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PROJECT AND PROGRAM MANAGEMENT

DOE Needs to Revise Requirements and Guidance for Cost Estimating and Related Reviews

GAO-15-29

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GAO Highlights

Highlights of GAO-15-29, a report to the Committee on Armed Services, U.S. Senate

Why GAO Did This Study

NNSA is responsible for the nation's nuclear security programs. These programs often include the design and construction of large projects to meet program needs. NNSA has a history of struggling to complete these and other projects and programs within cost estimates.

Senate Report 112-73 mandated that GAO report on NNSA's cost estimating practices. This report examines: (1) the extent to which DOE and NNSA cost estimating requirements and guidance for projects and programs reflect best practices and (2) the extent to which recent NNSA project and program reviews identified cost estimating weaknesses, and the extent to which the weaknesses can be attributed to not following best practices. GAO reviewed DOE and NNSA cost estimating practices and compared them to best practices, NNSA project and program reviews, and two programs selected among the largest and most complex NNSA programs. GAO also interviewed DOE and NNSA officials about requirements and guidance for cost estimates.

What GAO Recommends

GAO recommends that DOE, among other things, revise DOE requirements and guidance that apply to projects and programs to ensure: (1) the guidance is referenced in the project management order, (2) DOE and NNSA and its contractors develop cost estimates in accordance with the 12 best practices, (3) its cost estimating guide fully reflects best practices, and (4) independent reviews of programs are conducted periodically. DOE agreed with the report and its recommendations.

View GAO-15-29. For more information, contact David Trimble at (202) 512-3841 or trimbled@gao.gov.

What GAO Found

The Department of Energy's (DOE) and its National Nuclear Security Administration's (NNSA) cost estimating requirements and guidance for projects and programs do not fully reflect best practices for developing cost estimates. In regard to cost estimating requirements for projects, DOE's 2010 project management order requires 1 of the 12 cost estimating best practices—conducting an independent cost estimate—for larger projects at certain stages of development. In contrast, DOE's 2011 cost estimating guide describes recommended approaches for using 10 of 12 best practices and partially contains information about the other 2. Furthermore, because DOE's cost estimating guide was issued in 2011—after DOE's 2010 project order was issued—it is not referenced in the order. As a result, users of the order may not be aware of the guide's availability and may not benefit from its usefulness. In addition, although NNSA programs are required to follow DOE's budget formulation order and NNSA's budget process, both of which require the development of cost estimates, neither the order nor the process requires the use of best practices in developing the estimates. In February 2014, for example, GAO found that NNSA's lifecycle cost estimate for the Plutonium Disposition Program did not follow all key steps for developing high-quality cost estimates, in part because the agency did not have a requirement to develop a life-cycle cost estimate. In the absence of a requirement for using best practices, it is unlikely that DOE, NNSA, and their contractors will consistently develop reliable cost estimates.

NNSA's project and program reviews issued during fiscal year 2009 through March 2014 identified cost estimating weaknesses that can be attributed to not following best practices. DOE and NNSA require independent project reviews, including reviews of cost estimates at certain stages of development and at the discretion of project managers. Of the 50 reviews GAO analyzed, 39 identified a total of 113 cost estimating weaknesses. GAO determined that 71 of the 113 weaknesses—or about 63 percent—can be attributed to not following four best practices: (1) determining the estimating structure, (2) identifying ground rules and assumptions, (3) conducting risk and uncertainty analysis, and (4) documenting the estimate. Neither DOE nor NNSA, however, requires reviews of program cost estimates. Of the three program reviews conducted during fiscal years 2009 to 2013, two were of the B61 Life Extension Program, which is to extend the operational life of this nuclear weapon. Both reviews identified weaknesses in the cost estimates that can be attributed to not following three best practices: (1) determining the estimating structure, (2) defining program characteristics, and (3) obtaining data. In addition, a February 2014 GAO report on NNSA's program to dispose of weapons-grade plutonium found that NNSA did not follow several cost estimating best practices, such as conducting an independent cost estimate and as a result, the program cost estimate was not reliable. While the program reviews and GAO's February 2014 report indicate weaknesses in a few program cost estimates, the extent of program cost estimate weaknesses is largely unknown because neither DOE nor NNSA requires reviews of program cost estimates. Without a requirement for conducting independent program reviews, NNSA does not have the internal control necessary for assessing program performance over time.

