



Testimony

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NUCLEAR WEAPONS

NNSA's Modernization Efforts Would Benefit from a Portfolio Management Approach

Statement of Allison B. Bawden, Director
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GAO Highlights

Highlights of [GAO-20-443T](#), a testimony before the Subcommittee on Strategic Forces, Committee on Armed Services, House of Representatives

Why GAO Did This Study

NNSA is simultaneously modernizing the nation's nuclear weapon stockpile and the infrastructure on which weapon programs depend. In a 2019 report, NNSA stated that this is the busiest time for the nuclear security enterprise since the Cold War era. GAO's April 2017 review of NNSA nuclear modernization programs concluded that NNSA made optimistic assumptions about future costs. DOD and DOE estimate that nuclear modernization will cost hundreds of billions of dollars over the next decade.

This statement is based on 18 GAO reports issued from July 2003 to February 2020 and selected updates. It discusses (1) NNSA's ongoing and planned programs and projects to modernize weapons and related infrastructure and challenges they present; (2) NNSA's improvements in managing these programs and projects, and additional steps NNSA could take to make further improvements; and (3) GAO's prior recommendation to NNSA on assessing the affordability of its portfolio of modernization programs. To conduct the updates, GAO reviewed DOE planning and budget documents.

What GAO Recommends

GAO has made numerous recommendations to NNSA, including that it assess its portfolio of modernization programs to present options to align programs and budgets. NNSA has taken some action but has not fully responded to this recommendation.

View [GAO-20-443T](#). For more information, contact Allison B. Bawden at (202) 512-3841 or bawdena@gao.gov.

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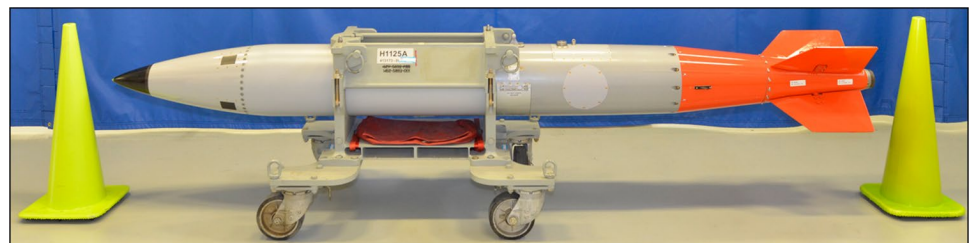
What GAO Found

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) is conducting four programs to modernize nuclear weapons, and the Department of Defense's (DOD) 2018 *Nuclear Posture Review* calls for NNSA to consider additional programs to refurbish or build new weapons over the next 2 decades. NNSA is also managing numerous, multi-billion-dollar construction projects to modernize the infrastructure it uses to produce components and materials needed for its weapon programs. GAO has reported on challenges NNSA faces in managing these efforts. For example, GAO's February 2020 report on the W87-1 warhead program found that NNSA's past challenges in managing plutonium activities cast doubt on NNSA's ability to produce the required number of plutonium weapon cores on schedule. GAO also found in June 2019 that future weapon programs will require newly produced explosives, including some that NNSA has not produced at scale since 1993.

NNSA has improved its management of weapon programs and related projects in some respects. For example, NNSA has established requirements for independent cost estimates in weapon programs and has made progress in revising plans for the Uranium Processing Facility project. However, GAO has identified additional actions that could further improve NNSA's management of weapon programs and projects. For example, in September 2017, GAO reported that NNSA had not developed a complete scope of work, a life-cycle cost estimate, or an integrated master schedule for its overall uranium program. GAO recommended that NNSA set a time frame for developing these plans. GAO expects to issue a report on NNSA's uranium program plans in March 2020.

GAO concluded in April 2017 that NNSA had not addressed a potential mismatch between funding needs and funding availability. GAO recommended that NNSA assess its portfolio of modernization programs—for example, by presenting options to align programs to potential future budgets, such as potentially deferring the start of or cancelling specific programs. NNSA did not explicitly agree or disagree with GAO's recommendation. NNSA included an affordability analysis in July 2019 planning documents, but the analysis does not fully respond to GAO's recommendation because it does not state how potential misalignment between program costs and budget projections may be addressed. GAO continues to believe that presenting options to align its portfolio of programs to potential future budgets could help Congress and NNSA better understand NNSA's priorities and trade-offs that may need to be undertaken in the future.

Figure: The B61-12 Nuclear Bomb



Source: Sandia National Laboratories. | GAO-20-443T

Chairman Cooper, Ranking Member Turner, and Members of the Subcommittee:

Thank you for the opportunity to discuss the challenges facing the Department of Energy's (DOE) National Nuclear Security Administration (NNSA) as it works to sustain and modernize the nation's nuclear arsenal.¹ NNSA's work comprises two simultaneous, interdependent efforts: modernizing the stockpile of nuclear bombs and warheads, and modernizing the research and production infrastructure on which stockpile programs depend.² NNSA manages these efforts in coordination with the Department of Defense (DOD), which undertakes related work to modernize nuclear weapon delivery systems, including heavy bombers, intercontinental ballistic missiles, and submarine-launched ballistic missiles and the submarines that carry them. According to NNSA's *Fiscal Year 2020 Stockpile Stewardship and Management Plan*, the nuclear security enterprise is experiencing its busiest time since the Cold War era.³

In an April 2017 report, we concluded that NNSA's assessment on the affordability of the agency's nuclear modernization programs was predicated on optimistic assumptions about future-year costs, particularly for fiscal years 2022 through 2026.⁴ In particular, we reported that, according to NNSA's fiscal year 2017 budget materials and agency officials, work deferred by NNSA contributed to a significant bow wave of funding needs in future years as the agency made plans to undertake

¹NNSA is a separately organized agency within DOE. It was created under Title 32 of the National Defense Authorization Act for Fiscal Year 2000, Pub. L. No. 106-65, §§ 3201 – 3299, 113 Stat. 512, 953-971 (1999) (codified as amended at 50 U.S.C. §§ 2401-2484). NNSA has responsibility for the nation's nuclear weapons, nonproliferation, and naval reactor programs.

