnel has been focused on planning the actions necessary to establish a long-term pit manufacturing capability. These actions include: (1) defining facility requirements, (2) complying with the National Environmental Policy Act (NEPA), (3) evaluating facility conceptual design alternatives, (4) planning technology development tasks, and (5) establishing the project management structure necessary for a major system acquisition.

In December 2001, the Department of Defense (DoD) issued the *Nuclear Posture Review (NPR)* to Congress in response to a request in the FY2001 National Defense Authorization Act. The NPR outlined a U.S. goal of reducing the nuclear weapons stockpile to 1700 - 2200 operationally deployed strategic nuclear warheads by 2012. This goal of 1700 - 2200 operationally deployed strategic nuclear weapons became a U.S. commitment in the 2003 Strategic Offensive Nuclear Reduction Treaty (Moscow Treaty). Based on the NPR and Moscow Treaty, guiding principles for long-term pit manufacturing are:

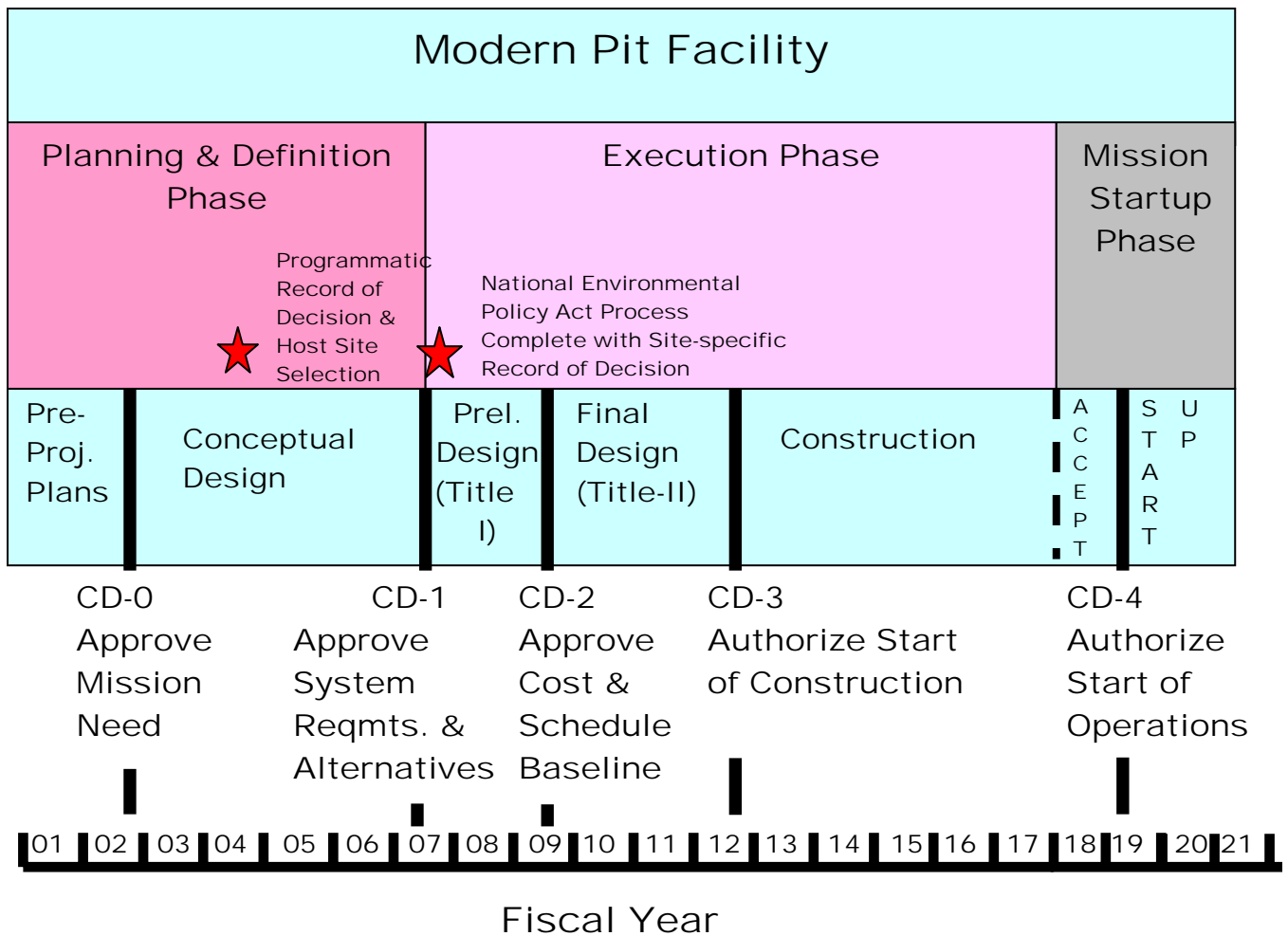
- Future planning should be based on significant reductions from current numbers of weapons in the stockpile, and
- Responsiveness of the production infrastructure must be increased to permit reductions in the nuclear arsenal while providing assurance to our allies and, at the same time, dissuade adversaries from starting a competition in nuclear armaments.