Contents

Abbreviations

CD	critical decision
DOE	Department of Energy
ICE	independent cost estimate
LEP	Life Extension Program
M&O	management and operating
MOX	Mixed Oxide
NNSA	National Nuclear Security Administration
OAPM	Office of Acquisition and Project Management
PPBE	Planning, Programming, Budgeting, and Evaluation
WBS	work breakdown structure

U.S. GOVERNMENT ACCOUNTABILITY OFFICE
441 G St. N.W.
Washington, DC 20548

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The Honorable Carl Levin
Chairman
The Honorable James Inhofe
Ranking Member
Committee on Armed Services
United States Senate

The National Nuclear Security Administration (NNSA)—a semiautonomous agency within the Department of Energy (DOE)—is responsible for managing the nation's nuclear security missions. These missions include maintaining the safety, security, and effectiveness of the U.S. nuclear weapons stockpile and reducing the threat posed by nuclear proliferation. To achieve its missions, NNSA manages numerous programs such as the Stockpile Life Extension Program and the Plutonium Disposition Program.[1] These and other programs frequently rely on the acquisition of capital assets to meet program needs.[2] For example, to meet the needs of the Plutonium Disposition Program, NNSA is currently managing the construction of two capital asset projects—the Mixed Oxide (MOX) Fuel Fabrication Facility and the Waste Solidification Building—at DOE's Savannah River Site in South Carolina.[3] NNSA has a

[1]DOE defines a program as an organized set of activities directed toward a common purpose or goal in support of an assigned mission area, and typically includes labor and operations and maintenance costs. The Stockpile Life Extension Program is intended to extend, through refurbishment, the operational lives of the weapons in the nuclear stockpile. The Plutonium Disposition Program is intended to dispose of 34 tons of surplus, weapons-grade plutonium.

[2]DOE defines a capital asset as land, structures, equipment, and intellectual property, which are used by the federal government and have an estimated useful life of 2 years or more. The acquisition of capital assets typically includes projects involving the design and construction of facilities with specialized equipment, such as facilities needed to maintain the nuclear weapons stockpile, conduct research and development, or process nuclear materials. DOE defines a capital asset project as having defined start and end points with an acquisition cost that includes all costs incurred to construct the project for its intended purpose, bringing it to a form and location suitable for its intended use, excluding operating expenses that are part of routine operations and maintenance functions.

[3]The MOX capital asset project is designed to remove impurities from plutonium feedstock obtained from nuclear weapon pits, form the plutonium into MOX fuel pellets, and fabricate pellets into fuel assemblies for use in commercial nuclear power reactors. The Waste Solidification Building is a capital asset project that is designed to process radioactive waste from the MOX facility.

history of struggling to complete these and other projects within their initial cost and schedule estimates. Since 1990, DOE's management of major contracts and projects, including those executed by NNSA, has been on our list of areas at high risk for fraud, waste, abuse, and mismanagement.[4] We have also recently reported that cost estimates for several NNSA projects were inaccurate, and significant cost increases were likely. For example, in 2014, we reported that the estimated cost of the MOX facility had increased from $4.8 billion in April 2007 to $7.7 billion in 2012.[5] In that report, we recommended, among other things, that DOE and NNSA conduct an analysis of the root causes of the increase and identify and prioritize recommended solutions. NNSA concurred with this recommendation and stated that it was planning to conduct such an analysis.

To support its missions, NNSA is organized into program offices, which include Defense Programs, Defense Nuclear Nonproliferation, and Naval Reactors.[6] These offices manage a wide variety of programs that can be generally placed into one of two categories. The first category includes those programs that are ongoing in nature with activities that contribute to a broad range of objectives and goals across the nuclear enterprise. Programs in this category consist of programs that have defined start and end points and a total cost that includes all costs incurred to complete the program, like capital asset projects programs of this type include NNSA's

[4]GAO, *High-Risk Series: An Update,* GAO-13-283 (Washington, D.C.: February 2013). Major contracts and projects are those with values of $750 million or greater. GAO designated DOE contract management as a high-risk area in 1990, and, in 2013, GAO narrowed the focus of its high-risk designation for DOE to the major contracts and projects of DOE's Office of Environmental Management and NNSA.

