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September 2016

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

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GAO Highlights

Highlights of GAO-16-549, a report to congressional committees

Why GAO Did This Study

DOE participates in the annual process to assess the safety and reliability of the U.S. nuclear stockpile, which is now made up largely of weapons that are beyond their original design lifetimes. In 2007, faced with a mounting backlog of required tests, DOE's NNSA announced plans to use its Enhanced Surveillance Program for a more cost-effective surveillance approach under its 2007 Surveillance Transformation initiative. Under this initiative, predictive models were to assess the impact of aging on weapons in the stockpile without having to dismantle them as the agency has done in the past.

The Senate Report accompanying the National Defense Authorization Act for Fiscal Year 2015 included a provision that GAO review the status of the Enhanced Surveillance Program. This report assesses the extent to which NNSA implemented the vision for the Enhanced Surveillance Program from its 2007 initiative and developed a long-term strategy for the program. GAO reviewed NNSA plans and budget and other documents; interviewed agency officials; and discussed surveillance issues with members of a group of nationally known scientists who advise the government and who reviewed the program in September 2013.

What GAO Recommends

GAO recommends that the NNSA Administrator develop a long-term strategy for the Enhanced Surveillance Program that incorporates leading practices. NNSA concurred with GAO's recommendation and estimated completion of a long-term strategy by June 2017.

View GAO-16-549. For more information, contact David Trimble at (202) 512-3841 or trimbled@gao.gov.

What GAO Found

The Department of Energy's (DOE) National Nuclear Security Administration (NNSA) did not fully implement the Enhanced Surveillance Program as envisioned in the agency's 2007 Surveillance Transformation Project (2007 initiative) and has not developed a long-term strategy for the program. Surveillance is the process of inspecting a weapon through various tests of the weapon as a whole, the weapon's components, and the weapon's materials to determine whether they are meeting performance expectations, through dismantling the weapon or through the use of diagnostic tools. As called for in its 2007 initiative, NNSA took steps to improve the management of the overall surveillance program, which primarily tests dismantled weapons and their components, but the agency did not increase the role of the Enhanced Surveillance Program, as envisioned. The program develops computational models to predict the impact of stockpile aging; identifies aging signs; and develops diagnostic tools. Under the 2007 initiative, NNSA was to conduct more Enhanced Surveillance Program evaluations using computer models to predict the impacts of aging on specific weapon components—especially nonnuclear components and materials—and to assess the validity of more diagnostic tools. Instead of expanding the program's role, NNSA reduced program funding by more than 50 percent from fiscal year 2007 to fiscal year 2015. NNSA also delayed some key activities and reduced the program's scope during this time. For example, NNSA did not complete its proposed evaluations of the impact of aging on nonnuclear components and materials. These evaluations, originally estimated to be completed by 2012, were dropped as program goals in fiscal year 2016, according to NNSA officials and contractor representatives.

In fiscal year 2016, NNSA broadly refocused the Enhanced Surveillance Program on multiple nuclear weapon life-extension efforts and supporting activities but has not developed a corresponding long-term strategy for the program. Instead, program officials have focused on developing general long-term goals and managing the program on a year-to-year basis under reduced funding levels to maintain key stockpile assessment capabilities. These general goals, however, do not provide measureable outcomes or encompass the entirety of the program. In addition, as GAO's previous work has shown, managing longer term work, such as multiyear technology development projects, on an annual basis makes it difficult for Congress and other decision makers to understand up front what they are funding and what benefits they can expect. As a result, these projects may receive a lower priority and may not be consistently funded. GAO's body of work has identified a number of leading practices in federal strategic planning that include defining strategic goals, defining strategies and resources for achieving these goals, and developing and using performance measures to track progress in achieving these goals and to inform management decision making. A new strategy for the Enhanced Surveillance Program that incorporates outcome-oriented strategic goals, addresses management challenges and identifies resources needed to achieve these goals, and develops and uses performance measures to track progress in achieving goals would allow the agency to better inform long-term planning and management decision making for the program as well as help ensure that it complements NNSA's other efforts to assess the nuclear weapons stockpile.

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Abbreviations

DOD	Department of Defense
DOE	Department of Energy
GPRA	Government Performance and Results Act of 1993
GPRAMA	GPRA Modernization Act of 2010
LEP	life extension program
NNSA	National Nuclear Security Administration
RDT&E	research, development, test, and evaluation

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The U.S. stockpile of nuclear weapons has grown smaller and older than when the United States was in the midst of the Cold War, and much of the stockpile has aged beyond its anticipated lifetime. From 1945 to 1992, the United States conducted both nuclear and nonnuclear testing to ensure the reliability and performance of these weapons.[1] Nuclear testing was largely conducted through underground, underwater, and aboveground explosions, and, since the 1960s, the United States has supplemented underground tests with a program of weapons analysis using nonnuclear laboratory and flight testing.[2] Since 1992, the United States has observed a moratorium on nuclear testing, with the result that the United States must rely on other methods to ensure that the aging weapons remaining in the nuclear stockpile are safe and reliable.[3]

In 1995, the President established an annual stockpile assessment and reporting requirement to help ensure that the nation's nuclear weapons remained safe and reliable without underground nuclear testing. Subsequently, Congress enacted into law the requirement for an annual stockpile assessment process.[4] The National Nuclear Security Administration (NNSA), a separately organized agency within the

[1]The U.S. nuclear testing program began with the Trinity test on July 16, 1945, at a location approximately 55 miles northwest of Alamogordo, NM, now called the Trinity Site. That test confirmed that the Fat Man implosion design weapon would function to produce a nuclear detonation. It also gave the Manhattan Project scientists their first look at the effects of a nuclear detonation.

[2]Nonnuclear laboratory testing involves pulling a certain number of units from each stockpiled weapon, either randomly or specifically, and disassembling, inspecting, and reconfiguring them at national security laboratories. Flight testing involves dropping or launching a weapon with its nuclear material removed. The Department of Energy coordinates flight tests with the Department of Defense, which is responsible for providing the military assets (e.g., aircraft and missiles) needed to drop or launch a weapon.

