Union of Concerned Scientists
BACKGROUNDER

The CMRR-Nuclear Facility: Why a Delay Makes Sense

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Executive Summary

In its FY2013 budget request, the Obama administration announced a delay of at least five years in the construction of a proposed new facility at the Los Alamos National Laboratory (LANL)—the Chemistry and Metallurgy Research Replacement-Nuclear Facility (CMRR-NF). Our analysis finds that there will be no adverse effects of delaying construction. Moreover, there is no clear need for the CMRR-NF as currently proposed. Delaying construction will also allow the National Nuclear Security Administration (NNSA) to fully assess alternatives to building CMRR-NF and to take into account forthcoming changes to U.S. nuclear weapons policy.

There will be no adverse effects of delaying construction. Moreover, there is no clear need for the CMRR-NF as currently proposed.

There are three primary reasons the administration wants to build the CMRR-NF: (1) to allow an increase in the capacity to produce to produce plutonium "pits," which are at the core of all U.S. nuclear weapons; (2) to provide replacement laboratory space for activities now undertaken at aging facilities at LANL; and (3) to provide additional storage space for plutonium and other nuclear materials.

The United States produces pits at LANL's Plutonium Facility-4 (PF-4) at a current rate of 10-20 annually. This rate could be increased to 50 annually without building the CMRR-NF. According to NNSA, increasing the pit production capacity to 50-80 annually would require the CMRR-NF, which would accommodate some of the activities now conducted at PF-4, thus making room for additional pit production at PF-4. The administration has not clearly defined the future need for pits, but has suggested the United States will need an annual production capacity of 50-80.

Given the estimated lifetime of current pits, there is no need to replace them due to aging for at least many decades. Nor is there a need to increase pit production capacity above the current level to replace pits destroyed for surveillance purposes under the Stockpile Stewardship Program, to increase the arsenal, or to replace a class of defective warheads.

Looking ahead two decades, we find that the only plausible need to increase pit production capacity above the current level is to support the upcoming life extension programs (LEP) for the W78 and W88 warheads—*if they use newly built pits.* (A LEP could simply refurbish the existing warhead and use the existing pit, or could use an existing pit from another warhead type.) However, even in this case, an annual production capacity of 40-45 pits would be adequate, and this could be accomplished without building a new CMRR-NF. If the United States reduced its arsenal below 3,500 weapons over the next few decades, an even lower annual production capacity could be sufficient.

To date, NNSA has not made a decision about whether it will use new pits for the W78 and W88 LEPs. The studies and engineering phase for the W78 will not be complete until FY2021. Thus, there is as yet no specific need for an increase in pit production capacity.

The CMRR-NF would also provide additional laboratory and storage space for handling plutonium and other radioactive materials. However, there are other, less expensive approaches, and a delay in the CMRR-NF will allow these other options to be assessed. For example, the administra-

tion has already indicated that a new safety analysis will allow the first phase of the CMRR project—a radiological laboratory that is already built—to take on a significant portion of the work planned for the Nuclear Facility. The administration has also identified an option for storing nuclear material in Nevada. Moreover, one of the factors driving the high costs of CMRR-NF is its location along a seismic fault line. A delay would also allow consideration of design options that could lower the costs of construction.

Delaying construction will provide time for the Obama adminisration to take into account the implications of its forthcoming changes in nuclear weapons policy.

Plans for the CMRR-NF were made long before the New START agreement was negotiated and the 2010 Nuclear Posture Review was completed. Following a lengthy Pentagon-led review of options, later this year the President will make decisions about the size, structure and mission of U.S. nuclear forces. It is likely that the administration will decide the United States can decrease its nuclear arsenal; the Pentagon has recently stated that *"It is possible that our deterrence goals can be achieved with a smaller nuclear force."*[1] (Emphasis in the original.) Thus, delaying construction will provide time for the Obama administration to take into account the implications of its forthcoming changes in nuclear weapons policy.

To address these issues, we recommend that Congress:

- Require an independent study to: (1) determine the materials analysis and other plutonium science-related capabilities that are required to maintain the nuclear stockpile (2) assess whether existing facilities at Los Alamos or elsewhere could meet those requirements on an ongoing basis, and (3) provide cost estimates for these options. The NNSA is currently undertaking a study like this, due for completion in April 2012. However, an independent study would ensure that all the options are thoroughly considered.
- Require an independent study to assess the future need for production of plutonium pits, once the administration makes pending decisions on U.S. nuclear policy.
- Require that NNSA update its findings on the lifetimes of plutonium pits and request the JASON panel to review that assessment. This assessment by NNSA and review by the JASON panel should occur periodically.

[1] Department of Defense (DOD). 2012. *Sustaining U.S. global leadership: Priorities for 21st century defense.* Washington, DC: Department of Defense, 5. Online at: *www.defense.gov/news/Defense_Strategic_Guidance.pdf*

1. Introduction

In its FY2013 budget request, the Obama administration announced it will delay for at least five years construction of a proposed new facility at the Los Alamos National Laboratory (LANL)—the Chemistry and Metallurgy Research Replacement Nuclear Facility (CMRR-NF).

This report examines the consequences of that decision. It first provides background on the facility and then considers the three primary reasons the NNSA proposes to build the CMRR-NF. They are:

- To support an increase in the capacity to produce new plutonium pits
- To acquire new, modern laboratories to perform the analytical work currently done in the CMR
- To create a secure storage vault that will allow consolidation of nuclear materials, particularly plutonium.

Finally, the report makes recommendations about how to move forward.

2. Background

The Chemistry and Metallurgy Research Replacement (CMRR) Project at Los Alamos National Laboratory (LANL) is designed to replace the existing Chemistry and Metallurgy Research (CMR) building, where scientists conduct technical analyses on a variety of materials used in nuclear weapons, with particular emphasis on plutonium.

The CMRR project consists of two phases. Construction of the first phase was completed in 2010. The 200,000 square-foot CMRR Radiological Laboratory/Utility/Office Building (RLUOB) contains office space and 20,000 square feet of radiological laboratory space. Workers are still installing the equipment for the lab, which is slated for completion this year, slightly ahead of schedule.