[5]GAO, *Plutonium Disposition Program: DOE Needs to Analyze the Root Causes of Cost Increases and Develop Better Cost Estimates*, GAO-14-231 (Washington, D.C.: Feb.13, 2014). DOE's fiscal year 2015 budget request stated that the MOX facility will be significantly more expensive than anticipated, and the request proposes to place the MOX facility in cold standby while NNSA evaluates plutonium disposition options.

[6]NNSA's other program offices include Emergency Operations, Defense Nuclear Security, Counterterrorism and Counterproliferation, Infrastructure and Environment, Management and Administration, and the Office of the Administrator.

Science Campaign and the Directed Stockpile Work program.[7] The second category consists of programs that have defined start and end points and a total cost that includes all costs incurred to complete the program.[8] Programs in this category include the B61 Life Extension Program (LEP) and the Plutonium Disposition Program. Programs in this second category are the programs discussed in this report.[9]

In April 2008, to assess the underlying causes of its contract and project management challenges, DOE conducted a root-cause analysis, which involved identifying the most significant issues that were impeding the department's ability to complete projects within their cost, scope, and schedule estimates. The analysis identified an inadequate cost estimating capability as one of the top five reasons that DOE was unable to successfully complete these projects. The analysis also identified DOE's lack of cost estimating policy or standards, personnel without the appropriate skills, and databases that lack current or historical information as root causes contributing to cost estimating problems. In July 2008, DOE published a corrective action plan to address the deficiencies identified in the root-cause analysis. The plan included actions to address cost estimating issues by establishing "a federal independent government cost estimating capability." In line with these efforts, DOE and NNSA have undertaken a number of activities to improve their cost estimating practices, including revising DOE's project management order, issuing a supplemental cost estimating guide, and strengthening training courses and certification requirements. In February 2011, DOE issued a report documenting the actions taken and progress made to implement corrective actions. In the report, DOE stated that the actions taken

[7]The Science Campaign is a program intended to improve the understanding of the complex processes that occur during a nuclear explosion by supporting several NNSA activities, including annual nuclear stockpile assessments and stockpile life extension program efforts. The Directed Stockpile Work program is intended to ensure the reliability of the nation's nuclear weapons stockpile, which includes activities such as LEP efforts and weapons dismantlement and disposition. Both of these programs are managed by the Office of Defense Programs.

[8]Ideally, according to DOE, execution of such projects should take no more than 4 years from when the start of construction or execution was approved. Programs, however, can continue for defined periods of a decade or more.

[9]The B61 is one of the nuclear weapons in the stockpile and the goal of the B61 LEP is to extend the operational life of this weapon. The B61 LEP is managed by the Office of Defense Programs. The Plutonium Disposition Program is a part of the Fissile Materials Disposition Program, which is managed by the Office of Defense Nuclear Nonproliferation.

effectively mitigated most of the root causes of their most significant contract and project management challenges and decreased the inherent risks involved with managing large, technically complex projects.

The Senate Report accompanying a proposed bill for the National Defense Authorization Act for Fiscal Year 2013 mandated that GAO report on NNSA's cost estimating practices and provide recommendations, if appropriate, to help NNSA conform to cost estimating best practices for projects and programs.[10] This report examines: (1) the extent to which DOE and NNSA cost estimating requirements and guidance for its projects and programs reflect best practices for developing and reviewing cost estimates, and (2) the extent to which NNSA project and program reviews identified weaknesses in cost estimates, and the extent to which any weaknesses can be attributed to not following cost estimating best practices. In May 2013, we testified before the U.S. Senate Subcommittee on Strategic Forces, Committee on Armed Services, relying on prior work and on preliminary observations from our work in this area.[11]

To examine the extent to which DOE and NNSA cost estimating requirements and guidance for its projects and programs reflect best practices for developing and reviewing cost estimates, we reviewed DOE and NNSA requirements and guidance related to cost estimating for projects and programs and compared them with the best practices identified in our 2009 Cost Estimating and Assessment Guide.[12] This guide is a compilation of cost estimating best practices drawn from across industry and government. We also interviewed DOE and NNSA officials at headquarters and NNSA project and program managers and their contractors at NNSA's Los Alamos and Sandia National Laboratories in New Mexico to discuss the requirements and guidance they follow in preparing, documenting, and reviewing project and program cost estimates. These NNSA sites were chosen because both sites have recently completed or have ongoing projects and are involved in the

[10]S. Rep. No. 112-173, 293-4 (2012).