[3]See Pub. L. No. 102-377 (1992).

[4]The National Defense Authorization Act for Fiscal Year 2003, Pub. L. No. 107-314, § 3141, codified at 50 U.S.C. § 2525.

Department of Energy (DOE),[5] provides input to the annual assessment on the basis of, in large part, a variety of tests that it conducts on weapons returned from the stockpile and supplemental information provided from aging studies under its stockpile surveillance program.[6] Surveillance is the process of inspecting individual weapons through various tests of the weapon as a whole, the weapon's components, and the weapon's materials to determine whether they are meeting performance expectations. Through this program, NNSA obtains critical information on the condition of the stockpile that, among other things, informs the annual assessment process.[7] According to NNSA's Stockpile Stewardship and Management Plan,[8] the stockpile surveillance program comprises two key efforts—the Core Surveillance program (Core Surveillance)[9] and the Enhanced Surveillance Program.[10] While these

[5]NNSA was established in 2000 by the National Defense Authorization Act for Fiscal Year 2000, Pub. L. No. 106-65, § 3211 (1999).

[6]The National Defense Authorization Act for Fiscal Year 1994, Pub. L. No. 103-160, § 3138 (1993), directed DOE to establish the Stockpile Stewardship Program to maintain the overall safety and reliability of U.S. nuclear weapons.

[7]By law, the Secretaries of Energy and of Defense must submit reports required to be completed by the head of each national security laboratory and the Commander of the U.S. Strategic Command to the President, along with the conclusions the Secretaries have reached about the safety, reliability, performance, and military effectiveness of the nuclear stockpile and other matters the Secretaries consider appropriate. The President, in turn, must forward to Congress the reports and matters received, along with any comments the President considers appropriate.

[8]NNSA's Stockpile Stewardship and Management Plan provides information on modernization and operations plans and budget estimates over the next 25 years. The plan is NNSA's formal means for communicating to Congress the status of certain activities and the agency's long-range plans and budget estimates for sustaining the stockpile and modernizing the nuclear security enterprise.

[9]Core Surveillance is also known as the "Stockpile Evaluation Program" and the "New Material and Stockpile Evaluation Program." In this report, we refer to the effort as "Core Surveillance."

[10]From fiscal year 2001 through fiscal year 2015, NNSA managed Enhanced Surveillance as a campaign. NNSA defines campaigns as technically challenging, multiyear, multifunctional efforts conducted across the nuclear security enterprise. According to NNSA, campaigns have milestones and specific end-dates or goals, effectively focusing research and development activities on clearly defined deliverables. In fiscal year 2016, NNSA recharacterized the Enhanced Surveillance Campaign, along with its other research, development, test, and evaluation (RDT&E) activities, as "programs" to better emphasize the ongoing nature of these activities.

programs share the common goals of improving and reducing the cost of surveillance, according to NNSA officials, NNSA has designed each effort to conduct different types of activities. NNSA also provides separate sources of funding for each effort.

According to officials at NNSA, Core Surveillance has historically been used to detect "birth defects" of weapons—the manufacturing defects or signs of aging in current components and materials. These weapons and weapons components are chosen, either randomly or specifically, from the stockpile each year for evaluation. NNSA's national security laboratories and NNSA production plants evaluate weapons and their components largely by dismantling weapons to evaluate their condition and obtain information on their reliability. According to agency documents, NNSA's Enhanced Surveillance Program is intended to gain a better long-term understanding of the impacts of aging on weapons. To do so, the Enhanced Surveillance Program conducts lifetime assessments and aging studies to predict where and when defects may occur in weapons and their components in the future; builds computational models; and develops diagnostic tools primarily for Core Surveillance, as well as other stockpile organizations. The program also assists in assessing the safety and reliability of the U.S. stockpile and evaluates weapons components and materials for NNSA weapons programs focusing on component reuse or weapons life extension.

In 2007, faced with budgetary constraints; a mounting backlog of Core Surveillance's required weapons tests; and concerns raised by us, Congress, the Department of Defense (DOD), and others, NNSA developed an initiative to revise its approach to stockpile surveillance—the Surveillance Transformation Project (2007 initiative). According to NNSA's implementation plan for the 2007 initiative, it would provide a more cost-effective, flexible way to address the mounting backlog of mandatory tests and to meet the future surveillance needs of an aging stockpile. NNSA outlined key goals for transforming Core Surveillance and the Enhanced Surveillance Program in its 2007 initiative project

plan.[11] According to an NNSA official who was involved in the 2007 initiative and NNSA documents, one key effort was to develop capabilities to predict the condition of the stockpile over its lifetime by increasing the ability to understand and predict the impacts of aging, particularly on nonnuclear components, without dismantling them, thereby reducing the overall number of weapons and components required to be disassembled. By, among other things, increasing the nondestructive evaluations of nonnuclear components and materials—work that was to be largely conducted under the Enhanced Surveillance Program—NNSA sought to reduce Core Surveillance's backlog of mandated nonnuclear laboratory tests requiring the dismantling of these components.

Over the past several years, NNSA has budgeted less funding for the Enhanced Surveillance Program.[12] For example, in fiscal year 2015, NNSA budgeted about 30 percent less funding than for the prior fiscal year for the program. Outside experts and the directors of NNSA's three national security laboratories have voiced concerns about the possible impacts that Enhanced Surveillance Program cuts could have on the agency's ability to fully assess the condition of the stockpile in the future. Specifically, according to representatives of the JASON group,[13] recent changes to Enhanced Surveillance Program funding pose a risk that NNSA may not have the tools it needs in the future to fully assess whether the stockpile remains safe and reliable. Within NNSA, the

[11]The 2007 initiative project plan laid out four key goals aimed at transforming both Core Surveillance and the Enhanced Surveillance Program—collectively, the stockpile surveillance program—into a more adaptive, flexible and cost-effective program. The four goals were to (1) establish clear requirements for determining stockpile evaluation needs; (2) implement an evaluation program based on increased knowledge of weapons components and materials design, manufacture, and aging potentials; (3) develop capabilities to project and predict the state of weapons health through the end of their lives; and (4) integrate surveillance activities through a strengthened governance structure.