Phase two is the Nuclear Facility—the so-called CMRR-NF. Before this delay, it was slated to begin operations in 2024. While pits would not be produced in the CMRR-NF, its construction would allow Los Alamos to increase the capacity of the current pit production facility—LANL's Plutonium Facility-4 (PF-4). The planned CMRR-NF, with almost 400,000 square feet of floor space, would be located next to PF-4 and the two facilities would be connected via an underground tunnel and share a vault capable of holding up to six metric tons of plutonium. All pits would continue to be produced in PF-4, but some of the activities now conducted there would be moved to the CMRR-NF and some of the materials stored in PF-4 would be moved to the shared vault, allowing pit production in PF-4 to expand.

According to the National Nuclear Security Administration (NNSA), the semi-autonomous agency within the Department of Energy (DOE) that oversees the weapons labs, producing up to 80 pits per year will only be possible by building the Nuclear Facility and upgrading PF-4.[2] However, the NNSA has also indicated that pit production could be increased without building CMRR-NF. The NNSA's FY2012 plan for maintaining the stockpile states, "One strategy for increasing this [pit] production capability is to add equipment to augment the existing manufacturing processes co-located inside a dedicated room in PF-4."[3]

Furthermore, when the Bush administration was planning to build significant numbers of Reliable Replacement Warheads (RRWs) that would have required new pits, the FY2008 budget request stated that LANL would "work to increase the pit manufacturing capacity to 30 to

[2] Department of Energy (DOE). 2011. *FY 2012 Stockpile stewardship and management plan*. Washington, DC: National Nuclear Security Administration. Online at *www.ucsusa.org/assets/documents/nwgs/SSMP-FY12-041511.pdf*

[3] Ibid, p. 147.

50 net RRW pits by the end of FY2012."[4] This increase was to take place well before the construction of the CMRR-NF. A 2009 analysis by LANL indicates that a production capacity of 50 pits per year could be achieved by 2020, before construction of CMRR-NF is complete.[5]

Thus, it appears that Los Alamos can increase the pit production capacity of PF-4 to 50 annually by adding equipment and perhaps increasing works shifts, even without construction of CMRR-NF.

The current NNSA cost estimate for the CMRR-NF is $3.7 to $5.9 billion, reflecting a six- to nine-fold increase from the initial estimate of $660 million provided to Congress in FY2004. The current estimate is from 2010, when the design for CMRR was 45% complete. As of early 2012, $350 million had been spent on the project and the design work was roughly 60-70% complete. Before the delay, NNSA had planned to release a final cost estimate later this year when the design was slated to be 90% complete; NNSA may now stop design work before that point and a final cost estimate could await a decision to begin construction.

It appears that Los Alamos can increase the pit production capacity of PF-4 to 50 annually by adding equipment and perhaps increasing works shifts, even without construction of CMRR-NF.

Roughly $500 million of the increased cost is due to the evolving understanding of the requirements for building the facility in a complex seismic fault zone between the Rio Grande rift valley and a dormant volcano, which has led NNSA to require a much larger foundation for the building.[6]

However, there are alternative and less expensive ways to protect buildings in seismic zones from earthquakes. For example, rather than a massive foundation, it is possible to use a "floating" base that absorbs an earthquake's movements. The delay in the construction of CMRR-NF will also allow NNSA to assess this and other possible types of construction.

In February 2012, the Obama administration released its FY2013 budget request. It eliminated all funding for CMRR-NF and stated that construction would be delayed for at least five years. In explaining why it made this decision, the administration stated: "NNSA has determined, in consultation with the national laboratories, that the existing infrastructure in the nuclear complex has the inherent capacity to provide adequate support for these missions. Studies are ongoing to determine long-term requirements. NNSA will modify existing facilities, and relocate some nuclear materials." [7]

The decision to delay CMRR-NF was driven largely by budget pressures. The administration had previously planned to simultaneously build the CMRR-NF and another multi-billion dollar facility, the Uranium Processing Facility (UPF) at the Y-12 complex in Tennessee. The passage of the 2011 Budget Control Act and the new budget environment forced the administration to prioritize and it selected the UPF. Delaying CMRR-NF will avoid $1.8 billion in costs over the next five years.

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[4] Department of Energy (DOE). 2007. *FY 2008 congressional budget request*, DOE/CF-014, 199. Volume 1. Washington, DC: Department of Energy.

[5] Kniss, Brett, and Drew Kornreich. 2009. Frequently asked questions (FAQ) on pit manufacturing capacity. Obtained by UCS through FOIA. Los Alamos National Laboratory. Online at: *http://www.ucsusa.org/assets/documents/nwgs/LANL-pit-mfg-capacity-FAQs-2009.pdf*

[6] Government Accountability Office (GAO). 2012. Modernizing the nuclear security enterprise: New plutonium research facility at los alamos may not meet all mission needs, GAO-12-337. Washington, DC.

[7] Department of Energy (DOE). 2012. *FY 2013 congressional budget request,* DOE/CF-0071, 8. Volume 1. Washington, DC: Department of Energy.

Model of proposed CMRR facility at Los Alamos National Laboratory
Photo: NNSA

The decision was based largely on two factors. First, the existing facility for uranium work at Y-12, known as 9212, is in significantly worse shape than is the CMR facility at Los Alamos. Second, the UPF will serve a production role in the complex, while CMRR-NF would be a support facility.

Now that it has decided to delay construction of the CMRR-NF, the NNSA is conducting a more detailed study of plutonium needs and how the complex will fare without the new facility. This 60-day study is scheduled to be released in mid-April 2012, and will consider the following options:[8]

- Substantially complete the design of CMRR-NF by the end of FY2012, while ensuring that documentation is available for potential future use.
- Phase out activities at the existing CMR building by 2019.
- Plan for maximum use of the newly-built RLUOB for analytical chemistry capabilities to support mission needs.
- Move material between RLUOB and PF-4 safely and securely and work on plutonium sample preparation at PF-4.
- Consider options at other NNSA sites to address residual analytical chemistry needs.
- Maintain required material characterization capabilities using the PF-4 at Los Alamos and an existing facility, Building 332 at Livermore.
- Process, package, and ship excess materials (primarily plutonium) from PF-4 to the Device Assembly Facility at the Nevada National Security Site (formerly known as the Test Site).

NNSA officials have also discussed the longer-term possibility of combining CMRR-NF and PF-4 into one new plutonium facility; the latter building is 35 years old and, officials argue, might need replacing in the next two decades.