NNSA planning for an MPF is consistent with a smaller stockpile and enhanced production readiness posture. Figure 1 shows a baseline schedule for MPF planning. The schedule shown in Figure 1 is consistent with the current NNSA Future-Years Nuclear Security Program (FYNSP). Notable points are:

- MPF conceptual design started in October 2002 following approval by the Secretary of Energy of mission need (critical decision zero, or CD-0) in May 2002 and notification to Congress in September 2002 of the intent to start conceptual design. A small (125 pits/year) MPF that would start construction in 2012 is estimated to cost about \$2.5 billion (midpoint of cost estimate range of \$2.1 B to \$2.9B). Annual operating costs of this plant are estimated at \$200-300 million.
- DOE prepared and circulated a draft programmatic environmental impact statement for MPF (MPF-EIS) in May 2003 that serves as the supplement to the SSM-PEIS required by prior court agreements. Public hearings were completed in July 2003 at all five sites under consideration—Savannah River, Pantex, Los Alamos, Nevada Test Site, and Carlsbad, NM. A final EIS is ready for distribution. If the Secretary decides to proceed with MPF and selects a host site, then a second “site-specific” environmental impact statement for MPF would follow the first “programmatic” MPF-EIS.
- A series of decisions are required by the Secretary of Energy prior to start of construction in 2012. Two decisions resulting from a two-step NEPA compliance process are: (1) a programmatic record of decision in 2004 and (2) a site-specific record of decision in 2007. Additionally, three major system acquisition critical decisions are: (1) approve system requirements and alternatives in 2007 (CD-1), (2) approve cost and schedule baseline in 2009 (CD-2), and (3) authorize start of construction in 2012 (CD-3).

- Initial MPF operations would begin in 2019 with full operations at planned production levels expected to begin in 2021.

**Figure 1: Current MPF Planning Schedule**



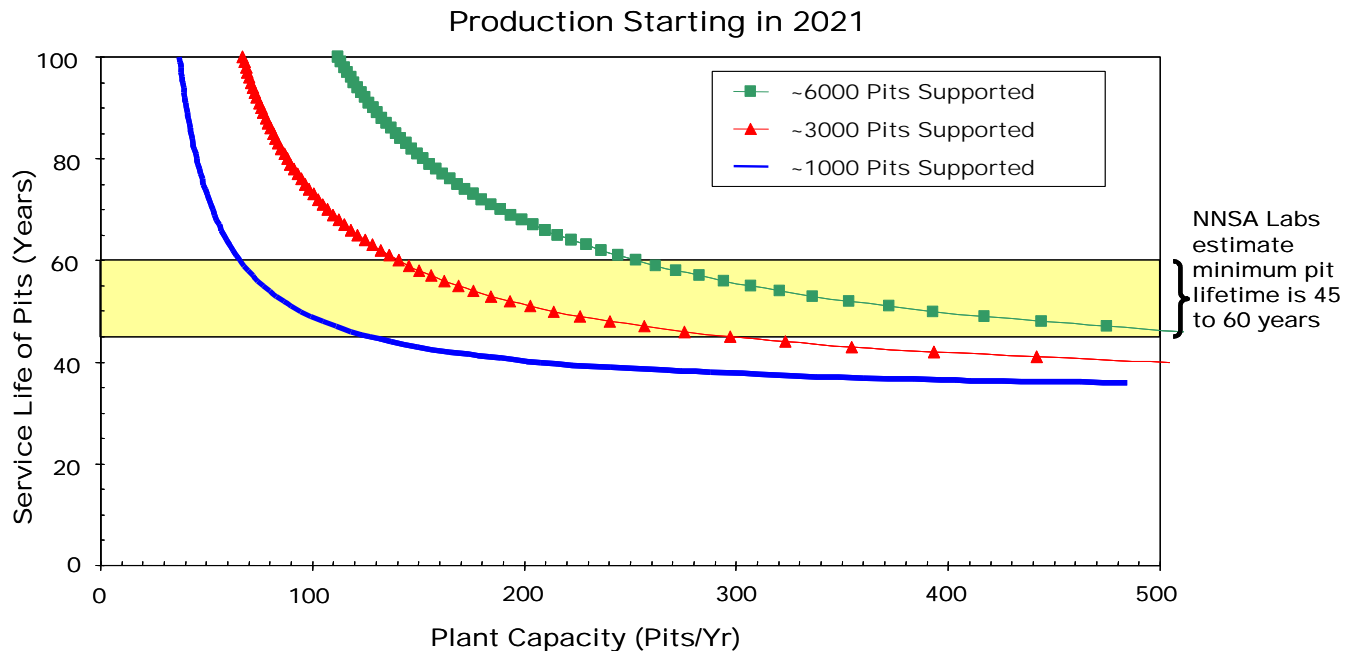
### Section 3: Need for an Enhanced Schedule for the Modern Pit Facility

The NNSA, the Department of Defense (DOD), and the Congress have highlighted the lack of a long-term pit manufacturing capability as a national security issue requiring timely resolution. While a small production capacity of 10 to 20 pits per year is being established at LANL, this interim capability is not sufficient for long-term maintenance of the nuclear stockpile. The required capacity for an MPF is based on a combination of the following parameters:

- Size of the future stockpile: defines number of pits to be manufactured.
- Composition of the stockpile: defines types of pits and production agility required.
- Pit lifetime: specifies how long current pits are expected to last and when replacements are needed.
- Start date for quantity production: defines when replacement pits first become available.
- Length of time between shutdown of Rocky Flats and start of new production: defines magnitude and duration of manufacturing schedule impacts caused by an approximately 30-year hiatus in pit production.