[12]NNSA requests funding for its programs through its annual budget submission to DOE. DOE, in turn, provides the departmentwide budget request to the Office of Management and Budget for submission to Congress as part of the President's budget request. Subsequently, Congress typically enacts appropriations to carry out NNSA programs and activities through lump sum appropriations, and NNSA generally allocates those appropriations internally in a manner consistent with its funding requests and any constraints imposed by law.

[13]The JASON group consists of nationally known scientists who advise government agencies on defense, energy, and other technical issues.

directors for the agency's three nuclear security laboratories, where the majority of the Enhanced Surveillance Program activities are conducted, have voiced similar concerns.

The Senate Report accompanying the National Defense Authorization Act for Fiscal Year 2015 included a provision that we review, among other things, the status of the Enhanced Surveillance Program, including NNSA's long-term strategy for the program.[14] This report assesses the extent to which NNSA has implemented the vision for the Enhanced Surveillance Program found in its 2007 initiative and the extent to which NNSA has developed a long-term strategy for the program.

To do this work, we reviewed stockpile surveillance program documents, including the annual Stockpile Stewardship and Management Plan, Enhanced Surveillance Program Implementation Plan, and Surveillance Transformation Project Plan. We also reviewed NNSA budgetary documents, our prior reports,[15] and DOE Office of Inspector General reports on NNSA's stockpile surveillance program.[16] We interviewed federal officials at NNSA headquarters and federal officials and contractor representatives at the three national security laboratories—Sandia National Laboratory in Albuquerque, New Mexico; Los Alamos National Laboratory in Los Alamos, New Mexico; and Lawrence Livermore National Laboratory in Livermore, California—either by visit or by telephone. We also interviewed officials in DOE's Office of Inspector General who were involved in the November 2010 review of Core Surveillance and the Enhanced Surveillance Program. In addition, we interviewed representatives of the JASON group who were involved in the

[14]S. Rep. No. 113-176, at 282 (2014). In fiscal year 2016, NNSA recharacterized the Enhanced Surveillance Campaign, along with its other RDT&E activities, as "programs" to better emphasize the ongoing nature of these activities.

[15]GAO, *Nuclear Weapons*: *NNSA Needs to Improve Guidance on Weapons Limitations and Planning for Its Stockpile Surveillance Program*, GAO-12-188 (Washington, D.C.: Feb. 8, 2012) and GAO, *Nuclear Weapons*: *Improvements Needed to DOE's Nuclear Weapons Stockpile Surveillance Program*, GAO/RCED-96-216 (Washington, D.C.: July 31, 1996).

[16]Department of Energy, Office of Inspector General, *Follow-Up Audit of the Stockpile Surveillance Program*, OAS-L-12-10 (Washington, D.C.: Sept. 13, 2012) and Office of Inspector General, *The National Nuclear Security Administration's Enhanced Surveillance Program*, DOE/IG-0646 (Washington, D.C.: Apr. 14, 2004).

organization's September 2013 review of Core Surveillance and the Enhanced Surveillance Program. We also reviewed NNSA's strategic planning efforts for the Enhanced Surveillance Program and selected leading practices in federal strategic planning, including (1) practices required at the federal department/agency level under the Government Performance and Results Act of 1993 (GPRA),[17] as amended by the GPRA Modernization Act of 2010 (GPRAMA),[18] which we have previously reported also can serve as leading practices for planning at lower levels within federal agencies, such as individual programs or initiatives;[19] (2) practices identified in Office of Management and Budget guidance to federal agencies for implementing GPRA's requirements;[20] and (3) related leading practices that our past work has identified. We also reviewed our prior work on program evaluation[21] and DOE's performance measurement guidelines.[22]

We conducted this performance audit from September 2014 to September 2016 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.

[17]Pub. L. No. 103-62 (1993).

[18]Pub. L. No. 111-352 (2011).

[19]For example, see GAO, *Foreign Aid Reform: Comprehensive Strategy, Interagency Coordination, and Operational Improvements Would Bolster Current Efforts*, GAO-09-192 (Washington, D.C.: Apr. 17, 2009).

[20]Office of Management and Budget, *Circular A-11, Section 210: Preparing and Submitting an Agency Strategic Plan* (Washington, D.C.: 2010).

[21]GAO, *Recreational Fisheries Management: The National Marine Fisheries Service Should Develop a Comprehensive Strategy to Guide Its Data Collection Efforts*, GAO-16-131 (Washington, D.C.: Dec. 8, 2015); GAO, *Program Evaluation: Strategies to Facilitate Agencies' Use of Evaluation in Program Management and Policy Making*, GAO-13-570 (Washington, D.C.: June 26, 2013); GAO-09-192; and GAO, *Agencies' Strategic Plans Under GPRA: Key Questions to Facilitate Congressional Review*, GAO/GGD-10.1.16 (Washington, D.C.: May 1997).

[22]Department of Energy, *Guidelines for Performance Measurement*, DOE G 120-1.5 (Washington, D.C.: June 30, 1996).

Background

The size and composition of the nuclear stockpile have evolved as a consequence of the global security environment and the national security needs of the United States. According to NNSA's Stockpile Stewardship and Management Plan for Fiscal Year 2016, the stockpile peaked at 31,255 weapons in 1967, and in September 2013, the stockpile consisted of 4,804 weapons—the smallest since the Eisenhower Administration. The New Strategic Arms Reduction Treaty between the United States and Russia,[23] which entered into force on February 5, 2011, is to reduce the operationally deployed stockpile even further by 2018. Weapons that were originally produced on average 25 to 30 years ago are now well past their original design life of approximately 15 to 20 years. In addition, no new nuclear weapons have been developed since the closing days of the Cold War.