[8]Broderick, B.P., and R.T. Davis. 2012. Los alamos report for week ending february 17, 2012. Defense Nuclear Facilities Safety Board, February 17. Online at: *www.dnfsb.gov/sites/default/files/Board%20 Activities/Reports/Site%20Rep%20Weekly%20Reports/Los%20Alamos%20National%20Laboratory/2012/wr_20120217_65.pdf*

3. Pit Production

One of the main reasons NNSA cites for building the CMRR-NF is to allow an increase in the pit production capacity at Los Alamos' P-4 facility.

However, NNSA has offered no clear rationale for how many pits it needs to be able to produce annually. The Obama administration's 2010 Nuclear Posture Review made strong commitments to maintaining the U.S. nuclear stockpile but was silent on the issue of pit production. The Nuclear Weapons Council, a joint Department of Defense and DOE/NNSA oversight body that provides policy guidance and oversight of the nuclear stockpile management process, has not established a requirement for increased pit production.[9] As a recent Government Accountability Office report on the CMRR notes, "Currently, pit capacity requirements are uncertain and still in flux."[10]

There are several potential reasons the United States might want to produce new pits. These include: (a) to replace pits at the end of their lifetime; (b) to replace pits destroyed in testing; (c) to increase the size of the arsenal; (d) to replace a class of defective warheads; and (e) to use in warheads that are undergoing a life extension program.

Replacing Pits at the End of Their Lifetime

Because plutonium is extremely rare naturally and was first produced in significant quantities in the 1940s, there was little information on how its properties would change as it aged. Before 2006, the DOE estimated that plutonium pits would have a lifetime of 45 to 60 years. The pits in today's nuclear arsenal were produced almost entirely between 1980 and 1989—meaning that they might need to be replaced by as early as 2025. Concerns about how long the pits would remain reliable was one of the primary reasons that NNSA initially sought to increase the ability to produce new ones and a key initial justification for the RRW program.

However, NNSA now knows much more about the aging of plutonium and the lifetime of plutonium pits. Scientists at the weapons laboratories have been conducting accelerated aging experiments that each year provide data on 16 years of natural aging. In 2006, the JASON group assessed this data and, according to the NNSA, found that "most primary[11] types have credible minimum lifetimes in excess of 100 years as regards aging of plutonium; those with assessed minimum lifetimes of 100 years or less have clear mitigation paths that are proposed and/or being implemented."[12]

Moreover, the DOE is quickly accruing more knowledge about pit lifetimes. According to the NNSA in 2006, it planned "to continue plutonium aging assessments through vigilant surveillance and scientific evaluation, and the weapons laboratories will annually re-assess plutonium in nuclear weapons, incorporating new data and observations."[13] LANL staff recently indicated that the work continues, but at present there are no plans to announce new results.[14]

It has been over five years since the 2006 JASON assessment, and enough data now exists to assess whether plutonium pits will last for

[9] The Nuclear Weapons Council has set some requirements for the capabilities of the NNSA's other proposed major construction project, the Uranium Processing Facility at the Y-12 site in Tennessee.

[10] GAO 2012, p. 5-6.

[11] A primary is the first stage of a modern, two-stage nuclear weapon. It includes the plutonium pit, high explosives to compress it, and metallic reflectors and radioactive gases to increase the yield.

[12] National Nuclear Security Adminisration (NNSA). 2006. Studies show plutonium degradation in U.S. nuclear weapons will not affect reliability soon." Press Release, November 29. Online at *www.nnsa.energy.gov/mediaroom/pressreleases/studies-show-plutonium-degradation-u.s.-nuclear-weapons-will-not-affect-reli*

[13] Ibid.

[14] Author's conversation with LANL staff, January 9, 2012.

more than 180 years.[15] If pit lifetimes are 180 years, there is no need to produce replacement pits for the foreseeable future and no rationale for expanding pit production capabilities for this purpose. In any event, the minimum pit lifetime is an important piece of information that should be made public to ensure a well-informed debate about the CMRR-NF. NNSA should update its assessment, again have JASON review it, and make the results public.

Even in a worst-case scenario, if the DOE finds that pits will last only 100 years, the nation could easily wait two decades before beginning to replace them. Under the conservative notion that the total U.S. arsenal will remain at the level of 3,500 warheads (which is NNSA's planning assumption), the agency could wait until 2030 to begin production of replacement pits at the rate of 70 per year. Since construction of the CMRR-NF is expected to take about a decade, the NNSA can wait until at least 2020 before beginning construction.

However, it is likely that the total arsenal will be reduced below 3,500 warheads in the next two decades, in which case NNSA could either wait longer to build the CMRR-NF (see Table 1) or reduce the annual rate of production (see Table 2)—perhaps avoiding the need for the CMRR-NF altogether.

Thus, even under the most conservative assumptions about pit lifetime and arsenal size, there is no urgent need to expand pit production for this purpose. Moreover, it could be a costly mistake to do so if future reductions in the U.S. arsenal render such an expansion unnecessary.

Table 1. The year that production of replacement pits would need to begin in order to replace all pits by 2080 (when the oldest pits will reach 100 years), assuming an annual production rate of 70 pits/year and a pit lifetime of 100 years.

Total size of U.S. nuclear arsenal in 2080, deployed and reserve	*Year that replacement production should begin*
100	2078
500	2072
1,000	2065
2,000	2051
3,000	2037
3,500	2030

Table 2: Required annual pit production capacity, under various arsenal sizes, assuming a pit lifetime of 100 years.

Size of U.S. nuclear arsenal in 2080	*Required average annual pit production, starting in 2030*
100	2
500	10
1,000	20
2,000	40
3,000	60
3,500	70

Replacing Pits Destroyed under the Stockpile Stewardship Program

Until a few years ago, the NNSA would remove 11 warheads of each type from the stockpile each year for disassembly and extensive testing. This is known as "Stage One" testing, and is designed to look at system-wide problems in either the design or the manufacture of each warhead type. The testing was the same for every type of warhead, regardless of how many were in the stockpile or what was already known about each type. As part of this testing, the nuclear components (the "nuclear explosive package") of one warhead were disassembled each year and the pit destroyed. The remaining warheads were reassembled and returned to the stockpile.

[15] Since each year provides data on 16 years of aging, the last five years have provided data on an additional 80 years of aging.

