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NUCLEAR WEAPONS

NNSA Needs to Determine Critical Skills and Competencies for Its Strategic Materials Programs

Why GAO Did This Study

NNSA is responsible for ensuring a sustainable supply of strategic materials critical to the nation's nuclear security missions, as well as the capability to process these materials. NNSA estimates that strategic materials management activities will cost about \$7.7 billion over the next 5 years.

The House Report accompanying H.R. 4909, a bill for the National Defense Authorization Act for Fiscal Year 2017, included a provision for GAO to review NNSA's management of its strategic materials programs. This report examines (1) the extent to which NNSA has, for these programs, defined requirements, including program manager roles and responsibilities, and (2) the progress of NNSA's implementation of those program requirements.

GAO reviewed NNSA program management policies and documents related to its strategic materials program manager positions and interviewed NNSA officials and program managers.

What GAO Recommends

GAO recommends that NNSA determine the critical skills and competencies that will be needed for the strategic materials programs and use this determination to develop strategies for addressing any gaps related to the number, deployment, and alignment of program staff. NNSA agreed with GAO's recommendation.

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NNSA Needs to Determine Critical Skills and Competencies for Its Strategic Materials Programs

What GAO Found

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) manages strategic materials programs for uranium, plutonium, tritium, and lithium—materials that are critical to national security. NNSA has set program requirements that each of the programs must follow and has established the roles and responsibilities of the program managers. NNSA has defined these requirements in two documents:

- **Program Execution Instruction (2016).** Outlines requirements for program management documents, such as a program plan, cost and schedule estimates, and an integrated master schedule that includes the entire scope of work for successful execution.
- **Program Management Policy (2017).** Outlines the program managers' authority and requirements for managing the strategic materials programs, such as managing risk, and requires each program to develop documents, such as a mission strategy and technology development plan.

NNSA officials reported that the agency is making progress implementing the requirements outlined for each of the strategic materials programs, although some of the programs are farther along than others. For example:

- The uranium and domestic uranium enrichment programs established in 2014 are the furthest along and have developed the documents needed to meet strategic program requirements.
- The plutonium program has met some of the requirements, such as developing a program plan, work breakdown structure, and decision analysis, but does not yet have an integrated master schedule.
- The tritium program met the requirements during the course of GAO's review.
- The lithium program, which is the newest, has made the least amount of progress and to date has developed only a mission strategy, a mission requirements matrix, and a technology development plan.

According to NNSA officials, shortage of staff assigned to the strategic materials programs has been the primary reason hampering progress in implementing the program requirements. For example, a lithium program manager has not yet been assigned, and all the other programs have identified the need for additional staff beyond the one or two staff currently assigned to each. According to officials, competing agency priorities and perceived staffing limits are the primary impediments to assigning more staff to these programs. However, GAO also found that NNSA has not determined the critical skills and competencies needed for these programs. GAO's prior work has identified certain activities or practices that can help an agency strategically manage its human capital. These activities include determining the critical skills and competencies that will be needed to achieve the program's mission and developing strategies to address gaps in the number, deployment, and alignment of staff needed. By determining the critical skills and competencies needed for the strategic materials programs and using this determination to develop strategies to address any gaps in the number, deployment, and alignment of program staff, NNSA may have the information it needs to better justify increased staffing levels for the programs.

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Abbreviations

CMRR	Chemistry and Metallurgy Research Replacement
DOD	Department of Defense
DOE	Department of Energy
NNSA	National Nuclear Security Administration
TVA	Tennessee Valley Authority
UPF	Uranium Processing Facility

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November 14, 2017

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

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

Certain materials—such as uranium, plutonium, tritium, and lithium—are critical to the nuclear security missions of the Department of Energy (DOE). These missions include ensuring a safe, secure, and reliable nuclear deterrent; achieving designated reductions in the nuclear weapons stockpile; and supporting the nation’s nuclear nonproliferation efforts. Managing these missions is the responsibility of the National Nuclear Security Administration (NNSA), a separately organized agency within DOE. To carry out this responsibility, NNSA must ensure a sustainable supply of these materials, which NNSA calls strategic materials.¹ For example, NNSA is seeking to establish a new capability to enrich uranium—a capability that it lost with the 2013 closure of the aging Gaseous Diffusion Plant in Paducah, Kentucky—to sustain the production of tritium.

NNSA has established programs for ensuring the supply of each of these four strategic materials, as well as a separate strategic materials program specifically to develop the new domestic uranium enrichment capability.² NNSA’s Office of Defense Programs, responsible for implementing NNSA’s stockpile mission, in 2014 and 2015 named federal program managers to oversee the uranium, domestic uranium enrichment,

¹NNSA’s effort to ensure the supply as well as the related handling and processing of these materials is referred to as “sustainment.”