²All nuclear weapons in the U.S. stockpile are designated either as a warhead or as a bomb. Warheads are weapons that have certain engineering requirements because they must interface with a launch or delivery system. Bombs are weapons that do not have these interface requirements, such as gravity bombs and atomic demolition munitions (now retired and dismantled).

³DOE/NNSA, *Fiscal Year 2020 Stockpile Stewardship and Management Plan* (Washington, D.C.: July 2019). The *Stockpile Stewardship and Management Plan* is NNSA's formal means for annually communicating to Congress the status of certain activities and its long-range plans and budget estimates for sustaining the stockpile and modernizing the nuclear security enterprise.

⁴GAO, *National Nuclear Security Administration: Action Needed to Address Affordability of Nuclear Modernization Programs*, [GAO-17-341](#) (Washington, D.C.: Apr. 26, 2017).

multiple, simultaneous life extension programs (LEP) and other weapon programs.⁵ A funding bow wave—that is, an impending and significant increase in the requirements for additional funds—occurs when agencies defer costs of their programs to the future, beyond their programming periods, and often occurs when agencies are undertaking more programs than their resources can support.⁶

At the time of our April 2017 report, NNSA had concluded that its nuclear modernization program plan was generally affordable because it assumed that future budgets would meet or exceed the low range of NNSA's cost estimates for its programs. However, we found that, particularly in the period of fiscal years 2022 through 2026, NNSA's budget estimates may have exceeded funding projections in the President's budget for those same years. We recommended that NNSA include an assessment of its portfolio of modernization programs in future versions of the *Stockpile Stewardship and Management Plan*—for example, by presenting options NNSA could consider to bring its estimates of modernization funding needs into alignment with potential future budgets. This could include potentially deferring the start of or canceling specific modernization programs if program budgets fell short of program estimates.

Less than 1 year later, in February 2018, DOD issued the *2018 Nuclear Posture Review*, which outlined plans for starting several additional nuclear weapon modernization programs while accelerating an existing program.⁷ DOD and DOE cost estimates show that nuclear weapon programs and related efforts are expected to cost hundreds of billions of

⁵NNSA undertakes LEPs, in coordination with DOD, to refurbish or replace nuclear weapons' components to extend their lives, enhance their safety and security characteristics, and consolidate the stockpile into fewer weapon types to minimize maintenance and testing costs while preserving needed military capabilities. Generally, we use the term "weapon programs" in this testimony to refer to LEPs and other weapon modernization efforts—such as alterations, which usually entail replacing an older component with a newer component that does not affect military operations, logistics, or maintenance, according to DOD documentation.

⁶We have reported on funding bow waves in other major government programs. See GAO, *Orion Multi-Purpose Crew Vehicle: Action Needed to Improve Visibility into Cost, Schedule, and Capacity to Resolve Technical Challenges*, [GAO-16-620](#) (Washington, D.C.: July 27, 2016) and *Weapon System Acquisitions: Opportunities Exist to Improve the Department of Defense's Portfolio Management*, [GAO-15-466](#) (Washington, D.C.: Aug. 27, 2015).

⁷Department of Defense, *Nuclear Posture Review*, February 2018. The *Nuclear Posture Review* assesses the global threat environment and establishes policy on U.S. nuclear forces.

dollars over the next decade, but neither agency has yet released long-term budget estimates that fully reflect implementation of the 2018 *Nuclear Posture Review's* priorities. The President's fiscal year 2021 budget request includes a 25 percent increase for NNSA's modernization program, suggesting the bow wave has arrived.

My testimony today discusses (1) NNSA's ongoing and planned programs and projects to modernize the nuclear stockpile and related production infrastructure and any challenges they present; (2) improvements in NNSA's management of weapon programs and related capital asset projects, and additional steps NNSA could take to make further improvements; and (3) our prior recommendation to NNSA on assessing the affordability of its portfolio of modernization programs.

My statement is based primarily on our work from 18 GAO reports issued from July 2003 to February 2020 and selected updates. Detailed information about the scope and methodology we used to conduct our prior work can be found in each of our issued reports. For the updates, we interviewed NNSA officials to assess any actions NNSA has taken in response to our April 2017 recommendation and included updated information on the status of other recommendations based on documentation NNSA provides to us periodically. In addition, we reviewed several documents to provide selected updates to information on program schedules, cost estimates, and budgets on which we had previously reported. Specifically, we reviewed *NNSA's Fiscal Year 2020 Stockpile Stewardship and Management Plan*; the testimony of an NNSA official from a September 2019 hearing on the status of two LEPs; the DOE Office of Project Management's January 2020 Monthly DOE Project Portfolio Status Report; and the President's DOE budget request for fiscal year 2021. NNSA also reviewed information from a classified report we issued in February 2020 to ensure that information we drew from that report was suitable for public release.

We conducted the work on which this statement is based in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

NNSA Faces Challenges in Executing Ongoing and Planned Weapon Programs and Related Capital Asset Projects to Modernize the Nuclear Stockpile

NNSA is executing and plans to carry out multiple weapon programs and a range of related capital asset projects over the next 2 decades. First, NNSA is currently conducting four weapon modernization programs: the B61-12 LEP, the W88 Alteration 370, the W80-4 LEP, and the W87-1 Modification program. Table 1 provides more information on each of these programs based on our prior work, with selected updates on program schedules, cost estimates, and budgets from the Fiscal Year 2020 *Stockpile Stewardship and Management Plan* and NNSA testimony.

