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Report to Congressional Committees

April 2017

NATIONAL NUCLEAR SECURITY ADMINISTRATION

Action Needed to Address Affordability of Nuclear Modernization Programs

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GAO Highlights

Highlights of GAO-17-341, a report to congressional committees

April 2017

NATIONAL NUCLEAR SECURITY ADMINISTRATION

Action Needed to Address Affordability of Nuclear Modernization Programs

Why GAO Did This Study

To ensure that the nation's existing nuclear weapons remain safe and reliable, the 2010 *Nuclear Posture Review* identified a set of long-term modernization goals for the nation's nuclear weapons stockpile that include sustaining a safe, secure, and effective nuclear arsenal and investing in a modern infrastructure. NNSA, which is responsible for the stockpile, is charged with carrying out these goals.

The National Defense Authorization Act for Fiscal Year 2011 includes a provision for GAO to report annually on NNSA's nuclear security budget materials. This is the sixth year that GAO has undertaken work in response to this provision. This report assesses the extent to which NNSA's fiscal year 2017 nuclear security budget materials (1) differ, if at all, from its budget estimates and plans for modernization activities as presented in its fiscal year 2016 budget materials and (2) align with NNSA's modernization plans.

GAO analyzed NNSA's fiscal year 2016 and 2017 nuclear security budget materials associated with those years' *Stockpile Stewardship and Management Plans*, and interviewed officials from NNSA and the Office of Management and Budget.

What GAO Recommends

GAO recommends that NNSA include an assessment of the affordability of its portfolio of modernization programs in future versions of the *Stockpile Stewardship and Management Plan*. NNSA did not explicitly agree or disagree with the recommendation. GAO continues to believe that the recommendation is valid, as discussed in this report.

View GAO-17-341. For more information, contact David C. Trimble, (202) 512-3841, trimbled@gao.gov

What GAO Found

The National Nuclear Security Administration's (NNSA) overall nuclear modernization budget materials and plans for the next 25 years, as presented in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, differ little from those in the fiscal year 2016 plan. Specifically,

- Budget estimates in the fiscal year 2017 plan increased about 1 percent over the 2016 plan in nominal terms, which is similar to the overall budget increases in the fiscal year 2016 plan compared to the fiscal year 2015 plan.
- Specific budget estimates changed to a greater degree for certain program areas and individual programs. For example, changes in NNSA's modernization estimates varied across the four program areas that make up the Weapons Activities appropriations account: stockpile; infrastructure; research, development, testing, and evaluation; and other weapons activities.
- Changes were made in the 25-year budget estimates for the Weapons Activities account as well as at the program level. Reasons for changes include movement of program funding to other areas. For example, the infrastructure area funding decreased 2.7 percent from fiscal year 2016 to fiscal year 2017, in part because about $6.5 billion in strategic materials sustainment funding was moved from the infrastructure area to the stockpile area.

In some cases, NNSA's fiscal year 2017 nuclear security budget materials do not align with the agency's modernization plans, both within the 5-year Future-Years Nuclear Security Program (FYNSP)—fiscal years 2017 through 2021—and beyond, raising concerns about the affordability of NNSA's planned portfolio of modernization programs. In particular, for some weapons refurbishments, the low end of NNSA's cost range estimates exceeds the estimates in the budget materials. For example, the W80-4 program's low-range cost estimate for fiscal year 2017 exceeds the budget estimate by about $26.9 million. In addition, the budget estimates for some modernization programs for fiscal years 2018 through 2021 are more than $5 billion below the funding levels NNSA has identified needing. If these needs are not met, NNSA may have to defer certain modernization work. Further, NNSA's budget estimates for fiscal years 2022 through 2026 may exceed out-year funding projections in the President's budget for those same years. GAO identified a similar funding gap in the prior year's budget materials. NNSA's fiscal year 2017 plan concludes that the modernization program is generally affordable in the years beyond the FYNSP, but this conclusion is optimistic, and the NNSA plan does not assess options to align future modernization plans and budgets with or without out-year funding increases. 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. By including an assessment of the affordability of its portfolio of modernization programs in future *Stockpile Stewardship and Management Plan*s, NNSA could develop a plan that could bring its estimates of modernization funding needs into alignment with potential future budgets.

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Abbreviations

CMRR	Chemistry and Metallurgy Research Replacement
DOD	Department of Defense
DOE	Department of Energy
FYNSP	Future-Years Nuclear Security Program

IW	interoperable warhead
LEP	life extension program
NNSA	National Nuclear Security Administration
OMB	Office of Management and Budget
UPF	Uranium Processing Facility

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Congressional Committees

The United States is in the midst of a long-term effort to modernize its nuclear security enterprise, including the nuclear weapons stockpile, which continues to be an integral part of the nation's defense strategy. Following the Cold War, the United States shifted from a strategy that focused on designing, testing, and producing new nuclear weapons to focusing on extending the operational lives of these weapons indefinitely through refurbishment. The Department of Energy (DOE), through the National Nuclear Security Administration (NNSA), seeks to carry out this strategy and ensure that the existing weapons remain safe and reliable.[1]

In addition to NNSA, two other organizations are responsible for the nation's nuclear weapons program. First, the Department of Defense (DOD) implements the U.S. nuclear deterrent strategy, which includes establishing the military requirements that are associated with planning for the stockpile. DOD also undertakes efforts to sustain and modernize the nation's nuclear delivery systems and the nuclear command, control, and communications system.[2] Second, the Nuclear Weapons Council, which is composed of representatives from DOD and DOE, facilitates high-level coordination to secure, maintain, and sustain the nuclear weapons stockpile. In response to the nuclear weapons requirements developed through the Nuclear Weapons Council, which are ultimately approved by the President, NNSA conducts an annual planning and budgeting process to identify funding needs for its portfolio of nuclear modernization programs.

Stockpile stewardship activities are largely executed at eight government-owned, contractor-operated sites that comprise NNSA's nuclear security

[1]NNSA is a separately organized agency within DOE that is responsible for DOE's nuclear weapons, nuclear nonproliferation, and naval reactor programs.

[2]Nuclear delivery systems consist of a variety of platforms, including heavy bombers, air-launched cruise missiles, dual-capable fighter aircraft, and land-based intercontinental ballistic missiles operated by the Air Force, as well as submarines and submarine-launched ballistic missiles operated by the Navy. The nuclear command, control, and communications system consists of satellites, early warning radars, aircraft, communications networks, and other systems that are managed by the Air Force, Navy, Defense Information Systems Agency, and other organizations.

enterprise.[3] These activities are not without their challenges. In particular, as the weapons age, certain nuclear weapons components must be replaced or they will begin to undermine the reliability and performance of the weapon. Further, many of the facilities within the nuclear security enterprise that support the nuclear weapons program date to the 1940s and 1950s and have become difficult and costly to maintain.

To respond to these challenges, the United States identified a set of goals and requirements intended to support and modernize the nation's nuclear weapons capabilities and physical infrastructure over the coming decades based on policy set forth in the 2010 *Nuclear Posture Review*, which outlined the United States' approach to maintaining its nuclear deterrent capability while pursuing further reductions in nuclear weapons.[4] Among its long-term modernization goals and requirements, the 2010 *Nuclear Posture Review* called for sustaining a secure and effective nuclear arsenal through the life extension of existing nuclear weapons; increasing investments to rebuild and modernize the nation's nuclear infrastructure; and strengthening the science, technology, and engineering base within the nuclear security enterprise, in part to ensure existing nuclear weapons remain reliable without conducting underground nuclear tests. To meet these modernization goals, NNSA is refurbishing weapons in the stockpile to extend their operational lives, replacing or renovating aging and outdated weapons-related facilities, performing simulations and laboratory experiments to seek to ensure that existing nuclear weapons remain safe and reliable, and recruiting and training personnel with the specialized skills to sustain the nation's nuclear weapons program and maintain the stockpile.

Two key documents, updated annually, describe NNSA's operations, modernization plans, and budget estimates for implementing these plans;

[3]NNSA oversees three national nuclear weapons design laboratories—Lawrence Livermore National Laboratory in California, Los Alamos National Laboratory in New Mexico, and Sandia National Laboratories in New Mexico and California. It also oversees four nuclear weapons production plants—the Pantex Plant in Texas, the Y-12 National Security Complex in Tennessee, the National Security Campus in Missouri (formerly known as the Kansas City Plant), and tritium operations at DOE's Savannah River Site in South Carolina. NNSA also oversees the Nevada National Security Site, formerly known as the Nevada Test Site.

[4]Department of Defense, *Nuclear Posture Review Report* (Washington, D.C.: Apr. 6, 2010).

these documents comprise NNSA's nuclear security budget materials.[5] First, the *Stockpile Stewardship and Management Plan* (the plan) is NNSA's formal means of communicating to Congress information on modernization and operations plans and budget estimates over the next 25 years. Second, NNSA's annual justification of the President's budget provides program information and budget estimates for the next 5 years. This 5-year plan is called the Future-Years Nuclear Security Program (FYNSP), and the budget estimates in this plan reflect funding levels approved by the Office of Management and Budget (OMB).[6] These estimates are identical to those presented in the first 5 years of the *Stockpile Stewardship and Management Plan*.[7] Congress funds NNSA's modernization efforts through various programs and activities within the Weapons Activities appropriations account. To implement NNSA's modernization plans, the agency's February 2016 justification of the President's budget for the Weapons Activities appropriations account included about $49.4 billion for fiscal years 2017 through 2021, of which about $9.2 billion was for fiscal year 2017.[8] In addition, DOE and DOD are required to submit jointly each year a third document to the relevant Senate and House committees and subcommittees that also includes information on modernization budget estimates; we refer to this document as the DOD-DOE joint report.[9] The DOD-DOE joint report addresses, among other things, the plan for the nuclear weapons stockpile and its

[5]NNSA refers to the cost figures included in its budget materials during the 5-year Future-Years Nuclear Security Program (FYNSP) period as "budget requirements" and those after that period as "budget requirements estimates." We refer to these figures as "budget estimates" throughout this report.

[6]The budget estimates for years included in the FYNSP must align with the 5-year overall federal budget estimates in the President's budget. The budget estimates for years beyond the FYNSP are not subject to this requirement.

[7]The *Fiscal Year 2017 Stockpile Stewardship and Management Plan* includes estimates that are identical to those presented in the FYNSP as well as estimated nominal program costs for fiscal years 2022 through 2041. According to the fiscal year 2017 plan, this information shows the potential evolution in program makeup and does not represent precise costs in the out-years.

[8]NNSA does not have a definition of "modernization," but NNSA officials consider all of the programs in the Weapons Activities appropriations account to directly or indirectly support modernization, and these are the monies we include.

[9]Department of Defense and Department of Energy, *Fiscal Year 2017 Report on the Plan for the Nuclear Weapons Stockpile, Nuclear Weapons Complex, Nuclear Weapons Delivery Systems, and Nuclear Weapons Command and Control System Specified in Section 1043 of the National Defense Authorization Act for Fiscal Year 2012* (Washington, D.C.: Aug. 5, 2016).

delivery systems and includes a 10-year range of budget estimates for both DOE's and DOD's modernization efforts.[10]

Concerns about future sequestration have affected the manner in which NNSA has carried out its budget planning processes. Sequestration is a budgetary enforcement mechanism that was revived by the Budget Control Act of 2011 to encourage agreement on deficit reduction legislation or, in the event that such an agreement cannot be reached, to automatically reduce spending so that an equivalent budgetary goal is achieved. Reductions to discretionary spending were triggered under sequestration in fiscal year 2013 and have not been required since, but under current law, reductions to discretionary spending limits could be required in fiscal years 2018 through 2021. Additionally, under the act, if in any year through fiscal year 2021 Congress and the President enact appropriations that exceed discretionary spending limits, there will be an after-session sequestration to eliminate the breach. Any reductions to discretionary spending through fiscal year 2021 could, therefore, create additional budgetary pressures for NNSA as it seeks to carry out an ambitious scope of work that includes simultaneously executing multiple weapons refurbishment efforts and major construction projects over the next decade.

The National Defense Authorization Act for Fiscal Year 2011 contains a provision that we study and report annually on whether NNSA's nuclear security budget materials provide for funding that is sufficient to modernize and refurbish the nuclear security enterprise as well as to recapitalize its infrastructure.[11] This is the sixth year that we have undertaken work in response to this provision.[12] This report assesses the extent to which NNSA's fiscal year 2017 nuclear security budget materials (1) differ, if at all, from its budget estimates and plans for modernization activities as presented in its fiscal year 2016 budget materials and (2) align with NNSA's modernization plans.

[10]The National Defense Authorization Act for Fiscal Year 2013 includes a provision that we review each joint report for accuracy and completeness with respect to the budget estimates. We are reviewing the August 2016 DOD-DOE joint report—which includes budget estimates for fiscal years 2017 through 2026—in another audit.

[11]Ike Skelton National Defense Authorization Act for Fiscal Year 2011, Pub. L. No. 111-383, § 3113, 124 Stat. 4137, 4509 (codified as amended at 50 U.S.C. § 2455).

[12]The results of last year's review are found in GAO, *Modernizing the Nuclear Security Enterprise: NNSA's Budget Estimates Increased but May Not Align with All Anticipated Costs*, GAO-16-290 (Washington, D.C.: Mar. 4, 2016).

To address these objectives, we reviewed NNSA's fiscal year 2017 nuclear security budget materials. Specifically, we reviewed the agency's budget justification, which contains estimates for the 5-year FYNSP, and the *Stockpile Stewardship and Management Plan*, which provides budget estimates over the next 25 years.[13] To determine the extent to which NNSA's budget estimates and plans for modernization activities differed from those in the fiscal year 2016 budget materials, we compared the information in the fiscal year 2017 budget materials with the information in the fiscal year 2016 materials. Specifically, for the purposes of this report, we compared the fiscal years 2017 through 2041 period from the 2017 plan with the fiscal years 2016 through 2040 period from the 2016 plan. Comparing the activities and budget estimates intended to support these activities across the 25-year periods in the different plans provides insights for budgeting and planning purposes as to how NNSA's nuclear security budget materials have changed from one plan to the next. To determine the extent to which NNSA's budget materials align with its modernization plans, we compared information on the budget estimates in the fiscal year 2017 budget materials with the information on modernization plans in the same documents. We also reviewed budget estimates from the DOD-DOE joint report and compared information from this report with that in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*. We compared the plan with portfolio management best practices and portfolio management standards developed by the Project Management Institute.[14] In addition, we interviewed officials from NNSA and OMB to obtain further information on the budget estimates and planning process, as well as on changes to modernization plans, and discussed any perceived misalignments with them. We focused our review for this report on those activities that NNSA officials consider major modernization efforts—for example, life extension programs

[13]The *Stockpile Stewardship and Management Plan* is intended as a budgetary planning guide—a strategic program of record—for the next 25 years.

[14]Project Management Institute, Inc., *The Standard for Portfolio Management*, 3rd ed. (Newtown Square, PA: 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.

(LEP);[15] major alterations of nuclear weapons; and major construction efforts, including both the Chemistry and Metallurgy Research Replacement (CMRR) and Uranium Processing Facility (UPF) construction projects.

The budget projections in the fiscal year 2016 and 2017 *Stockpile Stewardship and Management Plans* each contain budget estimates for 25 years, broken down by the component programs, with all dollar figures presented in nominal dollar values. As mentioned above, the estimates for the first 5 years of the 25-year plans are identical to the FYNSP. For the remaining 20 years, a range of estimates is given for each of the budget components to reflect the significant uncertainties underlying the estimates, and a point estimate is also provided.[16] For the purposes of this report, we refer to the point estimates as budget estimates, which represent the potential estimated costs of NNSA's nuclear modernization program. Our report focuses on NNSA's point estimates and presents all figures as originally provided by NNSA, in nominal dollars, unless otherwise noted.[17] To assess the reliability of the data underlying NNSA's budget estimates, we reviewed the data to identify missing items, outliers, or obvious errors; interviewed NNSA officials knowledgeable about the data; and compared the figures in the budget justification with those in the fiscal year 2016 and 2017 *Stockpile Stewardship and Management Plans* to assess the extent to which they were consistent. We determined that the data were sufficiently reliable for our purposes, which were to report

[15]LEPs extend, through refurbishment of components, the operational lives of weapons in the nuclear stockpile by 20 to 30 years and certify these weapons' military performance requirements without underground nuclear testing. Much like a nuclear weapon LEP, a weapon alteration replaces or refurbishes components to ensure the weapon can continue to meet military requirements. However, an alteration generally refurbishes fewer components than an LEP and does not specifically extend a weapon's operational lifetime.

[16]NNSA estimates a range of possible costs for each component program, with the point estimate being between the high and low extremes. The basis for the cost estimates beyond the FYNSP—including the point estimates—varies depending on the individual programs or subprograms. Some portions of the programs and activities funded from the Weapons Activities appropriations account are assumed to continue beyond the FYNSP at the same level of effort as in the FYNSP. For these cost projections, NNSA used inflation escalation factors based on numbers provided by OMB. For other programs and activities—the LEPs and major construction projects—NNSA uses either the mid-point between the range of estimates or a more robust bottom-up estimate used as the program's or project's baseline cost estimate.

[17]Nominal dollars, which can also be referred to as current dollars, are valued in the prices of the current year—that is, in terms of the prices that prevail at the time (with no adjustments to remove the effects of inflation).

the total amount of budget estimates and those estimates dedicated to certain programs and budgets and compare them with last year's estimates. All years are fiscal years, unless otherwise noted. A detailed description of our scope and methodology can be found in appendix I.

We conducted this performance audit from April 2016 to April 2017 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.

Background

NNSA's major modernization efforts consist of the LEPs and major alterations as well as the large construction projects that support NNSA's strategies to sustain strategic material commodity investments.[18] As discussed in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, ongoing and planned LEPs and major alterations include the W88 Alteration 370 as well as the following LEPs: W76-1; B61-12; B61-12 follow-on; W80-4; and the three interoperable warhead (IW) options, IW-1, IW-2, and IW-3. (See app. II for additional information on the W88 Alteration 370 and these LEPs.) Examples of large construction projects that support modernization include the CMRR project at Los Alamos National Laboratory, which supports NNSA's long-term plutonium strategy,[19] and the UPF project at the Y-12 National Security Complex, which seeks to ensure the ability to produce uranium

[18]According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, strategic materials, such as plutonium, uranium, and tritium, are key to ensuring the safety, security, and effectiveness of the nation's nuclear deterrent, as well as to addressing national security concerns such as nuclear proliferation and terrorism.