This approach, where one pit was destroyed every year, was the driving factor behind the decision to begin production of the pit for the W88 warhead at LANL. Previously, pits were produced at the Rocky Flats plant in Colorado, but that facility was shut down in 1989 due to environmental and health concerns. The DOE had intended to build several thousand W88 warheads to replace W76s, but made only some 400 before the shutdown.[16] Since the United States deployed approximately 384 W88 warheads until recently, this left only a small and decreasing reserve. As of 2004, only one pit for a W88 nuclear warhead was available to replace the one destroyed during testing.[17]

In September 2007 NNSA announced that the first new W88 warhead with a new pit was certified for entry into the stockpile since 1989.[18] In the last four years, LANL produced 29 certified W88 pits, concluding the production run in August 2011.[19] Of those, 18 went into the deployed stockpile, seven were dedicated to shelf-life testing, two were put in the reserve stockpile, and two were set aside for destructive testing.[20]

Now, the NNSA and weapons labs are developing a more focused method of assessing warheads. Under this "Stage Two" approach, the labs may test more or fewer than 11 warheads of each type, depending on several factors. For example, they will do more extensive tests of systems or components for which a problem is known or suspected based on previous testing. Rather than looking for manufacturing problems, which at this point have largely been found and addressed, the labs are spending more time looking at potential aging problems. Warheads going through Life Extension Programs (LEPs), where modifications could affect performance, will also likely receive particular attention. A case in point: the labs are testing more than 11 W76-1 warheads annually because significant changes have been made to these weapons as part of their LEP. Moreover, there are more than enough in the stockpile to allow destructive testing.

In contrast, because there are only a few hundred B61 bombs in the active stockpile, the labs might only remove four to five from the stockpile for testing and refrain from destroying any of the pits.

Aside from the W88, there are a significant number of reserve warheads for the other warhead types in the stockpile. This, along with the new stewardship practices, means there is no near-term need to produce new pits to replace those eliminated by destructive testing. And a new U.S. nuclear weapons policy could lead to the reduction or elimination of the W88 warheads, further extending the time until new W88 pits are needed for testing purposes, or eliminating the need entirely.

Increasing the Arsenal

According to the 2010 Nuclear Posture Review, new nuclear weapons production facilities "will be put in place to surge production in the event of significant geopolitical 'surprise'."[21] Administration officials have hinted that this increased production capacity is intended to serve

[16] Norris, Robert S. 1985. "Counterforce at sea: The trident II missile." *Arms Control Today*, September; and Norris, Robert S., and Hans M. Kristensen. 2008. "Nuclear notebook: U.S. nuclear forces, 2008." *Bulletin of the Atomic Scientists,* March/April, p. 52. The latter is online at: *http://.thebulletin.metapress.com/content/pr53n270241156n6/fulltext.pdf.*

[17] Medalia, Jonathan. 2004. Nuclear warhead "pit' production: Background and issues for Congress, RL31993. Congressional Research Service, updated March 29, p. CRS-3. Online at *www.fas.org/spp/starwars/crs/RL31993.pdf.*

[18] Department of Energy (DOE). 2007. Rebuilt W88 warhead formally accepted for use in U.S. nuclear weapon stockpile. Press release, September 27. Online at *http://nnsa.energy.gov/news/896.htm.*

[19] Sandoval, Marisa. 2011. Pit perfect: LANL meets plutonium pit production goal. *National Security Science.* Issue 3, October. Los Alamos National Laboratory. Online at *www.lanl.gov/science/NSS/issue3_2011/story3full.shtml*

[20] Author's conversation with Congressional staff, January 11, 2012.

[21] Department of Defense (DOD). 2010. *Nuclear posture review report.* Washington, DC: Department of Defense, 43.

as a hedge against a resurgent Russia or an emboldened China. However, this is not a sound rationale for expanded pit production at this time, for several reasons.

First, given the massive commitment required on Russia or China's part to alter the strategic balance, the United States would have more than sufficient time to respond if necessary. The expanded infrastructure and increased number of delivery vehicles required to produce an expanded nuclear force large enough to affect American security would take a decade or more, if it were possible at all. Such an effort would be detected by U.S. national technical means (and in Russia's case, New START's extensive verification provisions).

Second, the United States already stores over 14,000 pits from dismantled nuclear weapons at the Pantex Plant in Texas, which could be used for additional warheads if the need emerged. This approach would presumably take considerably less time than building new pits. Indeed, the existence of these pits creates an "upload" capability that the Russians have complained about.

Third, the need for a surge capacity is obviated by the reserve nuclear warheads the United States maintains in addition to those it deploys. The reserve is several thousand warheads today, more than the size of the deployed stockpile. Many experts believe so large a hedge is unnecessary and could be safely reduced, even without a large-scale capacity to produce new warheads.[22] In any case, while the reserve will likely decrease in concert with the deployed arsenal, it will not be eliminated any time soon.

Fundamentally, developing a capability to significantly increase the U.S. nuclear arsenal is outdated, Cold War-era thinking. As the 2010 Nuclear Posture Review states, the "fundamental role of U.S. nuclear weapons, which will continue as long as nuclear weapons exist, is to deter nuclear attack on the United States, our allies, and partners."[23] Russia and China would be deterred by an arsenal far smaller than the 1,550 nuclear weapons the United States will deploy under the New START agreement.

Given these considerations, the nation does not need to enhance its capacity to produce pits to allow an expansion of the nuclear arsenal.

Replacing a Class of Defective Warheads

The secretaries of Energy and Defense continue to certify annually that all warhead types in the U.S. nuclear stockpile are safe, secure and reliable. The existing nuclear stockpile is highly reliable and the likelihood of an entire class of warheads becoming defective through some common failure mode is extremely low.

Moreover, current practice reduces the consequences of such a failure. Each long-range delivery vehicle in the U.S. arsenal—land-based missiles, sea-based missiles, and bombers—has two associated warhead designs. This provides redundancy in case a defect emerges in one type of warhead. In addition, defective warheads could be replaced by those of a different type from the reserve arsenal, even by warheads on a different delivery platform. As the 2010 NPR states, "if there were a problem with a specific ICBM warhead type, it could be taken out of service and replaced with warheads from another ICBM warhead type, and/or nuclear warheads could be uploaded on SLBMs and/or bombers."[24]

Moreover, the 14,000 pits from dismantled nuclear weapons could be a source of pits for additional warheads if the need emerged. Again, this approach would presumably take considerably less time than building new pits.