Before the end of the U.S. underground nuclear testing program in 1992, developing and maintaining the nuclear stockpile were largely accomplished by a continual cycle of weapon design, weapon testing, and the incorporation of lessons learned in the next design. A critical step in this process was conducting underground nuclear explosive tests.[24] Since 1992, the United States has observed a self-imposed moratorium on nuclear explosive testing and has, instead, relied on a program of nonnuclear testing and modeling to ensure the reliability, safety, and effectiveness of the stockpile. While the United States maintains the policy of no new nuclear testing or weapon designs, and the stockpile is reduced in absolute numbers, confidence in the existing stockpile and the effectiveness of the deterrent must remain high to meet U.S. national security needs. For this reason, the United States is continuing to modernize the existing stockpile through life-extension programs (LEP). LEPs are modifications that refurbish warheads or bombs by replacing aged components with the intent of extending the service life of weapons

[23]The formal title of this treaty is the Treaty Between the United States of America and the Russian Federation on Measures for the Further Reduction and Limitation of Strategic Offensive Arms, April 8, 2010.

[24]From 1945 through 1992, the United States conducted 1,054 nuclear explosive tests, the majority of which tested design concepts, physics, and engineering details such as safety and radiation effects.

by 20 to 30 years, while increasing safety, improving security, and addressing defects.[25]

NNSA's Office of Defense Programs is responsible for the manufacture, maintenance, refurbishment, surveillance, and dismantlement of nuclear weapons. Most modern nuclear weapons consist of three sets of materials and components—a primary, a secondary, and a set of nonnuclear components. When detonated, the primary and secondary components, which together are referred to as the weapon's "nuclear explosive package," produce the weapon's explosive force, or "yield." Some nonnuclear components—collectively called "limited-life components"—have shorter service lives than the weapons themselves and, therefore, must be periodically replaced.

There are two key efforts in the stockpile surveillance program—Core Surveillance and the Enhanced Surveillance Program. NNSA's Core Surveillance, in one form or the other, has been in place for nearly 60 years. In contrast, the Enhanced Surveillance Program was established in the mid-1990s to assist in surveillance and evaluation of the stockpile primarily by identifying aging signs, developing aging models to predict the impact of aging on the stockpile, and developing diagnostic tools.

Core Surveillance

Since the late 1950s, Core Surveillance has focused on sampling and testing the nuclear stockpile to provide continuing confidence in its reliability. Core Surveillance conducts tests that provide current information—essentially a snapshot of the current condition of the stockpile—for the annual assessment of the stockpile. According to NNSA officials, Core Surveillance focuses mainly on identifying the "birth defects" of a system—the manufacturing defects in current components and materials.[26] Under Core Surveillance, NNSA's national security

[25]As we reported in February 2016, NNSA is currently conducting four LEPs or other refurbishments and is planning three additional LEPs over the next 25 years. See GAO, *Department of Energy: Observations on Efforts by NNSA and the Office of Environmental Management to Manage and Oversee the Nuclear Security Enterprise*, GAO-16-422T (Washington, D.C.: Feb. 23, 2016).

[26]Since the 1950s, NNSA's Core Surveillance has historically been used to detect "birth defects" of weapons.

laboratories and production plants[27] are to evaluate the current state of weapons and weapon components for the attributes of function, condition, material properties, and chemical composition through the following activities:

- **System-Level Laboratory Testing.** For such tests, units from each type of stockpiled weapon are chosen annually, either randomly or specifically, and sent to the Pantex Plant in Texas for disassembly, inspection, reconfiguration, and testing by the national security laboratories.
- **System-Level Flight Testing.** These tests drop or launch a weapon with its nuclear material removed. NNSA coordinates flight testing with DOD, which is responsible for providing the military assets (e.g., aircraft and missiles) needed to drop or launch a weapon.
- **Component and Material Testing.** These tests are conducted on nuclear and nonnuclear components and materials by both the national security laboratories and the production plants that manufactured them.

Organizationally, Core Surveillance is part of NNSA's Directed Stockpile Work Program. This program also conducts, among other things, maintenance of active weapons in the stockpile, LEPs, and dismantlement and disposition of retired weapons. Core Surveillance activities were funded at approximately $217 million in fiscal year 2016.

Enhanced Surveillance Program

According to NNSA documents, through scientific and engineering efforts, the Enhanced Surveillance Program enables the agency to better predict where defects might occur in the future to help determine useful lifetimes of weapons and certain key components, such as switches or detonators, and to help plan when replacement is needed. The creation of the Enhanced Surveillance Program in the mid-1990s came at a time when concerns were growing (1) with an aging stockpile and (2) that Core

[27]Surveillance activities are primarily conducted at the three NNSA national security laboratories: Sandia National Laboratories in Albuquerque, New Mexico; Los Alamos National Laboratory in Los Alamos, New Mexico; and Lawrence Livermore National Laboratory in Livermore, California. Surveillance activities are also conducted at the three defense production facilities: Pantex Plant in Amarillo, Texas; Oak Ridge Y-12 in Oak Ridge, Tennessee; and the Nuclear Security Campus at Kansas City, Missouri; as well as at the Savannah River National Laboratory in Aiken, South Carolina.

Surveillance tended to produce diminishing returns. More specifically, in a 2006 study, NNSA and the Sandia National Laboratories found that as more is known about manufacturing and current aging defects—the focus of Core Surveillance—fewer and fewer manufacturing-related defects are discovered. This 2006 study suggested a different approach to surveillance for aging weapons. According to NNSA officials, the Enhanced Surveillance Program conducts three key activities:

- **Aging studies.** Enhanced Surveillance Program aging studies support decisions on when and whether to reuse or replace weapons components and materials. As part of these studies the program identifies and develops new materials and components that can substitute for materials that are no longer available; identifies inadequately performing components; and assesses performance of existing components to assist in weapons life-extension decisions. For example, to assist in making decisions on the life extension of weapons, the Enhanced Surveillance Program assessed the feasibility of reusing certain components. Specifically, according to NNSA documents, in fiscal year 2014, the Enhanced Surveillance Program validated the reuse of a battery for one weapon through aging studies, resulting in eliminating the need and cost to redesign the part. In another example, according to NNSA officials, Enhanced Surveillance Program aging models made it possible to certify the potential reuse of a key part of the W80 warhead to allow life extension of that weapon. NNSA also uses information from these aging studies in LEPs to guide decisions on when future weapons modifications, alterations, and life extensions need to occur to reduce the risk of potential problems from future defects. Finally, NNSA uses information from the aging studies in the national security laboratory directors' annual assessment of the condition of the stockpile.
- **Computational modeling.** On the basis of its aging studies and other data, the Enhanced Surveillance Program develops computational models to predict the impacts of aging on weapons components and materials. According to the Enhanced Surveillance Program's federal program manager, computational predictive models primarily benefit weapons systems managers at the three nuclear security laboratories. The federal program manager noted that the models allow a projection of the future performance of the systems and anticipate failures with sufficient time to correct them.
- **Diagnostic tool development.** The Enhanced Surveillance Program develops diagnostic tools to support Core Surveillance and allow the evaluation of weapons without the need to dismantle and destroy them. This is important since new weapons are not being produced.