[19]NNSA initially approved the CMRR project to replace the aging Chemistry and Metallurgy Research facility that had supported plutonium work at the Los Alamos National Laboratory since the 1950s. In August 2014, DOE formally cancelled its original plan to construct a large nuclear facility as part of the CMRR project and approved a revised CMRR project. The revised project involved maximizing the use of existing space in two facilities at Los Alamos—a radiological lab and Plutonium Facility 4—by purchasing and installing plutonium analysis equipment in them. In August 2016, we completed a review of NNSA's revised CMRR project. See GAO, *DOE Project Management: NNSA Needs to Clarify Requirements for Its Plutonium Analysis Project at Los Alamos*, GAO-16-585 (Washington, D.C.: Aug. 9, 2016).

components for the stockpile and support nuclear propulsion for the Navy as part of NNSA's long-term uranium sustainment strategy.[20]

Congress funds NNSA's modernization efforts through various programs and activities within the Weapons Activities appropriations account that generally address the following areas: (1) stockpile, which includes activities that provide for, support, and maintain the nation's stockpile of nuclear warheads and bombs, such as the LEPs; (2) infrastructure, which includes government-owned, -leased, and -permitted physical infrastructure and facilities supporting weapons activities, such as CMRR and UPF; (3) research, development, testing, and evaluation, which encompasses programs that are technically challenging, multiyear, multifunctional efforts to develop and maintain critical science and engineering capabilities, such as capabilities that enable the annual assessment of the safety and reliability of the stockpile; and (4) other weapons activities, which includes budget estimates associated with nuclear weapon security, secure transportation, and information technology and cyber security as well as legacy contractor pensions.[21] Table 1 provides additional details on these four areas within the Weapons Activities appropriations account.

[20]The UPF project is designed to replace enriched uranium capabilities currently located in the aging Building 9212 at the Y-12 National Security Complex and is part of a larger strategy to maintain NNSA's enriched uranium capability by relocating enriched uranium operations performed in Building 9212 to other existing buildings by 2025 and by constructing a series of smaller buildings.

[21]NNSA is responsible for contributing to the pensions of certain employees and annuitants of the University of California who worked as contractors for NNSA until the mid-2000s.

Table 1: Description of the National Nuclear Security Administration's (NNSA) Weapons Activities Areas

Weapons Activities area	Description
Stockpile	This area includes weapons refurbishments through life extension programs and other major weapons alterations and modifications; surveillance efforts to evaluate the condition, safety, and reliability of stockpiled weapons; maintenance efforts to perform certain minor weapons alterations or to replace components that have limited lifetimes; and core activities that support these efforts, such as maintaining base capabilities to produce uranium and plutonium components.
Infrastructure	This area maintains, operates, and modernizes NNSA infrastructure, including two major construction projects: (1) the Uranium Processing Facility, which is part of a larger strategy to maintain NNSA's enriched uranium capability and is intended to replace most enriched uranium capabilities currently located in the aging Building 9212 at the Y-12 National Security Complex, and (2) the Chemistry and Metallurgy Research Replacement project at Los Alamos National Laboratory, which is part of NNSA's larger plutonium infrastructure strategy and is composed of several subprojects that are expected to move analytical chemistry and materials characterization activities into two existing facilities.
Research, development, testing, and evaluation	This area is composed of programs that are technically challenging, multiyear, multifunctional efforts to develop and maintain critical science and engineering capabilities. These capabilities enable the annual assessment of the safety and reliability of the stockpile, support the development of code-based models that replace underground testing, and improve understanding of the physics and materials science associated with nuclear weapons.
Other weapons activities	This area encompasses activities associated with nuclear weapon security, such as providing for safeguards and security requirements, including protective forces and systems at NNSA sites; secure transportation, which supports the safe, secure movement of nuclear weapons, special nuclear material, and weapons components; information technology and cyber security, which includes efforts to research and develop information technology and cyber security solutions to help meet increased proliferation-resistance and security; and legacy contractor pensions.

Sources: GAO analysis of NNSA documents. | GAO-17-341

The four areas are interconnected. For example, experiments funded under the research, development, testing, and evaluation area can contribute to the design and production of refurbished weapons, which is funded under the stockpile area. The infrastructure area offers critical support to the stockpile area as well as the research, development, testing, and evaluation area by providing a suitable environment for their various activities, such as producing weapons components and performing research and experimentation activities.

NNSA's current modernization efforts address six of the seven different weapons types that make up the U.S. nuclear weapons stockpile and associated delivery systems, including air-delivered bombs, ballistic missile warheads, and cruise missile warheads. Most of these nuclear weapons were produced more than 20 years ago and are being sustained beyond their original design lifetime (see table 2).

Table 2: Types of Nuclear Weapons Currently in the U.S. Stockpile and Refurbishment Activities Planned from 2017 through 2041

Warhead or bomb type	Delivery system	Life extension program (LEP) or major alteration planned from 2017 through 2041	Description of LEP or major alteration
B61-3/4/10 B61-7/11[a]	Tactical bomb Strategic bomb	Yes	The National Nuclear Security Administration (NNSA) is consolidating the 3, 4, 7, and 10 modifications of the B61 bomb into a single B61-12 modification during an ongoing LEP.[b]
W76-0/1	Submarine-launched ballistic missile warhead	Yes	NNSA is replacing a portion of W76-0 warheads with W76-1 warheads, which are currently being produced as part of an LEP. The remainder of the W76-0 warheads will not be refurbished and are being permanently dismantled.
W78	Intercontinental ballistic missile warhead	Yes	This warhead, together with the W88 warhead, will constitute the first interoperable warhead option, the IW-1. An interoperable warhead is designed to have a nuclear explosive package that can be used on multiple delivery systems.
W80-4	Air-launched cruise missile warhead	Yes	This LEP is intended to provide a warhead for a future long-range standoff missile that will replace the Air Force's current air-launched cruise missile warhead.
B83-1	Strategic bomb	Not applicablec	Not applicable[c]
W87	Intercontinental ballistic missile warhead	Yes	NNSA's second interoperable warhead, the IW-2, will involve this warhead.
W88	Submarine-launched ballistic missile warhead	Yes	This warhead, together with the W78 warhead, will constitute the first interoperable warhead option, the IW-1.

Legend: √ = Yes

Source: GAO analysis of NNSA data. | GAO-17-341

[a]The B61-11 is not yet scheduled for an LEP.

[b]The *Fiscal Year 2017 Stockpile Stewardship and Management Plan* also includes budget estimates for studies related to a B61-12 follow-on LEP, beginning in 2038, to replace the B61-12.

[c]Following completion of the B61-12 LEP, NNSA will retire the B83-1, the last megaton-class weapon in the nation's nuclear arsenal.

NNSA's Overall 2017 Budget Materials and Plans for Modernization Differ Little from 2016 Budget Materials and Plans, but Estimates for

Certain Programs Changed to a Greater Degree

NNSA's overall nuclear modernization budget materials and plans for the next 25 years, as presented in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, differ little from those in the fiscal year 2016 plan, although specific budget estimates changed to a greater degree in some individual programs. Specifically, budget estimates in NNSA's *Fiscal Year 2017 Stockpile Stewardship and Management Plan* for modernization of the nuclear weapons stockpile total $300.7 billion for the period covering fiscal years 2017 through 2041, which is a slight increase from the 2016 plan's estimates of $297.6 billion for the period covering fiscal years 2016 through 2040.[22] We also found that changes in the estimates varied across both the four areas that make up the Weapons Activities appropriations account and the individual programs in each of the four areas. In addition, we found that the 25-year budget estimates for some major modernization programs generally decreased. Further, we found that NNSA has taken steps to address our prior recommendations regarding deferred maintenance budgets.

Overall Fiscal Year 2017 25-Year Budget Estimates Increased Slightly from Those in the Fiscal Year 2016 Plan

According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA's estimates for the period covering fiscal years 2017 through 2041 totaled $300.7 billion for modernization activities—an increase of $3.1 billion, or about 1 percent (in nominal dollars), from the $297.6 billion total NNSA reported in the 2016 plan, which covers fiscal

[22]By comparison, the $297.6 billion budget estimate over 25 years in NNSA's *Fiscal Year 2016 Stockpile Stewardship and Management Plan* reflects an increase of approximately 1.4 percent (about $4.2 billion) from NNSA's $293.4 billion budget estimate in the 2015 plan covering fiscal years 2015 through 2039.

years 2016 through 2040.[23] Part of the reason for the difference is due to the effect of inflation on budgets over the 25-year periods in the two plans, which cover slightly different time frames, with the fiscal year 2017 plan including estimates for fiscal year 2041 and excluding those for fiscal year 2016. Moreover, the changes in the estimates varied across the four areas that make up the Weapons Activities appropriations account: stockpile; infrastructure; research, development, testing, and evaluation; and other weapons activities. The change in 25-year budget estimates ranged from an overall increase of 4.2 percent for the other weapons activities area, which includes programs for information technology, cybersecurity, and the secure transportation of nuclear materials and components, to a decrease of 2.7 percent in the infrastructure area, which includes major construction projects moving toward completion, such as UPF and CMRR.

- **Stockpile.** The stockpile area budget estimates in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* rose about 2.7 percent, or $3.1 billion, to $120.3 billion from the fiscal year 2016 plan. Increases in budget estimates for some programs to some extent offset decreases in other estimated stockpile area program budgets over the period covering fiscal years 2017 through 2041. For example, strategic materials increased by about 49.6 percent after the addition of strategic material sustainment, a new line that consolidated storage and material recycle and recovery, two programs that had previously been in the infrastructure area. In addition, weapons dismantlement and disposition increased by about 43.6 percent, in part because of an acceleration of program requirements in the fiscal year 2017 plan. On the other hand, stockpile systems decreased by about 9.8 percent. LEP funding, which is discussed later in this report, also decreased.
- **Infrastructure.** The budget estimate in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* for the infrastructure area decreased about $2.2 billion to $79.6 billion from nearly $81.9 billion,

[23]As mentioned above, the estimates for the first 5 years of the 25-year plans are identical to the FYNSP, and cost range estimates and point estimates are given for the remaining 20 years. For the fiscal year 2016 plan, the point estimate totaled $297.6 billion and the cost estimates ranged from a low of $283.6 billion to a high of $309.4 billion. For the fiscal year 2017 plan, the cost range around the point estimate of $300.7 billion was $285.6 billion to $320.5 billion. According to NNSA officials, the agency gives greater preference to the cost ranges over the point estimates when referring to the potential future cost of the nuclear modernization program. However, for the purposes of our report, we refer to the point estimates to discuss year-to-year changes in our comparisons of the fiscal year 2016 and 2017 plans.

a reduction of about 2.7 percent. This reduction is due in part to the movement of about $6.5 billion in strategic materials sustainment funding out of the infrastructure area to the stockpile area. In addition, two major construction projects—UPF at Y-12 and CMRR at Los Alamos—are moving toward completion in the mid-2020s and thus have 1 less year of requested funding in the 25-year *Fiscal Year 2017 Stockpile Stewardship and Management Plan* than in the fiscal year 2016 plan. As a result of having 1 less year of requested funding in the fiscal year 2017 plan, the total amount of funding to be requested for UPF decreased by 7.1 percent, from about $4.9 billion to $4.5 billion, and the amount for CMRR decreased by 8.2 percent, from about $1.9 billion to about $1.7 billion.[24]

- **Research, development, testing, and evaluation.** The budget estimate for the research, development, testing, and evaluation area slightly increased from $60 billion to $60.6 billion, or about 1.1 percent. There were no significant changes in three of the five programs within the research, development, testing, and evaluation area from the 2016 plan. In two programs, however, there was a shift in focus. According to the fiscal year 2017 plan, in the Engineering program, emphasis shifted to the immediate needs of Directed Stockpile Work, and in the Advanced Manufacturing Development program, priorities were realigned from technology development efforts to address higher NNSA priorities. In addition, budget estimates for advanced simulation and computing increased about 4.9 percent.
- **Other weapons activities.** The other weapons activities budget estimates increased by 4.2 percent, from $38.5 billion to $40.1 billion. This overall increase reflects, in part, expected budget increases for the costs of two programs—Information Technology and Cyber

[24]Budget estimates are not the same as program cost estimates, which are documented statements of costs to be incurred to complete a project or a defined portion of a project. Budget estimates in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* for a program are what NNSA estimates to be the cost to complete a project. For example, the total estimated cost for UPF through 2025 is no more than $6.5 billion, $4.5 billion of which is budgeted to complete the project in fiscal years 2017 through 2025.

Security and Secure Transportation Asset—which are estimated to increase 14.3 percent and 15.8 percent, respectively.[25]

Table 3 summarizes these changes in the 25-year budget estimates by area between the fiscal year 2016 and fiscal year 2017 plans.

Table 3: Changes in the National Nuclear Security Administration's (NNSA) 25-Year Estimates for Nuclear Weapons Modernization for Fiscal Years 2016 and 2017 (Dollars in billions)

Area	Fiscal year 2016 25-year budget (2016-2040)	Fiscal year 2017 25-year budget (2017-2041)	Difference	Percentage change
Stockpile	117.2	120.3	3.1	2.7
Infrastructure	81.9	79.6	-2.2	-2.7
Research, development, testing, and evaluation	60.0	60.6	0.6	1.1
Other weapons activities[a]	38.5	40.1	1.6	4.2
Total	**297.6[b]**	**300.7**	**3.1**	**1.0**

Source: GAO analysis of NNSA data. | GAO-17-341

Notes: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation. Because of rounding, numbers may not total exactly.

[a]Other weapons activities include budget estimates associated with nuclear weapon security and transportation as well as legacy contractor pensions, among other things, that are also included in the Department of Energy's Weapons Activities.

[b]In reviewing the *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, we found that NNSA had omitted $214 million in budget estimates for the Chemistry and Metallurgy Research Replacement line item construction project in the years beyond the Future-Years Nuclear Security Program. An NNSA official confirmed that this amount—which was reported in the 2016 congressional budget justification—should have been included and that its omission was the result of a data entry error. The budget estimates above reflect the revised data, which differ from the estimates contained in the *Fiscal Year 2016 Stockpile Stewardship and Management Plan*.

As stated above, part of the difference between the fiscal year 2016 and 2017 plans is due to the effect of inflation. The budget estimates in the fiscal year 2016 plan cover fiscal years 2016 through 2040, and budget estimates in the fiscal year 2017 plan cover fiscal years 2017 through 2041. We compared the two sets of estimates by summing the nominal dollar values for each, which is how NNSA reports the estimates. The total from the fiscal year 2017 plan is different from the fiscal year 2016

[25]NNSA's Cyber Security program is responsible for fostering a culture to ensure that information technology systems and projects are coordinated across NNSA, have the necessary cyber security protection, and are aligned with DOE requirements and objectives. The Secure Transportation Asset program provides for the secure transport of nuclear weapons, weapons components, and special nuclear material in support of LEPs, limited life component exchanges, surveillance, dismantlement, nonproliferation initiatives, and experimental programs.

plan's total in that the former includes fiscal year 2041 and excludes fiscal year 2016. Inflation makes the difference between the 2017 projection and the 2016 projection appear higher than it would be in the case of a comparison of the two series in real dollar values or in a comparison that looks strictly at the years that overlap from each plan.[26]

Budget Estimates for Some Major Modernization Programs Have Generally Decreased

Our review of NNSA's fiscal year 2016 and 2017 nuclear security budget materials found that, overall, budget estimates for the LEPs and major construction programs generally decreased. For example, the fiscal year 2017 budget estimate for LEPs and other weapons alteration activities—which are captured within the stockpile area in the budget—decreased $1.1 billion, or 2.3 percent, from the fiscal year 2016 estimate of $49.8 billion. However, changes in program scope in some LEPs also contributed to increases in the budget estimates of other programs.

Several reasons account for the changes in budget estimates. For example, the overall decrease in 25-year budget estimates in the fiscal year 2017 plan ending in 2041 is caused in part by the winding down of certain weapons refurbishment efforts, such as the W76-1 and B61-12 LEPs and the W88 Alteration 370. These efforts are scheduled to be completed by the early to mid-2020s and are thus estimated to have no funding for most of the 25 years in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*. The schedules for these modernization efforts have not changed since the 2016 plan (see app. III for the schedule changes for NNSA's major modernization programs during fiscal years 2010 through 2017). As a result, the 2017 plan contains 1 less year of budget estimates for each of these refurbishment efforts than the fiscal year 2016 plan. For example, funding for the W76-1, which is expected to be completed in fiscal year 2020, was $847.1 million

[26]In a comparison that looks strictly at the 23 years that overlap from each plan—that is, from fiscal years 2017 through 2040—the change in estimates is a decrease of about 1.2 percent from the 2016 plan to the 2017 plan. If all 25 years for each of the fiscal year 2016 and 2017 budgets are compared, but adjusted for inflation, the 2017 budget is lower by about 0.9 percent. As noted, the *Stockpile Stewardship and Management Plan* is intended as a budgetary planning guide—a strategic program of record—for the next 25 years. Consequently, comparing the activities and budget estimates intended to support these activities across the 25-year periods in the different plans provides insights for budgeting and planning purposes as to how NNSA's nuclear security budget materials have changed from one plan to the next.

in the fiscal year 2016 plan, which included annual budget estimates from fiscal year 2016 through expected program completion in fiscal year 2020. But that figure decreased by $253.5 million to $593.5 million in the fiscal year 2017 plan, which includes annual budget estimates from fiscal years 2017 through 2020. Budget estimates did increase for three of the LEPs in the 25 years covered in the fiscal year 2017 plan: the W80-4, the third interoperable warhead option or IW-3, and the B61-12 follow-on. For example, the estimates for both the IW-3 and B61-12 follow-on LEPs increased because the 2017 plan includes fiscal year 2041, which is not included in the 2016 plan. Table 4 shows the changes in budget estimates for the weapons refurbishment activities under way during the 25-year period covered by the fiscal year 2016 and fiscal year *Stockpile Stewardship and Management Plans*.

Table 4: Changes in Life Extension Program (LEP) and Alteration Activities' 25-Year Estimates for Nuclear Weapons Modernization for Fiscal Years 2016 and 2017(Dollars in billions)

LEP or alteration	Fiscal year 2016 estimates	Fiscal year 2017 estimates	Change in estimates from 2016 to 2017
W76-1	0.8	0.6	-0.3
B61-12	5.7	5.1	-0.6
W88 Alteration 370	2.0	1.9	-0.1
W80-4	8.2	8.4	0.2
Interoperable Warhead-1 (IW-1)	13.4	12.4	-1.0
IW-2	12.1	11.4	-0.7
IW-3	6.3	6.8	0.4
B61-12 follow-on	1.2	2.1	0.9
Total	**49.8**	**48.7**	**-1.1**

Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Notes: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation. Because of rounding, numbers may not total exactly.

In addition, the budget estimates for some of the weapons refurbishment efforts decreased as a result of changes in the cost-estimating models NNSA uses to develop LEP cost-range estimates and budget estimates, which led to differences between the fiscal year 2016 and 2017 LEP budget estimates.[27] According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, the effect of the cost-estimating model changes was very small on the estimates for the B61-12 and W80-

[27]We did not assess NNSA's cost-estimating models for the LEPs as part of our review.