An enhanced schedule for MPF would enable the NNSA to better manage risks to national security. Figure 2 is an unclassified representation of the above factors with MPF production starting in 2021 based on the assumption that pits in the stockpile will not exceed pit service life, or lifetime.

**Figure 2 Notional MPF Capacity Required for First 30 Years of Pit Production**



If the number of weapons in the U.S. stockpile reduces to the low 1000's with pit lifetimes about 60 years, Figure 2 shows the Nation needs a production capacity of some 125 pits per year. A stockpile in the low 1000's of weapons is consistent with the Moscow Treaty goal of 1700 - 2200 operationally deployed strategic nuclear weapons in 2012. The number of pits required to be manufactured will always be greater than the number of operationally deployed weapons because of the need for:

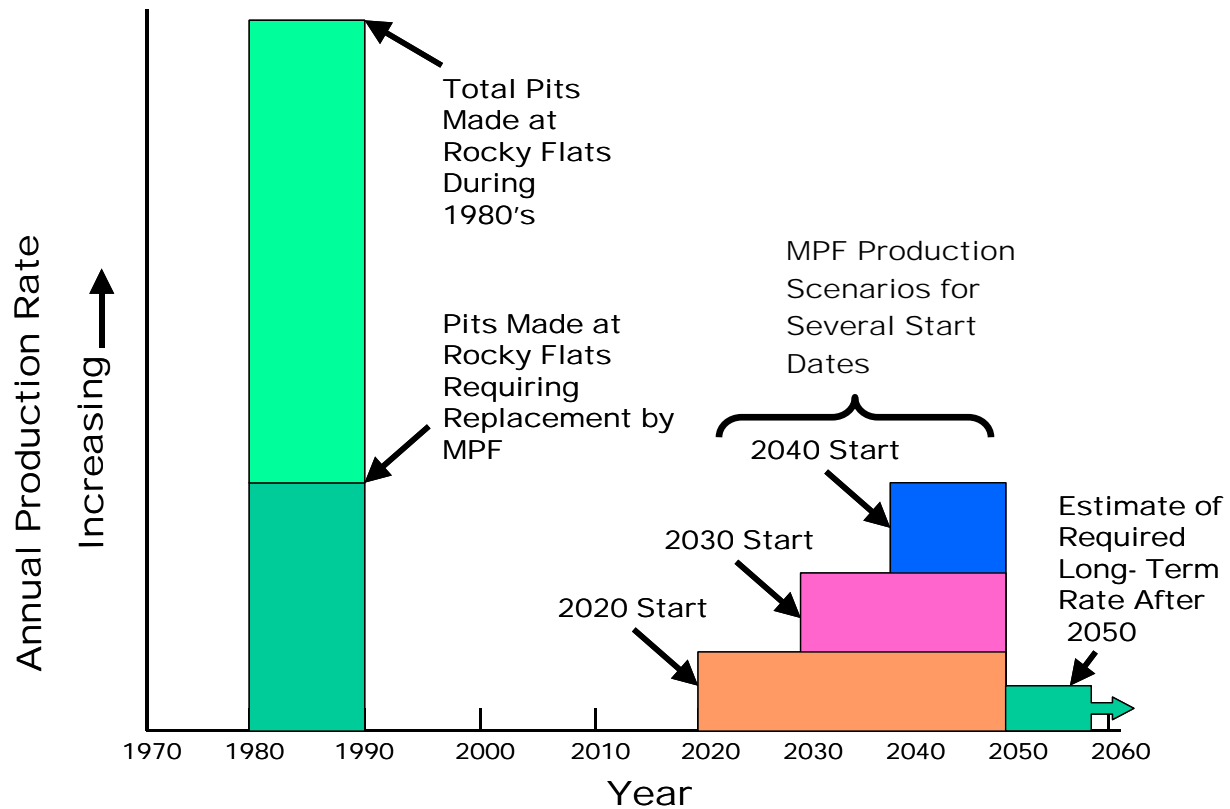
- Spares & Logistic Units – Extra pits (either in assembled weapons or held as spare parts) for DoD use.
- Quality and Reliability Testing (QART) Units – Replacements for pits destructively tested over the estimated lifetime of a pit.
- Quality Control Pits – Pits built and destructively tested during steady-state production to assure product quality.
- New Material Pits – Small number of extra pits withdrawn during production for destructive material testing.
- Shelf-Life Pits – Pits built and reserved by the design agency at the physics laboratory for later research and evaluation purposes.
- Production Start-up Pits – Pits built during production startup of a given pit-type to prove manufacturing processes.