One diagnostic tool developed by the program was the high-resolution computed tomography image analysis tool for a particular nuclear component, implemented in fiscal year 2009. NNSA officials said this diagnostic tool has enhanced the ability to identify potential defects or anomalies without the need to dismantle or destroy the component.

Organizationally, the Enhanced Surveillance Program is a part of NNSA's Engineering Program, which is part of NNSA's broader research, development, test, and evaluation (RDT&E) program. The Engineering Program creates and develops tools and capabilities to support efforts to ensure weapons are safe and reliable. NNSA's total RDT&E budget allocation for fiscal year 2016 is $1.8 billion; the Enhanced Surveillance Program budget allocation for fiscal year 2016 is approximately $39 million.

2007 Surveillance Transformation Initiative

According to agency documents, because of long-standing concerns over the stockpile surveillance program, NNSA launched its 2007 initiative to, among other things, better integrate stockpile surveillance program activities. The concerns date back to the mid-1990s. For example, our July 1996 report on the surveillance program found the agency was behind in conducting surveillance tests and did not have written plans for addressing the backlog.[28] A January 2001 internal NNSA review of the surveillance program made several recommendations to improve surveillance,[29] including addressing the selection and testing approach for weapons and components, developing new tools to allow for nondestructive testing of the stockpile, improving aging and performance models, and achieving closer coordination and integration of Core Surveillance and the Enhanced Surveillance Program. Further, an April 2004 review of the Enhanced Surveillance Program by DOE's Office of Inspector General found that NNSA experienced delays in completing some Enhanced Surveillance Program milestones and was at risk of not

[28]GAO/RCED-96-216. This report made two recommendations to the Secretary of Energy, including developing detailed plans to restore surveillance testing to its schedule and developing contingency plans in the case of testing facility closure. The agency agreed with our recommendations, stating that it was making every effort to get the surveillance program on schedule.

[29]National Nuclear Security Administration, Defense Programs, *Strategic Review of the Surveillance Program, 150-Day Report* (Washington, D.C.: Jan. 1, 2001).

meeting future milestones.[30] The report noted that such delays could result in NNSA's being unprepared to identify age-related defects in weapons and impact the agency's ability to annually assess the condition of the stockpile. Finally, an October 2006 DOE Office of Inspector General report found that NNSA had not eliminated its surveillance testing backlog.[31]

Faced with this criticism, a growing backlog of Core Surveillance's traditional surveillance testing, budgetary pressures, and an aging stockpile, NNSA developed its 2007 initiative. According to its project plan, the 2007 initiative sought to establish clear requirements for determining stockpile surveillance needs and to integrate all surveillance activities—to include Core Surveillance and the Enhanced Surveillance Program—through a strengthened management structure. In addition, NNSA sought to create a more flexible, cost-effective, and efficient surveillance program by, among other things, dismantling fewer weapons and increasing the understanding of the impact of aging on weapons, components, and materials by being able to predict the effects of aging activities. According to an NNSA official who previously oversaw surveillance activities, because of the nature of its work, the Enhanced Surveillance Program was intended to be a key part of this transformation effort. More specifically, according to the 2007 initiative project plan, one proposal was to increase evaluations of aging effects on nonnuclear weapons components and materials. The 2007 initiative project plan noted that more than 100 such evaluations would be undertaken at the Sandia National Laboratories in fiscal year 2007, the first year of the initiative's implementation. In addition, the 2007 initiative project plan stated that the Enhanced Surveillance Program would continue to assess the viability of diagnostic tools in support of Core Surveillance.

[30]DOE/IG-0646.

[31]Department of Energy, Office of Inspector General, *Follow-up Audit of Stockpile Surveillance Testing*, DOE/IG-0744 (Washington, D.C.: Oct. 30, 2006).

NNSA Did Not Fully Implement Its 2007 Vision for the Enhanced Surveillance Program and Has Not Developed a Long-Term Strategy for the Program

NNSA implemented some aspects of its 2007 initiative but did not fully implement its envisioned role for the Enhanced Surveillance Program and has not developed a long-term strategy for the program. NNSA has substantially reduced the program's funding since 2007 and recently refocused some of its RDT&E programs on multiple weapon life-extension efforts and supporting efforts.

NNSA Did Not Fully Implement the Increased Role for the Enhanced Surveillance Program Envisioned in Its 2007 Initiative and Budgeted Less Funding