Table 1: Ongoing National Nuclear Security Administration (NNSA) Weapon Modernization Programs

Program	Description
B61-12 Life Extension Program (LEP)	The B61 bomb is the oldest nuclear weapon in the stockpile. ^a It was first fielded in 1968, with current modifications fielded from 1979 to 1991. The B61-12 LEP is to consolidate and replace the B61-3, B61-4, B61-7, and B61-10 modifications of the bomb. ^b NNSA formally estimated in October 2016 that it would incur a total cost of about \$7.6 billion for the program and that it would complete the first production unit in March 2020. ^c However, in September 2019, due to problems with an electrical part, NNSA revised its estimated first production date for the program to the first quarter of fiscal year 2022. According to September 2019 congressional testimony by NNSA’s Deputy Administrator for Defense Programs, the electrical part problem and resulting delay will increase the cost of the program by about \$600 million to \$700 million.
W88 Alteration 370 program ^d	The W88 Alteration 370 program is to replace the arming, fuzing, and firing subsystem and high explosive main charge for the W88 warhead, which is deployed on the Navy’s Trident II D5 submarine-launched ballistic missile system. As of 2017, NNSA formally estimated the program would cost about \$2.6 billion and would complete the first production unit in December 2020. ^c However, in September 2019, due to problems with an electrical part—the same part affecting the B61-12 LEP—NNSA revised its estimated first production date for the program to the fourth quarter of fiscal year 2021. According to September 2019 congressional testimony by NNSA’s Deputy Administrator for Defense Programs, the electrical part problem and resulting delay will increase the cost of the program by about \$120 million to \$150 million.
W80-4 LEP	The W80-4 LEP is intended to provide a warhead for a future long-range standoff missile to replace the Air Force’s current air-launched cruise missile. As of January 2019, according to NNSA’s preliminary estimates, the program will cost about \$12 billion and will complete the first production unit by fiscal year 2025. ^{c,e}
W87-1 Modification program ^b	In fiscal year 2019, NNSA restarted a program to replace the capabilities of the W78 warhead, used on Air Force intercontinental ballistic missiles. As of July 2019, NNSA preliminarily estimated that the program would cost about \$11.7 billion to \$14.8 billion. NNSA plans to produce the first production unit by the beginning of the second quarter of fiscal year 2030 to field on the Air Force’s Ground Based Strategic Deterrent, which is also in development. ^{c,f}

Source: GAO, with selected updates based on the DOE Fiscal Year 2020 *Stockpile Stewardship and Management Plan* and NNSA testimony. | GAO-20-443T

^aAll nuclear weapons in the U.S. stockpile are designated either as warheads or as bombs. Warheads are weapons that have certain engineering requirements because they must interface with a launch

or delivery system. Bombs are weapons that do not have these interface requirements, such as gravity bombs and atomic demolition munitions (now retired and dismantled).

^bThroughout the history of nuclear weapons development, the United States has developed families of weapons based on a single design. Thus, some weapons in the U.S. stockpile were developed as modifications to an already complete design. For example, the B61 bomb has had 12 variations over time, each designated as a different modification.

^cThe first production unit milestone occurs when DOD accepts the weapon's design and NNSA verifies that the first produced weapon or weapons meets the design.

^dThe W88 Alteration 370 program is an alteration, not an LEP. An alteration is usually a replacement of an older component with a newer component that does not affect military operations, logistics, or maintenance, according to DOD documentation. NNSA manages significant alterations as LEPs.

^eThe estimated cost of about \$12 billion for the W80-4 program includes about \$800 million in sunk costs, which are not factored into the \$11.2 billion estimate given in the program's Weapon Design and Cost Report.

^fThe Ground Based Strategic Deterrent is intended to replace the Minuteman III intercontinental ballistic missile.

In addition to these four ongoing programs, the 2018 *Nuclear Posture Review* calls for NNSA to consider additional weapon programs—specifically, a program to develop a modern nuclear-armed sea-launched cruise missile, and another to develop a new submarine-launched ballistic missile warhead (now being referred to as the W93). The *Nuclear Posture Review* also instructs NNSA to maintain the B83-1 bomb until a suitable replacement can be found.⁸

To support and enable ongoing and planned weapon programs, NNSA also plans to spend billions of dollars over the next 2 decades on capital asset projects and other infrastructure risk reduction and recapitalization efforts to modernize the production infrastructure NNSA uses to produce components and materials needed for its weapon programs. Table 2 provides more information on selected NNSA capital asset projects discussed in our recent reports, with selected updates on program schedules and cost estimates from the DOE Office of Project Management's January 2020 Monthly DOE Project Portfolio Status Report.

⁸Congressional committees have requested reports from DOD, NNSA, and the Commander of U.S. Strategic Command on aspects of the B83-1 replacement. S. Rep. No. 116-48, at 331 (2019); H.R. Rep. No. 115-676, pt. 2, at 236-7 (2018).