Most pits in the enduring nuclear stockpile were manufactured between 1978-1989 at the Rocky Flats Plant. With current MPF planning based on 60-year pit lifetimes, all pits must be replaced before 2050. Figure 3 shows several notional MPF early-year production scenarios to replace Rocky Flats pits assuming 60-year pit lifetimes. A notable observation from Figure 3 is that the required capacity for the first 10 to 30 years of MPF operations is dependent on the start date of production. As the duration of the multi-decade hiatus between Rocky Flats Plant and MPF production increases, the required early-year MPF production capacity increases because fewer years are available build pits before reaching pit lifetime limits. Delaying the start date for MPF increases the risk that:

- NNSA would need to construct a larger capacity MPF than is needed for the long-term to replace aging pits.
- NNSA may not be able to replace existing pits as required to maintain safety and reliability of the stockpile if the minimum lifetimes of some pit types are closer to 45 years instead of the planning assumption of 60 years.

Conversely, by accelerating the schedule for an MPF, NNSA could better address the risk of pit lifetimes less than the 60 years.

**Figure 3: Notional MPF Early-Year Production to Replace Rocky Flats Pits with 60-Year Lifetimes**



Pit lifetime defines how long current pits are expected to last and thus when replacements will be needed. Exact pit lifetimes are uncertain and have a direct impact on when an MPF would need to start production. The NNSA weapons laboratories estimate that the minimum age for replacement of pits (i.e., minimum pit lifetime) is between 45 to 60 years ([Plutonium Aging: Implications for Pit Lifetimes](#), J. Martz, LANL & A. Schwartz, LLNL, LA-UR-03-0259). Since the U.S. needs the capability to produce replacements before existing pits reach an end of useful life, MPF planning should ensure sufficient capability is available when needed. Uncertainty in pit lifetimes increases the challenge of how to best plan for an MPF to manage pit-related risks to the safety and reliability of the U.S. nuclear weapons stockpile.

The oldest plutonium made in the U.S. and available for analysis is approximately 40 years of age. Processes different from pit materials in the existing stockpile were used in manufacturing this 40-year-old plutonium. As a result, a direct comparison of this oldest plutonium to modern alloys provides insight into aging behavior but not without uncertainty. Plutonium is a very complex metal that is further complicated by internal damage caused by radioactive decay. The accumulation of damage from alpha decay is significant within the time frames of interest to pits since, on average, each atom of plutonium becomes displaced once every ten years. In addition to the generation of alpha particles that ultimately lead to the formation of helium atoms and helium bubbles in the metal lattice structure, an atom of uranium is also created in each radioactive decay event. Hence, aging plutonium material becomes enriched in uranium and also americium, which may have implications for long-term phase stability of the plutonium metal. Since plutonium did not exist in significant quantities before the 1940's, there is little data on plutonium material properties with increasing age. Current information is based on computer models and plutonium

metal from pits that are approximately 40 years old. This results in significant uncertainties for estimating plutonium material properties for ages greater than 45 years. The NNSA is addressing these uncertainties in age-related plutonium with research projects at both LANL and LLNL. By FY2006, LANL and LLNL material scientists will have results from accelerated aging of plutonium metals for lifetimes approaching 60 years. The accumulation of damage from alpha-decay within plutonium has been accelerated by the addition of isotopes with shorter half-lives. An alloy of normal weapon-grade plutonium mixed with 7.5% of the Pu-238 isotope accumulates radiation damage at a rate 16 times faster than weapon-grade material alone. Analyses of these accelerated aging samples in FY2006 may reduce uncertainties in plutonium material properties used in computer models analyzing pit performance.

In the absence of underground nuclear testing, NNSA infers nuclear performance through computer models that rely on plutonium material properties, comparisons with pits that have been nuclear tested, and non-nuclear experiments. Unfortunately, prior nuclear testing did not emphasize the relationship of plutonium microstructure or laboratory material properties to nuclear performance. In addition, accelerated aging material will not be available in sufficient quantities for large-scale, non-nuclear experiments. Consequently, significant uncertainty is likely to remain in relating small changes in material properties to nuclear performance even as the understanding of the impacts of aging on plutonium material properties improves.

In addition to capacity and capability to build replacements before existing pits exceed estimated lifetimes, agility is a driver for MPF. As long as the U.S. nuclear weapons stockpile contains multiple pit types, NNSA requires the agility to simultaneously manufacture different types of pits. Manufacturing agility is a key contributor to a responsive production infrastructure necessary to facilitate planned reductions in the nuclear arsenal.

The interim capacity being established in Technical Area 55 (TA-55) at LANL does not have this agility for production quantities, nor does the facility have the floor capacity to introduce this agility while achieving personnel safety and reduced radiation exposure goals required for newer facilities. NNSA could make do with TA-55 if the long-term stockpile is at a level in the 100's of weapons with a reduced number of pit types and if modifications to TA-55 to manufacture 50 pits per year could be made without constructing an additional building. If NNSA has to complete a new building or major addition to TA-55, analyses confirm that it would be less costly in the long-term to build and operate a new small MPF to meet production requirements. However, there is no scenario currently envisioned for the future nuclear stockpile that will reduce the number of weapons to this level. On the other hand, if the stockpile size were in the 1000's, TA-55 would require multiple costly upgrades and a new building to achieve production levels comparable to a small MPF.