[11]GAO, *Department of Energy: Observations on Project and Program Cost Estimating in NNSA and the Office of Environmental Management,* GAO-13-510T (Washington, D.C.: May 8, 2013).

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

execution of several NNSA programs. We focused on projects and programs managed by NNSA's Offices of Defense Programs and Defense Nuclear Nonproliferation because they manage a diverse array of programs and manage NNSA's largest ongoing capital asset projects—these two offices account for approximately 85 percent of NNSA's fiscal year 2015 budget request. We also analyzed NNSA program-specific cost-estimating policies and guidance for the B61 LEP. We focused on the B61 LEP and the Plutonium Disposition Program because they represent two of the largest and most complex NNSA programs and have defined start and end points and a total cost that includes all costs incurred to complete the program.

To determine the extent to which recent NNSA project and program reviews identified any weaknesses associated with the cost estimates for projects and programs and whether any of these weaknesses can be attributed to not following cost estimating best practices, we obtained project and program reviews completed from February 2009 through February 28, 2014. We limited our assessment to those reviews conducted since February 2009 to coincide with NNSA's issuance of a requirement in February 2009 to conduct independent cost estimates (ICE) or independent reviews for certain projects.[13] The reviews included independent cost assessments, independent project reviews, peer reviews, and external independent reviews conducted primarily by DOE's Office of Acquisition and Project Management (OAPM), NNSA's Office of Acquisition and Project Management, and U.S. Army Corps of Engineers, and other subject matter experts including former federal contractors.[14] We obtained and assessed a total of 50 reviews of 21 projects and the results from two program reviews. We analyzed these reviews to determine whether they included any references to weaknesses in the cost estimates associated with these projects and programs, and we

[13]An ICE is generated by an entity that has no stake in approval of the project but uses the same detailed technical information as the project estimate. Having an independent entity conduct an ICE and compare it to a project team's estimate provides an unbiased test of whether a project team's cost estimate is reasonable. As our cost estimating guide points out, the most rigorous independent review is an ICE. In contrast, an independent cost review addresses a project cost estimate's high-value, high-risk, and high-interest aspects without evaluating the remainder of the estimate. According to our cost guide, conducting an ICE is a cost estimating best practice, while an independent cost review is not.

[14]These reviews are independent in the sense that they are conducted by offices other than the office that manages a particular program.

determined whether the weaknesses could be attributed to not following specific cost estimating best practices. When a weakness was noted, we determined whether the weakness fit into any of the 12 best practices as described in the Cost Estimating and Assessment Guide. As a measure to collect reliable data, two GAO analysts reviewed each report independently and compared their responses.

We conducted this performance audit from November 2012 to November 2014, in accordance with generally accepted government auditing standards. Those standards require that we plan and perform the audit to obtain sufficient, appropriate evidence to provide a reasonable basis for our findings and conclusions based on our audit objectives. We believe that the evidence obtained provides a reasonable basis for our findings and conclusions based on our audit objectives.

Background

This section describes: (1) NNSA organization and management, (2) DOE and NNSA cost estimating requirements and guidance for projects, (3) DOE and NNSA cost estimating requirements and guidance for programs, (4) our 2009 cost estimating best practices, and (5) federal standards for internal controls.