² See app. I for further information on individual strategic materials managed by NNSA.

plutonium, and tritium programs and has designated a lead point of contact for the lithium program.³ As we reported in November 2016, program managers play key roles in the federal government, including overseeing contracts to help agencies get what they need at the right time and at a reasonable price.⁴

The strategic materials program managers and lithium lead point of contact are responsible for complex programs that may take decades and cost billions of dollars to execute and that often include the design and construction of major projects (i.e., those with an estimated cost of \$750 million or greater). Such projects include the Uranium Processing Facility (UPF), which is under construction in Tennessee to replace and modernize a portion of NNSA's enriched uranium capabilities, and a variety of activities to replace the capabilities of the Chemistry and Metallurgy Research Facility—built in the 1950s—in New Mexico for conducting plutonium analysis. NNSA estimated that it would cost about \$1.4 billion in fiscal year 2018 to carry out its annual activities associated with its strategic materials programs.

The House Armed Services Committee report accompanying H.R. 4909, a bill for the National Defense Authorization Act for Fiscal Year 2017, included a provision for us to review NNSA's management of its strategic materials programs.⁵ This report examines (1) the extent to which NNSA has, for its strategic materials programs, defined program requirements, including program manager roles and responsibilities; and (2) the progress of NNSA's implementation of those program requirements.

To examine the extent to which NNSA has defined program requirements for its strategic materials programs, we reviewed NNSA directives on

³Lithium sustainment activities are still in the early stages of development. NNSA has recognized the need to establish a lithium program and appoint a program manager and plans to do so following pending senior NNSA leadership decisions. According to NNSA officials, the lithium lead point of contact has full decision authority and serves as the functional, acting lithium program manager with the ability to plan and execute the overall lithium mission strategy. See also GAO, *DOE Project Management: NNSA Should Ensure Equal Consideration of Alternatives for Lithium Production*, [GAO-15-525](#) (Washington, D.C.: July 13, 2015).

⁴GAO, *Program Management: DOE Needs to Develop a Comprehensive Policy and Training Program*, [GAO-17-51](#) (Washington, D.C.: Nov. 21, 2016).

⁵H.R. Rep. No. 114-537, at 397-8 (2016).

program management, including its 2016 *Program Execution Instruction*.⁶ To review NNSA's definition of strategic materials program manager roles and responsibilities, we reviewed the NNSA memorandums that created and described strategic materials program manager positions, where applicable, as well as NNSA's 2017 *Program Management Policy for Weapons and Strategic Materials Programs*. To examine NNSA's progress toward implementing program requirements for its strategic materials programs, we obtained and reviewed all of the documents that NNSA programs had completed as of June 2017 in response to requirements contained in NNSA's 2017 Program Management Policy for Weapons and Strategic Materials Programs. In addition, we obtained and reviewed documents for a nonprobability sample of 22 of the 65 total requirements that strategic materials programs must implement based on NNSA's 2016 *Program Execution Instruction*. This sample included key documents such as program plans and the work breakdown structures for all of the strategic materials programs. The results of our review of this sample of requirements are not generalizable but represent illustrative examples of NNSA's progress. NNSA also identified a number of documents that were still being developed in response to both sets of requirements. We interviewed all four of NNSA's appointed strategic materials managers and the lithium lead point of contact, as well as other NNSA officials to better understand the steps NNSA had taken as of September 2017 to implement these requirements. We also reviewed NNSA's budget requests for fiscal years 2016, 2017, and 2018 and other relevant agency documents, such as strategies and implementation plans for the strategic materials programs.

We conducted this performance audit from June 2016 to November 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.

⁶NNSA institutionalizes policies, requirements, responsibilities, and procedures through NNSA Policy Letters in the form of NNSA Policies, Supplemental Directives, and Business Operating Procedures. See National Nuclear Security Administration, Supplemental Directive 251.1, *Policy Letters: NNSA Policies, Supplemental Directives, and Business Operating Procedures* (Washington, D.C.: Oct. 7, 2013).

Background

NNSA's strategic materials programs include a broad range of activities. The programs often include (1) building unique new facilities, (2) modifying and repairing existing facilities and equipment, and (3) developing and deploying new technologies for processing and producing strategic nuclear materials. The programs may involve multiple NNSA and DOE sites and multiple facilities at a given site. For example, since the days of the Manhattan Project, a large portion of the nation's uranium mission has been executed at the Y-12 National Security Complex in Oak Ridge, Tennessee, with uranium production and associated operations housed in several nuclear facilities within the complex. These facilities are in some cases more than 60 years old. NNSA's uranium program is coordinating efforts to build the UPF, invest in the infrastructure of existing facilities to extend their lives, and develop and deploy several new technologies that are expected to increase the efficiency and effectiveness of uranium processing. Collectively, these uranium program activities may take more than 2 decades to implement and cost several billion dollars.

NNSA's 2017 future-years nuclear security program estimate projected that NNSA would need about \$1.4 billion in fiscal year 2018 to carry out its annual activities associated with the management of these strategic materials programs (see table 1). NNSA documents indicate that the agency expects to spend about \$7.7 billion over the next 5 years on activities related to managing its strategic materials. This spending, which would represent about 12 percent of the approximately \$63 billion NNSA expects to spend on all weapons activities over this same time period, includes:

- \$4.8 billion for costs related to construction of facilities and other capital equipment purchases that will be used to support the strategic materials mission; and
- \$2.9 billion for program costs related to general activities such as reducing risk and ensuring sufficient supply, as well as the consolidation, disposition, tracking, and accounting of nuclear materials.