Upgrading LANL facilities for long-term pit production is an alternative that was evaluated as part of the *Supplemental Programmatic Environmental Impact Statement on Stockpile Stewardship and Management for a Modern Pit Facility* (MPF-EIS), (DOE/EIS-236-S2) (Draft – May, 2003). In addition to the insufficient production capacity and agility noted earlier, upgrading LANL TA-55 was not recommended as the preferred alternative for the following reasons:

- Any upgrade of TA-55 would occur while the facility is operating. This incurs substantial risk, not only to the schedule of the upgrade project, but also to on-going programs, such as

continued manufacture of W88 pits, stockpile surveillance programs, support to National Aeronautics and Space Administration work, and other important plutonium research.

- There is a high risk that an upgrade to 50 pits per year at LANL is not achievable within TA-55 (e.g., limitations on the material transport system may preclude reaching 50 pits/year in existing facilities at LANL).
- Major modifications to an operational nuclear facility increase the risk of cost overruns or significant safety, contamination, or security events during upgrade. If a protracted shutdown were planned or inadvertently occurred during an upgrade, then re-start of an older nuclear facility such as TA-55 would be problematic.
- LANL TA-55 would be approximately 40 years old when a first upgrade could be completed in about 2015 to support expanded pit manufacturing. Operating the facility for an additional 50 years would be even more problematic.
- TA-55 was designed for research and development applications. The building layout and location of facility services are not optimal for production operations.
- Physical constraints of TA-55 limit opportunities to enhance production efficiencies, reduce worker exposures, and minimize safety and security risks.
- Other TA-55 missions, not related to stockpile certification, would need to be moved to other sites, eliminated, or reduced at additional costs.

Finally, concentrating all pit manufacturing expertise in a single location, such as TA-55, obviates one of the lessons learned from the shutdown of Rocky Flats – the importance of having a backup capability.

#### **Section 4: Options for the Acceleration of MPF Design and Construction**

The approval of mission need (Critical Decision 0 or “CD-0”) by the Secretary of Energy in May 2002 was based on the recognition that NNSA needed to advance long-term pit manufacturing readiness. Given the long time durations required to plan and construct nuclear facilities, planning now for a modern pit manufacturing facility, while better defining the size and composition of the future nuclear weapons stockpile and estimates of pit lifetimes, is sound risk management. The MPF development schedule shown in Figure 1 is conservative (i.e., lower schedule risk by assuming longer time durations) and consistent with the expected timing of improved information on stockpile size and pit lifetimes. The current schedule is also a realistic reflection of funding constraints and the time required to make a series of decisions on whether to continue with an MPF. Each phase of the project, and the transitions between phases, has been evaluated to develop strategy options that could result in shorter schedules with reasonable risk to the project. These options, with more details provided in Table 1, include:

- Completing the National Environmental Policy Act (NEPA) process for MPF.
- Minimizing transitions between conceptual, preliminary, and final design.
- Accelerating the design schedule.
- Shortening the procurement time for construction services.
- Initiating specific construction actions before final design completion.
- Selecting facility design features that optimize the construction schedule.
- Selecting a more aggressive construction workday schedule.

Completing MPF activities to comply with the National Environmental Policy Act (NEPA) is beneficial for all schedule acceleration options. A two-step NEPA process was chosen because it allows early programmatic and site selection decisions, and more cost effective detailed evaluation of the selected MPF host site. This NEPA process approach allows early involvement of operations and engineering personnel from the MPF host site, which is important to project success, and timely investigation of subsurface conditions and other environmental factors that may influence the facility design. Maintaining a timely NEPA process schedule is essential for further MPF schedule acceleration.

The current MPF schedule can potentially be accelerated by 3-4 years by implementing all of the strategies that have been identified in Table 1. One option is to select facility design features that shorten the construction schedule. Implementation of these strategies is estimated to result in only a modest reduction in the total project cost because of lower overhead costs that directly scale with project duration. However, MPF schedule acceleration would require both an increase in early year budgets and tradeoffs consistent with the FYNSP. Current MPF planning is based on a risk management strategy that attempts to balance competing demands for funds, long-term pit manufacturing capability requirements, and timing of information (e.g., stockpile size and pit lifetimes) necessary for quality decisions.