NNSA Organization and Management

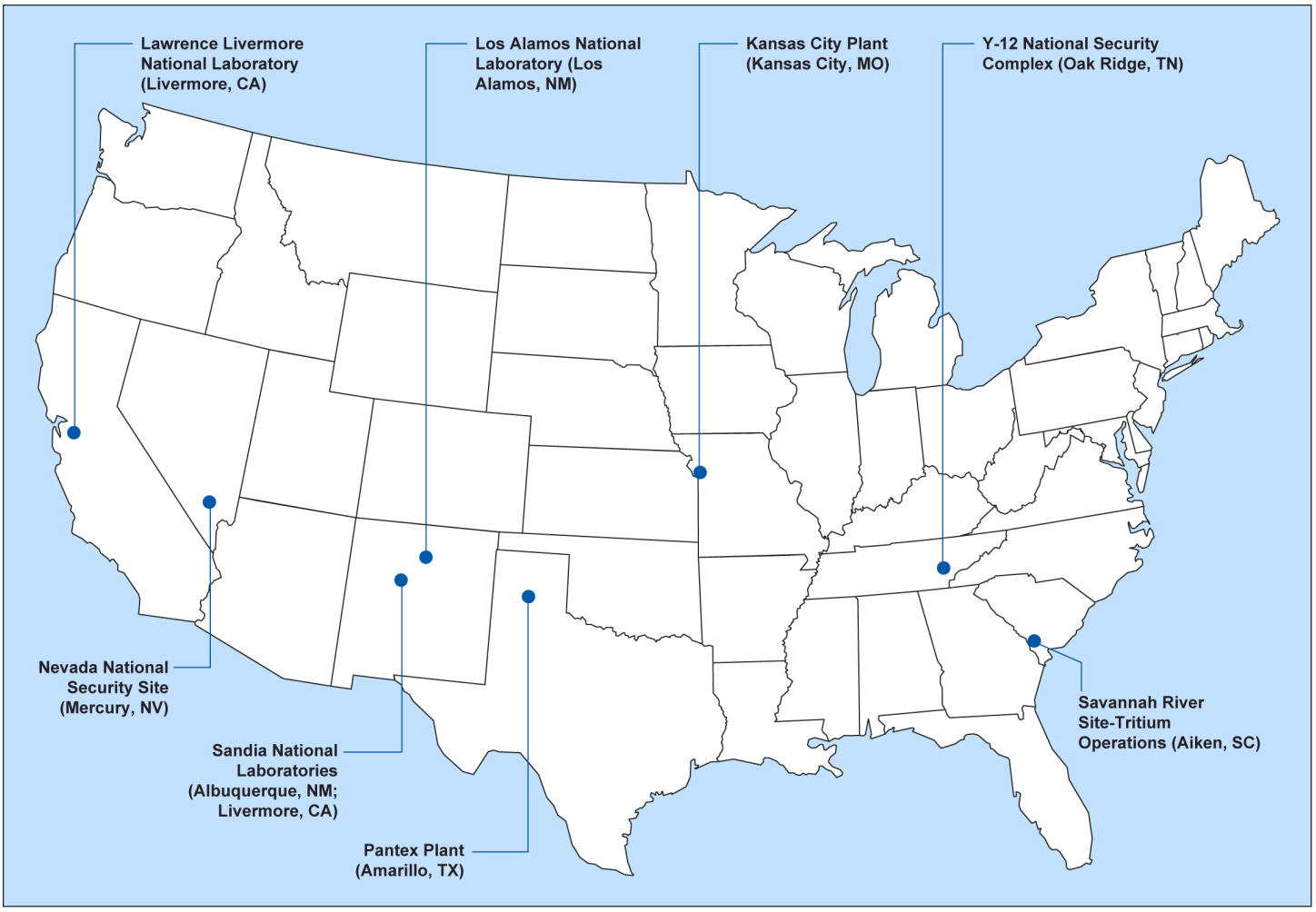
To fund NNSA's projects and programs, the President requested approximately $11.7 billion for NNSA in the fiscal year 2015 budget submission to Congress, the majority of which is intended to fund program operations. Work activities on both projects and programs are largely carried out by management and operating (M&O) contractors at NNSA's eight government-owned, contractor-operated sites—collectively referred to as the nuclear security enterprise. Among other things, these contractors operate and maintain the government-owned facilities and infrastructure deemed necessary to support the nuclear security enterprise and to support the capabilities to conduct scientific, technical, engineering, and production activities.