4 LEPs and the W88 Alteration 370; however, the changes in the models had a more significant effect on the IW-1, IW-2, and IW-3 estimates. Specifically, as stated in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, the changes in the cost-estimating models for the IW LEPs lowered the upper range of the cost estimate by an average of about 8 percent because a shared component was re-evaluated to be much simpler and less expensive than in last year's plan. The changes to the models affected all three systems to a similar and significant extent and led to lower budget estimates for these LEPs in the fiscal year 2017 budget materials. For example, the IW-2 LEP budget estimate from the fiscal year 2016 plan totaled approximately $12.1 billion over the 2023 to 2040 period, whereas the estimate in the fiscal year 2017 plan for this LEP over the same period totaled about $10.8 billion—a 12-percent decrease.

Changes in scope in some programs, however, contributed to increases in the budget estimates. For example, the budget estimate for the W88 Alteration 370 continued to experience changes as a result of a decision made in November 2014 to expand the program's scope of work to include a conventional high explosive replacement, or "refresh." According to the *Fiscal Year 2016 Stockpile Stewardship and Management Plan,* the fiscal year 2016 budget reflected adjustments to partially fund these activities. That plan further noted that NNSA would annually evaluate its budget submissions to look for ways to fund the remaining conventional high explosive refresh activities. NNSA's fiscal year 2017 nuclear security budget materials reflect additional increases to the budget estimates for the W88 Alteration 370, particularly over the 5-year FYNSP period, as a result of further reassessment of the costs of the expanded scope of work. Specifically, the fiscal year 2017 FYNSP estimates increased by about $128 million, or 11.5 percent, over the fiscal year 2016 FYSNP estimates. Further, when comparing the fiscal year 2016 plan's total estimated program costs for fiscal years 2016 through 2026 with the fiscal year 2017 plan's total estimated program costs, which cover fiscal years 2017 through 2025, the 2017 estimate increased by about $111.3 million, or 5.8 percent. Nonetheless, the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* notes that NNSA is still in the process of completing a baseline cost report for the W88 Alteration 370 that will serve as the cost and schedule baseline for the program and be reflected in future budget materials.

The remaining total estimated costs for the two major construction projects we reviewed—UPF and CMRR—have 1 less year of requested funding in the fiscal year 2017 plan; therefore, the total amount of funding

to be requested decreased as compared with the fiscal year 2016 plan.[28] Specifically, the remaining budget estimates for UPF in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* total approximately $4.5 billion from fiscal year 2017 through the project's planned completion in fiscal year 2025, down from about $4.9 billion in the fiscal year 2016 plan.[29] The *Fiscal Year 2017 Stockpile Stewardship and Management Plan's* remaining budget estimates for the CMRR construction project decreased about 8.2 percent to a total of about $1.7 billion compared with a total of about $1.9 billion in the fiscal year 2016 plan. These projects, included in the infrastructure area in NNSA's budget materials, support NNSA's uranium and plutonium strategies, respectively.

NNSA Has Taken Steps to Address Our Prior Recommendations Regarding Deferred Maintenance Budgets

Like the *Fiscal Year 2016 Stockpile Stewardship and Management Plan*, the fiscal year 2017 plan includes a goal to stop the growth of the agency's deferred maintenance backlog.[30] In August 2015, we found that NNSA's infrastructure budget estimates were not adequate to address its deferred maintenance backlog and that the backlog would continue to grow.[31] We recommended that, when budget estimates do not achieve DOE benchmarks for maintenance and recapitalization investment over the 5-year budget estimates, NNSA identify in the budget materials the amount of the shortfall and the effects, if any, on the deferred

[28]According to NNSA officials, both of these projects have total estimated costs for the beginning-to-end cost of the projects. Further, the officials said that it is not the total estimated costs that have changed, but rather the amount of funding that remains to be requested as detailed in the construction project data sheets presented in the President's fiscal year 2017 budget.

[29]According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA is committed to ending enriched uranium programmatic operations in Y-12's Building 9212 and delivering UPF by 2025 for no more than $6.5 billion.

[30]In general, deferred maintenance consists of maintenance activities that were not performed when they should have been or were scheduled to be and therefore are put off or delayed.

[31]GAO, *Modernizing the Nuclear Security Enterprise: NNSA Increased Its Budget Estimates, but Estimates for Key Stockpile and Infrastructure Programs Need Improvement*, GAO-15-499 (Washington, D.C.: Aug. 6, 2015). In this report, we also assessed the extent to which NNSA's 2015 budget estimates addressed the agency's goal of stopping the growth of its deferred maintenance backlog.

maintenance backlog. We also recommended that, until improved data about the importance of facilities and infrastructure to mission are available, NNSA clarify in the budget materials for the 5-year FYNSP the amount of deferred maintenance associated with facilities that have little to no effect on program operations and are therefore low priority. NNSA concurred with our recommendations. Specifically, NNSA agreed to include more information on maintenance, recapitalization, and deferred maintenance on excess facilities and stated that it will address them in the 2017 budget request or budget support materials, as appropriate. Similarly, NNSA officials agreed that, until improved data about the importance of facilities and infrastructure to the mission are available, NNSA will clarify in the budget materials for the FYNSP the amount of the deferred maintenance backlog that is associated with these facilities.

According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA is deploying management tools and processes to help it make data-driven and risk-informed investment decisions to address its infrastructure needs.[32] In addition, in the 2017 budget materials, NNSA included data explicitly in response to our recommendations that provide dollar amounts for deferred maintenance in total, on excess facilities, and on facilities that will be in excess in 10 years; the budget materials further note that NNSA will deliberately not perform some maintenance and repair on facilities that are or soon will be in excess. NNSA also identified in the budget materials the top 10 facilities posing the highest risk to the mission, the workers, the public, and the environment and stated that these facilities will be addressed using fiscal year 2017 funding.

[32]According to the fiscal year 2017 plan, NNSA's strategy for reducing deferred maintenance has two main elements. The first entails revising NNSA's approach to managing its infrastructure to ensure that senior decision makers understand the funding required for current maintenance needs while also reducing deferred maintenance to an acceptable level of risk. The second element involves making deferred maintenance estimates auditable and comparable across all sites and improving how required maintenance is identified. More specifically, according to the 2017 plan, with steady commitment over several years, the reduction in deferred maintenance will be accomplished by prioritizing NNSA's routine investments in general purpose infrastructure, which will allow NNSA to make risk-informed strategic choices that address the deferred maintenance backlog, dispose of unneeded facilities, and revitalize the general purpose infrastructure.

Misalignment between Estimates in NNSA's Budget Materials and Modernization Plans Raises Affordability Concerns

The budget estimates in some of NNSA's fiscal year 2017 nuclear security budget materials do not align with the agency's plans for its modernization efforts at several levels, raising concerns about the overall affordability of NNSA's planned portfolio of nuclear modernization programs. In particular, for some nuclear weapon refurbishment programs, the low end of NNSA's internally developed cost range estimates exceeds the estimates in the fiscal year 2017 budget materials. Moreover, the costs of some refurbishments and the plutonium sustainment program may increase. In addition, budget estimates for some modernization programs during 4 years of the FYNSP—fiscal years 2018 through 2021—are below the funding levels NNSA has identified as needed for those efforts. Moreover, NNSA's fiscal year 2017 budget materials, as well as NNSA officials, have acknowledged that the deferral of modernization work has contributed to impending and significant funding needs for fiscal years 2022 through 2026—the first 5 years beyond the FYNSP. Finally, NNSA's fiscal year 2017 plan concludes that its modernization program is generally affordable in the years beyond the FYNSP but does not thoroughly explain the basis for this conclusion or provide options for how potential affordability concerns—that is, the period during which NNSA's estimated funding needs may exceed projections of available resources—may be addressed if future funding is not increased.

Budget Estimates for Several Nuclear Weapon Refurbishments Are below NNSA's Internal Cost Range Estimates

Our analysis found misalignment between NNSA's budget estimates and NNSA's internal cost range estimates for several major modernization

programs.[33] Specifically, we analyzed the NNSA-developed high- and low-range cost estimates for the nuclear weapon refurbishments that are included in the fiscal year 2017 plan and found that, in some years, NNSA's budget estimates for five refurbishment efforts do not align with the fiscal year 2017 modernization plan because the low end of the cost range estimates that NNSA developed for these refurbishments exceeds the budget estimates.[34]

In particular, we assessed the extent to which the budget estimates aligned with each program's high- and low-range cost estimates and examined those instances in which the low end of NNSA's cost range estimates was greater than the budget estimates.[35] We found the annual budget estimates are generally consistent with NNSA's internal cost range estimates; that is, in most years, the annual budget estimates for each weapon refurbishment effort fall within the high- and low-range cost estimates that NNSA developed for each program. However, in some years, NNSA's budget estimates for some refurbishment efforts do not align with modernization plans. Specifically, for some years, the low end of the cost ranges that NNSA developed for some weapon refurbishments exceeds the budget estimates. As we have reported in the past, this

[33]We analyzed NNSA's annual budget estimates for nuclear weapon refurbishments in the FYNSP included in the President's fiscal year 2017 budget as well as for the 25 years covered by the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*. Specifically, the nuclear weapon refurbishment estimates we analyzed included those for the W76-1, the B61-12, the B61-12 follow-on, the W80-4, and the IW-1, -2, and -3 LEPs, as well as for the W88 Alteration 370.

[34]According to NNSA officials, two approaches are used to estimate the costs of the LEPs, except for the W76-1. Under the first approach, according to officials, NNSA develops specific budget estimates by year through a "bottom-up" process. NNSA officials described this as a detailed approach to developing the LEP budget estimates that, among other things, integrates resource and schedule information from site participants. Under the second approach, which NNSA refers to as a "top-down" process, NNSA uses historical LEP cost data and complexity factors to project high and low cost ranges for each LEP distributed over the life of the program using an accepted cost distribution method. According to NNSA, the W76-1 LEP, which is the only weapon program that has been through the development phase and the majority of the production phase, is used as the primary basis for modeling cost ranges for all future LEPs. NNSA does not prepare high- and low-range cost estimates for it. Officials noted that the values in these cost ranges reflect idealized funding profiles and do not account for the actual detailed schedule of program activities, planning for risk in the project, or the results of execution to date.

[35]Because NNSA does not prepare high and low cost estimates for the W76-1, we compared the budget estimates for each fiscal year with the internal cost estimates NNSA developed for the LEP.

misalignment indicates that estimated budgets may not be sufficient to fully execute program plans and that NNSA may need to increase budget estimates for those programs in the future.[36] Specific modernization programs in which we identified such misalignments are as follows

- **W76-1 LEP.** The program's cost model estimates exceed its budget estimates for fiscal years 2017, 2019, and 2020. Specifically, the cost model estimates exceed the budget estimates by about $5.9 million for fiscal year 2017, about $57 million for fiscal year 2019, and about $80.5 million for fiscal year 2020. According to NNSA officials, the program's budget estimates are in accordance with the approved baseline estimate reflected in the program's selected acquisition report.[37] Nonetheless, additional adjustments to the budget estimates could be required in the future. For example, according to W76-1 program officials and the W76-1 LEP's March 2016 selected acquisition report, which was issued following the release of the fiscal year 2017 budget materials, cost increases associated with the management and operating contract currently in place at the Y-12 National Security Complex have led the program to use reserve funds to cover changes in cost that were not built into the W76-1 LEP cost model. According to these officials, if the program exhausts its reserve funds, the W76-1 LEP could need additional funding to ensure that it is completed on schedule, meaning its overall costs could exceed its total cost estimate as of fiscal year 2017. However, NNSA officials said that they believed the W76-1 program could be completed for the cost reflected in the March 2016 selected acquisition report, which was released at about the same time as the fiscal year 2017 plan.
- **B61-12 LEP.** The program's budget estimates for the 5-year period covered by the FYNSP align with the cost range estimates for the LEP. However, as presented in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, the low-range cost estimate of $199.6 million for the final year of production in fiscal year 2025 exceeds the program's budget estimate of $64.4 million by about $135.2 million. NNSA officials told us that this difference between the budget estimate and the low-range cost estimate in the final year of

[36]GAO-16-290 and *Modernizing the Nuclear Security Enterprise: NNSA's Budget Estimates Do Not Fully Align with Plans*, GAO-14-45 (Washington, D.C.: Dec. 11, 2013).

[37]A selected acquisition report is to document weapon program cost and schedule, among other information. Selected acquisition reports on each nuclear weapon system undergoing life extension or a major alteration project are required to be submitted to the congressional defense committees on a quarterly basis. 50 U.S.C. § 2537(a) (2017).

the program is not a concern because the program expects to have prior year carryover funding available for fiscal year 2025. As described further below, we found additional concerns related to the B61-12 that could impact the potential availability of such carryover funding and how the program's budget estimates align with the internal cost estimates NNSA developed for the LEP.

- **W80-4 LEP.** The program's low-range cost estimate of $247.2 million for fiscal year 2017 exceeds its budget estimate of $220.3 million by about $26.9 million. According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* and NNSA officials, NNSA reduced its planned funding for the W80-4 LEP in fiscal year 2017. NNSA expected that some funding would carry over from fiscal year 2016 for certain activities in fiscal year 2017 as a result of the late receipt of full funding resulting from three continuing resolutions at the start of fiscal year 2016. However, one NNSA official disagreed that the fiscal year 2016 carryover would be used for certain activities in fiscal year 2017 because the carryover funds were still tied to activities that needed to be completed in fiscal year 2016. Moreover, this official noted that the lower funding request for fiscal year 2017, which is about $90 million below what was requested for the program in the President's fiscal year 2016 budget, could add risk to the W80-4 LEP and possibly slow or delay certain planned activities meant to address the program's ambitious design goal of completing the first production unit by fiscal year 2025. NNSA officials also noted that the program is already operating at lower funding levels because of constraints put on the program by the fiscal year 2017 continuing resolution in place as of March 29, 2017.
- **IW-1 LEP.** The program's low-range cost estimates as presented in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* exceed its budget estimates for fiscal years 2019 and 2020. The low end of the cost estimate for fiscal year 2019 is $48.8 million, but the President's fiscal year 2017 budget does not include any funding for that year. Moreover, the fiscal year 2020 low-range cost estimate of $146.3 million exceeds the program's budget estimate of $112.4 million by about $33.9 million. According to IW-1 program officials, the IW-1 has no funding for fiscal year 2019 because the Nuclear Weapons Council made a decision in May 2014 to defer this program until fiscal year 2020. In addition, these officials said that the budget estimate for fiscal year 2020 is below the low-range cost estimate because the IW-1 program needs to conduct a gradual restart, and it may not be practical for the program to respond to the large funding increase currently reflected in the low-range cost estimate. The IW-1 program officials added that they would prefer the LEP to receive less

funding in fiscal year 2020 and have some funding provided in fiscal year 2019 to allow the program to conduct a gradual restart and avoid potential challenges associated with the larger ramp-up or a continuing resolution in fiscal year 2020.[38] The officials told us that they have had discussions with the Nuclear Weapons Council about pursuing the gradual restart in fiscal year 2019 and will continue such discussions in the future. They further noted that if a decision is made to pursue the gradual restart, funding can be added as part of the fiscal year 2019 budget year programming process.

- **W88 Alteration 370.** The program's low-range cost estimates exceed its budget estimates for fiscal years 2020 and 2021. The low end of the cost estimate for fiscal year 2020 is $260.2 million, whereas the President's fiscal year 2017 budget estimate is $245.8 million, a difference of about $14.4 million. Moreover, the low-range cost estimate for fiscal year 2021 of $258.7 million exceeds the program's budget estimate of $213.8 million by about $44.9 million. According to NNSA officials, this misalignment occurred, in part, because more funding was moved into fiscal years 2017 through 2020 to keep NNSA's acceleration of the new conventional high explosive refresh scope of work on track with its original schedule. As a result of the increased funding for fiscal years 2017 through 2019, the total budget estimate for the W88 Alteration 370 over the current 5-year FYNSP period is about $1.2 billion. This exceeds the total low-range cost estimate of $953 million over that same period. NNSA officials pointed out that the increased funding levels for fiscal years 2017 through 2019 will offset the potential funding shortfalls in fiscal years 2020 and 2021. However, as described below, the program's total cost estimate in the fiscal year 2017 budget materials may increase in the future.

[38]According to NNSA officials, having some funding in fiscal year 2019 would allow the program to mitigate the potential risk of a continuing resolution heading into fiscal year 2020. That is, under a continuing resolution, the program would revert to the previous year's budget, which at present would be $0.

Costs of Some Major Modernization Programs May Increase

We also found that the costs of some major modernization programs may increase in the future based on NNSA information produced after the release of the fiscal year 2017 budget materials.[39]

- **B61-12 LEP.** According to two NNSA cost estimates issued following the release of the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* and other fiscal year 2017 budget materials, the B61-12 LEP may cost about $200 million to about $2.6 billion more than the cost estimate presented in the fiscal year 2017 plan (an increase of about 3 percent to 35 percent). According to the plan, the budget estimates for the B61-12 LEP total approximately $7.4 billion. This total estimate falls within the plan's low- and high-range cost estimates, which total $7.3 billion and $9.6 billion, respectively. However, according to NNSA officials, the program's baseline cost report—which was completed by the B61-12 program office in June 2016—estimates that the LEP may cost approximately $7.6 billion, or about $200 million more than the budget estimate provided in the fiscal year 2017 plan.[40] Officials from NNSA's Office of Planning and Programming we spoke with confirmed that the estimated total cost of the B61-12 LEP will increase by about $200 million. Specifically, they told us that the B61-12 LEP's baseline cost report is the official NNSA cost estimate for the program and will be used to inform both the fiscal year 2018 budget and *Stockpile Stewardship and Management Plan*.[41] However, officials from NNSA's Office of Cost Estimating and Program Evaluation told us that the baseline cost report estimate may be understated, based on an independent cost estimate completed by

[39]NNSA's fiscal year 2017 budget materials include two key documents: the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, which was issued in March 2016, and the agency's annual justification of the President's budget, which was issued in February 2016. The DOD-DOE joint report, which also includes information on modernization budget estimates, was issued in August 2016.

[40]A baseline cost report is a more mature program cost estimate, developed in this case by the B61-12 program office, which is used to formalize the program's cost baseline. The development of the baseline cost report is one of the key steps preceding the transition to production engineering.

[41]According to NNSA officials, the independent cost estimate developed by the Office of Cost Estimating and Program Evaluation was useful in providing a separate assessment of cost and schedule risk to leadership but did not change NNSA's position that the B61-12 LEP's baseline cost report is the definitive estimate for the program.

that office in October 2016. According to these officials, the independent cost estimate assesses a 2-year slip to the program office's estimated March 2020 first production unit date and indicates a projected cost for the B61-12 program of approximately $10 billion, which would be $2.6 billion more than the $7.4 billion program estimate and $400 million more than the high-range cost estimate for the program as indicated in the fiscal year 2017 plan.