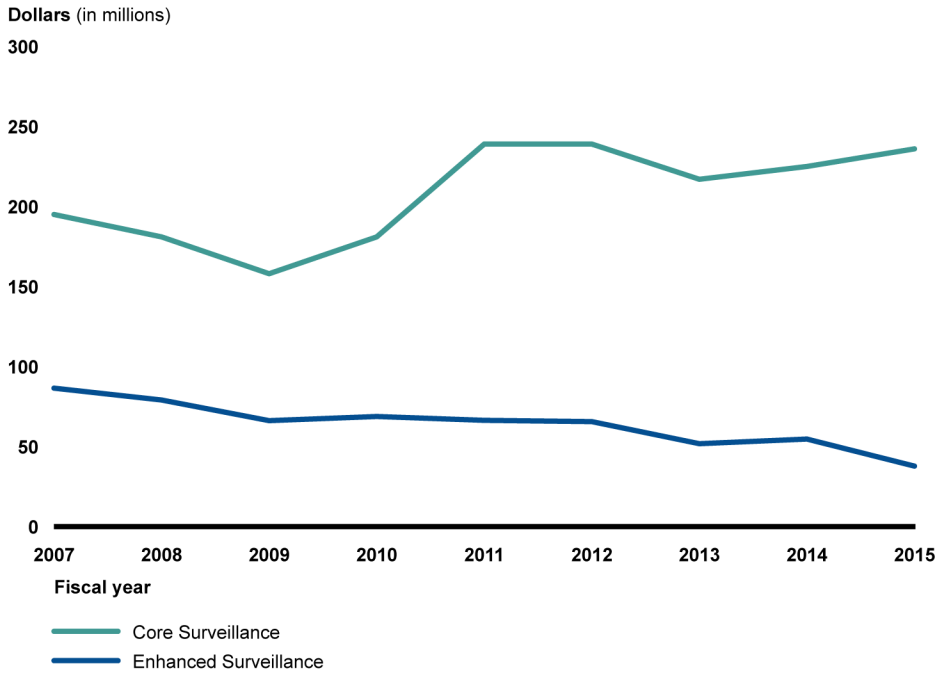
A February 2010 internal NNSA review noted that NNSA had implemented some important aspects of the 2007 initiative. For example, NNSA updated guidance laying out processes for identifying surveillance requirements. In addition, the agency had implemented a governance structure consisting of working committees to harmonize requirements between Core Surveillance and the Enhanced Surveillance Program. Furthermore, the agency had created a senior-level position to lead the overall surveillance effort and better integrate Core Surveillance and the Enhanced Surveillance Program.

However, according to NNSA documents and officials, the agency did not fully implement its envisioned role for the Enhanced Surveillance Program. Instead of increasing the role of the program by conducting the range of aging studies as envisioned, NNSA budgeted less funding to it, delayed some planned work, and transferred work to other NNSA programs. The amount of funding the agency budgeted to the Enhanced Surveillance Program declined from $87 million in fiscal year 2007—the first year of the 2007 initiative's implementation—to $79 million in fiscal year 2008. NNSA has continued to budget less funding to the Enhanced Surveillance Program. Funding dropped to approximately $38 million in fiscal year 2015, a reduction of more than 50 percent from fiscal year

2007.[32] While the Enhanced Surveillance Program has experienced reductions in funding and scope since the 2007 initiative, Core Surveillance funding has generally kept pace with required stockpile testing, according to an NNSA official. After an initial funding reduction from $195 million in fiscal year 2007 to $158 million in fiscal year 2009, NNSA increased the budgeted funding to Core Surveillance in 2010 and has stabilized its funding levels since then. Agency officials said they believe the Core Surveillance program is now generally stable. Figure 1 shows funding levels for the two programs for fiscal years 2007 through 2015.

[32]According to its fiscal year 2016 budget documents, NNSA is planning slight increases to Enhanced Surveillance Program funding of nearly 17 percent over a 2-year period—from $37.8 million in fiscal year 2015 to approximately $41.2 million by fiscal year 2017—and the agency plans to maintain or slightly increase program funding levels for a period of years after that. The budget documents note that Enhanced Surveillance Program funding over the next several years is intended primarily to maintain current activities and not to begin new initiatives.

Figure 1: Enhanced Surveillance Program and Core Surveillance Enacted Funding for Fiscal Years 2007 through 2015



Source: DOE budget documents. | GAO-16-549

NNSA also delayed some key Enhanced Surveillance Program activities during this time. For example, NNSA did not complete the proposed evaluations of the effects of aging on nonnuclear components and materials that were to be largely carried out at the Sandia National Laboratories. These evaluations—which NNSA viewed as an important part of the Enhanced Surveillance Program when it was being managed as a campaign, according to an NNSA official—were initiated in fiscal year 2007 and originally estimated to be completed by 2012. However, a 2010 NNSA review concluded these evaluations had not occurred. According to a contract representative at the Sandia National Laboratories overseeing Enhanced Surveillance Program work, these evaluations no longer have an estimated time frame for completion and their systematic completion, as was once envisioned, is no longer a

program goal.[33] Furthermore, while the program has developed some diagnostic tools to aid Core Surveillance, such as high-resolution computed tomography image analysis,[34] NNSA officials and the NNSA fiscal year 2016 budget request said that other efforts to develop diagnostic tools had been deferred because of lack of funding.

In addition, NNSA transferred some Enhanced Surveillance Program work to other programs. For example, NNSA transferred experiments (and related funding) to measure aging effects and to provide lifetime assessments on the plutonium pits—a key nuclear weapons component—from the Enhanced Surveillance Program to NNSA's Science Campaign in fiscal year 2009.[35]

According to the Enhanced Surveillance Program's federal program manager, NNSA has budgeted reduced funding because of competing internal priorities. The federal program manager said that the Enhanced Surveillance Program has to compete for funding with other internal high-priority activities, such as LEPs and infrastructure projects[36] in a climate of overall agency funding constraints caused by, among other things, internal agency pressures to achieve budgetary savings to enable modernization of the stockpile and other priorities. In addition, Core Surveillance's importance in detecting "birth defects" of weapons—the manufacturing defects or signs of aging in current components and materials—has increased, according to NNSA officials, as NNSA has

[33]The Enhanced Surveillance Program still does, however, conduct some evaluations of the aging effects on nonnuclear components and materials, according to the federal program manager.

[34]Computed tomography (CT) X-ray scans are in widespread medical and industrial use.

[35]According to NNSA's fiscal year 2015 budget request, NNSA's Science Campaign provides expertise and tools to identify future risks to the performance of the stockpile and to help develop risk mitigation strategies. One of the Science Campaign's efforts is to develop predictive capabilities for the performance of weapons.