Table 1: National Nuclear Security Administration’s (NNSA) Estimated Strategic Materials Program Costs, Fiscal Years (FY) 2017-2021

Dollars in millions

Construction costs	FY 2017	FY 2018	FY 2019	FY 2020	FY 2021	Total
Uranium Processing Facility	575.0	663.0	722.0	735.0	740.0	3,435.0
Chemistry and Metallurgy Research Replacement Facility	150.6	180.9	236.0	239.6	274.0	1,081.1
Lithium Production Facility	1.6	0.0	30.4	37.5	56.0	125.5
Tritium Production Capability	3.0	9.8	28.5	52.5	16.0	109.8
Subtotal	730.2	853.7	1,016.9	1,064.6	1,086.0	4,751.4
Other program costs^a						
Uranium	21.0	20.6	24.3	29.3	30.3	125.4
Domestic Uranium Enrichment	50.0	60.0	70.0	110.0	112.5	402.5
Plutonium	185.0	153.4 ^b	169.0	191.0	194.4	892.8
Tritium	109.8	157.2 ^c	120.4	122.9	125.2	635.5
Strategic Materials Sustainment ^d	179.1	172.5	168.7	175.8	180.7	876.8
Subtotal	544.9	563.6	552.5	629.0	643.1	2,933.1
Total	1,275.1	1,417.3	1,569.4	1,693.6	1,729.1	7,684.5

Source: Department of Energy and NNSA data. | GAO-18-99

^aOther program costs are associated with activities such as reducing risk and ensuring sufficient supply, as well as technology development and deployment, modernization of existing facilities, and the consolidation, disposition, tracking, and accounting of nuclear materials.

^bNNSA’s fiscal year 2018 budget request for plutonium sustainment is \$210.4 million.

^cNNSA’s fiscal year 2018 budget request for tritium sustainment is \$198.2 million. According to NNSA officials, current estimates are being revised and could be higher for fiscal years 2019 to 2023.

^dThis item includes some material recycle, recovery, and storage processes as well as approximately \$17.8 million for lithium over the next 5 years. Additional lithium program funding comes from production support, weapons dismantlement and disposition, and other sources.

Program managers are an important part of the federal government’s workforce. They interact with the managers of individual projects to provide support and guidance on those projects but also must take a broad view of the overall objectives of programs and an agency’s organizational culture. According to leading practices outlined by the Project Management Institute, organizations develop program plans, capture and understand stakeholder needs, and establish processes for

maintaining program management oversight, among other activities.⁷ Recognizing the importance of improving program management, in December 2016 the President signed the “Program Management Improvement Accountability Act” that required the Office of Management and Budget to, among other things, adopt and oversee implementation of government-wide standards, policies, and guidelines for program and project management for executive agencies and assess the quality and effectiveness of program management for these agencies.⁸ We have previously reported on DOE’s and NNSA’s program management challenges.

- In March 2009, we found that NNSA and the Department of Defense (DOD) established unrealistic schedules, did not establish consistent cost baselines, and did not effectively manage technical risks in some of their nuclear weapon life extension programs.⁹ These problems resulted in delays, additional expenditures, difficulties tracking the cost of the programs, and difficulties in meeting all of NNSA’s and DOD’s technical objectives. We recommended that NNSA develop and use consistent budget assumptions and criteria for the baseline to track costs over time, among other actions. NNSA agreed with our recommendations and made changes to its cost estimating procedures.
- In November 2014, we found that the lack of requirements for programs meant that DOE could not ensure that it was developing fully credible cost estimates for programs.¹⁰ We recommended that DOE revise its program management directives to require that programs develop life-cycle cost estimates in accordance with our 12

⁷See Project Management Institute, Inc., *The Standard for Program Management*, Third Edition 2013. The Project Management Institute 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.

⁸Pub. L. No. 114-264, 130 Stat. 1371 (2016) (codified at 31 U.S.C. §§ 503, 1126 (2017)).

⁹GAO, *Nuclear Weapons: NNSA and DOD Need to More Effectively Manage the Stockpile Life Extension Program*, [GAO-09-385](#) (Washington, D.C.: Mar. 2, 2009). Life extension programs entail refurbishing or replacing weapon components to extend the lives of weapons such as the B61 bomb. These programs may also enhance safety and security characteristics of weapons.

¹⁰GAO, *Project and Program Management: DOE Needs to Revise Requirements and Guidance for Cost Estimating and Related Reviews*, [GAO-15-29](#) (Washington, D.C.: Nov. 25, 2014).

cost-estimating best practice steps. DOE agreed with our recommendation but has not yet incorporated the best practice steps into its program management directives.

- In February 2016, we found that the B61-12 life extension program, the most complex such program NNSA has undertaken to date, faces ongoing management challenges in some areas, including staff shortfalls and an earned value management system that has yet to be tested.¹¹ We did not make any recommendations but reiterated previous recommendations such as those already mentioned.
- In November 2016, we found that DOE and NNSA had not established organization-wide policies or practices addressing leading practices related to program management, and we recommended that DOE do so.¹² DOE did not agree or disagree with this recommendation. NNSA, however, in late 2016 instituted a training program for program management.