- **W80-4 LEP.** NNSA officials told us that the W80-4 LEP's budget estimates in the fiscal year 2017 budget materials may increase in the future. An NNSA official said that a reevaluation of the LEP's estimated costs conducted in March 2016 found that budget estimates for the program for the current FYNSP may not be adequate to support program needs. Specifically, the official stated that the program's budget estimates for fiscal years 2019 through 2021 exceeded those identified in the FYNSP and *Fiscal Year 2017 Stockpile Stewardship and Management Plan*. Similarly, officials from NNSA's Office of Cost Policy and Analysis said they believe the total budget estimates for the W80-4 LEP are understated. According to these officials, the W80-4 program, which is operating under an accelerated, compressed schedule to complete its first production unit by fiscal year 2025, may be underfunded by at least $1 billion. The Office of Cost Policy and Analysis officials explained that the program may need additional funding not only to counter the more compressed schedule but also to address what they described as prior year underfunding. Further, there may be additional cost increases not yet factored into the program's total cost estimate because the W80-4 LEP is still in the early stages of NNSA's Phase 6.X process and the scope of work has not yet been fully defined.[42] For example, officials from the Office of Cost Policy and Analysis said that an option to conduct a refurbishment of the weapon's secondary is being evaluated. They said a refurbishment could add approximately $250 million to $300 million to the total cost of the program, which, as of the fiscal year 2017 plan, could range from $7.4 billion to $9.9 billion. In addition, an NNSA official with the W80-4 program said that the LEP may face additional cost increases as a result of ongoing timing and synchronization issues associated with the Air Force's long-range

[42]NNSA's Phase 6.X process is a seven-step process under which NNSA and DOD jointly manage an LEP. NNSA and DOD implement the Phase 6.X process under a guidance document, *Procedural Guideline for the Phase 6.X Process*, which describes key high-level joint tasks and deliverables for each phase and lists key milestones, such as tests and cost estimates, that a nuclear refurbishment activity, such as an LEP, is directed to take before proceeding to subsequent steps of the Phase 6.X process.

standoff missile program, which is developing a new nuclear cruise missile that will carry the W80-4 warhead. NNSA officials told us that the program will have a better idea of its estimated cost as it advances toward Phase 6.2A, which focuses on investigating preferred design options and expected refurbishment costs.

- **W88 Alteration 370.** According to officials from the Office of Cost Policy and Analysis, this program's expanded scope of work may result in about $1 billion in additional costs. The additional scope, which, as described above, entails undertaking work to refresh the weapon's conventional high explosive, has not resulted in any changes to the program's current fiscal year 2020 schedule for delivery of the first production unit. However, funding levels for this program have increased compared with those presented in the fiscal year 2016 budget as a result of an NNSA reassessment of the cost of this effort. Officials from NNSA's Office of Cost Estimating and Program Evaluation told us that they conducted an independent cost estimate of the program's baseline cost report estimate, which was completed in September 2016, and found that it may be understated. According to these officials, the independent cost estimate, which was expected to be published by the end of February or early March 2017, will provide further details on cost and schedule impacts to the W88 Alteration 370 program. The *Fiscal Year 2017 Stockpile Stewardship and Management Plan* further states that the program's baseline cost report will establish the cost and schedule baseline for the W88 Alteration 370 and will be reflected in future budget materials.
- **Plutonium Sustainment.** According to preliminary observations from a July 2016 cost analysis report prepared by NNSA's Office of Cost Policy and Analysis, the funding profiles for some activities within NNSA's Plutonium Sustainment program may be underfunded.[43] The report, which NNSA officials said will be used internally to inform the fiscal year 2018 budgeting process, examined activities related to reconfiguring and upgrading plutonium pit manufacturing equipment at Los Alamos National Laboratory's Plutonium Facility 4. The report indicated that, based on preliminary schedule analysis of these pit manufacturing equipment activities, a 2 to 3 year slip in schedule is likely. In light of the potential slip in schedule, costs for these activities

[43]NNSA's Plutonium Sustainment program supports the requirements for pit production outlined in the National Defense Authorization Act for Fiscal Year 2015 that requires NNSA to produce 10 war reserve pits in 2024, 20 war reserve pits in 2025, and 30 war reserve pits in 2026. A pit is the central core of a nuclear weapon that is commonly produced using plutonium.

could collectively exceed their original cost estimates by more than $100 million. Therefore, according to the report's preliminary observations, NNSA may need to increase its estimated budget request for the Plutonium Sustainment program by approximately $100 million over the fiscal year 2018 to 2022 period. According to additional preliminary observations from the report, funding requirements for Plutonium Sustainment program activities other than the pit manufacturing equipment upgrades, such as those related to Los Alamos' plutonium experimental device fabrication, could also need increased levels of funding over the fiscal year 2018 to 2022 period. These activities, all of which fall under the auspices of the Plutonium Sustainment program, are being undertaken to assist Los Alamos's plutonium production activities, particularly the ability to support a 30-pits-per-year manufacturing capacity by 2026. According to officials from the Office of Cost Policy and Analysis, producing an increased number of pits per year is critical because the IW-1 LEP, among other LEPs, will need access to the newly produced pits to meet its scheduled first production unit date of fiscal year 2030. NNSA officials further told us that some of the potential funding increases identified in the report's preliminary observations reflect a ramp up in work to meet these mandated pit production levels and that NNSA continues to evaluate these additional requirements for fiscal years 2018 through 2022 through its budgeting process.

Repeated Deferral of NNSA Funding Needs Contributes to Impending and Significant Funding Needs beyond the FYNSP

Funding needs NNSA has identified for certain modernization programs during fiscal years 2018 through 2021 may not be met by the President's budget for that period. For example, the Energy Secretary identified $5.2 billion in additional funding needs for NNSA beyond OMB-approved funding levels for fiscal years 2018 through 2021. In addition, NNSA's fiscal year 2017 budget materials, as well as NNSA officials, have acknowledged that the deferral of modernization work has contributed to impending and significant funding needs for fiscal years 2022 through 2026—the first 5 years beyond the FYNSP.

Energy Secretary Identified $5.2 Billion in Additional Funding Needs for NNSA beyond OMB-Approved Funding Levels for Fiscal Years 2018 through 2021

In a December 2015 letter to the OMB Director, the Energy Secretary stated that an additional $5.2 billion above OMB-approved funding levels would be needed for fiscal years 2018 through 2021 to establish a viable and sustainable modernization program portfolio. The Energy Secretary stated that the funding level for NNSA facility infrastructure activities for fiscal years 2018 through 2021 was approximately one-half of the $2.8 billion needed to address infrastructure issues in the future. In addition, the Energy Secretary noted that the $120 million in funds designated for the exascale high-performance computing initiative for fiscal years 2018 through 2021 was $550 million below NNSA's request.[44] Other examples of programs with known shortfalls between the approved funding levels and NNSA's estimated budget needs identified in the letter included the Domestic Uranium Enrichment program; the NNSA Center for Heterogeneous Integration Packaging and Processes; and a number of other technology development, surveillance, security, and infrastructure programs. According to the Energy Secretary's letter, if these shortfalls were not addressed, they would fuel uncertainty in program execution, creating the potential for cost and schedule growth across the nuclear security enterprise, with the result that NNSA might not be able to sustain a viable portfolio of modernization programs.

NNSA officials did not dispute the Energy Secretary's statement indicating that NNSA had identified a significant gap between the level of funding believed to be necessary to address modernization requirements and the funding profile in the FYNSP for fiscal years 2018 through 2021. NNSA officials attributed this gap to budgetary caps imposed by Congress and said that if Congress does not lift or change these caps for fiscal years 2018 through 2021—the remaining fiscal years for which reductions to discretionary spending limits could be required—the scope of planned modernization work during that time could not be sustained. NNSA officials stated that they believed that the administration and

[44]NNSA's exascale high-performance computing initiative is a joint program between NNSA and DOE's Office of Science focused on advanced simulation through a capable exascale computing program that emphasizes sustained performance on mission relevant applications, such as integrated design codes and supporting modeling and simulation capabilities. These capabilities enable NNSA to evaluate and address the performance, safety, effectiveness, and security of the nuclear weapons stockpile and to quantify margins and uncertainties, among other things.

Congress need to establish a long-term plan that will address the existing budget caps, including consideration of appropriate adjustments to the out-year budget spending caps, to provide a firm foundation to continue the current plan of work.

An OMB official we interviewed told us that the budget caps require OMB to prioritize NNSA's modernization programs in its evaluation of budget estimates and that lower priority modernization programs are often not approved at funding levels NNSA proposes to OMB. The official stated that OMB considers several criteria in prioritizing NNSA programs and assessing proposed funding. These criteria include whether there is a well-defined need for a particular program; the program provides a unique and useful capability; the timing of a particular program or capability that needs to be replaced or recreated is a pressing priority in need of funding within the 5-year period covered by the FYNSP, or if it can be deferred to beyond the FYNSP; and any independent cost estimates or analysis of alternatives have been conducted to justify the program need or the proposed funding level. The OMB official stated that, in applying these criteria, more analysis and justification were needed to support the funding levels requested for most of the programs identified in the Energy Secretary's December 2015 letter.

NNSA Plans Have Repeatedly Deferred Costs and Assumed Funding Increases beyond the FYNSP

NNSA's fiscal year 2017 budget materials, as well as NNSA officials, have acknowledged that work deferred by the agency has contributed to a significant bow wave of funding needs in the out-years—that is, there is an impending and significant increase in the requirements for additional funds. In particular, NNSA officials stated that the deferral of funding is one of the necessary strategies the agency uses to manage risk in order to address funding needs of programs deemed to be higher priorities within the FYNSP. For example, NNSA officials said that they reduced budget estimates for technology maturation activities during the FYNSP associated with the fiscal year 2017 nuclear security budget materials, in part, to provide additional funding in the fiscal years 2017 through 2021 FYNSP for deferred maintenance-related activities, which are currently a

higher priority for NNSA.[45] Moreover, according to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, several construction projects scheduled to start sometime during fiscal year 2016 through fiscal year 2020 have been deferred to outside the current FYNSP period to address higher NNSA priorities. These deferred projects include the Energetic Materials Characterization Facility at Los Alamos; the Weapons Engineering Facility at Sandia; the High Explosive Component Fabrication and Qualification Facility at Pantex; and the High Explosive Science and Engineering Facility, also at Pantex. According to the President's fiscal year 2016 budget, the amount of funding requested for these four projects totaled approximately $193.8 million for fiscal years 2017 through 2020.[46]

According to NNSA officials, there is a propensity for program managers who believe program funding is insufficient within the FYNSP to seek funding beyond the FYNSP period. As a result of such actions, additional funding needs are pushed into the out-years under the assumption that NNSA will receive higher funding levels in the future to complete its programs. For example, the fiscal year 2017 budget materials show that NNSA's budget estimates for fiscal years 2022 through 2026—the first 5 years beyond the FYNSP—may require significant funding increases over this period. For example, in fiscal year 2022, the first year beyond the FYNSP, NNSA's modernization budget estimates are projected to rise significantly compared with the budget estimates for fiscal year 2021, the last year of the FYNSP. Specifically, NNSA estimates that its modernization funding needs for fiscal year 2022 may be about $11.3 billion, or about 7 percent greater than the fiscal year 2021 estimate of $10.5 billion. By fiscal year 2026, NNSA estimates that its funding needs may total approximately $12.1 billion, which is about 15.3 percent greater than the fiscal year 2021 estimate. This increasing need for additional funding is commonly referred to as a bow wave. As we have previously reported, such bow waves occur when agencies defer costs of their

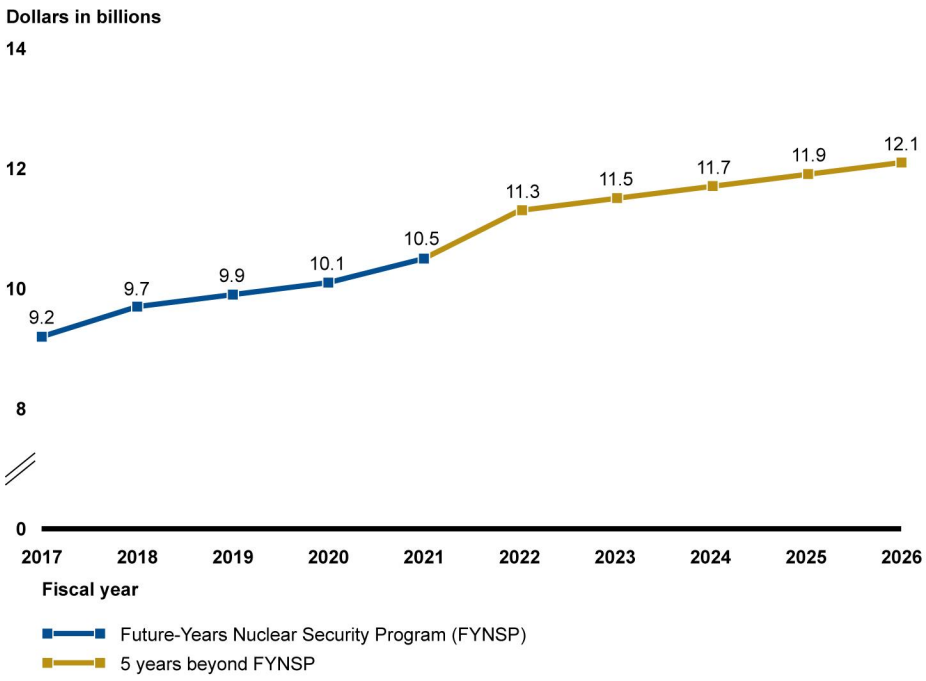
[45]Technology maturation enables development and delivery of design-to-manufacturing capabilities to meet current and future nuclear weapons needs for the nation's stockpile. In addition, many early-stage technologies developed at the national laboratories require "maturation" in the form of additional development, testing, or prototyping before companies are willing to invest in them for commercials purposes.

[46]NNSA planned to start construction of the High Explosive Science and Engineering Facility at Pantex in fiscal year 2017, design of the High Explosive Component Fabrication and Qualification Facility at Pantex and the Energetic Materials Characterization Facility at Los Alamos in fiscal year 2018, and design of the Weapons Engineering Facility at Sandia in fiscal year 2019.

programs to the future, beyond their programming periods, and often occur when agencies are undertaking more programs than their resources can support.[47]

As figure 1 shows, NNSA's budget estimates increase each year within the FYNSP and then increase more significantly in fiscal year 2022, the start of NNSA's bow wave of out-year funding needs.

Figure 1: Comparison of the National Nuclear Security Administration's Fiscal Year 2017 Budget Estimates for the Future-Years Nuclear Security Program and 5 Years Beyond



Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

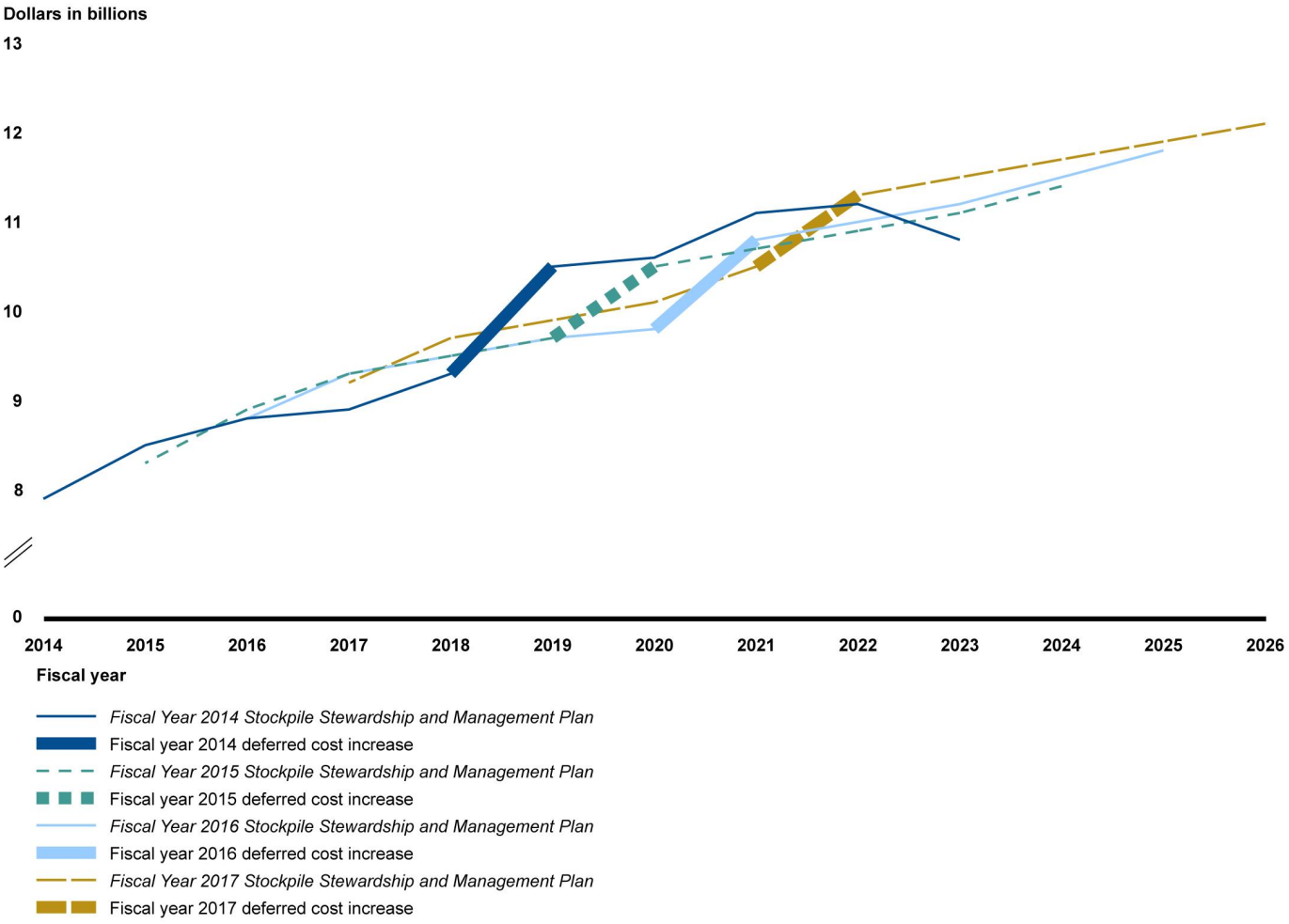
Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

In addition, our analysis shows that NNSA has shifted this modernization bow wave to the period beyond the FYNSP time frame in each of the past

[47]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).

four versions of the annual *Stockpile Stewardship and Management Plan* (see fig. 2).