Table 2: Selected Ongoing Department of Energy (DOE) and National Nuclear Security Administration (NNSA) Capital Asset Projects Supporting Production Modernization and Discussed in Recent GAO Reports

Project	Description
Chemistry and Metallurgy Research Building Replacement (CMRR)	The current Chemistry and Metallurgy Research Building at the Los Alamos National Laboratory in New Mexico is nearly 70 years old and is used to conduct chemical analysis and materials characterization for nuclear weapon pit production, development and testing; stockpile life extension programs; and dismantlement efforts. The CMRR project includes several subprojects, one of which is to reconfigure space in the existing Radiological Laboratory Utility Office Building and install plutonium analysis equipment by January 2022 at a cost of \$633 million, according to NNSA's formal estimates. Another subproject will reconfigure space in the existing Plutonium Facility and install new plutonium analysis equipment by April 2022 at a cost of \$394 million, according to NNSA's formal estimates. Two additional subprojects are at an earlier planning stage and could be completed by December 2024 at a total cost of \$731 million to \$1.05 billion, according to NNSA's preliminary estimates.
Plutonium Pit Production Facilities	The plutonium pit is a critical component of a nuclear weapon. NNSA is pursuing a two-pronged approach to produce 80 pits per year to meet anticipated pit requirements for ongoing and future weapon programs. Specifically, NNSA plans to repurpose the Mixed Oxide Fuel Fabrication Facility at the Savannah River Site in South Carolina to produce at least 50 pits per year in 2030 and modernize its pit production capabilities at Los Alamos National Laboratory to produce at least 30 pits per year by 2026. According to NNSA's preliminary estimates, the effort to repurpose the Savannah River Site facility could cost from \$1.3 billion to \$3 billion and be completed by the end of 2027. According to DOE documentation, the scope associated with modernizing pit production at Los Alamos will be satisfied under an expanded version of the current CMRR project.
Uranium Processing Facility	NNSA conducts enriched uranium activities, produces uranium-related components for nuclear warheads, and processes nuclear fuel for the U.S. Navy at the Y-12 National Security Complex in Tennessee. Current operations are conducted in four separate facilities facing aging, safety and other challenges. To address these issues, NNSA plans to construct the Uranium Processing Facility to consolidate these activities into one facility. According to NNSA's formal estimates, the project will be completed by December 2025 at a cost of \$6.5 billion. We are doing ongoing work on the Uranium Processing Facility and expect to issue a report in March 2020.
High Explosives Facilities	Approximately 100 different explosive components are essential to the operation of nuclear weapons, and NNSA's supply of certain highly specialized explosive materials is dwindling. Future weapon programs will require newly produced explosives; however, the design of several older facilities is insufficient to meet current needs, negatively affecting productivity and safety. NNSA's plans to build a new high explosives science and engineering facility at the Pantex Plant in Texas—at a cost of up to \$155 million, according to preliminary estimates—have been on hold since September 2018. At that time, the facility was projected to be completed in 2023. NNSA completed the conceptual design report for a high explosives synthesis, formulation, and blending facility at Pantex in December 2019. According to NNSA's preliminary estimates, the project could be completed by September 2025 at a cost of \$96 million to \$240 million.
Lithium Processing Facility	An isotope of lithium is a key component of nuclear weapons and is essential for their refurbishment. The United States no longer maintains full lithium production capabilities and relies on recycling as the only source of lithium for nuclear weapon systems, but could run out without further action. NNSA is preparing to construct a new Lithium Processing Facility at the Y-12 National Security Complex in Tennessee. According to NNSA's preliminary estimates, the facility could be completed by September 2031 at a cost of \$955 million to \$1.65 billion. We are currently reviewing these plans.
Tritium Finishing Facility	Tritium, an isotope of hydrogen, is used in a component in the triggering mechanism in nuclear weapons. NNSA plans to replace an aging facility at the Savannah River Site in South Carolina that processes tritium with a new Tritium Finishing Facility. According to NNSA's preliminary estimates, the facility could be completed by September 2031 at a cost of \$305 million to \$640 million.