Given these considerations, the nation does

[22] See, for example, Blair, Bruce G. , Thomas B. Cochran, et al. 2008. *Toward true security: Ten steps the next president should take to transform U.S. nuclear weapons policy,* Federation of American Scientists, Natural Resources Defense Council, Union of Concerned Scientists. Online at: *http://www.ucsusa.org/truesecurity.*

[23] DOD 2010, p. viii.

[24] DOD 2010, p. 22.

not need to enhance its capacity to produce pits to allow the replacement of defective warheads.

New Pits for Life Extension Programs

Under current plans, all U.S. warheads will undergo life extension programs over the next several decades (see Table 3). According to the 2010 Nuclear Posture Review plan, "the full range of LEP approaches will be considered: refurbishment of existing warheads, reuse of nuclear components from different warheads, and replacement of nuclear components." However, it goes on to say: "In any decision to proceed to engineering development for warhead LEPs, the United States will give strong preference to options for refurbishment or reuse. Replacement of nuclear components would be undertaken only if critical Stockpile Management Program goals could not otherwise be met, and if specifically authorized by the president and approved by Congress."[25]

The first option—refurbishment—would not entail new pits. NNSA's current life extension programs are both designated as refurbishments: the W76 and B61-3/4/7/11 LEPs will use existing pits. (The NNSA proposed but could not win approval for making significant modifications to the B61's nuclear explosive package, which includes the pit.) The second option—reuse—would use a primary from one existing warhead type in the life extension program for another. If not enough primaries of the first type are available, new ones—including new pits—would be manufactured. Under the third option—replacement—the labs would develop and produce a newly designed primary (and pit).

Table 3. Planned life extension programs through FY2035[26]

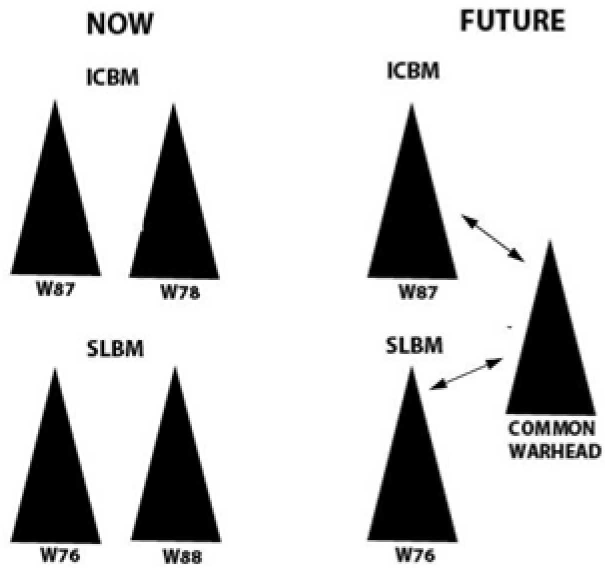
Warhead type	*Studies and Engineering Phase*	*Full-Scale Production*
W76 (SLBM warhead)	FY1998-FY2009	FY2009 –FY2018
B61-3/4/7/10 (strategic/tactical Bomb)	FY2009-FY2017	FY2017-FY2021
W78 (ICBM warhead)	FY2011-FY2021	FY2021-FY2024
Additional W78 hedge warheads		FY2024-FY2035
W88 (SLBM warhead)	FY2016-FY2024	FY2024-FY2031
W80-1 (air-launched cruise missile warhead)	FY2021-FY2031	FY2031-FY2035
W87 (ICBM warhead)	FY2029-FY2035	Beyond FY2035
B61-11/ B83-1 (strategic bombs)	Beyond FY2035	

[25] DOD 2010, p. xiv.
[26] DOE 2011, Figure 1, p. 14.

W78 and W88 LEPs

A need for new pits could be created in the upcoming LEPs for the W78 and W88. The 2010 NPR noted that NNSA and the Pentagon would, as part of the W78 LEP, study the "possibility of using the resulting warhead also on multiple platforms in order to reduce the number of warhead types."[27] NNSA is proposing to build a "common warhead" to replace the current W78 and the W88 warheads, intended to simplify the stockpile and allow a reduction in the number of reserve warheads. Rather than having two warhead types for ICBMs (the W78 and the W87) and two for SLBMs (the W76 and the W88), there would be three warheads for both: the W87 on land-based missiles, the W76 on submarines, and the common warhead, which would be deployed on both types of delivery vehicles. (See Figure 1.)

Figure 1. Warheads deployed on ICBMs and SLBMs, currently and if the W78 and W88 LEPs produce a common warhead.



As mentioned above, the United States maintains reserve warheads in part to allow replacement of an entire class of warheads should a problem with all of them arise. In this case, the reserve stockpile of the common warhead would serve as the replacement backup for both the W76 and W87 warheads. Since it is highly unlikely that a problem would arise simultaneously with the W76 and W87 warheads, the common warhead could serve as a backup for both types, thus allowing a reduction in the reserve arsenal.

How many common warheads would be needed? The United States currently deploys 250 W78 warheads and maintains another 360 in the reserve stockpile. Under the New START agreement, by 2018 the number of deployed W78 warheads will likely decrease to 150,[28] and it is likely that the reserve will decrease in concert with the deployed weapons to a range of 150-300. The United States currently has roughly 400 W88 warheads, almost all of which are deployed, and it is likely that this number will remain the same under New START. Thus, in the most likely scenario, a total of some 700-850 common warheads would be needed for the W78 and W88 LEPs—*assuming no further reductions in U.S. nuclear weapons take place beyond those required under New START.* (See Table 4.)

Table 4. Current and Future Arsenal under New START

	Current Arsenal		Under New START		After W78 and W88 LEPs	
	Deployed	*Reserve*	*Deployed*	*Reserve*	*Deployed*	*Reserve*
W78	250	360	150	150-300		
W88	400	0	400	0		
Common Warhead					550	150-300

[27] DOD 2010, p. 39.

[28] Kristensen, Hans and Robert S. Norris. 2011. US nuclear forces, 2011. *Bulletin of the Atomic Scientists*.Online at: http://bos.sagepub.com/content/67/2/66.full.pdf+html

The NNSA has not yet decided which of the three LEP approaches—refurbishment, reuse or replacement—it would use if it moves ahead with the common warhead. However, it is unlikely that it would seek to replace the W78 and W88 warheads with one of an entirely new design, given the administration's stated preference for refurbishment or reuse options.