Figure 2: Comparison of the National Nuclear Security Administration's Fiscal Year 2014 through 2017 *Stockpile Stewardship and Management Plans* for Fiscal Years 2014 through 2026



Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Notes: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation. In addition, the first 5 years of each *Stockpile Stewardship and Management Plan* represent the Future-Years Nuclear Security Program (FYNSP), which is included in the President's budget. The FYNSP covered 2014 through 2018 in the 2014 plan, 2015 through 2019 in the 2015 plan, 2016 through 2020 in the 2016 plan, and 2017 through 2021 in the 2017 plan. The deferral of major increases in NNSA's overall modernization budget estimates can be observed in the increase in budget estimates from the last year of the FYNSP (year 5) to the first year beyond the FYNSP (year 6). As illustrated by the bolded line segments presented in this figure, this increase from year 5 to year 6 continues to be deferred in each subsequent *Stockpile Stewardship and Management Plan*—from the expected increase from 2018 to 2019 detailed in the 2014 plan to the currently scheduled increase from 2021 to 2022 as detailed in the 2017 plan.

Each of the plans for fiscal years 2014 through 2017 shows a pattern of significant increases in NNSA's modernization budget estimates immediately after the relevant 5-year FYNSP, representing a deferral of modernization costs to the years beyond the FYNSP. For example, in the *Fiscal Year 2014 Stockpile Stewardship and Management Plan*, NNSA's budget estimates for its modernization programs increased from a total of about $9.3 billion in fiscal year 2018, the last year of the FYSNP, to about $10.5 billion in fiscal year 2019, the first year after the FYNSP—an increase of about 13 percent. Similar patterns showing a jump in funding needs immediately after the last year of the FYNSP are repeated in the funding profiles contained in the fiscal year 2015, 2016, and 2017 plans. As we have previously reported, deferring more work to future years can raise cost and schedule risks and also put programs in the position of potentially facing a backlog of deferred work that grows beyond what can be accommodated in future years.[48]

NNSA's Modernization Budget Estimates in the Years beyond the FYNSP May Exceed Projections of the President's Budget, but NNSA Maintains the Plan Is Affordable

NNSA's modernization budget estimates for fiscal years 2022 through 2026—as presented in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*—may exceed the out-year projections for funding levels in the President's budget for nuclear modernization efforts during that time, raising concerns about the affordability of NNSA's modernization programs beyond the FYNSP. However, the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* concludes that NNSA's modernization program is generally affordable in the years beyond the FYNSP—an optimistic assessment that is not well supported—in spite of the mismatch between its budget estimates and likely available funding for fiscal years 2022 through 2026.

[48]GAO-16-620.

NNSA's Modernization Budget Estimates for Fiscal Years 2022 through 2026 May Exceed Projections of Modernization Funding Levels in the President's Budget for That Period

The *Fiscal Year 2017 Stockpile Stewardship and Management Plan* shows that NNSA's overall modernization budget estimates for fiscal years 2022 through 2026 may exceed the out-year projections for funding levels in the President's fiscal year 2017 budget. According to NNSA's data, the agency's overall modernization budget estimates total about $58.4 billion for fiscal years 2022 through 2026, and the out-year funding projections from the President's fiscal year 2017 budget for the same period total about $55.5 billion.[49] The President's out-year funding projections, therefore, are approximately $2.9 billion, or about 5.2 percent, less than NNSA estimates needing over the same time period. We identified a similar mismatch between NNSA's budget estimates for the first 5 years beyond the FYSNP and the President's out-year funding projections for the same period as part of our review of the fiscal year 2016 nuclear security budget materials.[50] Table 5 provides more information on the differences by year between NNSA's modernization budget estimates and the out-year funding projections of the President's budget for fiscal years 2022 through 2026.

Table 5: Comparison of NNSA's Cost Range Estimates, the *Fiscal Year 2017 Stockpile Stewardship and Management Plan's* Weapons Activities Account Budget Estimates, and Out-Year Funding Projections from the President's Fiscal Year 2017 Budget for Fiscal Years 2022 through 2026 (Dollars in billions)

		2022	2023	2024	2025	2026	Total for 2022-2026
NNSA's cost range estimates for the Weapons Activities account	High range	12.4	12.6	12.9	13.0	13.2	**64.1**
	Low range	10.5	10.6	10.8	11.2	11.2	**54.4**
Fiscal year 2017 budget materials	*Fiscal Year 2017 Stockpile Stewardship and Management Plan's* Weapons Activities account budget estimates	11.3	11.5	11.7	11.9	12.1	**58.4**
	Out-year funding projections from the President's fiscal year 2017 budget	10.7	10.9	11.1	11.3	11.5	**55.5**

[49]The out-year projections for funding levels in the President's budget for fiscal years 2022 through 2026 are reported on in the 2017 DOD-DOE joint report.

[50]GAO-16-290.

		2022	2023	2024	2025	2026	Total for 2022-2026
Differences	Amount the plan's estimates may exceed out-year funding projections in the President's budget	0.6	0.6	0.6	0.6	0.6	**2.9**
	Amount the out-year funding projections in the President's budget may exceed NNSA's low-range cost estimates	0.2	0.2	0.3	0.1	0.3	**1.2**

Sources: GAO analysis of National Nuclear Security Administration (NNSA) data. | GAO-17-341

Notes: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation. Because of rounding, numbers may not total exactly.

The 2017 plan acknowledges that NNSA's estimates may exceed the President's out-year funding projections but notes that those projections are subject to annual adjustments in the future. Nevertheless, the misalignment between these estimates raises questions about the affordability of NNSA's modernization plans in the 5 years beyond the FYNSP absent either significant increases in the President's out-year funding projections or reductions in NNSA's estimated modernization funding needs.

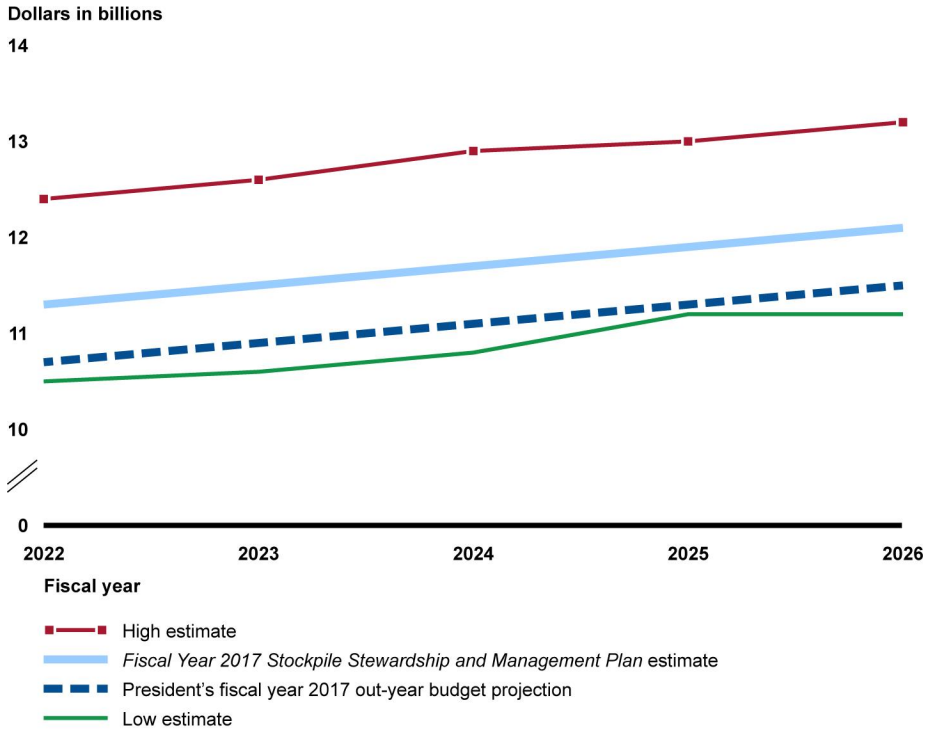
NNSA Concludes Out-Year Modernization Programs Are Affordable Based on an Optimistic Assessment That Is Not Well Supported

The *Fiscal Year 2017 Stockpile Stewardship and Management Plan* concludes that NNSA's nuclear modernization plans for the years beyond the FYNSP are generally affordable, and more executable than the modernization program presented in the fiscal year 2016 plan, for two reasons.

First, when evaluating whether or not its modernization plans are affordable, NNSA considers its cost range estimates and whether or not the President's out-year funding projections fall within or outside the ranges. Regarding the fiscal year 2017 plan, the President's out-year funding projections exceed NNSA's low-range cost estimates for its modernization programs over fiscal years 2022 through 2026. Based on NNSA data, the low-range cost estimates for fiscal years 2022 through 2026 total approximately $54.4 billion, and the President's out-year funding projections total about $55.5 billion. Consequently, the President's out-year funding projections may be sufficient to support NNSA's modernization programs assuming program costs approximate the low-range cost estimate. Figure 3 illustrates data from the 2017 plan

showing NNSA's nominal budget estimates, including high- and low-range cost estimates for its modernization program, along with the out-year funding projections from the President's fiscal year 2017 budget, for fiscal years 2022 to 2026.

Figure 3: Comparison of the *Fiscal Year 2017 Stockpile Stewardship and Management Plan's* Budget Estimates and High- and Low-Range Cost Estimates with the President's Fiscal Year 2017 Out-Year Budget Projections, Fiscal Years 2022 through 2026



Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

Second, NNSA concludes that its modernization programs are generally affordable in the years beyond the FYNSP because, as stated in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, estimated budget needs will begin to decrease in fiscal year 2027. Specifically, the 2017 plan states that the nominal cost of NNSA's modernization program is expected to decrease by approximately $1

billion in fiscal year 2027.[51] At that time, according to the 2017 plan, it is anticipated that NNSA's estimated budgets for its modernization program will begin to fall in line with projections of future presidential budgets. The 2017 plan also notes that by fiscal year 2027, NNSA's projections of the President's out-year modernization budget fall around NNSA's total high-range cost estimate for its modernization program.[52]

Nonetheless, NNSA's conclusion in its 2017 plan that its modernization costs are generally affordable in the years beyond the FYNSP is optimistic, given the following affordability concerns.

- **Potential rising costs of some modernization programs.** NNSA's conclusion that its modernization plan is generally affordable is predicated on optimistic assumptions regarding the cost of the modernization program beyond the FYNSP, particularly for fiscal years 2022 through 2026. Specifically, for the overall modernization program to be considered affordable during the fiscal years 2022 through 2026 period, NNSA's modernization programs would need to be collectively executed at the low end of their estimated cost ranges. The plan does not discuss, however, options NNSA could pursue to ensure an affordable modernization program if costs were to exceed its low-range cost estimates. As we noted above, there may be potential future cost growth in several modernization programs. For example, the B61-12 LEP may cost $200 million to $2.6 billion more than the cost estimate presented in the fiscal year 2017 plan, the W80-4 LEP may be underfunded by at least $1 billion, and the additional scope of work added to the W88 Alteration 370 may amount to about $1 billion in added costs. Other cost increases could occur if other modernization programs encounter schedule delays or unexpected challenges.
- **Impending bow wave of funding requirements.** As discussed above, NNSA is facing a significant bow wave of increased funding needs in the 5 years beyond the FYNSP (fiscal years 2022 through

[51]According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, the approximate billion-dollar reduction that will occur in fiscal year 2027 will be the result of the winding down of a number of construction projects slated for the fiscal years 2022 through 2026 period.

[52]The *Fiscal Year 2017 Stockpile Stewardship and Management Plan* states that the escalation rates for fiscal years 2022 through 2026 match those in the President's fiscal year 2017 budget for those years, and rates for fiscal year 2027 and beyond were 2.25 percent, consistent with OMB projections of the Consumer Price Index.

2026) and a misalignment between its modernization budget estimates and projections of the President's modernization budgets during that period. Besides noting the approximate $1 billion reduction in modernization budgets beginning in fiscal year 2027, the fiscal year 2017 plan does not explain how the modernization bow wave and misalignment will be addressed by NNSA should the President's budget not increase to close the fiscal years 2022 through 2026 funding gap. The decrease in NNSA's modernization budget estimates beginning in fiscal year 2027 may not be achievable if the projected mismatch between NNSA's budget estimates and the President's out-year funding projections for fiscal years 2022 through 2026 is not resolved. This mismatch creates concerns that NNSA will not be able to afford planned modernization costs during fiscal years 2022 through 2026 and will be forced to defer them to fiscal year 2027 and beyond, continuing the bow wave patterns discussed above.

NNSA's plan does not specify how the agency intends to address these affordability concerns. Specifically, the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* does not assess all options to align plans for NNSA's portfolio of nuclear modernization programs with potential future budget estimates, such as increases above projected future presidential out-year budgets or cancellation or deferral of programs that NNSA could consider undertaking in consultation with DOD and the military services. Portfolio management best practices and portfolio management standards developed by the Project Management Institute state that organizations can optimize their portfolios of programs and projects by assessing the organization's capability and capacity to finance specific portfolio components.[53] As part of this assessment, organizations should determine which portfolio components should receive the highest priority and identify portfolio components to be suspended, reprioritized, or terminated based on the balancing or rebalancing activities. Our March 2009 cost guide also states that an assessment of affordability should address requirements at least through the programming period and, preferably, several years beyond.[54] Moreover, portfolio management entails operating within the constraint of resources expected to be available in the future.[55] However, NNSA does not include such an assessment in the plan and it does not utilize the

[53] *The Standard for Portfolio Management.*

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

[55] *The Standard for Portfolio Management*.

projected out-year funding availability as a constraining factor when evaluating the affordability of its modernization plans.

We have previously found that portfolio reviews can help increase return on taxpayers' investments in weapon systems in a number of ways, such as: helping to ensure investments align with national security and military strategies, prioritizing the most important investments, selecting the optimum mix of investments, identifying and eliminating unwarranted duplication, monitoring programs' health to determine whether changes to the portfolio are warranted, and determining whether investments are affordable.[56] By including an assessment of the affordability of NNSA's portfolio of modernization programs in future versions of the *Stockpile Stewardship and Management Plan*, NNSA could develop a plan that is consistent with portfolio management best practices. Such an assessment could present options (e.g., potentially deferring the start of or canceling specific modernization programs) that NNSA could consider to bring its estimates of modernization funding needs into alignment with potential future budgets, which could help congressional and NNSA decision makers better understand the potential rebalancing of priorities and trade-offs that may need to be undertaken to address affordability concerns.

Conclusions

NNSA is carrying out an ambitious, costly, decades-long effort to modernize the nation's nuclear security enterprise, which includes ensuring that existing nuclear weapons remain safe and reliable and that aging and outdated weapons-related facilities are replaced or renovated. The next decade represents a particularly challenging period for NNSA's modernization efforts, as the agency plans to simultaneously execute at least four LEPs along with major construction projects, such as efforts to modernize NNSA's uranium and plutonium capabilities. However, NNSA's modernization budget estimates for the first 5 years beyond the FYNSP—fiscal years 2022 through 2026—may exceed the funding levels available for modernization in future budgets, raising affordability concerns. NNSA acknowledges these differences but provides an optimistic conclusion regarding the affordability of its modernization programs. Moreover, NNSA has not addressed the projected bow wave of future funding needs

[56]GAO-15-466.

and mismatch between potential funding needs and potential funding available in the years beyond the FYNSP. By not including an assessment of the affordability of NNSA's portfolio of modernization programs in the *Stockpile Stewardship and Management Plan*—such as an assessment of the potential implications of funding level increases above projected future presidential out-year budgets or of the cancellation or deferral of specific modernization programs that NNSA could consider taking to bring its estimates of modernization funding needs into alignment with potential future budgets—the agency has not developed a plan that is consistent with portfolio management best practices.

Recommendation for Executive Action

To help NNSA put forth more credible modernization plans, we recommend that the NNSA Administrator include an assessment of the affordability of NNSA's 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.

Agency Comments and Our Evaluation

We provided a draft of this report to NNSA for review and comment. We also provided an informational copy of our draft report to OMB. NNSA provided written comments, which are summarized below and reproduced in appendix IV. NNSA also provided technical comments, which we incorporated as appropriate.

In its written comments, NNSA did not explicitly agree or disagree with our recommendation. Specifically, with respect to our recommendation for NNSA to include an assessment of the affordability of its modernization program in future *Stockpile Stewardship and Management Plans*, NNSA stated that it compares its financial requirements and budget requests in the *Stockpile Stewardship and Management Plan* and highlights the potential risks associated with insufficient resources. In reviewing whether NNSA compares its financial requirements and budget requests in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* and highlights the potential risks associated with insufficient resources, we found that NNSA does not, as stated, highlight the potential risks

associated with insufficient resources. For example, while the fiscal year 2017 plan highlights the instances in which NNSA's estimated funding needs exceed projected available resources for fiscal years 2022 through 2026, the plan does not discuss or highlight risks associated with this potential funding shortfall. Moreover, in the 2017 plan NNSA does not raise concerns with this potential funding shortfall because it believes estimated funding needs fall within its estimates of the high- and low-range modernization cost estimates for fiscal years 2022 through 2026.

By not articulating the risks and potential program impacts associated with this potential funding shortfall, NNSA raises questions about its ability to achieve its modernization program goals at cost and on schedule. NNSA's budget materials are a key source of information used by Congress to make appropriation decisions. Including in future versions of the *Stockpile Stewardship and Management Plan* information such as an assessment of the potential implications of funding level increases above projected future presidential out-year budgets or a discussion of broadly construed trade-offs that NNSA could make to align its estimated modernization funding needs with potential future budgets would improve the transparency and quality of information available to congressional and NNSA decision makers. For these reasons, we continue to believe that NNSA should include an assessment of the affordability of NNSA's portfolio of modernization programs in future versions of the *Stockpile Stewardship and Management Plan*.

NNSA also provided four general comments that summarize key points from its technical comments.

First, NNSA stated that clarification was necessary for comparisons made in our draft report between the budget estimates in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* and the President's fiscal year 2017 budget, and the assessment of affordability in the fiscal year 2017 plan. For example, NNSA noted that program-by-program level variations in near-term budget justifications, external out-year budget estimates, and future years' planning documents are normal and expected for any federal agency. NNSA stated that these differences exist primarily in the out-years where the uncertainty is higher and estimates are typically not constrained (i.e., by the more rigorous programming requirements used during the budgeting process to develop the 5-year FYNSP estimates).

We acknowledge that NNSA's modernization budget estimates for years beyond the FYNSP do not have to align with the 5-year overall federal

budget estimates in the President's budget. We clarified this in our report. Nevertheless, our March 2009 cost guide states that an assessment of affordability should address requirements at least through the programming period and, preferably, several years beyond. For these reasons, we believe it would be useful for NNSA to take into consideration program funding requirements for several years beyond the 5-year FYNSP period. By including such an assessment in future versions of the *Stockpile Stewardship and Management Plan*, NNSA could broadly discuss options (e.g., potentially deferring the start of or canceling specific modernization programs) that it might need to consider in future programming cycles to bring its estimates of modernization funding needs into alignment with potential future budgets.