[36]For more than a decade, we have reported on the challenges DOE's NNSA and the Office of Environmental Management have faced in meeting their projects' cost performance targets as developed in estimates and in ensuring that these cost estimates are based on sound assumptions. NNSA and the Office of Environmental Management are included on our High-Risk List in recognition of the potential for vulnerabilities to fraud, waste, abuse, and mismanagement in contract administration and management of major projects. See GAO, *High-Risk Series: An Update*, GAO-15-290 (Washington, D.C.: Feb. 11, 2015).

undertaken and completed more LEPs. In fiscal year 2016, NNSA shifted the focus of some of its RDT&E efforts, including efforts in the Enhanced Surveillance Program, to meet the immediate needs of its ongoing and planned LEPs and related supporting efforts. According to NNSA officials, the funding and scope reductions in the Enhanced Surveillance Program reflect ongoing internal prioritization tensions within NNSA over meeting immediate needs—such as understanding current stockpile condition using traditional surveillance methods—and investing in the science, technology, and engineering activities needed to understand the impacts of aging on weapons and their components in the future.

The Enhanced Surveillance Program federal program manager as well as other stakeholders, such as the JASON group of experts, noted funding changes may have a larger impact on the program than is immediately apparent. NNSA officials said that the program plays a considerably broader role in assessing the condition of the stockpile than its name suggests and supports a wide variety of efforts, including the statutorily required annual assessment process, weapons life extension and modernization programs, and ongoing efforts to maintain weapons systems. According to a 2014 NNSA analysis conducted by the Enhanced Surveillance Program's federal program manager, slightly less than 15 percent of the program's fiscal year 2014 budget allocation supported the development of diagnostic tools largely for Core Surveillance.[37] About half of the program's fiscal year 2014 budget allocation went to conducting aging studies, predictive modeling, and component and material evaluation studies that may support Core Surveillance but also benefit weapons life extension and modernization programs and ongoing efforts to maintain weapons systems, according to agency officials. The analysis found that about one-third of the Enhanced Surveillance Program's fiscal year 2014 budget allocation went to activities supporting the annual assessment process and ongoing or planned LEPs.

[37]According to NNSA's Enhanced Surveillance Program federal program manager, this study was undertaken as a one-time effort to better understand how the program's budget was used to support stockpile programs.

NNSA Has Not Developed a Current Long-Term Strategy for the Enhanced Surveillance Program

As of April 2016, NNSA was no longer pursuing the vision for the Enhanced Surveillance Program contained in the 2007 initiative and did not have a current long-term strategy for the program. Specifically, the fiscal year 2017 Stockpile Stewardship and Management Plan noted that NNSA refocused all of its RDT&E engineering activities—including the activities within the Enhanced Surveillance Program—on supporting more immediate stockpile needs and, according to the program's federal program manager, NNSA has not developed a corresponding long-term strategy for the program. Enhanced Surveillance Program officials continue to focus on year-to-year management of the program under reduced funding levels to maintain key stockpile assessment capabilities, such as supporting Core Surveillance activities, the annual assessment process, and LEPs.

Our previous work has demonstrated that a long-term strategy is particularly important for technology-related efforts such as the Enhanced Surveillance Program. Specifically, our April 2013 report[38] found that for technology-related efforts, without a long-term strategy that provides an overall picture of what an agency is investing in, it is difficult for Congress and other decision makers to understand up front what they are funding and what benefits they can expect.

In 1993, GPRA established a system for agencies to set goals for program performance and to measure results. GPRAMA, which amended GPRA, requires, among other things, that federal agencies develop long-term strategic plans that include agencywide goals and strategies for achieving those goals.[39] Our body of work has shown that these requirements also can serve as leading practices for strategic planning at lower levels within federal agencies, such as NNSA, to assist with planning for individual programs or initiatives that are particularly challenging.[40] Taken together, the strategic planning elements

[38]GAO, *IRS Website: Long-Term Strategy Needed to Improve Interactive Services*, GAO-13-435 (Washington, D.C.: Apr. 16, 2013).

[39]*Government Performance and Results Act Modernization Act of 2010*, Pub. L. No. 111-352 (2011).

[40]For example, see GAO-16-131; GAO-09-192: and GAO, *Environmental Justice: EPA Needs to Take Additional Actions to Help Ensure Effective Implementation*, GAO-12-77 (Washington, D.C.: Oct. 6, 2011).

established under these acts and associated Office of Management and Budget guidance, and practices we have identified, provide a framework of leading practices in federal strategic planning and characteristics of good performance measures.[41] For programs or initiatives, these practices include

- defining strategic goals,
- defining strategies that address management challenges and identify resources needed to achieve these goals, and
- developing and using performance measures to track progress in achieving these goals and to inform management decision making.

Our review of NNSA documents and interviews with NNSA officials found that NNSA does not have a current long-term strategy for the Enhanced Surveillance Program defining the program's strategic goals that includes these practices. Strategic goals explain the purpose of agency programs and the results—including outcomes—that they intend to achieve. The Enhanced Surveillance Program has general long-term goals, such as "developing tools and information useful to ensure the stockpile is healthy and reliable." However, the program's long-term goals do not provide outcomes that are measurable or that encompass the entirety of the program. NNSA officials told us they use annual goals, which help manage work on a yearly basis. For example, the program's goals for fiscal year 2015 included "develop, validate and deploy improved predictive capabilities and diagnostics to assess performance and lifetime for nuclear and non-nuclear materials." By managing work on an annual basis, longer-term work—such as technology development projects extended over several years—may receive a lower priority and thus, according to NNSA officials, may not be funded.

In addition, NNSA funds the program's annual requirements as part of the agency's annual budget formulation process and funds the program in

[41]For example, see GAO, *Executive Guide: Effectively Implementing the Government Performance and Results Act*, GAO/GGD-96-118 (Washington, D.C.: June 1, 1996); *Tax Administration: IRS Needs to Further Refine Its Tax Filing Season Performance Measures,* GAO-03-143 (Washington, D.C.: Nov. 22, 2002); *Managing for Results: Enhancing Agency Use of Performance Information for Management Decision Making,* GAO-05-927 (Washington, D.C.: Sept. 9, 2005); and Office of Management and Budget, *Circular No. A-11, Preparation, Submission, and Execution of the Budget* (Washington, D.C.: 2015).

accordance with the agency's internal process for allocating its budget authority. For fiscal year 2016, the agency budgeted funding for the program at a slightly higher level to meet stockpile requirements, such as surveillance, and the annual assessment process. However, without a current long-term strategy for the program, NNSA cannot plan for any management challenges that threaten its ability to meet its long-term strategic goals or the resources needed to meet those goals.