NNSA's stockpile stewardship program has established strategic materials as one of the major elements to sustain the nation's nuclear weapons stockpile. According to NNSA budget documents, the strategic materials programs help ensure the sustainment of nuclear material processing capabilities and fund the stabilization, consolidation, disposition, tracking, and accounting of nuclear materials. Strategic materials are generally not available, or are available only in limited quantities, from commercial suppliers because of their specific properties and use in nuclear weapons or for other national security purposes. NNSA named strategic material program managers in 2014 and 2015 to integrate, oversee, plan, and execute material strategies for uranium (including domestic uranium enrichment), plutonium, and tritium.

In addition to the general program management challenges highlighted above, we have also reported previously on challenges facing NNSA's strategic materials programs:

- In July 2015, we found that NNSA had identified various challenges in its lithium production strategy that may impact its ability to meet

¹¹GAO, *Nuclear Weapons: NNSA Has a New Approach to Managing the B61-12 Life Extension, but a Constrained Schedule and Other Risks Remain*, [GAO-16-218](#) (Washington, D.C.: Feb. 4, 2016).

¹²[GAO-17-51](#).

demand for lithium in the future.¹³ These challenges included insufficient supply of lithium material and constraints facing NNSA's efforts to replace the aging lithium production facility. We recommended that NNSA objectively consider all alternatives, without preference for a particular solution, as it proceeds with its analysis of alternatives process. NNSA neither agreed nor disagreed with our recommendation but did undertake a formal analysis of alternatives in 2017, according to NNSA officials.

- In August 2016, we found that NNSA had not documented important requirements for its plutonium program at Los Alamos National Laboratory in New Mexico.¹⁴ We recommended that, among other things, NNSA should update its program requirements. NNSA outlined actions taken and planned to address this recommendation.

NNSA Has Defined Strategic Materials Program Requirements, Including Roles and Responsibilities for Program Managers

NNSA's Office of Defense Programs has set program requirements for the strategic materials programs and has established the roles and responsibilities of the programs' managers. NNSA defined these program requirements in two documents issued in 2016 and 2017. Collectively these documents set documentation requirements as well as established the roles and responsibilities of the strategic materials program managers. According to NNSA officials, these requirements apply to each of the programs, including the lithium program. These requirements are outlined below.

- **Program Execution Instruction (2016)** – In January 2016, NNSA approved a Program Execution Instruction that defines requirements for carrying out NNSA defense programs, such as the strategic materials programs.¹⁵ This instruction outlines a series of requirements that vary based on the categorization—and therefore the rigor—of management applied to a program. Of the four categories outlined in the instruction—Standard Management, Enhanced Management A, Enhanced Management B, and Capital Acquisition Management—NNSA has generally designated the strategic materials programs as “Enhanced Management B,” the most rigorous designation applicable to this type of program, according to

¹³[GAO-15-525](#).

¹⁴GAO, *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).

¹⁵National Nuclear Security Administration, “DP Program Execution Instruction: NA-10 Program Management Tools and Processes,” Rev. 1 (Oct. 15, 2015).

NNSA officials.¹⁶ The “Enhanced Management B” programs are required to have the following elements documented: a program plan, a work breakdown structure that details the work elements necessary to organize the total work scope with cost estimates, a decision analysis, an integrated master schedule that includes the entire scope of work required for the program’s successful execution, a performance management approach, and a lessons learned/best practices review.¹⁷ According to the instruction, if the scope, cost, and schedule of a program are more complex, moving to a more rigorous program management category is often required. According to the instruction, when enhanced complexity and risk are associated with a program, among other things, “Enhanced Management B” is the appropriate designation. The instruction also allows for programs to “tailor,” or modify, the application of certain requirements depending on risk and other factors.

- **Program Management Policy for Weapons and Strategic Materials Programs (2017)** – NNSA issued a program management policy in January 2017 that defines general roles and responsibilities for all four strategic materials program managers.¹⁸ This policy broadly outlines the managers’ authority and responsibilities for managing the strategic materials; these responsibilities include developing program documentation and managing risk. According to NNSA officials we interviewed, the policy is based on NNSA’s experience in implementing the uranium program in 2014. The policy requires each of the strategic materials programs to develop a number of guidance documents, including a mission strategy, mission requirements, and a technology development plan. For each program, the policy also requires the formation of a strategic materials mission

¹⁶NNSA designated the lithium program as a “Standard Management” program, which entails a slightly less rigorous set of requirements.

¹⁷The instruction includes additional required documents not listed here because, according to the instruction, they may be included in the program plan.

¹⁸National Nuclear Security Administration, “Program Management Policy for Weapons and Strategic Materials Programs,” BOP-06.07 (Jan. 17, 2017). Since NNSA has not yet appointed a manager for the lithium program, this policy only applies to the other four materials programs.

working group that is comprised of the key stakeholders involved in the program.¹⁹

NNSA Officials Reported Progress in Meeting Strategic Materials Program Requirements but Challenges from Staffing Shortages

NNSA officials told us that they are making progress in implementing the program requirements outlined for each of the strategic materials programs, although some are further along than others. However, these officials said that relatively few staff had been assigned to these programs, which has challenged implementation efforts.