As shown in figure 1, the nuclear security enterprise sites include national research and development laboratories, as well as production plants. Specifically, NNSA manages three national nuclear weapons design laboratories—Lawrence Livermore National Laboratory in California, Los Alamos National Laboratory in New Mexico, and Sandia National Laboratories in New Mexico and California. It also manages four nuclear weapons production plants—the Pantex Plant in Texas, the Y-12 National Security Complex in Tennessee, the Kansas City Plant in Missouri, and

Tritium Operations at DOE's Savannah River Site in South Carolina. NNSA also manages the Nevada National Security Site, formerly known as the Nevada Test Site. Various headquarters organizations within NNSA develop policies and NNSA site offices, collocated with NNSA's sites, conduct day-to-day oversight of the M&O contractors, and evaluate the M&O contractors' performance in carrying out the sites' missions.[15]

[15]See GAO, *National Nuclear Security Administration*: *Observations on NNSA's Management and Oversight of the Nuclear Security Enterprise*, GAO-12-473T (Washington, D.C.: Feb. 16, 2012).

Figure 1: NNSA Nuclear Security Enterprise



Sources: National Nuclear Security Administration; Map Resources (map). | GAO-15-29

The Secretary of Energy is authorized under the National Nuclear Security Administration Act to establish policy and provide direction to NNSA.[16] The NNSA Administrator, however, is also vested with the authority to establish NNSA-specific policies, unless disapproved by the

[16]Pub. L. No. 106-65, § 3203, 113 Stat. 512, 954 (1999); codified at 42 U.S.C. §7144 (2012).

Secretary of Energy. NNSA does this through the issuance of Policy Letters.[17] According to NNSA officials responsible for project management, DOE directives and orders and NNSA Policy Letters, including business operating procedures, collectively establish requirements for the development of NNSA project and program cost estimates, and we refer to them as such throughout this document.

DOE and NNSA Cost Estimating Requirements and Guidance for Projects

NNSA is required to manage its projects, including the development of cost estimates, in accordance with DOE Order 413.3B.[18] The purpose of the order is to provide program and project management direction for the acquisition of capital assets, and it includes requirements for developing project cost estimates. The order also provides management direction for NNSA and other DOE offices with the goal of delivering projects within the original performance baseline that are fully capable of meeting mission performance and other requirements such as environmental, safety, and health standards.[19] The order defines five major milestones—or critical decision points—that span the life of a project. These critical decision (CD) points are:

- CD-0: Approve mission need.
- CD-1: Approve alternative selection and cost range.
- CD-2: Approve project performance baseline.
- CD-3: Approve start of construction.
- CD-4: Approve start of operations or project completion.

The order specifies requirements that must be met, along with the documentation necessary, to move a project past each CD point. In addition, the order requires senior management to review the supporting documentation and decide whether to approve the project at each CD.

[17]NNSA, *Policy Letters: NNSA Policies, Supplemental Directives, and Business Operating Procedures,* NA SD 251.1 (Washington, D.C.: July 5, 2011).

[18]DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets,* (November 2010). DOE's project management order applies to programs only in conjunction with a program's acquisition of capital assets.

[19]A project's performance baseline consists of three interrelated targets—scope, cost, and completion date. A project's scope defines its technical goals and includes targets for specific technical requirements that the project is to deliver at completion.

DOE also provides suggested approaches for meeting the requirements contained in Order 413.3B through a series of guides, such as guides for project reviews and risk management.

The order includes several cost estimating requirements for projects. Specifically, the order requires:

- a cost estimate be provided at each CD point;
- the degree of rigor and detail for a cost estimate be carefully defined, depending on the degree of confidence in project scale and scope that is reasonable to expect at that stage;
- a cost estimate range for CD-0 and 1 explicitly noting any relevant caveats concerning uncertainties; and
- a program sponsor never be the sole cost estimator at any critical decision given the inherent conflict of interest, and a second cost estimator should come from outside of the line manager's chain of command to avoid conflict of interest.

The order also establishes requirements for the review of cost estimates for certain projects at CD-0 through CD-3, depending on the estimated cost of the project. Table 1 shows these requirements and an NNSA requirement for review.