**Table 1: Summary of Options to Accelerate MPF Design and Construction**

<b>Current Schedule</b>	<b>Acceleration Options</b>	<b>Potential Schedule Reduction</b>
<p>Design Phase (2003 to 2012)</p> <ul style="list-style-type: none"> <li>• Conceptual – 2003 to 2007</li> <li>• Preliminary – 2007 to 2009</li> <li>• Final – 2009 to 2012</li> </ul>	<p><u>Minimize Transitions Between Conceptual, Preliminary, and Final Design Steps:</u> The transition from the NNSA integrated contractor team currently completing conceptual design, to an architect/engineering services contractor can be shortened. To minimize any delay in the start of the preliminary design, selection of the design services contractor could be initiated prior to the completion of the conceptual design. Final design could be an option that is included in a single design services contract.</p> <p><u>Accelerate Design Schedule:</u> An analysis of the design work scope indicates that the design can be completed in a shorter time period with a reasonable staffing peak, if required funding were available.</p>	<p>16 to 24 months</p>
<p>Construction Phase (2012 to 2018)</p> <ul style="list-style-type: none"> <li>• Construction start in 2012</li> <li>• Authorize start of operations (Critical Decision-4) in 2018</li> </ul> <p>Note: The above construction phase is intended to support the following:</p> <ul style="list-style-type: none"> <li>• Initial operations in 2019</li> <li>• Full production operations in 2021</li> </ul>	<p><u>Shorten Procurement Time for Construction Services:</u> The time period to acquire a construction services contractor can be eliminated by changing the “design services” contract to a “design with option to build” contract.</p> <p><u>Initiate Specific Construction Actions Before Completion of Final Design:</u> Design could be finalized early on selected construction work packages, such as site preparation and support facilities, and limited construction activities could be underway prior to completion of the balance of the final design.</p> <p><u>Select Facility Design Features that Optimize Construction Schedule:</u> Facility configuration and design options that could result in more effective phased construction are now being identified and evaluated. Results are expected in 2005.</p> <p><u>Select a More Aggressive Construction Workday Schedule:</u> The current construction schedule is based on five 8-hour workdays per week. A more aggressive work schedule, such as seven 10-hour days per week, could accelerate construction substantially at a modest cost increase.</p>	<p>20 to 23 months</p>

### Section 5: Evaluation of Technical Expertise Required for Pit Production

While the closure of the Rocky Flats Plant did result in the loss of pit production expertise for the U.S., start-up of an interim pit manufacturing capability at LANL provides a foundation of technical expertise required for long-term support of the U.S. nuclear weapons stockpile. Since the early 1990's, LANL has served as the U.S. focal point for pit manufacturing development activities. Some fifty former Rocky Flats personnel moved to LANL thus helping to transfer the technical expertise necessary to manufacture stockpile-certified pits. Until MPF becomes fully operational, Los Alamos will retain primary responsibility for maintaining and developing pit production expertise. LANL expertise will also be supplemented by expertise from organizations listed in Table 2.

**Table 2: Technical Expertise Required for Pit Production**

<b>Required Expertise</b>	<b>Source of Technical Expertise for MPF</b>
Pit Manufacturing	<ul style="list-style-type: none"> <li>• Los Alamos National Laboratory (LANL)</li> <li>• Lawrence Livermore National Laboratory (LLNL)</li> <li>• Retired Rocky Flats Plant (RFP) employees</li> </ul>
Plutonium Processing	<ul style="list-style-type: none"> <li>• Los Alamos National Laboratory</li> <li>• Lawrence Livermore National Laboratory</li> <li>• Savannah River Site (SRS)</li> </ul>
Nuclear Facility Operations	<ul style="list-style-type: none"> <li>• Savannah River Site</li> <li>• Los Alamos National Laboratory</li> <li>• Lawrence Livermore National Laboratory</li> <li>• Waste Isolation Pilot Plant (WIPP)</li> <li>• Pantex Plant (PX)</li> <li>• Y-12 Plant (Y-12)</li> <li>• U.S. nuclear utilities</li> </ul>
Small-Quantity/ High-Value Manufacturing	<ul style="list-style-type: none"> <li>• Kansas City Plant (KCP)</li> <li>• Sandia National Laboratories (SNL)</li> <li>• Y-12 Plant</li> <li>• U.S. manufacturing industry</li> </ul>

Over the past years, DOE has supported knowledge retention activities to archive key nuclear weapons information that is at risk of loss from workload reductions in the nuclear weapons complex, closure of NNSA production plants, and aging of the NNSA workforce. Pit production records and equipment at Rocky Flats have been reviewed and transferred to either Los Alamos or Savannah River as appropriate. Coupled with an interim capacity at LANL, planning for additional pit manufacturing capabilities is the cornerstone of NNSA actions to ensure the Nation's experience in pit manufacturing is not further degraded. These plans include implementation of the actions listed in Table 3 to protect U.S. institutional knowledge of pit production and provide a robust capability for the long-term.