Progress Reported in Implementing Program Requirements

For its two strategic materials programs established in 2014—uranium and domestic uranium enrichment—NNSA officials told us that they are generally meeting the strategic materials program management requirements outlined in the Program Execution Instruction and the Program Management Policy for Weapons and Strategic Materials.²⁰ NNSA officials identified documents for each program, including mission strategy, mission requirements, program plan, and work breakdown structure. For the other programs, according to agency officials, NNSA is still working to meet these requirements, though the tritium program met all requirements during the course of this review. More specifically, according to agency officials:

¹⁹Prior to the issuance of this policy, in July and October of 2014, the NNSA Administrator issued specific memorandums for the uranium and domestic uranium enrichment program managers. These memorandums assigned oversight and coordination roles to those program managers and listed their responsibilities. For example, the uranium program manager’s memorandum lists responsibilities such as the creation of a uranium strategy. The domestic uranium enrichment program manager’s memorandum lists responsibilities such as overseeing existing enrichment technology, determining budget requirements, and assessing legal issues. According to agency officials, NNSA has not issued similar detailed memorandums for the other strategic materials programs and does not have plans to do so, given the more broadly applicable program management policy that it issued in January 2017.

²⁰NNSA officials said that the Program Execution Instruction applies only to the sustainment activities within each strategic materials program.

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- **The plutonium sustainment program** has met some of the Program Execution Instruction requirements to date, including having in place a program plan, work breakdown structure, and decision analysis, but not an integrated master schedule (although one is being developed, according to agency officials). The plutonium program also has a mission strategy in place, as called for by the Program Management Policy for Weapons and Strategic Materials, but has not yet met the other strategic materials program management requirements. According to agency officials, those requirements are being developed.
 - **The tritium sustainment program** has recently met the Program Execution Instruction requirements as well, including having a program plan, work breakdown structure, integrated master schedule, and performance management approach in place. Additionally, the program recently updated documentation to meet the Program Management Policy requirements including revising its Strategic Material Mission Working Group in 2017, according to agency officials.
 - **The lithium program** is early in its development, and no program manager has been appointed yet, pending senior NNSA leadership decisions. NNSA has a lithium mission strategy, a mission requirements matrix, and a technology development plan in place, as required by the Program Management Policy for Weapons and Strategic Materials, but the rest of the strategic materials program management requirements are still in the process of being developed, according to agency officials. NNSA officials said that even though the lithium program is not subject to the same requirements, they intend for it to meet all of the same requirements as the other strategic materials programs.

Staffing Challenges Reported

Officials from the Office of Defense Programs, including the strategic materials program managers themselves, said that a shortage of staff has presented a challenge in terms of implementing the requirements of the strategic materials programs and meeting their missions. According to NNSA officials, all of the strategic materials programs have been assigned relatively few federal staff to implement the programs. The officials also said that while they plan to have all five strategic materials programs fully meet the requirements and operate as cohesive programs, the lack of staff has hampered their efforts to do so. For example, the plutonium manager said more staff were needed to successfully implement the program, and the lithium lead point of contact said that at least two full-time staff members would be required to accomplish the

work needed to make the lithium program meet program requirements. Specifically, according to agency officials as of October 2017, in addition to contractor support:

- **the uranium program** had the program manager and two federal staff assigned;
- **the domestic uranium enrichment program** had the program manager and one federal staff assigned;
- **the plutonium program** had the program manager and one federal staff member;
- **the tritium program** had the program manager and no dedicated staff, relying instead on staff in other programs such as a federal program manager from a different program who acts as staff for this program; and
- **the lithium program** had the lead point of contact and no dedicated staff, although a contracted senior technical advisor provides some support.

NNSA officials cited competing agency priorities and current perceived staffing limits as the primary impediments to assigning more staff to these programs. First, according to agency officials, the relative newness of the strategic materials programs and competing agency priorities to modernize the nuclear weapons infrastructure and modernize and extend the lives of current nuclear weapons have meant that federal staff are in high demand across the agency. This concern is consistent with issues we have identified in our past work as well. For example, in April 2017, we noted NNSA's ambitious, costly, decades-long effort to modernize the nation's nuclear security enterprise.²¹ In addition to ongoing and planned infrastructure modernization, some of which is associated with the strategic materials programs, this modernization includes four ongoing expensive weapons refurbishments and efforts to improve the agency's research, development, testing, and evaluation capabilities by, for example, continuing efforts in advanced modeling, simulation, and computing. Similarly, we found in September 2016 that the competing agency priorities for infrastructure modernization and weapons

²¹GAO, *National Nuclear Security Administration: Action Needed to Address Affordability of Nuclear Modernization Programs*, [GAO-17-341](#) (Washington, D.C.: Apr. 26, 2017).

refurbishments had negatively affected another NNSA program: the Enhanced Surveillance Program.²²

Second, NNSA officials said that they have limited flexibility when it comes to increasing federal staff levels. Specifically, in each year that the total number of federal employees at NNSA exceeds 1,690, the Administrator is required by law to submit to the congressional defense committees a report justifying such excess.²³ In the NNSA Administrator's testimony before the Senate Appropriations Subcommittee on Energy and Water Development in June 2017, he stated that since 2010, NNSA's program funding had increased 28 percent, while its federal staffing levels had decreased by 17 percent. He said that initial results from a yet-to-be-completed study by the Office of Personnel Management in support of the Reform of Government Initiative indicate the need for a 20 percent increase in federal staff at NNSA.