The refurbishment option for the common warhead would entail refurbishing the W78 and then using this warhead to replace the W88 as well. (The existing W78 warhead could fit on the Trident Mark V reentry vehicle.) In this case, 400 refurbished W78s would be needed to replace the W88s. Roughly 1,000 W78s were built and some 600 are still in the active stockpile. Of the other 400 W78s, some 20-30 pits would have been destroyed for testing purposes and the rest are either awaiting dismantlement or dismantled, with the pits stored at Pantex. Thus, almost enough W78 pits already exist for the W88 LEP. The W78 and W88 LEPs are slated to be in production from FY2021 through FY2024 and FY2025 to FY2031, respectively. This would leave 19 years to produce any additional W78 pits that would be needed.

Among reuse options, one possibility is to use the primary from the W80 warhead, which has more safety features than either the W78 or the W88. In particular, the W80 uses insensitive high explosives rather than conventional ones to surround the pit, reducing the risk of an accidental detonation. The W80-0, deployed on sea-launched cruise missiles, is in the process of being retired and there are some 350 available. Thus, to meet the need for a total of 700-850 common warheads, an additional 350-500 W80-0 pits would need to be produced by FY2031, requiring an annual production capacity of 18-26 pits. While this is somewhat greater than the current production capacity of 10-20 pits annually, as noted above it is feasible to increase the capacity of PF-4 to 50 pits annually without building the CMRR-NF.

Another possibility is to use the primary from the W87, which also uses insensitive high explosives and adds a fire-resistant pit, which reduces the risk that a fire will result in the dispersal of plutonium.[29] It appears that this is NNSA's first choice: the pit production facility at PF-4 is currently preparing to produce W87 pits. If the United States proceeds to use the W87 primary in the W78 LEP, the question becomes one of numbers: how many existing W87 primaries are available and how many more would have to be built?

In addition to the 250 deployed W87 warheads, another 300 are in the reserve stockpile. It is likely that the reserve stockpile will be reduced along with the number of deployed weapons under the New START agreement, so some of the primaries from these reserve warheads may be available for use in the common warhead. However, unlike the W78, there are no excess W87 pits in storage or awaiting dismantlement.

As noted above, PF-4 is already preparing to produce W87 pits, although it may take a few years to produce certified pits.

Thus, to produce a total of 700-850 W87 pits for both the W78 and W88 LEPs, the average annual production rate over the next 19 years would need to be 37-45 pits. Moreover, the production capacity can be ramped up slowly since the W78 does not enter full-scale production until FY2021.

Note, however, that using either a W80-1 or a W87 primary in another warhead would go well beyond the scale of life extension programs to date. Such a "mix and match" approach has technical risks that could compromise confidence in the reliability of the weapon. In light of this, Congress may not approve the production of such a warhead, even if it reuses existing pits. Congress has repeatedly refused to support new warhead designs. It cancelled the Robust Nuclear Earth Penetrator, a nuclear-armed "bunker buster," in 2005. In 2008, it denied funding for the Reliable Replacement Warhead program,

[29] However, a fire resistant pit is designed to withstand the temperature of an airplane fuel fire, not the higher temperatures associated with a missile propellant fire.

which would have entailed designing and building a new warhead. Even more recently, Congress expressed serious concern about the NNSA's proposals for significant changes to the B61s nuclear explosive package, even though it used the existing B61 pit.

In short, the NNSA's plans for undertaking a common warhead approach using components from one warhead in another will face both technical and political challenges.

4. Modern Laboratories and Nuclear Facilities

In addition to allowing increased pit production, a new CMRR-NF would include a modern and safe facility to undertake the laboratory work done in the CMR, which was first constructed almost 60 years ago. Currently, CMR researchers perform analytical chemistry (AC) and materials characterization (MC) to determine isotopic ratios of plutonium, uranium, and other radioactive elements and identify major and trace elements in materials, with an emphasis on plutonium. Work also includes a program on plutonium-238, which is used as an energy source for space missions by the National Aeronautics and Space Administration (NASA).[30]

The CMR has eight wings, three of which have been shut down primarily due to seismic concerns, and work with radioactive materials has been restricted in scope in the remaining wings. In particular, Wing 2, where most of the materials characterization work was conducted, is shut down. As a result, "the broad spectrum of MC work once performed at the CMR Building has been relocated to other wings of the CMR Building or has been suspended."[31] A small subset of MC work is currently performed in Wings 5 and 7. One of the goals of the CMRR-NF is to reestablish the full suite of MC work at LANL.

There are two basic options for the work currently done at the CMR: upgrade the CMR so the work can continue there, or move it elsewhere. A combination of the two options would also be possible.

Under the first option, the CMR would be improved to increase the building's safety. (Note that, even if the CMRR-NF is built, LANL had plans to continue to use parts of the CMR indefinitely.) This option was evaluated when NNSA was planning for the CMRR-NF, as a part of the required environmental impact assessment. However, NNSA states that the feasible upgrades to allow continued AC and MC work would not reliably prevent the release of radioactive materials in the event of a major earthquake.

It is worth quoting in detail NNSA's analysis of this option:

> This alternative would result in very limited AC and MC capabilities at LANL over the extended period, depending on the overall ability of the CMR Building to be safely operated and maintained. Over time, these capabilities could gradually become more limited and more focused on supporting plutonium operations necessary for the immediate requirements of the stockpile. Moving the TA-3 CMR Building personnel and radiological laboratory functions into RLUOB over the next couple of years would result in considerable operational inefficiencies because personnel would have to travel by vehicle between offices and radiological laboratories at RLUOB and Hazard Category 2 laboratories that remain in the CMR Building. Additionally, the overall laboratory space allotted for certain functions, along with associated materials, might have to be duplicated at the two locations. . .

30 The plutonium used in nuclear weapons is Pu-239.

31 Department of Energy (DOE). 2011. *Final supplemental environmental impact statement for the nuclear facility portion of the chemistry and metallurgy research building replacement project at los alamos national laboratory, los alamos, new mexico: Summary,* DOE/EIS-0350-S1, S-5.