In its second general comment, NNSA stated that the draft report also compares range estimates in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* data for fiscal years 2022 through 2026 with out-year funding projections in the President's fiscal year 2017 budget for those same years. NNSA stated that it assumes we are referencing the out-year budget projections OMB included in an appendix to the President's fiscal year 2017 budget. As we explain in the report, we are comparing NNSA's nuclear modernization budget estimates—its estimated funding needs—for fiscal years 2022 through 2026 included in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* against the projections of modernization funding levels in the President's fiscal year 2017 budget for the same time period, which are also included in the plan. NNSA describes its projections of the President's future budgets as the level of funding NNSA's modernization programs might expect to receive for the out-years. Nevertheless, NNSA stated that caution should be used in benchmarking these numbers as decisions in the current budget have an amplifying effect on NNSA's future budgets. We are not benchmarking these numbers; instead, we use these out-year projections to illustrate that NNSA's current estimated funding needs exceed the projections of available resources by nearly $3 billion over fiscal years 2022 through 2026. Therefore, we continue to believe that NNSA should address potential funding shortfalls identified in its own illustration of budget projections, including the causes of the potential shortfalls and options for addressing them in future versions of the agency's plan.

In its third general comment, NNSA stated that its ability to execute its modernization plan under the current projections of future presidential budgets is manageable. NNSA stated that the plan provides wide, unconstrained range estimates of potential costs in out-years for which

there is uncertainty and that it gauges affordability by evaluating whether its modernization budget estimates fall within (or outside) the range estimates. NNSA stated that for fiscal years 2022 through 2026, the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* high-end cost is approximately 15 percent greater than the total of estimated available resources, while the low-end estimate is approximately 2 percent less. NNSA therefore concluded that its modernization program would be manageable under the estimates of future available resources.

As we state in the report, NNSA's conclusion that the modernization program is generally affordable in the years beyond the FYNSP is optimistic and not well supported, particularly given the nearly $3 billion mismatch between its budget estimates and likely available funding for fiscal years 2022 through 2026. NNSA's method of evaluating affordability—gauging where the budget projections fall within (or outside) its cost range estimates—is a broad and generous approach for evaluating affordability. We assessed affordability under a narrower, more conservative approach—which we further clarified in the report—by comparing NNSA's estimated out-year funding needs against its estimates of modernization funding levels that may be available under future President budgets. In our view, NNSA risks overstating the affordability of its modernization programs for fiscal years 2022 through 2026 because the funding projections of the President's out-year modernization budgets fall within a very wide range of high and low cost estimates. In doing so, NNSA implies that its modernization program could still be considered affordable at the high end of the cost range, which totals approximately $8.6 billion more than the projections of the President's modernization budgets for fiscal years 2022 through 2026. Furthermore, as stated in our report, for the overall modernization program to be considered affordable during the fiscal years 2022 through 2026 period, NNSA's modernization programs would need to be collectively executed at the low end of their estimated cost ranges, which may be optimistic because of the potential for increased costs in several specific modernization programs.

In its final general comment, NNSA stated that its method for evaluating affordability is part of a portfolio management approach in line with the level of uncertainty affecting the out-years. NNSA further stated that while it is reasonable to evaluate whether potential "trade-space" may be sufficient to manage out-year variances, trying to define specific potential decisions so far in advance requires a level of precision that would be unreliable. NNSA also stated that as the out-years move into the FYNSP window, greater scrutiny and prioritization are applied in the programming

and budgeting processes. We did not recommend that NNSA undertake a formal budget programming process to define specific funding decisions that would span the 25-year period addressed in the *Stockpile Stewardship and Management Plan*. Instead, we noted that NNSA could optimize the management of its portfolio of nuclear modernization programs by taking additional steps to assess and discuss the affordability of these programs when a gap is apparent between projections of potential future funding needs and available resources. This is especially true for instances in which NNSA's estimated costs exceed projections of funding to be available in the future. As we state in our report, taking these additional steps—which are in line with portfolio management best practices—could allow for a more fulsome discussion in future *Stockpile Stewardship and Management Plans* of funding shortfalls, the potential near- and long-term impacts of such shortfalls, and options to be considered so as to bring estimated costs into alignment with potential future budgets. Therefore, we continue to believe that such a discussion could help congressional and NNSA decision makers better understand the potential trade-offs and rebalancing of priorities that may need to be undertaken in the future to align budgets and plans.

We are sending copies of this report to the appropriate congressional committees, the NNSA Administrator, the Director of OMB, and other interested parties. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

If you or your staff members have any questions about this report, please contact me at (202) 512-3841 or trimbled@gao.gov. Contact points for our Offices of Congressional Relations and Public Affairs may be found on the last page of this report. GAO staff who made major contributions to this report are listed in appendix V.

David C. Trimble
Director, Natural Resources and Environment

List of Committees

The Honorable John McCain
Chairman
The Honorable Jack Reed
Ranking Member
Committee on Armed Services
United States Senate

The Honorable Lamar Alexander
Chairman
The Honorable Dianne Feinstein
Ranking Member
Subcommittee on Energy and Water Development
Committee on Appropriations
United States Senate

The Honorable Mac Thornberry
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Mike Simpson
Chairman
The Honorable Marcy Kaptur
Ranking Member
Subcommittee on Energy and Water Development,
and Related Agencies
Committee on Appropriations
House of Representatives

Appendix I: Objectives, Scope, and Methodology

Our objectives were to assess the extent to which the National Nuclear Security Administration's (NNSA) fiscal year 2017 nuclear security budget materials (1) differ, if at all, from its budget estimates and plans for modernization activities as presented in its fiscal year 2016 budget materials and (2) align with NNSA's modernization plans.

We limited the scope of our review to NNSA's Weapons Activities appropriations account because NNSA's activities in the *Stockpile Stewardship and Management Plan* are funded by this account. This scope is consistent with that of our March 2016 review.[1] We focused our review on major modernization efforts—that is, the refurbishment of nuclear weapons through life extension programs (LEP) and alterations and major construction efforts to replace existing, aging facilities for plutonium and uranium.[2] The budget projections in the fiscal year 2016 and 2017 *Stockpile Stewardship and Management Plans* each contain budget dollar figures for 25 years, presented in nominal dollar values, including high- and low-range cost estimates, that also reflect potential future costs and which attempt to take into account the significant uncertainties that make up the estimates.[3] Our report presents all figures in nominal dollars unless otherwise noted. Further, all years noted in our report refer to fiscal years, unless otherwise noted.

To determine the extent to which NNSA's budget estimates and plans for modernization activities differed from those in the fiscal year 2016 nuclear security budget materials, we compared the information in the fiscal year

[1]GAO, *Modernizing the Nuclear Security Enterprise: NNSA's Budget Estimates Increased but May Not Align with All Anticipated Costs*, GAO-16-290 (Washington, D.C.: Mar. 4, 2016).

[2]LEPs extend, through refurbishment of components, the operational lives of weapons in the nuclear stockpile by 20 to 30 years and certify these weapons' military performance requirements without underground nuclear testing. Much like an LEP, a weapon alteration replaces or refurbishes components to ensure that a weapon can continue to meet military requirements. However, an alteration generally refurbishes fewer components than an LEP and does not specifically extend a weapon's operational lifetime.

[3]Nominal dollars, which are also referred to as current dollars, are valued in the prices of the current year—that is, in terms of the prices that prevail at the time (with no adjustments to remove the effects of inflation).

2017 materials with the information in the fiscal year 2016 materials.[4] NNSA's nuclear security budget materials comprise two key documents that are issued annually: the agency's budget justification, which contains estimates for the 5-year Future-Years Nuclear Security Program (FYNSP), and the *Stockpile Stewardship and Management Plan*, which provides budget estimates over the next 25 years.[5] In particular, for the purposes of this report, we compared the fiscal years 2017 through 2041 period from the 2017 plan with the fiscal years 2016 through 2040 period from the 2016 plan. Comparing the activities and budget estimates intended to support these activities across the 25-year periods in the different plans provides insights for budgeting planning purposes as to how NNSA's nuclear security budget materials have changed from one plan to the next. Specifically, we compared the 2017 and 2016 budget materials (1) for the four broad modernization areas—stockpile; infrastructure; research, development, testing, and evaluation; and other weapons activities—and (2) for specific weapons refurbishment activities and major construction projects. We interviewed knowledgeable officials from NNSA about changes we identified between the 2017 and 2016 budget materials. We also reviewed a third document on plans for the nuclear deterrent that includes information on the Department of Defense's (DOD) and Department of Energy's (DOE) modernization budget estimates. We refer to this annual report that DOD and DOE are required to submit jointly to the relevant Senate and House committees and subcommittees as the DOD-DOE joint report. We compared the information in the 2017 DOD-DOE joint report with that in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*.

To determine the extent to which NNSA's budget materials align with its modernization plans, we compared information on the budget estimates in the fiscal year 2017 budget materials with the information on modernization plans in the budget materials, as well as with the DOD-DOE joint report, and reviewed our prior reports to provide context for the

[4]The basis for the cost estimates beyond the FYNSP varies depending on the individual programs or subprograms. Some portions of the programs and activities funded from the Weapons Activities appropriations account are assumed to continue beyond the FYNSP at the same level of effort as in the FYNSP. For these cost projections, NNSA used inflation escalation factors based on numbers provided by OMB. For other programs and activities—the LEPs and major construction projects—NNSA uses either the mid-point between the range of estimates or a more robust bottom-up estimate used as the program's or project's baseline cost estimate.

[5]The *Stockpile Stewardship and Management Plan* is intended as a budgetary planning guide—a strategic program of record—for the next 25 years.

concerns we identified. We reviewed portfolio management best practices identified in our prior reports and the portfolio management standards developed by the Project Management Institute and determined that these practices were applicable to our review of NNSA's portfolio of nuclear modernization programs.[6] We also interviewed NNSA officials to obtain further information on changes to modernization plans and discussed any perceived misalignments with them. In addition, we interviewed officials from the Office of Management and Budget (OMB) to discuss the Secretary of Energy's December 2015 letter to the Director of OMB and the steps taken by OMB in response to the letter.

For weapons refurbishment efforts under way during the 25 years covered by the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, we analyzed NNSA's budget estimates for these activities over the 25-year period by comparing them with NNSA's internally developed cost ranges for each LEP. According to NNSA officials, NNSA uses two different approaches to estimate the costs of all LEPs except the W76-1. Under the first approach, according to officials, NNSA develops specific budget estimates by year through a "bottom-up" process. NNSA officials describe this as a detailed approach to developing the LEP budget estimates, which, among other things, integrates resource and schedule information from site participants. Under the second approach that NNSA refers to as a "top-down" process, NNSA uses historical LEP cost data and complexity factors to project high and low cost ranges for each LEP distributed over the life of the program using an accepted cost distribution method. Officials noted that the values in these cost ranges reflect idealized funding profiles and do not account for the practical constraints of the programming and budgeting cycle.

For the W76-1 LEP, NNSA has developed specific budget estimates by year. Because the W76-1 LEP is the basis for NNSA's top-down model, NNSA does not develop high and low cost ranges for it. Instead, NNSA published the W76-1 LEP estimates in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* as a comparison between the FYNSP request and a single LEP model line. For the W76-1 LEP, we compared the budget estimates with the LEP model line.

[6]GAO, *Weapon System Acquisitions: Opportunities Exist to Improve the Department of Defense's Portfolio Management*, GAO-15-466 (Washington, D.C: Aug. 27, 2015) and Project Management Institute, Inc., *The Standard for Portfolio Management*, 3rd ed. (Newtown Square, PA: 2013).

For all LEPs except the W76-1, we assessed the extent to which the specific bottom-up budget estimates were aligned with the high and low cost ranges developed through the top-down model. Specifically, we examined where the specific budget estimates were under the low end of the cost range predicted by the top-down model. We did this by reviewing charts in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* and the underlying data for those charts. When the low cost range exceeded the budget estimates, we followed up with NNSA officials for additional information.

To assess the reliability of the data underlying NNSA's budget estimates, we reviewed the data to identify missing items, outliers, or obvious errors; interviewed NNSA officials knowledgeable about the data; and compared the figures in the President's fiscal year 2017 budget with those in the fiscal year 2016 and fiscal year 2017 *Stockpile Stewardship and Management Plans* to assess the extent to which they were consistent. We determined that the data were sufficiently reliable for our purposes, which were to report the total amount of budget estimates and those estimates dedicated to certain programs and budgets and to compare them with last year's estimates.

We conducted this performance audit from April 2016 to April 2017 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.

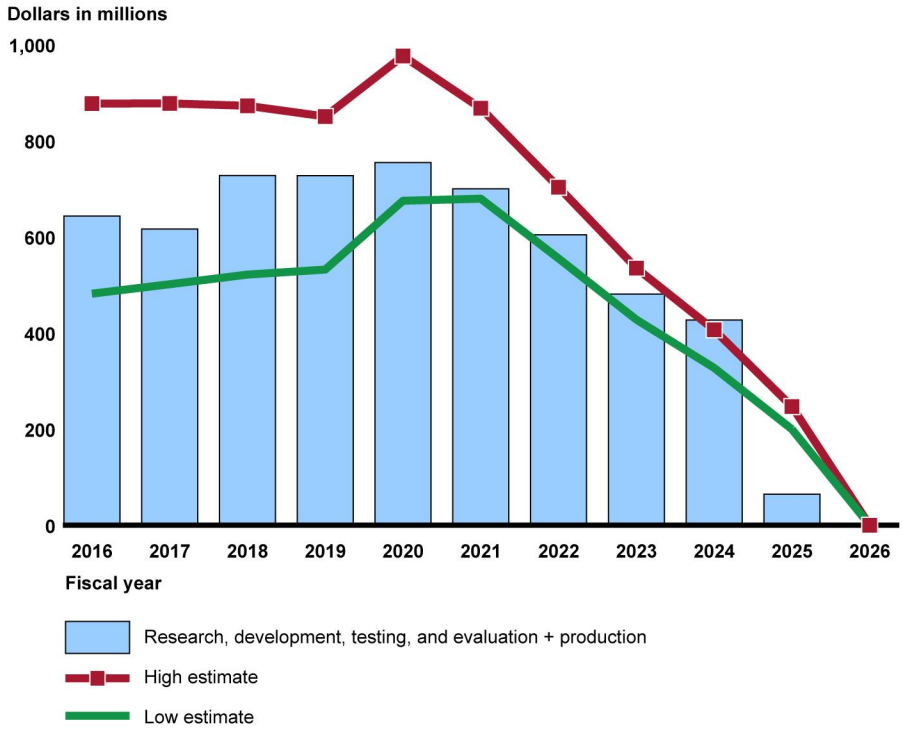
Appendix II: Information on Life Extension Program and Alteration Budget Estimates and Cost Ranges as of Fiscal Year 2017

The National Nuclear Security Administration (NNSA) has developed budget estimates for its nuclear weapons life extension programs (LEP)—the B61-12, W76-1, W80-4, interoperable warhead (IW)-1, IW-2, IW-3, and B61-12 follow-on—and the W88 Alteration 370. The estimates include NNSA's internally developed high and low cost ranges for each program except for the W76-1.[1] The following figures present budget estimates for each LEP and alteration. The budget estimates appear as bars for each year, while the high and low cost ranges are represented by lines across the figures (in the case of the W76-1, the line represents the LEP model). Similar figures appear in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*.

B61-12: The B61 bomb is one of the oldest nuclear weapons in the stockpile. The B61-12 LEP will consolidate and replace the B61-3, -4, -7, and -10 bombs. According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, this consolidation will enable a reduction in the number of gravity bombs, which is consistent with the objectives of the 2010 *Nuclear Posture Review*. The first production unit of the B61-12 is planned for fiscal year 2020; the program is scheduled to end in 2025. In the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA estimates that the B61-12 LEP will require a total of $5.1 billion from 2017 through 2025. As seen in figure 4, which illustrates NNSA's budget estimates against projected cost ranges, the low-range cost estimate of $199.6 million for fiscal year 2025 is not aligned with the program's budget estimate, as it exceeds the budget estimate of $64.4 million by about $135.2 million.

[1]According to NNSA, the W76-1 LEP, which is the only weapon program that has been through the development phase and the majority of the production phase, is used as the primary basis for modeling cost ranges for all future LEPs. NNSA does not prepare high and low cost estimates for it.

Figure 4: B61-12 Life Extension Program Budget Estimates from 2016 to Completion



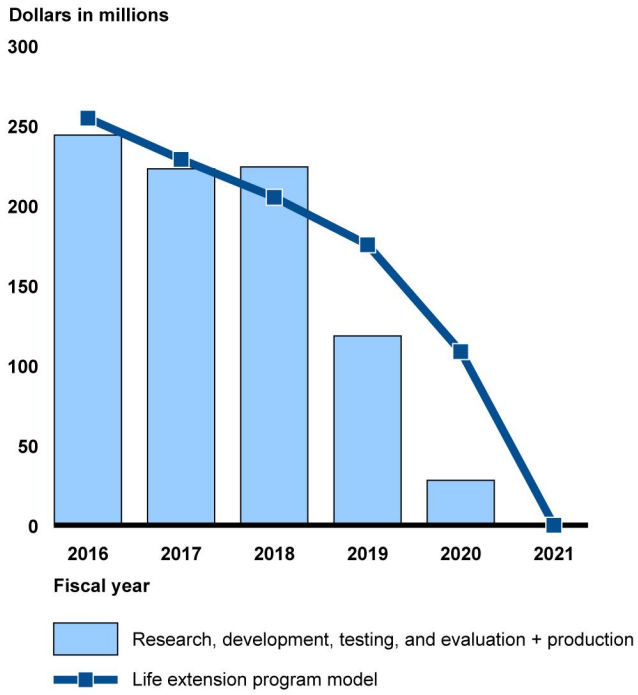
Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

W76-1: The W76 warhead was first introduced into the stockpile in 1978 and is deployed with the Trident II D5 missile on the Ohio-class nuclear ballistic missile submarines. The W76-1 LEP is intended to extend the original warhead service life and address aging issues, among other things. The first production unit was completed in September 2008, and the program will end in calendar year 2020. In the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA estimates that approximately $593.5 million will be required for this program from 2017 through 2020. As seen in figure 5, which illustrates NNSA's budget estimates against the program's cost model estimates, the cost model estimates are not aligned with the program's budget estimates for fiscal years 2017, 2019, and 2020. Specifically, the cost model estimate of $228.8 million for 2017 exceeds the program's budget estimate of $222.9 million by about $5.9 million, the cost model estimate of $175.4 million for 2019 exceeds the program's budget estimate of $118.4 million by about $57 million, and the cost model estimate of $108.6 million for 2020

exceeds the program's budget estimate of $28.1 million by about $80.5 million.