We have also previously reported that staffing shortages have affected NNSA's efforts to improve management capability. For example, we reported in October 2014 that NNSA determined that inadequate levels of federal staff had contributed to management problems with the UPF project.²⁴ As a result, NNSA increased staffing levels for the UPF project office from 9 full-time equivalents in 2012 to more than 50 as of January 2014.²⁵ According to NNSA officials, the additional staff enabled NNSA to conduct more robust oversight of the contractor's design efforts than was previously possible. Similarly, in 2016, we found that the B61-12 life extension program, the most costly and complex such program undertaken to date, successfully requested that NNSA enlarge its program office staff from 3 to 8 full-time equivalent staff to provide more

²²GAO, *Nuclear Weapons: NNSA Should Evaluate the Role of the Enhanced Surveillance Program in Assessing the Condition of the U.S. Nuclear Stockpile*, [GAO-16-549](#) (Washington, D.C.: Sept. 14, 2016). The Enhanced Surveillance Program develops computational models to predict the impact of stockpile aging, identifies signs of aging, and develops diagnostic tools.

²³50 U.S.C. § 2441a (2017). NNSA projects a total federal workforce of 1,715 by the end of fiscal year 2018.

²⁴GAO, *Nuclear Weapons: Some Actions Have Been Taken to Address Challenges with the Uranium Processing Facility Design*, [GAO-15-126](#) (Washington, D.C.: Oct. 10, 2014). NNSA determined that it needed more federal staff to oversee its contractors.

²⁵According to NNSA officials, during this period the NNSA staffing level increased to 11 with the balance of the full-time equivalents (roughly 39) comprised of United States Army Corps of Engineers personnel, support subcontractors, and technical experts.

management capability.²⁶ However, we found that even with this increase in federal staff, some NNSA and DOD officials said that they believe that NNSA needs two to three times more personnel in the federal program manager's office to ensure sufficient federal management and oversight.

One area that we noted in this review is that with regard to the strategic materials programs, NNSA has not conducted a workforce needs assessment. Strategic materials program officials acknowledged that they had neither specifically assessed the number or skills of staff needed to manage the strategic materials programs, nor did they have current plans to do such an assessment. Our prior work on strategic human capital management has identified certain activities or practices that can help an agency strategically manage its human capital.²⁷ These activities include determining the critical skills and competencies that will be needed to achieve the programs' missions and developing strategies to address gaps in the number, deployment, and alignment of staff needed. NNSA officials said that individual offices have attempted over time to assess resource and skill needs but that these efforts have been hampered by, among other things, a lack of staff. By determining the critical skills and competencies needed to achieve each strategic material program's mission and using this determination to develop strategies to address any gaps in the number, deployment, and alignment of staff needed, NNSA may find it has better information to justify increased staffing levels for its strategic materials programs.

Conclusions

Since 2014, NNSA has taken steps to establish programs to maintain and modernize the nation's nuclear weapons stockpile, including appointing federal program managers for four of the five strategic materials programs, as well as steps to establish and organize the programs according to internal program management requirements. This is a significant step given the importance, cost, and complexity of these strategic materials programs. However, NNSA has made varying progress implementing these strategic materials programs, in part because these programs may not have been allotted staff and management capacity commensurate with their cost and scope of work.

²⁶[GAO-16-218](#).

²⁷See, for example, GAO, *Human Capital: Strategies to Help Agencies Meet Their Missions in an Era of Highly Constrained Resources*, [GAO-14-168](#) (Washington, D.C.: May 7, 2014), and GAO, *Human Capital: Key Principles for Effective Strategic Workforce Planning*, [GAO-04-39](#) (Washington, D.C.: Dec. 11, 2003).

Although strategic materials program officials acknowledged staffing limitations, they have not determined the critical skills and competencies that will be needed to meet program requirements and, ultimately, achieve the programs' missions.²⁸ By determining the critical skills and competencies needed to achieve each strategic materials programs' missions and using that determination to develop strategies to address any gaps in the number, deployment, and alignment of staff needed, NNSA may find it has more information to justify increased staffing levels for its strategic materials programs.

Recommendation for Executive Action

The NNSA Administrator should determine the critical skills and competencies that will be needed for the strategic materials programs and use this determination to develop strategies for addressing challenges, if any, related to the number, deployment, and alignment of program staff (Recommendation 1).

Agency Comments

We provided a draft of this report to DOE and NNSA for their review and comment. NNSA provided written comments, which are reproduced in full in appendix II, as well as technical comments, which we incorporated in our report as appropriate. In its comments, NNSA agreed with our recommendation and stated that the recommendation is consistent with the programs' current evolution. NNSA further stated that it recognizes the need to define the range of skills and competencies necessary to execute the programs' critical missions and that it plans to identify the complete set of core competencies needed for these programs by December 31, 2018.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Energy, the Administrator of the National Nuclear Security Administration, and other interested parties. In addition, the report is available at no charge on the GAO website at <http://www.gao.gov>.

²⁸ In its response to this report, NNSA noted that it has begun a study (in connection with the Office of Management and Budget) of its federal staffing levels and has also launched an effort to outline competencies needed for program managers across the agency.