Moreover, NNSA program officials told us that the agency has not defined specific quantifiable performance measures that could be used to track the program's progress toward its long-term goals, as called for by leading practices. The need for NNSA to develop clear, measureable performance metrics for the Enhanced Surveillance Program has been highlighted in past reviews, namely by DOE's Inspector General and by the JASON group. For example, in a September 2012 report, the Inspector General noted that NNSA's performance measure for the program was based on the percentage of funding spent rather than on work accomplishments.[42] Furthermore, a July 2013 memorandum from the director of the Office of Management and Budget to executive agency heads noted that, in accordance with OMB Circular A-11 and GPRAMA, agencies should describe the targeted outcomes of research and development programs using meaningful, measurable, quantitative metrics, where possible, and describe how they plan to evaluate the success of the programs.

We found in past work that effective long-term planning is needed to guide decision making in programs, including laboratory research and development programs, so that congressional and other decision makers can better understand up front what they are funding and what benefits they can expect.[43] As NNSA refocused its research and technology development efforts for the Enhanced Surveillance Program on LEPs and related activities and as NNSA officials said that they recognized the need for a new long-term strategy for the program, it is an opportune time to incorporate sound federal strategic planning practices. A new strategy for

[42]DOE/OAS-L-12-10.

[43]GAO, *A Long-Term Plan Is Needed to Guide DOE and Multiprogram Laboratory Research and Development Activities*, GAO/RCED-84-30 (Washington, D.C.: Jan. 16, 1984) and GAO-13-435.

the program that incorporates outcome-oriented strategic goals, addresses management challenges and identifies resources needed to achieve these goals, and develops and uses performance measures to track progress in achieving goals would allow the agency to better inform long-term planning and management decision making for the program.

Conclusions

By seeking to increase the nondestructive evaluations of nonnuclear components—work that was to be conducted under the Enhanced Surveillance Program—NNSA sought to reduce Core Surveillance's backlog of mandated system-level tests requiring the dismantling of these components. However, NNSA did not fully implement its vision for the Enhanced Surveillance Program in its 2007 initiative. For example, rather than expanding the program, NNSA budgeted reduced funding for it, and the program did not complete the proposed evaluations of the effects of aging on nonnuclear components and materials. More recently, NNSA directed its RDT&E programs to focus on LEPs and related activities. This includes the Enhanced Surveillance Program. Enhanced Surveillance Program personnel have focused on year-to-year management of a program that has seen a nearly 50-percent funding reduction over the past decade and have not yet sought to redefine a strategy for how the program can best complement NNSA's other efforts to assess the condition of the stockpile, including Core Surveillance. With funding appearing to have been stabilized and with NNSA's adopting a different approach for all of its RDT&E programs, it is an opportune time to develop an Enhanced Surveillance Program strategy. A new long-term strategy for the program that incorporates outcome-oriented strategic goals, addresses management challenges and identifies resources needed to achieve these goals, and develops and uses performance measures to track progress in achieving goals would allow the agency to better inform long-term planning and management decision making for the program.

Recommendation for Executive Action

To help ensure that NNSA can better inform long-term planning and management decision making as well as to ensure that the Enhanced Surveillance Program complements NNSA's other efforts to assess the nuclear weapons stockpile, we recommend that the NNSA Administrator develop a long-term strategy for the Enhanced Surveillance Program that incorporates outcome-oriented strategic goals, addresses management challenges and identifies resources needed to achieve these goals, and develops and uses performance measures to track progress in achieving these goals.

Agency Comments

We provided a draft of this report to the NNSA Administrator for review and comment. In his written comments, the NNSA Administrator agreed with our recommendation that the agency develop a long-term strategy for the Enhanced Surveillance Program. The Administrator noted that the growth envisioned for the Enhanced Surveillance Program did not materialize as originally intended but that the agency remains committed to long-term success of the program. The Administrator noted that the agency estimated completing a long-term strategy for the program by June 2017.

We are sending copies of this report to the appropriate congressional committees, the NNSA Administrator, 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 that made key contributions to this report are listed in appendix II.

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
Subcommittee on Energy and Water Development,
and Related Agencies
Committee on Appropriations
House of Representatives

Appendix I: Comments from the National Nuclear Security Administration

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

August 31, 2016

Mr. David C. Trimble
Director, National 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 Should Evaluate the Role of the Enhanced Surveillance Program in Assessing the Condition of the U.S. Nuclear Stockpile" (GAO-16-549). The National Nuclear Security Administration (NNSA) appreciates GAO's recognition of the important aspects of the 2007 Surveillance Transformation Initiative that have been implemented. Specifically, program requirements were defined for both Core and Enhanced Surveillance, guidance was developed for laying out processes for identifying surveillance requirements, and a senior-level position was created to lead the overall surveillance effort.

As with many complex initiatives, challenges surfaced that altered the original path forward for this effort. Most notably, the requirement to pursue multiple Life Extension Programs and to carry out major infrastructure projects in an era of tightly constrained resources led to significant reductions in funding for the Enhanced Surveillance Program. As a result, the Program has not grown as originally anticipated. However, NNSA remains committed to its long-term success as demonstrated in the current out-year funding projections.

NNSA agrees with the auditors' recommendation to develop a long-term strategy for the Enhanced Surveillance Program that incorporates outcome-oriented strategic goals, addresses management challenges, and identifies the necessary resources. This strategy will include the use of performance measures to track our progress in achieving program goals. The estimated completion date for developing the strategy is June 30, 2017.

Technical comments have been provided under separate cover for your consideration to enhance the clarity and accuracy of the 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

Frank G. Klotz

Appendix II: GAO Contact and Staff Acknowledgments

GAO Contact

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

Staff Acknowledgments

In addition to the individual named above, Jonathan M. Gill (Assistant Director), Greg Campbell, William Horton, Nancy Kintner-Meyer, Rebecca Shea, and Kiki Theodoropoulos made key contributions to this report.