Figure 5: W76-1 Life Extension Program Budget Estimates from 2016 to Completion

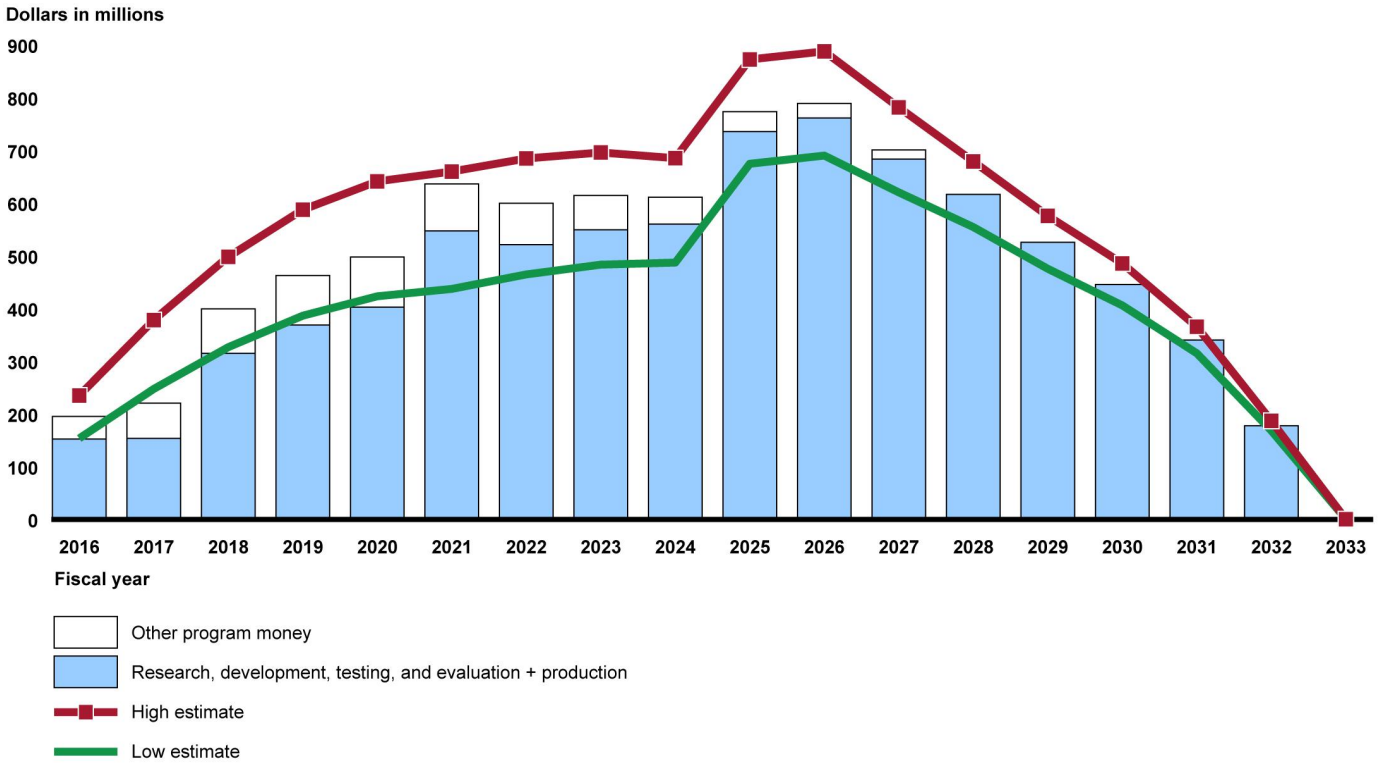


Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

W80-4: The W80-4 LEP is intended to provide a warhead for a future long-range standoff missile that will replace the Air Force's current air-launched cruise missile. The first production unit is planned for fiscal year 2025, and the program is scheduled to end in fiscal year 2032. In the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA estimates that the W80-4 LEP will require approximately $8.4 billion from 2017 through 2032. As seen in figure 6, which illustrates NNSA's budget estimates against projected cost ranges, the low-range cost estimate of $247.2 million for fiscal year 2017 is not aligned with the program's budget estimate, as it exceeds the budget estimate of $220.3 million by about $26.9 million.

Figure 6: W80-4 Life Extension Program Budget Estimates from 2016 to Completion



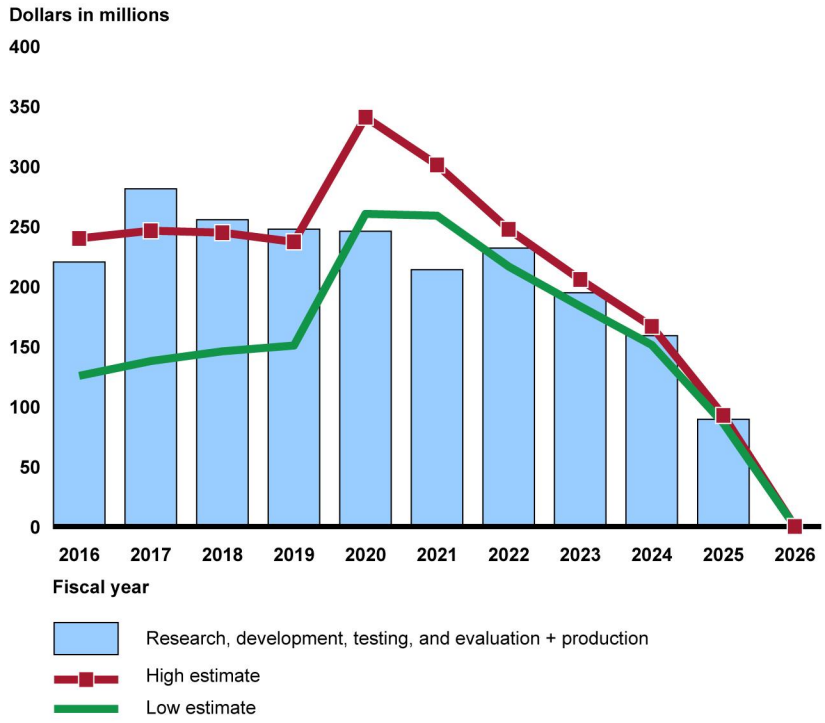
Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

W88 Alteration 370: Among other things, the W88 Alteration 370 will replace the arming, fuzing, and firing subsystem for the W88 warhead, which is deployed on the Navy's Trident II D5 submarine-launched ballistic missile system. In November 2014, the Nuclear Weapons Council decided to replace the conventional high explosive main charge, which led to an increase in costs for the alteration. The first production unit is scheduled for December 2019, and the program is scheduled to end in fiscal year 2025. In the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA estimates that the program will require a total of $1.9 billion from 2017 through 2025. As seen in figure 7, which illustrates NNSA's budget estimates against projected cost ranges, the low-range cost estimates are not aligned with the program's budget estimates for fiscal years 2020 and 2021. Specifically, the low-range cost estimate of $260.2 million for fiscal year 2020 exceeds the program's budget estimate of $245.8 million by about $14.4 million. Further, the low-

range cost estimate of $258.7 million for fiscal year 2021 exceeds the program's budget estimate of $213.8 million by about $44.9 million.

Figure 7: W88 Alteration 370 (with Conventional High Explosive Refresh) Budget Estimates from 2016 to Completion



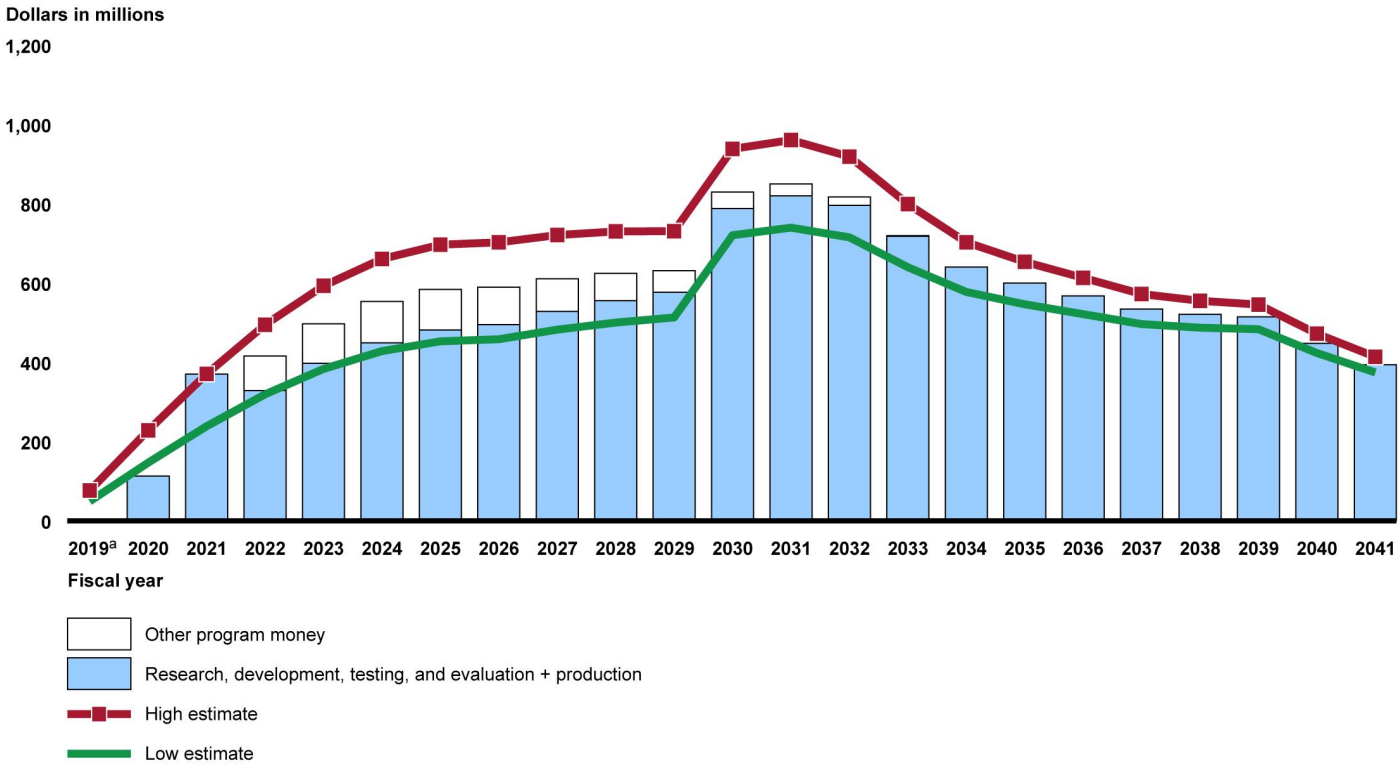
Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

IW-1: The IW-1, also known as the W78/88, is the first ballistic missile warhead LEP being produced under NNSA's interoperable strategy to transition the stockpile to three interoperable ballistic missile warheads and two air-delivered warheads. The first production unit is planned for fiscal year 2030, and the LEP is scheduled to end in fiscal year 2043. In the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA estimates that the program will require a total of $12.4 billion from 2020 to 2041. As seen in figure 8, which illustrates NNSA's budget estimates against projected cost ranges, the low-range cost estimates are not aligned with the program's budget estimates for fiscal years 2019 and 2020. Specifically, the low-range cost estimate for fiscal year 2019 is $48.8 million, but the program's budget estimate does not include any funding for that year. Further, the low-range cost estimate of $146.3

million for fiscal year 2020 exceeds the program's budget estimate of $112.4 million by about $33.9 million.

Figure 8: IW-1 Life Extension Program Budget Estimates from 2019 through 2041



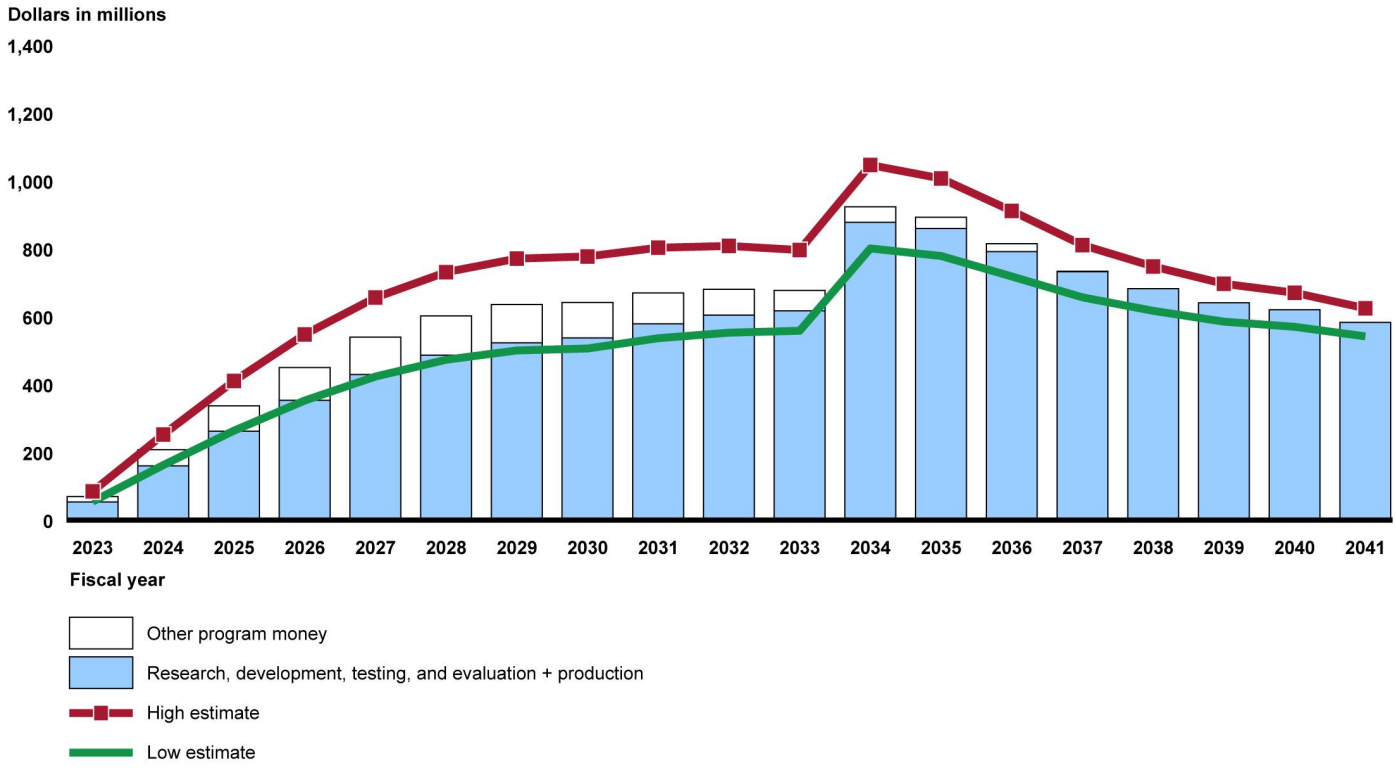
Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

[a]The internal cost estimate developed for the interoperable warhead (IW)-1 life extension program (LEP) includes a low-range cost estimate of $48.8 million and a high-range cost estimate of $76.0 million for fiscal year 2019. However, the IW-1 LEP has no funding for fiscal year 2019 because of a decision made by the Nuclear Weapons Council in May 2014 to defer this program until fiscal year 2020.

IW-2: The IW-2 is an interoperable warhead intended to replace the W87/88 warhead. The Nuclear Weapons Council has not yet developed a more detailed implementation plan for this LEP. The first production unit is planned for fiscal year 2034, and the LEP is scheduled to end in fiscal year 2049. In the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA estimates that the program will require a total of $11.4 billion from 2023 through 2041. See figure 9 for an illustration of budget estimates against projected cost ranges.

Figure 9: IW-2 Life Extension Program Budget Estimates from 2023 through 2041

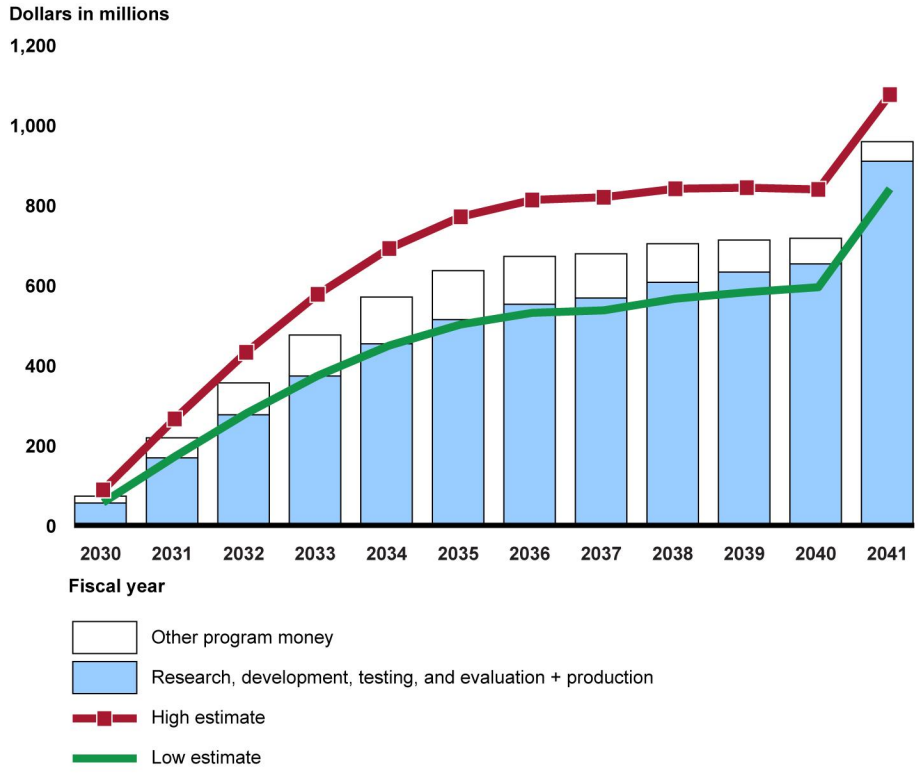


Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

IW-3: The IW-3 is intended to provide the third interoperable warhead for NNSA's future strategy for the stockpile. According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, the IW-3 will involve the W76-1. The first production unit is planned for fiscal year 2041, and the LEP is scheduled to end in fiscal year 2057. In the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA estimates that a total of $6.8 billion will be required for this program from 2030 through 2041. See figure 10 for an illustration of budget estimates against projected cost ranges.