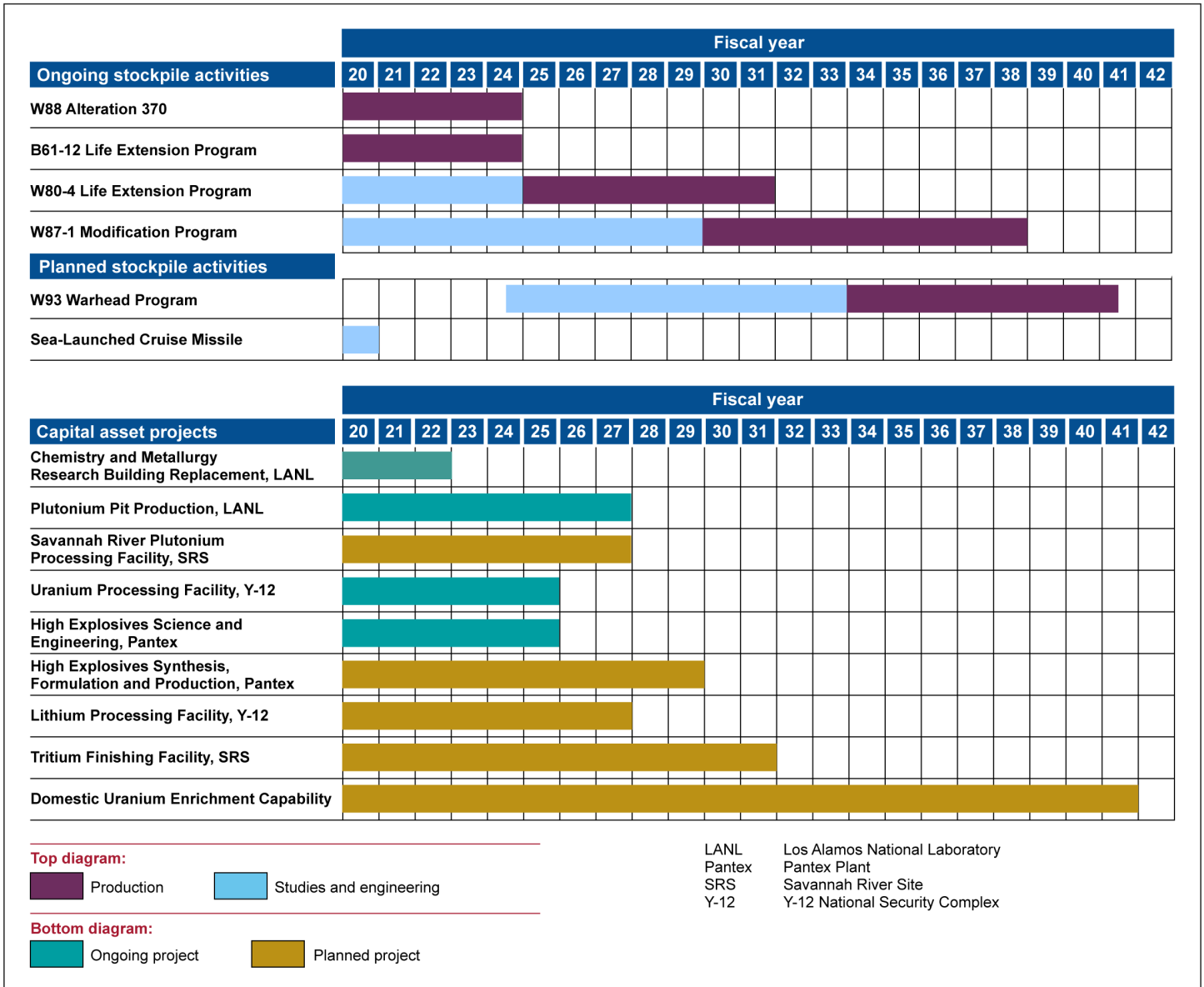
Project	Description
Domestic Uranium Enrichment	NNSA has several mission needs for enriched uranium, including providing low-enriched uranium to fuel a nuclear reactor that produces tritium. Because of its relatively short half-life of 12.3 years, NNSA needs an assured source of tritium, which relies on irradiating enriched uranium to produce. NNSA projects that it will exhaust its supply of low-enriched uranium to produce tritium by 2041. The agency is currently evaluating alternatives to reestablish a domestic uranium capability to produce enriched uranium and expects to complete its evaluation this year. If NNSA decides to pursue a government funded enrichment solution, a capability sized to produce enriched uranium solely for tritium production could cost \$3.3 billion to \$14.1 billion, according to NNSA's preliminary estimates.

Source: GAO, with selected updates based on the DOE Office of Project Management's January 2020 Monthly DOE Project Portfolio Status Report. | GAO-20-443T

Note: We are currently reviewing other programs and capital asset projects supporting modernization. We expect to issue reports on NNSA's production capabilities for depleted uranium and specialized microelectronics later this year.

According to NNSA's plans, the agency must carry out many of its weapon programs while simultaneously modernizing the very infrastructure on which these weapon programs rely for components and other materials. Therefore, any delays or technical challenges that affect NNSA's plans for its production facilities may be expected to result in delays and challenges to the weapon programs. Figure 1 shows the estimated schedules for the weapon programs and related capital asset projects described in tables 1 and 2 and reported on in our prior work, with updated information as presented in the *Fiscal Year 2020 Stockpile Stewardship and Management Plan*.

Figure 1: Estimated Schedules of National Nuclear Security Administration (NNSA) Weapon Modernization Programs and Selected Enabling Capital Asset Projects



Source: Department of Energy and National Nuclear Security Administration, *Fiscal Year 2020 Stockpile Stewardship and Management Plan*. | GAO-20-443T

We have reported on the potential effects on NNSA's weapon programs of delays or technical challenges in modernizing its production facilities. For example:

- The W87-1 Modification program's schedule may be particularly vulnerable to production challenges, including pit production challenges, because, as we reported in November 2018, it will require all newly-made components, including pits.⁹ In our most recent report on the W87-1 program, a classified report issued in February 2020, we found that NNSA's past challenges in managing plutonium activities at Los Alamos and in executing projects of this size cast doubt on NNSA's ability to produce 80 pits per year in 2030.¹⁰ As we note in that report, an independent assessment of NNSA's pit production strategy in March 2019 concluded that no options evaluated by NNSA could be expected to produce 80 pits per year by 2030.¹¹ The independent assessment further stated that NNSA had no precedent for major projects costing more than \$700 million dollars that had been completed in fewer than 16 years, and that many similar projects were eventually cancelled.
- Future weapon programs will require newly produced explosives, including some that NNSA has not produced at scale since 1993. As we reported in June 2019, NNSA officials stated that producing these materials will pose challenges that include replicating decades-old recipes for the materials and preparing for their full-scale production in aging facilities.¹² As we noted in that report, similar problems restarting dormant production capabilities have delayed past weapon programs—notably, the W76-1 LEP, which NNSA completed in December 2018. As we reported in March 2009, NNSA had to delay first production of the W76-1 from September 2007 to September

⁹GAO, *Nuclear Weapons: NNSA Has Taken Steps to Prepare to Restart a Program to Replace the W78 Warhead Capability*, [GAO-19-84](#) (Washington, D.C.: Nov. 30, 2018).

¹⁰GAO, *Nuclear Weapons: NNSA Should Further Develop Cost, Schedule, and Risk Information for the W87-1 Warhead Program*, GAO-20-207C (Washington, D.C.: Feb. 28, 2020). Between 2021 and 2026, NNSA is required to increase pit production from 10 to 30 pits per year. During 2030, NNSA is required to produce not less than 80 pits. 50 U.S.C. § 2538a.