**Table 3: Planned NNSA Actions to Preserve Pit Production Expertise**

<b>Action</b>	<b>Discussion</b>
Maintain an interim pit manufacturing capability at LANL	Continuously manufacture limited numbers of pits at LANL to maintain production “recipe,” provide current operating experience, and train future MPF operating personnel.
Engage U.S. plutonium expertise in planning for MPF	Key personnel from LANL, LLNL, and SRS, will be engaged in MPF design and technology development activities to maintain and transfer expertise on plutonium operations.
Engage U.S. small-quantity/ high-value manufacturing expertise in planning for MPF	Key personnel from KCP, Y-12, SNL, and specialized U.S. manufacturing companies will be engaged in MPF activities to provide the required experience base on small-quantity/ high-value manufacturing.
Engage nuclear facility operating expertise in planning for MPF	Personnel from LANL, LLNL, SRS, PX, Y-12, WIPP, and U.S. nuclear utilities will be engaged in MPF activities to provide the required experience base in nuclear facility operations.
Utilize Rocky Flats experience in key MPF design decisions	Rocky Flats retirees are providing input on MPF design features and manufacturing facility requirements. To fully use the experience of this population, key MPF design decisions must be made over the next several years to directly benefit from Rocky Flats experience.
Develop and demonstrate initial technology for MPF while weapon design agency personnel with nuclear test experience are still available	Pit manufacturing technology has evolved since Rocky Flats closure. Some equipment is obsolete and cannot be replaced. Some materials and solvents are eliminated to comply with environmental restrictions. Some proposed technology changes improve manufacturing efficiency or reduce radiation doses to workers. Risks to weapon performance are minimized if new production technology is demonstrated while weapon design agency personnel with nuclear test experience are available. Therefore, initial MPF technology should be demonstrated over the next decade
Engage selected host site personnel early in MPF planning	Key personnel will be selected at the host site to obtain pit manufacturing experience, ensure unique site attributes are considered in MPF design, and prepare staff recruitment and training plans. Temporary assignments of personnel to LANL and LLNL will augment the needed training and experience base. These key host site personnel would become lead trainers for the balance of the host site workforce. Cooperative programs with local technical colleges or universities would be established.
Initiate larger-scale staff development actions for MPF at least 5 years prior to start of operations	Prior to MPF start-up, staff development plans will be implemented. Depending on the host site, experienced plutonium workers may be available for re-assignment to MPF. If experienced personnel are not available, early training will qualify new plutonium workers. Temporary personnel assignments between MPF and LANL/ LLNL/ SRS will support training activities. A non-radiological development laboratory will be completed early in MPF construction to serve as the initial location for job-specific training at the host site.

## **Section 6: Approach for Ensuring Production Agility and Facility Flexibility**

A pit manufacturing facility should have the capability to accommodate a great deal of change during a more than 15-year design and construction phase and an anticipated 50-year operating lifetime. The design of the facility and planning for its operation should offer flexibility, with agility, to support a range of mission and production scenarios, as well as the ongoing insertion of improved technology. Production flexibility becomes more important as stockpile size decreases and contingency or unexpected production needs become a more dominant requirement. An MPF should have flexibility with sufficient agility to accommodate changes in mission requirements such as increased/decreased production rates, changes in the composition of the stockpile, evolving pit certification requirements, changes in regulatory requirements, and new production technologies.

The size and composition of the future stockpile are uncertain, and pit lifetimes will continue to be assessed. Since the trend is toward a smaller stockpile, the MPF strategy is to design a small facility that is both flexible and agile. MPF requirements are being developed during conceptual design in a manner consistent with this strategy. A minimum set of pit manufacturing equipment would result in a manufacturing facility with a capacity of approximately 125 pits/year.

Many of the individual production process steps have a natural throughput capacity that equals or exceeds 125 pits/year. Only 10 to 20% of the process steps have individual workstation throughputs less than this value. Consequently, no major cost savings can be achieved from designing a new facility with a capacity significantly smaller than 125 pits/year. A 125 pits/year plant also provides an appropriate modular base size that can be scaled to higher production capacities if required. However, this modular scaling does not apply to an existing facility, such as TA-55, where existing infrastructure and material transport systems are rate limiting and original building layout was focused on research and development rather than production operations.

Manufacturing models have been used to determine the number of workstations needed for MPF. Based on this modeling, the design for a potential MPF includes spare workstations at a limited number of strategic locations to reduce risks from single-point failures and enhance facility flexibility and production agility. A modular design concept is planned for MPF that assembles production equipment into manageable subsets of the overall production process. A small MPF would include a limited amount of undeveloped floor space for introduction of new technology, meeting new certification or regulatory requirements, and/or introduction of new mission assignments. Process development space is included in the facility design that could be used for pre-production testing of critical process operations and associated tooling to minimize the time necessary to transition production from one pit type to a second pit type in the production lines.

In the near-term, NNSA plans to use interim production at LANL and technology development underway at U.S. plutonium facilities (LANL, LLNL, and SRS) to maintain the integrity of the Nation's pit manufacturing capability. For the long-term, NNSA believes a flexible and agile MPF that has the capability to meet changing military requirements is needed. The current MPF approach includes the following:

- Design requirements to ensure a small, modular facility that is flexible with production agility.
- Manufacturing process equipment placed in modules.

- Facility features that provide contingency and limited new process development floor-space to support the use of new technologies and evolving environmental or security requirements.
- Design and operations planning based on modern manufacturing and model-based design practices.