Figure 10: IW-3 Life Extension Program Budget Estimates from 2030 through 2041

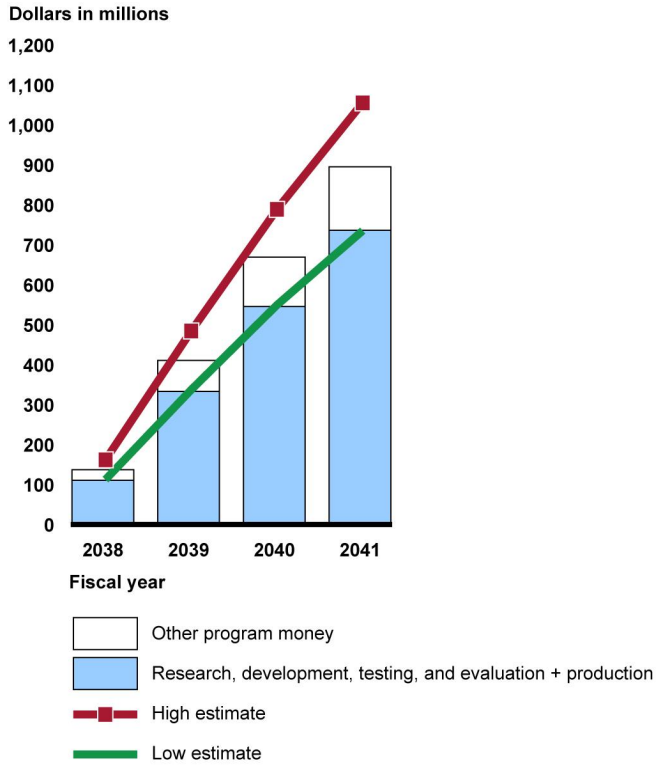


Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

B61-12 follow-on: According to NNSA officials, the B61-12 follow-on LEP is intended to replace the B61-12 bomb. The *Fiscal Year 2017 Stockpile Stewardship and Management Plan* provides total estimated cost data for this LEP for fiscal years 2038 through 2057; however, a planned first production unit is not yet specified. In the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, NNSA estimates that a total of $2.1 billion will be required for this program from 2038 through 2041. See figure 11 for an illustration of budget estimates against projected cost ranges.

Figure 11: B61-12 Follow-On Life Extension Program Budget Estimates from 2038 through 2041



Source: GAO analysis of National Nuclear Security Administration data. | GAO-17-341

Note: Amounts are presented in nominal dollars, which are not adjusted for the effects of inflation.

Appendix III: Schedule Changes for Major Modernization Efforts for Fiscal Years 2010 through 2017

The milestone dates for major modernization programs remained the same in the *Fiscal Year 2017 Stockpile Stewardship and Management Plan* as in the previous year. The 2010 *Nuclear Posture Review* included discussion of a number of planned major modernization programs for the National Nuclear Security Administration (NNSA), while other programs were identified in the 2011 update to the Department of Defense-Department of Energy joint report and subsequent *Stockpile Stewardship and Management Plans.* Table 6 shows key milestone dates for life extension programs and major construction projects as they have changed since 2010, according to agency planning documents.

Table 6: Changes in Schedules for the National Nuclear Security Administration's (NNSA) Major Modernization Efforts, According to Agency Planning Documents, Fiscal Years 2010 through 2017

	2010 *Nuclear Posture Review*	2011 Update to the DOD-DOE joint report[a]	2012 *Stockpile Stewardship & Management Plan*	2014 *Stockpile Stewardship & Management Plan*	2015 *Stockpile Stewardship & Management Plan*	2016 *Stockpile Stewardship & Management Plan*	2017 *Stockpile Stewardship & Management Plan*
W76-1 life extension program (LEP) end of production date[b]	2017	2018	2018	2019	2019	2019	2019
B61-12 LEP first production unit date[c]	2017	2017	2017	2019	2020	2020	2020
W88 Alteration 370 first production unit date[c]	Not discussed	Not provided	2018[d]	2019	2020	2020	2020
Cruise missile (W80-4) LEP first production unit date[c]	Not discussed	Not discussed	2031	2024	2027	2025	2025

	2010 *Nuclear Posture Review*	2011 Update to the DOD-DOE joint report[a]	2012 *Stockpile Stewardship & Management Plan*	2014 *Stockpile Stewardship & Management Plan*	2015 *Stockpile Stewardship & Management Plan*	2016 *Stockpile Stewardship & Management Plan*	2017 *Stockpile Stewardship & Management Plan*
W78/88-1 / Interoperable Warhead (IW-1) LEP first production unit date[c]	Initiate study	Study options	Study options[e]	2025	2030	2030	2030
IW-2 LEP first production unit date[c]	Not discussed	Not discussed	Not discussed	2031	2034	2034	2034
IW-3 LEP first production unit date[c]	Not discussed	Not discussed	Not discussed	2037	2041	Not specified	2041[f]
Uranium Processing Facility operational date[g]	2021	2024	2024	Phase 1: 2025 Begin phases 2 and 3 in 2030	Phase 1: 2025 Begin phases 2 and 3 in 2030	Completion of most activities by 2025	Completion of most activities by 2025
Chemistry and Metallurgy Research Replacement / plutonium sustainment strategy operational date[h]	2021	2023	2023	Deferred. Alternative strategy in development	Deferred. Alternative strategy in development	Construct at least two modular structures that will achieve full operating capacity by 2027[h]	Begin demonstrating higher levels of pit manufacturing capacity by 2027[h]

Sources: GAO analysis of NNSA planning documents and the joint report by the Departments of Defense (DOD) and Energy (DOE). | GAO-17-341

Note: NNSA did not publish a *Stockpile Stewardship and Management Plan* for 2013.

[a]This document is the update to the fiscal year 2011 DOD-DOE joint report, which contained the first set of long-term budget estimates made available after the release of the 2010 *Nuclear Posture Review*.

[b]For the W76-1 LEP, we report the date from the end of production rather than for the first production unit because the first production unit was completed in 2008.

[c]The first production unit is the first complete warhead from a production line certified for deployment.

[d]The first production unit schedule discussed is for a W88 program of smaller scope than the W88 Alteration 370.

[e]The *Fiscal Year 2012 Stockpile Stewardship and Management Plan* included separate schedules for first production units of LEPs for the W88 and W78 warheads if a single, interoperable warhead was not to be pursued. In June 2012, the Nuclear Weapons Council authorized a study for a W78/88-1 interoperable warhead, now known as the IW-1.

[f]According to the *Fiscal Year 2017 Stockpile Stewardship and Management Plan*, the first production unit date for the IW-3 LEP is planned for 2041, which has not changed since the 2015 plan. The *Fiscal Year 2016 Stockpile Stewardship and Management Plan* did not include this planned first production date for the IW-3 LEP.

[g]The Uranium Processing Facility construction project began as a single large project but was later broken up into seven separately phased projects. The current Uranium Processing Facility line item construction project is intended to replace activities in an aging building at Y-12.

[h]In 2014, NNSA adopted a new three-step plutonium sustainment strategy. Two steps pertain to the Chemistry and Metallurgy Research Replacement (CMRR) project, which NNSA has estimated will be completed by 2024. The third step relates to the construction of two separate laboratory modules by the end of 2027 in support of the goal of achieving a capability of 50 to 80 pits per year by 2030. The CMRR project and the plutonium modular approach are separate projects with separate budget lines; however, both support NNSA's overall long-term plutonium sustainment strategy and efforts to meet pit production requirements. Therefore, for the purposes of this table, we include information related to the CMRR project, the plutonium modular approach, and the overall plutonium sustainment strategy.

Appendix IV: Comments from the National Nuclear Security Administration

Department of Energy
Under Secretary for Nuclear Security
Administrator, National Nuclear Security Administration
Washington, DC 20585

March 28, 2017

Mr. David C. Trimble
Director, Natural Resources
and Environment
U.S. Government Accountability Office
Washington, DC 20548

Dear Mr. Trimble:

Thank you for the opportunity to review the Government Accountability Office (GAO) draft report "National Nuclear Security Administration (NNSA): Action Needed to Address Affordability of Nuclear Modernization Programs" (GAO-17-341). NNSA appreciates the auditors' recognition of our efforts to enhance the transparency of information presented in the Stockpile Stewardship and Management Plan (SSMP) and to address GAO's prior audit recommendations. With respect to the GAO recommendation in this report for NNSA to include an assessment of the affordability of the modernization program in future SSMPs, NNSA compares its financial requirements and budget requests in the SSMP and highlights the potential risks associated with insufficient resources.

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Sincerely,

Frank G. Klotz

Frank G. Klotz

NNSA's Combined Technical Comments
GAO Nuclear Security Budget Review (100720)

NNSA General Comments

These general comments summarize key points from NNSA's technical comments provided in response to GAO Report, GAO-17-341.

1. For proper context, clarification is necessary for comparisons made between numbers in the SSMP and President's Budget, and the assessment of affordability in the SSMP. Program-by-program level variations in near-term budget justifications, external out-year budget estimates, and future years' planning documents are normal and expected for any Federal agency. Each agency, working with Federal partners (e.g. the Department of Defense for NNSA); the Office of Management and Budget (OMB); and Congress work through the programming and budgeting process to strike a balance between available funding and priorities, including NNSA prioritizing programs in the five years of the Future-Years Nuclear Security Program (FYNSP). The draft report identifies a number of these differences, which are documented and exist primarily in the out-years where the uncertainty is higher and estimates are typically not constrained.

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3. The report also questions the affordability of NNSA's modernization plans in the SSMP. The SSMP provides wide, unconstrained range estimates of potential cost in out-years where there is uncertainty. Affordability is gauged by evaluating where the rough budget projections fall within (or outside) the range estimates. For FY 2022 through 2026, the SSMP high end cost is approximately 15 percent greater than the total of estimated available resources, while the low end estimate is approximately two percent less. NNSA concludes this is manageable given uncertainties in future costs (i.e., FY 2027 through 2041).

4. NNSA's method for evaluating affordability is part of a portfolio management approach in line with the level of uncertainty effecting the out-years. While it is reasonable to evaluate whether potential trade-space may be sufficient to manage out-year variances, trying to define specific potential decisions so far in advance requires a level of precision that would be unreliable. As the out-years move into the FYNSP window, greater scrutiny and prioritization is applied in the programming and budgeting processes.

Appendix V: GAO Contact and Staff Acknowledgments

GAO Contact

David C. Trimble, (202) 512-3841 or trimbled@gao.gov

Staff Acknowledgments

In addition to the contact named above, William Hoehn (Assistant Director), Greg Campbell, Antoinette Capaccio, Pamela Davidson, Philip Farah, Bridget Grimes, Kevin Remondini, Dan C. Royer, and Kevin Tarmann made key contributions to this report.

Appendix VI: Accessible Data

Data Tables

Data table for Figure 1: Comparison of the National Nuclear Security Administration's Fiscal Year 2017 Budget Estimates for the Future-Years Nuclear Security Program and 5 Years Beyond (Dollars in billions)

Fiscal year	Budget Estimate
2017	9.2
2018	9.7
2019	9.9
2020	10.1
2021	10.5
2022	11.3
2023	11.5
2024	11.7
2025	11.9
2026	12.1

Data table for Figure 2: Comparison of the National Nuclear Security Administration's Fiscal Year 2014 through 2017 Stockpile Stewardship and Management Plans for Fiscal Years 2014 through 2026

	FY 2014 SSMP	*FY 2015 SSMP*	*FY 2016 SSMP*	*FY 2017 SSMP*
2014	7.9	NA	NA	NA
2015	8.5	8.3	NA	NA
2016	8.8	8.9	8.8	NA
2017	8.9	9.3	9.3	9.2
2018	9.3	9.5	9.5	9.7
2019	10.5	9.7	9.7	9.9
2020	10.6	10.5	9.8	10.1
2021	11.1	10.7	10.8	10.5
2022	11.2	10.9	11.0	11.3
2023	10.8	11.1	11.2	11.5
2024	NA	11.4	11.5	11.7
2025	NA	NA	11.8	11.9
2026	NA	NA	NA	12.1

Data table for Figure 3: Comparison of the Fiscal Year 2017 Stockpile Stewardship and Management Plan's Budget Estimates and High- and Low-Range Cost Estimates with the President's Fiscal Year 2017 Out-Year Budget Projections, Fiscal Years 2022 through 2026

	Fiscal Year 2017 Stockpile Stewardship and Management Plan estimates	President's fiscal year 2017 out-year budget projections	High estimate	Low estimate
2022	11.3	10.7	12.4	10.5
2023	11.5	10.9	12.6	10.6
2024	11.7	11.1	12.9	10.8
2025	11.9	11.3	13.0	11.2
2026	12.1	11.5	13.2	11.2

Data table for Figure 4: B61-12 Life Extension Program Budget Estimates from 2016 to Completion

	RDT&E Production	Other Program Money	Low Estimate	High Estimate
2016	643.3	0	481.7	877.2
2017	616.1	0	501.3	877.5
2018	727.6	0	521.4	872.6
2019	727.2	0	531.8	850.3
2020	754.6	0	675.0	976.1
2021	699.7	0	679.3	867.5
2022	604.1	0	554.9	703.1
2023	480.9	0	427.7	534.8
2024	426.9	0	327.3	406.4
2025	64.4	0	199.6	246.9
2026	0	0	0	0

Data table for Figure 5: W76-1 Life Extension Program Budget Estimates from 2016 to Completion

	RDT&E Production	Other Program Money	LEP Model
2016	244.0	0	254.6
2017	222.9	0	228.8
2018	224.1	0	205.1
2019	118.4	0	175.4
2020	28.1	0	108.6
2021	0	0	0

Data table for Figure 6: W80-4 Life Extension Program Budget Estimates from 2016 to Completion

	RDT&E Production	Other Program Money	Low Estimate	High Estimate
2016	152.3	42.7	153.4	234.8
2017	153.4	66.8	247.2	377.9
2018	314.8	84.3	326.4	497.8
2019	368.5	93.8	386.1	587.1
2020	402.5	95.0	422.9	640.9
2021	546.9	89.3	436.9	659.6
2022	520.8	78.6	464.4	684.3
2023	549.2	65.1	482.9	695.7
2024	559.8	51.0	486.8	684.9
2025	735.4	37.9	674.3	872.2
2026	761.1	27.6	689.8	887.5
2027	683.3	17.2	620.0	781.2
2028	616.4	0	554.2	678.7
2029	525.3	0	475.1	575.4
2030	445.4	0	405.6	485.2
2031	339.9	0	314.8	365.1
2032	177.3	0	168.0	186.6
2033	0	0	0	0

Data table for Figure 7: W88 Alteration 370 (with Conventional High Explosive Refresh) Budget Estimates from 2016 to Completion

	RDT&E Production	Other Program Money	Low Estimate	High Estimate
2016	220.2	0	125.4	239.8
2017	281.1	0	137.7	246.2
2018	255.3	0	145.8	244.6
2019	247.5	0	150.6	236.9
2020	245.8	0	260.2	340.7
2021	213.8	0	258.7	301.0
2022	231.8	0	216.4	247.3
2023	194.5	0	183.3	205.6
2024	158.8	0	151.1	166.6
2025	89.2	0	85.9	92.4
2026	0	0	0	0

Data table for Figure 8: IW-1 Life Extension Program Budget Estimates from 2019 through 2041

	RDT&E + Production	Other Program Money	Low Estimate	High Estimate
2019	0	0	48.8	76.0
2020	112.4	0	146.3	227.6
2021	369.7	0	238.2	370.1
2022	328.0	87.3	318.6	494.1
2023	396.8	99.7	382.7	592.3
2024	448.4	104.5	427.6	660.1
2025	481.0	102.2	452.3	696.1
2026	494.5	94.2	457.6	701.9
2027	527.7	82.3	481.8	720.3
2028	555.0	68.5	499.6	729.5
2029	575.9	54.4	512.5	730.2
2030	787.4	41.4	719.9	937.7
2031	819.3	30.1	739.0	960.0
2032	795.3	21.0	714.5	918.2
2033	717.4	1.5	639.2	798.5
2034	639.5	0	576.8	702.2
2035	599.2	0	545.7	652.7
2036	566.7	0	520.9	612.4
2037	533.7	0	495.8	571.6

	RDT&E + Production	Other Program Money	Low Estimate	High Estimate
2038	520.6	0	486.7	554.5
2039	513.9	0	482.9	545.0
2040	447.1	0	422.8	471.5
2041	393.4	0	373.7	413.1

Data table for Figure 9: IW-2 Life Extension Program Budget Estimates from 2023 through 2041

	RDT&E Production	Other Program Money	Low Estimate	High Estimate
2023	53.0	15.9	53.9	84.0
2024	159.4	47.2	161.5	251.7
2025	261.2	75.0	263.0	409.4
2026	352.5	96.6	351.7	546.6
2027	428.5	110.3	422.4	655.1
2028	485.5	115.6	472.0	730.1
2029	521.6	113.0	499.3	770.0
2030	536.5	104.2	505.1	776.3
2031	577.6	91.1	535.4	802.1
2032	603.7	75.8	551.7	807.3
2033	616.1	60.2	557.3	795.3
2034	877.1	45.8	800.0	1045.8
2035	858.6	33.3	777.7	1006.1
2036	790.7	23.3	717.4	910.6
2037	731.2	1.6	655.8	809.9
2038	681.5	0	616.1	746.9
2039	640.0	0	584.2	695.8
2040	619.2	0	569.0	669.4
2041	582.2	0	540.8	623.6

Data table for Figure 10: IW-3 Life Extension Program Budget Estimates from 2030 through 2041

	RDT&E Production	Other Program Money	Low Estimate	High Estimate
2030	56.1	16.9	57.3	88.7
2031	168.7	50.0	171.7	265.8
2032	276.5	79.4	279.6	432.2
2033	373.2	102.2	373.9	577.0
2034	453.7	116.7	449.2	691.7

	RDT&E Production	Other Program Money	Low Estimate	High Estimate
2035	514.0	122.3	501.9	770.8
2036	552.3	119.6	530.9	812.9
2037	568.0	110.3	537.1	819.6
2038	607.1	96.4	566.2	840.9
2039	632.6	80.2	582.4	843.4
2040	653.3	63.7	594.9	839.1
2041	909.7	48.5	840.5	1075.8

Data table for Figure 11: B61-12 Follow-On Life Extension Program Budget Estimates from 2038 through 2041

	RDT&E Production	Other Program Money	Low Estimate	High Estimate
2038	110.6	26.3	112.3	161.5
2039	332.8	77.7	337.0	484.0
2040	545.3	123.4	549.0	788.4
2041	736.1	158.9	735.0	1055.0

Agency Comment Letter

Text of Appendix IV: Comments from the National Nuclear Security Administration

Page 1

March 28, 2017

Mr. David C. Trimble Director, Natural Resources and Environment

U.S. Government Accountability Office Washington, DC 20548

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