¹¹Institute for Defense Analysis, *Independent Assessment of the Plutonium Strategy of the National Nuclear Security Administration: Executive Summary*, IDA Paper P-10524 (Alexandria, VA: March 2019).

¹²GAO, *Nuclear Weapons: Additional Actions Could Help Improve Management of Activities Involving Explosive Materials*, [GAO-19-449](#) (Washington, D.C.: June 17, 2019).

2008 when it encountered problems restarting production of a key material, known as Fogbank.¹³ NNSA is working to reconstitute its high explosives capabilities, as we reported in June 2019.

- Nonnuclear parts and components comprise over 80 percent of the items in a nuclear weapon, and NNSA's Kansas City National Security Campus procures or produces most of these. In April 2019, we found that work on the B61-12 LEP and W88 Alteration 370 was expected to double at the Kansas City site during fiscal years 2020 through 2022.¹⁴ Our April 2019 report also identified challenges that could complicate work at the site. For example, disruption to the established supply chain for externally supplied parts—which comprise about 65 percent of the nonnuclear parts used at the Kansas City site—could result in production delays, and the site needs hundreds of thousands of additional square feet of manufacturing space to meet workload demands.

We have also recently completed work in which we reported on challenges integrating the schedules of NNSA's weapon programs with the schedules for DOD's modernized delivery systems. For example, the W87-1 warhead will need to be integrated on a delivery system that is under development, an intercontinental ballistic missile known as the Ground-Based Strategic Deterrent. We have ongoing work examining DOD and DOE plans to modernize and integrate warheads and delivery vehicles and expect to issue a classified report in spring 2020.

¹³GAO, *Nuclear Weapons: NNSA and DOD Need to More Effectively Manage the Stockpile Life Extension Program*, [GAO-09-385](#) (Washington, D.C.: Mar. 2, 2009).

¹⁴GAO, *Modernizing the Nuclear Security Enterprise: NNSA Is Taking Action to Manage Increased Workload at Kansas City National Security Campus*, [GAO-19-126](#) (Washington, D.C.: Apr. 12, 2019).

NNSA Has Taken Steps to Improve Its Management of Weapon Programs and Enabling Capital Asset Projects, but Additional Improvements Are Needed

As we have recently reported, NNSA has made improvements in its management of some weapon modernization programs and enabling capital asset projects. We have concluded that NNSA's federal program and project management capacity is improving, as are the controls it has developed for program and project performance.¹⁵ For example:

- We found in January 2018 that NNSA has established and strengthened management requirements for LEPs.¹⁶ Specifically, in January 2016, NNSA's Office of Defense Programs issued a program management directive that designates risk-based program execution requirements that all programs must follow.¹⁷ The directive places LEPs in one of the highest-risk categories, meaning these programs are required to apply more rigorous management controls specified in the directive, including using earned value management.¹⁸ Further, in January 2017, NNSA issued two directives implementing requirements for NNSA's Office of Cost Estimating and Program Evaluation to conduct independent cost estimates.¹⁹ In May 2018, we found that the program cost estimate for the B61-12 LEP substantially met the criteria for all four characteristics of a high-quality, reliable

¹⁵For additional information on DOE and NNSA improvements and challenges in managing projects, see GAO, *High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas*, [GAO-19-157SP](#) (Washington, D.C.: Mar. 6, 2019).

¹⁶GAO, *Nuclear Weapons: NNSA Should Adopt Additional Best Practices to Better Manage Risk for Life Extension Programs*, [GAO-18-129](#) (Washington, D.C.: Jan. 30, 2018).

¹⁷National Nuclear Security Administration, *DP Program Execution Instruction: NA-10 Program Management Tools and Processes* (Washington, D.C.: Jan. 14, 2016). NNSA has subsequently updated this directive; the current version is dated June 2019.

¹⁸Earned value management is a means of conducting cost and schedule performance analysis, through which programs measure the value of work accomplished in a given period and compare the measured value with the planned value of work scheduled for that period and the actual cost of work accomplished.

¹⁹Independent cost estimates provide an objective and unbiased assessment of whether a program's cost estimate can be achieved. We recommended in July 2003 that NNSA establish its LEPs as projects and manage them according to DOE project management requirements, which then included the use of earned value management and independent cost estimates. See GAO, *Nuclear Weapons: Opportunities Exist to Improve the Budgeting, Cost Accounting, and Management Associated with the Stockpile Life Extension Program*, [GAO-03-583](#) (Washington, D.C.: July 28, 2003).

cost estimate, in part because it was the first LEP to undergo an independent cost estimate.²⁰

- We reported in our February 2017 high-risk update that DOE demonstrated a strong commitment and top leadership support for improving project management.²¹ For example, DOE made changes to its revised project management order, issued in May 2016, in response to recommendations we made in prior years, such as requiring that projects develop cost estimates and analyses of alternatives according to best practices we identified.
- In September 2017, we found that NNSA had made progress in developing a revised scope of work, cost estimate, and schedule for the Uranium Processing Facility project, which is to modernize uranium production efforts at the Y-12 National Security Complex.²² We reported at that time that these improvements may help NNSA stabilize escalating project costs and technical risks experienced under the previous strategy.
- In November 2017, we found that NNSA had established programs to manage strategic materials—specifically, uranium, plutonium, tritium, and lithium—and had defined requirements and managerial roles for program managers.²³ Since that time, NNSA has taken steps to implement a new enterprise-wide approach for managing explosives activities, as we found in our June 2019 report on those activities.²⁴

²⁰GAO, *B61-12 Nuclear Bomb: Cost Estimate for Life Extension Incorporated Best Practices, and Steps Being Taken to Manage Remaining Program Risks*, [GAO-18-456](#) (Washington, D.C.: May 31, 2018). Our cost estimating guide identifies best practices for developing a high-quality, reliable cost estimate and identifies four characteristics of such an estimate: it is comprehensive, well-documented, accurate, and credible. See *GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs*, [GAO-09-3SP](#) (Washington, D.C.: March 2009).