Table 1: DOE and NNSA Critical Decision Review Requirements for Projects

Critical decision (CD)	Action required	Source of requirement	Office responsible[a]	
CD-0	Independent cost review	DOE Order 413.3B	Office of Acquisition and Project Management (OAPM)	Required for projects with a total estimated cost of $750 million or greater, or for projects as designated by the DOE (or NNSA) acquisition executive responsible for the project.
CD-1	Independent cost estimate OR independent cost review	DOE Order 413.3B	OAPM	Required for projects with a total estimated costs of $100 million or greater or as OAPM deems appropriate.
CD-2	Independent cost estimate	DOE Order 413.3B	OAPM	Required for projects with a total estimated costs of $100 million or greater.

Critical decision (CD)	Action required	Source of requirement	Office responsible[a]	
CD-2	Independent cost review OR independent cost estimate	National Nuclear Security Administration (NNSA) Business Operating Procedure 06.03	NNSA Office of Acquisition and Project Management	Independent cost estimate or independent cost review required for projects with a total estimated cost greater than $20 million and less than $100 million.[b]
CD-3	Independent cost estimate	DOE Order 413.3B	OAPM	Required for projects with a total estimated cost greater than or equal to $100 million if warranted by risk and performance indicators, or as designated by the DOE (or NNSA) acquisition executive responsible for the project.[c]

Source: GAO | GAO-15-29

[a]Order 413.3B currently refers to the Office of Engineering and Construction Management as the office responsible for conducting these independent reviews. OECM was replaced as part of DOE's reorganization in June 2012 by OAPM.

[b]NNSA Business Operating Procedure 06.03, Independent Cost Estimating Procedure, February 27, 2014. According to the procedure, the decision of whether to conduct an ICE or an independent cost review is determined by NNSA's Director of Enterprise Project Management, which is in NNSA's Office of Acquisition and Project Management, in consultation with the NNSA acquisition executive responsible for the project.

[c]In addition to the ICE requirements in Order 413.3B for CD-3, the Consolidated Appropriations Act, 2012, prohibited expenditure of fiscal year 2012 funds to approve CD-2 or CD-3 for construction projects with a total estimated cost of $100 million or greater prior to the development of an ICE. DOE officials treat this as an ongoing requirement.

As a supplement to Order 413.3B, DOE provides guidance for the development of cost estimates in its Cost Estimating Guide, which was issued in May 2011.[20] According to the guide, its purpose is to provide uniform guidance and best practices that describe recommended methods and procedures that projects and programs could use for preparing cost estimates. The guide states that it is based on accepted industry practices and processes, including practices outlined in our 2009 Cost Estimating and Assessment Guide, to meet federal and DOE requirements.[21]

[20]DOE Guide 413.3-21, *Cost Estimating Guide*, May 2011. NNSA also issued a cost estimating guide that has many similarities to DOE's cost estimating guide. See NNSA, *Cost Estimating Guide 50.005*, Jan. 11, 2010. According to NNSA officials, the NNSA guide was superseded and replaced by DOE's guide.

[21]GAO-09-3SP.

DOE and NNSA Cost Estimating Requirements and Guidance for Programs

DOE and NNSA cost estimating requirements and guidance for programs are primarily defined in four documents.[22]

- *DOE Order 130.1*. This order requires all DOE and NNSA program budget requests be based on cost estimates that have been thoroughly reviewed and deemed reasonable prior to their inclusion in department budgets.[23]
- *DOE Cost Estimating Guide 413.3-21.* DOE's cost estimating guide is primarily intended for use in managing the phases involved in the acquisition of a capital asset project. However, the guide states that it also could be used by DOE and NNSA programs in preparing cost estimates.
- *NNSA Planning, Programming, Budgeting, and Evaluation (PPBE) Requirements.* NNSA's PPBE process provides a framework for the agency to plan, prioritize, fund, and evaluate its program activities. This process includes a budget validation step to review the process contractors follow in developing program cost estimates for budgeting purposes.[24]
- *NNSA Phase 6.X Process.* NNSA manages life extension programs, including the B61 LEP, according to a process called Phase 6.X that was developed by DOE in collaboration with the Department of Defense.[25] The Phase 6.X process provides NNSA with a framework to conduct and manage LEP activities, including the development and documentation of a program cost estimate.