> This alternative does not completely satisfy NNSA's stated purpose and need to carry out AC and MC operations at a level to satisfy the entire range of DOE and NNSA mission support functions. However, this alternative is analyzed in the *CMRR-NF SEIS* as a prudent measure in light of possible future fiscal constraints.[32]

In short, this assessment states that work might be limited to the "immediate requirements of the stockpile." As long as that work could be carried out, this would appear to be a sensible limitation. It also states that it would be inefficient to travel between CMR and the RLUOB, and that some functions might have to be duplicated. That may be true, but does not justify the cost of the CMRR-NF. It states that this option does not "completely satisfy" the need to carry out the "entire range" of NNSA mission support functions. The question, however, is whether this option can adequately satisfy the need to carry out the *required* range of NNSA functions.

Finally, it states that this option was considered "in light of possible future fiscal constraints." That is, in fact, the environment faced today not only by NNSA, but the entire government.

Under the second option, the work at CMR would be moved to another location. Possibilities include:

An annual production capacity of 40-45 pits would be adequate, and this could be accomplished without building a new CMRR-NF.

- Conducting some of the work at CMRR-RLUOB. The facility is not qualified to do all the work of CMR, but can take over some part of it. Prior to the delay of the CMRR-NF, planning documents stated that the radiological lab could only handle very small amounts of plutonium, limited to 8.4 grams at a time.[33] More recently, NNSA officials testified before Congress that, based on current international safety standards, the RLUOB could handle up to 34-39 grams of plutonium.[34] This will allow NNSA to perform more of the work in the new lab than anticipated previously, and officials cite this as one of the major reasons they are comfortable with delaying the CMRR-NF.[35]
- Continuing work at Building 332 (also known as "Superblock") at Lawrence Livermore National Laboratory in California, where NNSA had planned to end work on significant amounts of plutonium. The administration's FY2013 budget request confirms that this is an option, but given safety considerations,it should not be pursued.
- Increasing work at PF-4. This facility already conducts some MC work and could potentially do more. The NNSA dismisses this option, stating that it would "interfere with performing work currently being conducted there and reduce the space available in the building that could be used to conduct future DOE and NNSA mission support work."[36] The reference to "future" work is nonspecific and, as a result, does not seem reasonable grounds

[32] DOE 2011, p. S-21 – S-22.

[33] National Nuclear Security Administration. 2010. CMRR-NF project and environmental description document," LA-UR 10-07497. Online at: *http://nnsa.energy.gov/sites/default/files/seis/CMRR%20NF%20Project%20and%20Environmental%20Description%20Document%20Final_LA-UR%2010-07497.pdf*

[34] Senate Appropriations Committee, Energy and Water Development Subcommittee. 2012. Hearing on FY13 national nuclear security administration budget request. With NNSA Administrator Tom D'Agostino, March 21.

[35] Ibid.

[36] DOE 2011, p. S-24.

to refuse to undertake work that NNSA says it needs to do.
- Conducting work at the Device Assembly Facility (DAF) at the Nevada National Security Site, which is also qualified to work on fissile materials. The DAF has plenty of under-utilized space, but is not convenient to PF-4, which generates many of the samples that are tested in the CMR.

As noted above, NNSA has cited the increase in the amount of plutonium that can be handled by the radiological laboratory as a key factor supporting the decision to delay the CMRR-NF. NNSA has also previously considered most of these other options but, as noted above, used the criteria for the maximum capability possible, rather than the minimum capability required. NNSA should reconsider these alternatives now that it will be at least five years before the administration makes a decision about the future of the CMRR-NF.

5. Plutonium Storage

One of the purposes of the planned CMRR-NF is to provide storage space for nuclear materials. These include weapons-grade material such as plutonium 239, and material such as plutonium 238, which is used to provide long-term power sources, primarily for NASA space vehicles. As of 1994, the last time such data were made public, 2.7 metric tons of plutonium was stored at LANL.[37] PF-4 is the primary location at LANL currently able to store significant quantities of these materials, and it uses substantial vault space to do so.

In its FY2013 budget release, the administration laid out its plan to handle storage issues without CMRR-NF:

> In place of CMRR Nuclear Facility for nuclear material storage, the budget request includes $35 million to accelerate actions that process, package, and dispose of excess nuclear material and reduce material at risk in the plutonium facility at Los Alamos. If additional space for special nuclear material is required, NNSA can stage plutonium for future program use in the Device Assembly Facility in Nevada. The Office of Secure Transportation Asset will execute shipments as needed."[38]

This Device Assembly Facility was one of several facilities that was identified in a 1996 study on storage of nuclear materials. According to that study, up to 8,000 pits could be stored by the DAF.[39]

Another option is to cancel CMRR-NF as a whole, but retain the vault portion of the plan. Building an underground vault attached to PF-4 would be significantly less expensive than building the entire new facility and could be done in less time.

Another option is to move the material to the U1a facility at the Nevada National Security Site (NNSS, formerly known as the Nevada Test Site.) U1a is the only facility in the United States where explosive tests using fissile materials are conducted. According to documents that are a part of a compilation assembled for the Complex Transformation environmental impact assessment, U1a would be a suitable location for storing weapons-grade nuclear material.[40]

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[37] Department of Energy (DOE). 1996. *Plutonium: The first 50 years.* Figure 4, "Location of DOE/DoD Plutonium Inventory." Online at: https://www.osti.gov/opennet/document/pu50yrs/fig4.gif

[38] DOE 2012, 185.

[39] Department of Energy (DOE). 1996. *Final environmental impact statement for the continued operation of the pantex plant and associated storage of nuclear weapons components,* DOE/EIS-0225. Volumes I-III. Online at: *www.globalsecurity.org/wmd/library/report/enviro/eis-0225/index.html*

[40] National Nuclear Security Administration (NNSA). 2007. *Complex transformation supplemental programmatic environmental impact statement reference materials*. "Nevada Test Site (NTS) Alternative," April 20, p. 12-13. Online at: *www.complextransformationspeis.com/Full%20Document.pdf.*

According to the CMRR-NF's environmental impact assessment, the plutonium stored in the proposed vault would be in powdered form.[41] Since powdered plutonium can easily be inhaled, it poses a greater health risk than do plutonium pits. However, the safety and security challenges may be similar enough that these facilities could be used to store powdered plutonium as well as pits.