²¹GAO, *High-Risk Series: Progress on Many High-Risk Areas, While Substantial Efforts Needed on Others*, [GAO-17-317](#) (Washington, D.C.: Feb. 15, 2017). GAO's biennial high-risk update identifies government operations with greater vulnerabilities to fraud, waste, abuse, and mismanagement or the need for transformation to address economy, efficiency, or effectiveness challenges.

²²GAO, *Modernizing the Nuclear Security Enterprise: A Complete Scope of Work Is Needed to Develop Timely Cost and Schedule Information for the Uranium Program*, [GAO-17-577](#) (Washington, D.C.: Sept. 8, 2017).

²³GAO, *Nuclear Weapons: NNSA Needs to Determine Critical Skills and Competencies for Its Strategic Materials Programs*, [GAO-18-99](#) (Washington, D.C.: Nov. 14, 2017).

²⁴[GAO-19-449](#).

However, we have identified additional actions NNSA could take to further improve its management of weapon modernization programs and related projects. As NNSA's workload increases, additional management rigor will help ensure that programs and projects are executed consistent with cost and schedule estimates, and that risk is effectively managed and communicated. For example:

- We found in our January 2018 report that NNSA had not adopted the best practice of having an independent team validate its earned value management systems against the national standard for such systems, which could help the agency better manage risk in its LEPs.²⁵ We also found that NNSA had not established specific benchmarks for technology readiness at LEP decision points, consistent with best practices. We recommended that NNSA require an independent team to validate contractor earned value management systems for LEPs and establish technology readiness requirements at LEP decision points. According to an update NNSA provided to us in September 2019, the agency has not taken action to address these recommendations. We continue to believe that it should do so.²⁶
- We found in our September 2017 report that NNSA had not developed a complete scope of work, a life-cycle cost estimate, or an integrated master schedule for its overall uranium program—of which the Uranium Processing Facility is only one part—and had no time frame for doing so.²⁷ We recommended that NNSA should set a time frame for when the agency would develop a complete scope of work, a life-cycle cost estimate, and an integrated master schedule for the overall uranium program. NNSA generally agreed with our recommendation and has taken actions to respond to it. We expect to

²⁵[GAO-18-129](#).

²⁶NNSA stated at the time of our report that it agreed with our recommendations. Furthermore, it cited DOE's surveillance reviews of its earned value management systems and NNSA's use of technology readiness benchmarks at decision points in stating that it had already taken steps to address them. As we noted in our report, however, NNSA's internal reviews of its earned value management systems cannot replace validating those systems against the national standard for such systems; both of these activities are important and supplement each other. We also noted that without a requirement for explicit management approval in cases where an LEP's critical technology does not meet a specific technology readiness level, NNSA may not have a sufficiently developed process for assessing and accepting technical risk.

²⁷[GAO-17-577](#).

issue a report on the Uranium Processing Facility and NNSA's plans for its uranium program in March 2020.

- As we reported in February 2020, the plutonium program has begun to develop a schedule for pit production.²⁸ However, NNSA allows strategic materials programs such as the plutonium program to tailor their approach to developing schedules and does not require that they meet best practices for schedule estimating. We recommended that NNSA ensure that the plutonium program develop a schedule for pit production consistent with best practices for schedule development. NNSA agreed with our recommendation.

Our ongoing work includes reviews of NNSA's management of other efforts essential to ongoing weapon modernization programs, such as the production of radiation-hardened microelectronics at Sandia National Laboratories in New Mexico and of depleted uranium at the Y-12 National Security Complex in Tennessee.

NNSA Needs a Portfolio-based Approach to Managing Its Weapon Modernization Programs and Related Efforts

NNSA's weapon modernization programs and enabling infrastructure efforts have significant interdependencies that require integrated management across the portfolio of programs to effectively manage cost, schedule, and risk. Portfolio management best practices developed by the Project Management Institute state that organizations can optimize their portfolios of programs and projects by assessing their capability and capacity to finance specific portfolio components; determining which portfolio components should receive the highest priority; and identifying components to be suspended, reprioritized, or terminated.²⁹ In our April 2017 report on NNSA's budget materials and modernization plans, we found that NNSA did not clearly identify the extent to which its long-range budget estimates for its overall modernization program fell short of specific annual budget requests anticipated in this plan.³⁰ We concluded that NNSA had not addressed the projected bow wave of future funding needs and the mismatch between those needs and the potential funding available in the years in question. By not addressing the risks associated with the potential funding shortfall, we concluded, NNSA raised questions

²⁸GAO-20-207C.

²⁹Project Management Institute, Inc. *The Standard for Portfolio Management*, Third Edition, 2013. The Project Management Institute, Inc., is a not-for-profit association that provides global standards for, among other things, project and program management. These standards are utilized worldwide and provide guidance on how to manage various aspects of projects, programs, and portfolios.