If you or your staff 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 key contributions to this report are listed in appendix III.



David C. Trimble
Director, Natural Resources and Environment

Appendix I: Strategic Nuclear Materials Managed by the National Nuclear Security Administration (NNSA)

NNSA has established programs for ensuring the supply of each of the following strategic materials as well as the capability to process them:

- **Uranium** – National security needs for uranium are met using a large existing inventory of previously enriched uranium.¹ Although NNSA has estimated that stocks are sufficient for projected needs, existing uranium needs to be purified, machined, and recovered from existing operations. The Y-12 National Security Complex in Oak Ridge, Tennessee, is the NNSA site for conducting enriched uranium activities, producing uranium-related components for nuclear warheads and bombs, and processing feedstock for nuclear fuel for the U.S. Navy. In 2004, NNSA decided to construct a new Uranium Processing Facility (UPF) that consolidated the functions of four separate uranium facilities into a single building. In 2014, NNSA, on the advice of a peer review team, decided to pursue a uranium program that includes a smaller UPF and, among other program elements, modifications to existing uranium buildings and capabilities to include several new uranium processing technologies. Construction on the UPF continues at the Y-12 site, and NNSA continues to request funds for that project.² Fiscal year 2018 funds are to be used for construction of some related subprojects. According to NNSA officials, the UPF is expected to be complete by 2025 and cost no more than \$6.5 billion. NNSA estimates that additional investments needed to upgrade existing uranium facilities will cost about \$20 million per year for the next 20 years.
- **Domestic Uranium Enrichment** – To produce tritium, the Tennessee Valley Authority (TVA) must use unobligated uranium in certain nuclear reactors, under an interagency agreement between Department of Energy (DOE) and TVA. The United States has not had a sustained uranium enrichment capability since the 2013 closure of the Paducah Gaseous Diffusion Plant, which was originally constructed in 1952. In 2014, NNSA created the domestic uranium enrichment program manager position with responsibility to sustain the agency's supply of low-enriched uranium for tritium production.

¹According to Department of Energy officials, the department's current uranium inventory allocations are sufficient to meet national security demands through 2064, based on several assumptions, including no reallocation of non-excess uranium to downblending operations in support of tritium production.

²The UPF consists of processing capabilities for enriched uranium casting, oxide production, and salvage and accountability operations. The UPF project includes a Main Process Building, a Salvage and Accountability Building, a Mechanical Electrical Building, and various support facilities.

We currently have ongoing work reviewing the program's plan to ensure supply through 2060. NNSA estimated that over the next 5 years alone, these activities will likely cost more than \$400 million.

- **Plutonium** – A set of aging facilities at Los Alamos National Laboratory provides the backbone of NNSA's plutonium work, such as certifying the safety of existing nuclear weapons' plutonium pits and producing new pits to extend the life of nuclear weapons in the stockpile.³ NNSA conducts plutonium analysis in the Chemistry and Metallurgy Research facility, which was built in the 1950s, but NNSA plans to cease programmatic operations in this facility by 2019 because of its aging infrastructure and because it sits on a seismic fault line. NNSA produces pits and conducts pit surveillance in the 38-year-old high-hazard, high-security Plutonium Facility 4 at Los Alamos. Other important plutonium activities, such as NNSA's plutonium disposition efforts and the processing of plutonium used to provide heat sources for space missions, are not included in the plutonium manager's portfolio because other program offices are responsible for these activities, according to NNSA officials. Officials said that these program offices coordinate capability and facility needs with the plutonium program manager.

In August 2014, DOE cancelled plans to construct the nuclear facility that was part of the overall Chemistry and Metallurgy Research Replacement (CMRR), which was approved in 2005 to replace the aging Chemistry and Metallurgy Research facility. In its place, DOE approved the implementation of the first part of NNSA's new plutonium strategy: the revised CMRR project, which includes a subproject to remove contaminated equipment no longer in use in Plutonium Facility 4, install new plutonium analysis equipment, and modify an existing building to handle higher quantities of plutonium. NNSA estimated that the CMRR project would cost from \$2.4 billion to \$2.9 billion and be completed by 2024. In addition, in November 2015, DOE approved the mission need for the implementation of the second part of the strategy: building modular nuclear facilities to add high-hazard, high-security laboratory space at Los Alamos (the Plutonium Modular Approach) to meet plutonium pit production requirements. NNSA estimated that the Plutonium Modular Approach could cost from \$1.3 billion to \$3.0 billion and be completed by the end of 2027.

³A "pit" is the central core of a nuclear weapon that is commonly produced using plutonium.