## **Section 7: Planned Approach to Ensure that MPF is Appropriately Sized**

Reductions in the size of future nuclear weapons stockpiles translate into a need for a long-term U.S. pit manufacturing capacity that is significantly smaller than the historical capacity at the Rocky Flats Plant. NNSA analyses of future stockpile ranges indicate that a reliable production capacity that is about one order of magnitude smaller than Rocky Flats may be sufficient to manage the long-term need for replacement pits. Because of uncertainty in parameters that define the required capacity for an MPF (size and composition of the future stockpile, pit lifetime, start date for quantity production, and length of time between shutdown of Rocky Flats and start of new production), the NNSA approach to ensure that an MPF would be appropriately sized evaluates realistic ranges of parameters and selects a capacity that manages overall risks to the nuclear weapons stockpile. The NNSA approach has two major components:

- Plan for an MPF, but include major decision points prior to start of construction that allow for adjustments to plant capacity and start date, or provide a choice to end the project if it is no longer needed. These major decision points include:
  - Two decisions resulting from a two-step NEPA compliance process (programmatic record of decision in 2004 and site-specific record of decision in 2007)
  - Three major system acquisition critical decisions (approve system requirements and alternatives in 2007 (CD-1), approve cost and schedule baseline in 2009 (CD-2), and authorize start of construction in 2012 (CD-3)).
- Complete periodic revalidations of the required MPF capacity based on the most recent stockpile size and composition guidance from DoD and pit lifetime estimates from NNSA physics laboratories. Factor this information into MPF planning.

Periodic NNSA revalidations of the required MPF capacity will use a specially developed Capacity Assessment Model (CAM) to standardize the assessment methodology. CAM is a computer model that relies on a classified data-base (original production information of existing weapons in the enduring stockpile) to estimate future pit production requirements by pit type by year necessary to prevent stockpile weapons from exceeding a specified lifetime. By completing multiple analyses for ranges of stockpile sizes and compositions, pit lifetimes, and MPF start dates, trends become apparent relative to the appropriate size range for a future MPF.

Results of CAM analyses were used to support the selection of the bounding capacities evaluated in the MPF NEPA compliance process. While an MPF with the upper bound capacity of 450 pits/year is unlikely to be constructed, some hypothetical stockpile size/ pit lifetime/ MPF start date combinations yield required manufacturing capacities in that range. Since NEPA assessments typically bound the maximum (rather than the most likely) impacts of a proposed action, a 450 pits/year plant was used as the upper bound for the MPF-EIS process. More likely MPF capacities (lower end of the 125 to 450 pits/year range used to assess environmental impacts) are expected to be the basis for future MPF decisions.

As DoD defines specific stockpile sizes and compositions, the CAM model will continue to be used to predict future manufacturing requirements by pit type by year. MPF plans contain a requirement to revalidate manufacturing capacity estimates based on latest estimates of pit

lifetimes and stockpile size and composition prior to major project decisions. This requirement is to ensure that an MPF would be appropriately sized. Table 4 lists the schedule for revalidating pit manufacturing capacity requirements to support subsequent NNSA decisions.

**Table 4: Schedule for Revalidating Pit Manufacturing Capacity Requirements**

<b>Purpose of Capacity Revalidation</b>	<b>Year</b>
Provide input to revision of MPF Program Requirements Document (PRD) and first Draft of MPF Facility Design Description (FDD).	2004
Provide input to MPF Conceptual Design Report (CDR) and review package required to support Critical Decision 1 (CD-1) in 2007.	2006
Provide input to Record of Decision in 2007 on Site-specific Environmental Impact Statement to define exact location for facility on host site and facility features to mitigate potential long-term environmental impacts.	2006
Provide input to review package required to support Critical Decision 2 (CD-2) in 2009.	2008
Provide input to review package required to support Critical Decision 3 (CD-3) in 2012.	2011

## Section 8: Conclusions

NNSA must select an approach to long-term pit manufacturing that best manages risks and uncertainties. Planning a small pit manufacturing capability based on a reduced number of weapons consistent with the Moscow Treaty, a 60-year pit lifetime, and a required production capability in place by 2021 is the NNSA risk management strategy. NNSA should continue planning for a small pit manufacturing capability because:

- The lack of a U.S. pit manufacturing infrastructure capable of supporting future stockpiles is a serious national security deficiency.
- A responsive production infrastructure is required to permit reductions in the nuclear arsenal and manage risks to national security.
- Existing facilities at LANL do not have the capacity or agility to support future pit replacement needs without modifications that would be more costly in the long-term than building a new, small MPF.
- Impacts of pit aging are likely to remain uncertain, thereby resulting in risk to stockpile performance if there is not sufficient capability to manufacture replacement pits.
- A steady MPF planning course will enable NNSA to meet long-term national security needs for pits in a manner that also meets modern safety and environmental goals while utilizing state-of-the-art manufacturing methods that minimize risks to the environment and manufacturing workers.
- MPF planning provides an opportunity to more effectively address evolving physical security requirements relative to pit manufacturing.

Additional points relative to the specific request for information by Congress are:

- The current MPF schedule can potentially be accelerated by 3-4 years. However, MPF schedule acceleration would require changes in the FYNSP funding profile to increase early year budgets.
- Until MPF becomes fully operational, LANL will retain primary responsibility for maintaining and developing pit production expertise with assistance from LLNL.
- In the near-term, NNSA will use interim production at LANL and technology development work underway at U.S. plutonium facilities (LANL, LLNL, and SRS) to maintain the integrity of the Nation's pit manufacturing capability. For the long-term, NNSA planning would address the need for a flexible and agile MPF that can meet changing military requirements.
- MPF project plans contain a requirement and schedule to revalidate manufacturing capacity estimates based on latest estimates of pit lifetimes and stockpile size and composition prior to major project decisions. This requirement is to ensure that an MPF would be appropriately sized.