One complication in these plans is that the NNSA has been planning to remove all significant quantities of plutonium from Lawrence Livermore National Laboratory, the nation's other weapons-design facility. The plutonium at Livermore, currently stored in the "Superblock" building, is designated to be moved to Los Alamos, and delaying the CMRR-NF could delay that transfer.

However, there are several potentially less expensive possibilities for increasing nuclear materials storage capacity that should be considered before moving ahead with the CMRR-NF.

6. Conclusions

There are three possible reasons to build the CMRR-NF: to allow an increase in pit production capacity above the rate of 50 annually that could be achieved without the CMRR-NF; to provide replacement laboratory space for activities now undertaken at the CMR; and to provide additional storage space for plutonium and other nuclear materials.

Replacing aging pits at the end of their lifetime is one potential reason to produce new pits. However, according to the NNSA, the lifetime of pits is known to be at least 100 years. Moreover, ongoing experiments likely indicate a minimum lifetime of 200 years. In either case, there is no need to produce replacement pits for at least several decades—even if the arsenal remains at the level of 3,500 weapons.

Another potential reason for new pit production is to replace those destroyed in annual tests. However, for all seven warhead types in the arsenal except the W88, there are enough warheads in the reserve to allow destructive testing for many decades. The United States recently stopped producing additional W88 pits, so NNSA must have determined that there was no need for more reserve warheads to allow destructive testing of the W88.

As NNSA now states, there are less expensive alternatives to CMRR-NF.

Nor does the United States need to produce pits to increase its arsenal or to replace a class of defective warheads.

The only plausible need for the United States to increase its pit production capacity above the current level of 10-20 annually is to support a life extension program for the W78 and W88 warheads—*if they use new pits*. However, even in this case, an annual production capacity of 40-45 pits would be adequate, and this could be accomplished without building a new CMRR-NF. If the United States reduced its arsenal below 3,500 weapons over the next few decades, a lower annual production capacity would be required.

NNSA has not yet made a decision to use new pits for the W78 and W88 LEPs, and the studies and engineering phase for the W78 will not be complete until FY2021. Thus, there is as yet no identified need for an increase in pit production capacity. It is not clear that, if NNSA proposed it, Congress would support a life extension program that entailed using pits from a different warhead.

There is a need to provide laboratory space to allow at least some of the activities now taking place at the CMR to continue. However, as NNSA has already stated, there are cheaper ways to do at least some of that work rather than

[41] DOE 2011, Volume 1, p. C-12.

building the CMRR-NF. Similarly, there is a need for additional storage space for plutonium, but as NNSA now states, there are less expensive alternatives to CMRR-NF.

To address these issues, we recommend that Congress:

- Require an independent study to: (1) determine the materials analysis and other plutonium science-related capabilities that are *required* to maintain the nuclear stockpile (2) assess whether existing facilities at Los Alamos or elsewhere could meet those requirements on an ongoing basis, and (3) provide cost estimates for these options. The NNSA is currently undertaking a study like this, due for completion in April 2012. However, an independent study would ensure that all the options are thoroughly considered.
- Require an independent study to assess the future need for production of plutonium pits, once the administration makes pending decisions on U.S. nuclear policy.
- Require that NNSA update its findings on the lifetimes of plutonium pits and request the JASON panel to review that assessment. This assessment by NNSA and review by the JASON panel should occur periodically.

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Glossary

AC	**Analytical chemistry** is the study, evaluation, and analysis of materials.
CMR	**Chemistry and Metallurgy Research** facility, the existing facility at Los Alamos that undertakes analytical chemistry, materials characterization, plutonium and uranium chemistry, and metallurgy.
CMRR-NF	**Chemistry and Metallurgy Research Replacement-Nuclear Facility**, the proposed new facility at Los Alamos that would take over the work of CMR, provide storage space for nuclear materials, and support an increased production of plutonium pits.
DAF	**Device Assembly Facility** at the Nevada National Security Site, a relatively new facility capable of performing work on radioactive materials, but presently underutilized.
ICBM	**Intercontinental Ballistic Missile**, a land-based long-range delivery system for nuclear-armed warheads.
JASON	An independent group of scientists that advises the U.S. government on matters of science and technology.
LANL	**Los Alamos National Laboratory** in New Mexico, one of three national laboratories devoted to nuclear weapons research, design and development.
LEP	**Life Extension Programs** are intended to extend the service lives of U.S. nuclear weapons and, in some cases, to add new features.
LLNL	**Lawrence Livermore National Laboratory** in California, one of three national laboratories devoted to nuclear weapons research, design and development.
MC	**Material characterization** is used to determine the isotopic ratios of elements and identify major and trace elements in materials.
New START	**New Strategic Arms Reduction Treaty,** an arms control agreement between the United States and Russia that requires each country to reduce its deployed strategic nuclear forces to 1,550 warheads by 2018.
NNSA	**National Nuclear Security Administration**, the semi-autonomous agency within the Department of Energy responsible for maintaining the nuclear weapons stockpile.
NNSS	**Nevada National Security Site**, formerly the Nevada Test Site, where the United States used to conduct underground nuclear explosive tests, and where tests using small amounts of nuclear material are currently conducted.

NPR **Nuclear Posture Review** is a formal review of U.S. nuclear weapons policy performed three times to date. The Obama administration completed its NPR in 2010.

PF-4 **Plutonium Facility 4** at LANL is the site where plutonium pits are produced and a significant quantity of plutonium, enough for hundreds of warheads, is stored.

pit A hollow sphere of plutonium-239 metal inside a metal casing, the core of the primary of modern, two-stage nuclear weapons.

primary The first stage of a modern, two-stage nuclear weapon, consisting of a plutonium pit, high explosives, radioactive gases, and other components.

Pu-239 **Plutonium 239**, the isotope used in the pit of nuclear weapons.

RLUOB **Radiological Laboratory/Utility/Office Building,** the first phase of the CMRR project, which is completed.

RRW **Reliable Replacement Warhead**, a newly designed warhead proposed by the NNSA during the Bush administration and rejected by Congress.

SEIS **Supplemental Environmental Impact Statement**, a mandatory assessment of the environmental impact of major government construction projects.

SLBM **Submarine-Launched Ballistic Missile**, a sea-based long-range delivery system for nuclear-armed warheads.

SSP **Stockpile Stewardship Program** comprises NNSA's work to maintain the U.S. nuclear weapons stockpile.

TA-3 **Technical Area 3**, one of many distinct areas at LANL.

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