- **Tritium** – NNSA has relied on tritium produced many years ago; recycling and recovery of existing tritium is currently the source of most of the tritium in the stockpile, according to NNSA officials. However, tritium decays relatively rapidly,⁴ and in 2015 NNSA identified a need to produce additional tritium. To produce tritium, lithium target rods—called tritium-producing burnable absorber rods—are irradiated in TVA’s reactors. The irradiated rods are transported to DOE’s Tritium Extraction Facility at the Savannah River Site in South Carolina, where they are processed in a specialized facility to extract and then prepare the tritium for nuclear warheads. NNSA requested \$9.8 million in design funds in fiscal year 2018 for construction of a new tritium production capability. In its fiscal year 2018 budget request, NNSA estimated that this facility would cost about \$425 million and be approved for operations in 2027.
- **Lithium** – Lithium is a key component of nuclear weapons and is essential for their refurbishment.⁵ NNSA has a sufficient supply of enriched lithium-6 (the isotope used in refurbishments and for tritium production), but that lithium is stored in another form and must undergo complex processing before it can be used for these purposes. NNSA halted certain aspects of its lithium processing operation—conducted at its Y-12 site in Oak Ridge, Tennessee—in May 2013 due to the condition of the site’s 72-year-old lithium production facility. Currently, NNSA is relying on a less complex but also less efficient process that results in a loss of approximately 50 percent of material. In 2013, NNSA developed a lithium production strategy that proposed a new lithium production facility, which the agency estimated would cost more than \$500 million. NNSA plans to request \$30.4 million in fiscal year 2019 for construction of this facility. This strategy includes sustaining current infrastructure and deploying new technologies to sustain lithium production.

⁴Tritium has a relatively short half-life—the time it takes for the radioactivity to decay by 50 percent—of about 12 years and decays at a rate of about 5.5 percent per year.

⁵DOE/NNSA also provides lithium for nuclear reactors, radiation detectors, and other purposes.

Appendix II: Comments from the National Nuclear Security Administration



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



October 23, 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 *Nuclear Weapons: NNSA Needs to Determine Critical Skills and Competencies for Its Strategic Materials Programs* (GAO-18-99).

As noted in the report, the strategic materials programs are at various levels of maturity, and face unique and complex implementation challenges. The National Nuclear Security Administration (NNSA) has made continuous progress over the previous three years to firmly establish and advance these programs. Since 2014, NNSA created specific program offices for uranium, plutonium, domestic uranium enrichment, and tritium; and, we plan to establish a lithium program office in the near future. Each office has developed an overarching mission strategy document, which defines the capabilities, infrastructure, and technologies required to sustain NNSA's strategic material requirements.

In January 2017, NNSA issued NNSA BOP-06.07, *Program Management Policy for Weapons and Strategic Materials Programs*, which formalized the programs' roles, responsibilities, and authorities. This policy ensures that effective program management and enhanced rigor are applied to each of the materials programs, commensurate with the level of resources and critical nature of the mission.

NNSA recognizes the need to define the range of skills and competencies necessary to execute the programs' critical missions as they continue to mature. We have requested the Office of Personnel Management conduct a study of Federal staffing across the nuclear security enterprise, which will assist in assessing resource allocation. The NNSA Office of Management and Budget has also established foundational competencies specific to program and project management, as well as related cross-cutting competencies representing core skills and abilities required for proficiency. The NNSA Office of Defense Programs will leverage these corporate initiatives, together with reviews of internal staffing and technical requirements, to identify the complete set of core competencies for the strategic materials programs and to develop an actionable resource strategy. This action is planned for completion by December 31, 2018.



**Appendix II: Comments from the National
Nuclear Security Administration**

We agree with GAO's recommendation, which is consistent with the program evolution identified above. We have provided technical comments under separate cover for your consideration to enhance the clarity and accuracy of the final report. If you have any questions, regarding this response, please contact Dean Childs, Director, Audits and Internal Affairs, at (301) 903-1341.

Sincerely,


Frank G. Klotz

Appendix III: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition to the contact above, Jonathan Gill (Assistant Director), Alisa Beyninson, Antoinette Capaccio, Jeff Larson, Cynthia Norris, and Kiki Theodoropoulos made key contributions to this report.

Related GAO Products

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

Program Management: DOE Needs to Develop a Comprehensive Policy and Training Program. [GAO-17-51](#). Washington, D.C.: November 21, 2016.

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

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

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.: August 6, 2015.

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

DOE and NNSA Project Management: Analysis of Alternatives Could Be Improved by Incorporating Best Practices. [GAO-15-37](#). Washington, D.C.: December 11, 2014.

Project and Program Management: DOE Needs to Revise Requirements and Guidance for Cost Estimating and Related Reviews. [GAO-15-29](#). Washington, D.C.: November 25, 2014.

Nuclear Weapons: Some Actions Have Been Taken to Address Challenges with the Uranium Processing Facility Design. [GAO-15-126](#). Washington, D.C.: October 10, 2014.

Nuclear Weapons: Technology Development Efforts for the Uranium Processing Facility. [GAO-14-295](#). Washington, D.C.: April 18, 2014.

Plutonium Disposition Program: DOE Needs to Analyze the Root Causes of Cost Increases and Develop Better Cost Estimates. [GAO-14-231](#). Washington, D.C.: February 13, 2014.

Nuclear Weapons: Information on Safety Concerns with the Uranium Processing Facility. [GAO-14-79R](#). Washington, D.C.: October 25, 2013.

Nuclear Weapons: Factors Leading to Cost Increases with the Uranium Processing Facility. [GAO-13-686R](#). Washington, D.C.: July 12, 2013.

Nuclear Weapons: National Nuclear Security Administration's Plans for Its Uranium Processing Facility Should Better Reflect Funding Estimates and Technology Readiness. [GAO-11-103](#). Washington, D.C.: November 19, 2010.

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