³⁰GAO-17-341.

about its ability to achieve its modernization program goals at cost and on schedule. As a result, as discussed above, we recommended that NNSA include an assessment of the affordability of its portfolio of modernization programs in future versions of the *Stockpile Stewardship and Management Plan*—for example, by presenting options NNSA could consider to bring its estimates of modernization funding needs into alignment with potential future budgets, such as potentially deferring the start of or canceling specific modernization programs. NNSA did not explicitly agree or disagree with our recommendation. The President’s fiscal year 2021 budget request for NNSA indicates that the bow wave has arrived, requesting an increase of about \$3.1 billion over the funding enacted for Weapons Activities in fiscal year 2020—a year-to-year increase of over 25 percent.³¹

The *Fiscal Year 2020 Stockpile Stewardship and Management Plan*, issued in July 2019, includes a new section on affordability analysis and states that the section was added in response to our April 2017 recommendation. However, our review of this section indicates that it does not fully respond to our recommendation because it does not provide information about how potential misalignment between NNSA’s modernization budget estimates and projections of the President’s modernization budgets may be addressed, or about the potential impacts of adjusting program schedules or cost or schedule overruns. Since the issuance of the 2018 *Nuclear Posture Review*, NNSA’s portfolio of planned programs has only grown more extensive and complex. We continue to believe that NNSA, by assessing its portfolio of modernization programs in future versions of the *Stockpile Stewardship and Management Plan*—for example, by presenting options NNSA could consider to bring its estimates of modernization funding needs into alignment with potential future budgets, such as potentially deferring the start of or canceling specific modernization programs—could help congressional and NNSA decision makers better understand NNSA’s priorities and trade-offs that it may need to undertake in the future, depending on funding and program performance.

³¹Specifically, the DOE budget justification indicates that NNSA’s enacted funding level was about \$12.5 billion in fiscal year 2020 and that it is requesting about \$15.6 billion for fiscal year 2021.

Chairman Cooper, Ranking Member Turner, and Members of the Subcommittee, this completes my prepared statement. I would be pleased to respond to any questions you may have at this time.

GAO Contact and Staff Acknowledgments

If you or your staff members have any questions about this testimony, please contact me at (202) 512-3841 or bawdena@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this statement. GAO staff who made key contributions to this testimony are Jason Holliday, Assistant Director; Antoinette C. Capaccio; Julia Coulter; Rob Grace; John Hocker; Dan Royer; and Kiki Theodoropoulos.

Related GAO Products

The following is a selection of GAO's recent work assessing the National Nuclear Security Administration's management of nuclear weapon programs and related capital asset projects:

Nuclear Weapons: NNSA Should Further Develop Cost, Schedule, and Risk Information for the W87-1 Warhead Program. [GAO-20-207C](#). Washington, D.C.: February 28, 2020.

Nuclear Weapons Sustainment: Improvements Made to Budget Estimates in Fiscal Year 2019 Joint Report, but Opportunities Remain to Enhance Completeness. [GAO-20-37R](#). Washington, D.C.: November 7, 2019.

Nuclear Weapons: Additional Actions Could Help Improve Management of Activities Involving Explosive Materials. [GAO-19-449](#). Washington, D.C.: June 17, 2019.

Modernizing the Nuclear Security Enterprise: NNSA Is Taking Action to Manage Increased Workload at Kansas City National Security Campus. [GAO-19-126](#). Washington, D.C.: April 12, 2019.

High-Risk Series: Substantial Efforts Needed to Achieve Greater Progress on High-Risk Areas. [GAO-19-157SP](#). Washington, D.C.: March 6, 2019.

Nuclear Weapons: NNSA Has Taken Steps to Prepare to Restart a Program to Replace the W78 Warhead Capability. [GAO-19-84](#). Washington, D.C.: November 30, 2018.

B61-12 Nuclear Bomb: Cost Estimate for Life Extension Incorporated Best Practices, and Steps Being Taken to Manage Remaining Program Risks. [GAO-18-456](#). Washington, D.C.: May 31, 2018.

Nuclear Weapons: NNSA Should Clarify Long-Term Uranium Enrichment Mission Needs and Improve Technology Cost Estimates. [GAO-18-126](#). Washington, D.C.: February 16, 2018.

Nuclear Weapons: NNSA Should Adopt Additional Best Practices to Better Manage Risk for Life Extension Programs. [GAO-18-129](#). Washington, D.C.: January 30, 2018.

Nuclear Weapons: NNSA Needs to Determine Critical Skills and Competencies for Its Strategic Materials Programs. [GAO-18-99](#). Washington, D.C.: November 14, 2017.

Related GAO Products

Modernizing the Nuclear Security Enterprise: A Complete Scope of Work Is Needed to Develop Timely Cost and Schedule Information for the Uranium Program. [GAO-17-577](#). Washington, D.C.: September 8, 2017.

National Nuclear Security Administration: Action Needed to Address Affordability of Nuclear Modernization Programs. [GAO-17-341](#). Washington, D.C.: April 26, 2017.

High-Risk Series: Progress on Many High-Risk Areas, While Substantial Efforts Needed on Others. [GAO-17-317](#). Washington, D.C.: February 15, 2017.

DOE Project Management: NNSA Needs to Clarify Requirements for Its Plutonium Analysis Project at Los Alamos. [GAO-16-585](#). Washington, D.C.: August 9, 2016.

DOE Project Management: NNSA Should Ensure Equal Consideration of Alternatives for Lithium Production. [GAO-15-525](#). Washington, D.C.: July 13, 2015.

Nuclear Weapons: NNSA and DOD Need to More Effectively Manage the Stockpile Life Extension Program. [GAO-09-385](#). Washington, D.C.: March 2, 2009.

GAO Cost Estimating and Assessment Guide: Best Practices for Developing and Managing Capital Program Costs. [GAO-09-3SP](#). Washington, D.C.: March 2009.

Nuclear Weapons: Opportunities Exist to Improve the Budgeting, Cost Accounting, and Management Associated with the Stockpile Life Extension Program. [GAO-03-583](#). Washington, D.C.: July 28, 2003.

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