[22]According to DOE officials, DOE also defines cost estimating requirements and guidance for the procurement of goods and services associated with management of department programs. These cost estimating requirements for procurements require the development of "independent government cost estimates." This report does not assess the cost estimating requirements and guidance associated with procurement activities and instead focuses on cost estimating related to the planning and budgeting for projects and programs. While programs rely on the acquisition of capital assets, this report does not address the effectiveness or efficiency of DOE or NNSA's acquisition process.

[23]DOE Order 130.1, *Budget Formulation,* Sept. 29, 1995.

[24]For more information about NNSA's PPBE process, see GAO, *Modernizing the Nuclear Security Enterprise: NNSA's Reviews of Budget Estimates and Decisions on Resource Trade-offs Need Strengthening*, GAO-12-806 (Washington, D.C.: July 31, 2012).

[25]Department of Defense and Department of Energy, *Procedural Guideline for the Phase 6.X Process* (Washington, D.C.: Apr. 19, 2000).

GAO Cost Estimating Best Practices

Drawing from federal cost estimating organizations and industry, our cost estimating guide provides best practices about the processes, procedures, and practices needed for ensuring development of high-quality—that is, reliable cost estimates.[26] A high-quality cost estimate helps ensure that management is given the information it needs to make informed decisions. The guide identifies the following four characteristics of a high-quality cost estimate. Specifically, such an estimate is:

- **Credible** when it has been cross-checked with an ICE, the level of confidence associated with the point estimate has been identified through the use of risk and uncertainty analysis, and a sensitivity analysis has been conducted;[27]
- **Well-documented** when supporting documentation is accompanied by a narrative explaining the process, sources, and methods used to create the estimate and contains the underlying data used to develop the estimate;
- **Accurate** when it is not overly conservative or too optimistic and based on an assessment of the costs most likely to be incurred; and
- **Comprehensive** when it accounts for all possible costs associated with a project, it contains a cost estimating structure in sufficient detail to ensure that costs are neither omitted nor double-counted, and the estimating teams' composition is commensurate with the assignment.

To develop a cost estimate that embodies these four characteristics, our cost estimating guide lays out 12 best practice steps. For example, one step—determining the estimating structure—includes the need to develop a "product-oriented" work breakdown structure (WBS) that reflects the requirements and basis for identifying resources and tasks necessary to accomplish the project's objectives. A product-oriented WBS is organized to reflect the cost, schedule, and technical performance of project components. Such a WBS allows a project to track cost by defined deliverables, promote accountability by identifying work products that are independent of one another, and provides a basis for identifying

[26]GAO-09-3SP.

[27]A risk and uncertainty analysis assesses the variability in the cost estimate from such effects as schedules slipping, missions changing, and proposed solutions not meeting users' needs. A sensitivity analysis examines the effect of changing one assumption related to each project activity while holding all other variables constant in order to identify which variable most affects the cost estimate.

resources and tasks for developing a cost estimate. Table 2 shows the four characteristics of a high-quality cost estimate with the corresponding steps.

Table 2: Four Characteristics of a High-Quality Cost Estimate with Corresponding Best Practices

Characteristic	12 best practice steps
Credible	• Compare the point estimate to an independent cost estimate[a] • Conduct sensitivity analysis • Conduct risk and uncertainty analysis
Well-documented	• Define the estimate's purpose, scope, and schedule • Define the program's characteristics • Identify ground rules and assumptions • Obtain the data • Document the estimate • Present the estimate to management for approval
Accurate	• Develop the point estimate[a] • Update the estimate to reflect actual costs and changes
Comprehensive	• Develop the estimating plan • Determine the estimating structure

Source: GAO | GAO-15-29

[a]As described in the GAO Cost Estimating and Assessment Guide, developing the point estimate and comparing it with an independent cost estimate are separate parts of a single step. For purposes of assessing the extent to which a cost estimate achieves the characteristics of a high-quality cost estimate, developing the point estimate contributes to accuracy, and comparing the point estimate with an independent cost estimate contributes to credibility.

Federal Standards for Internal Controls

In addition to the requirements for cost estimating established by DOE and NNSA, according to *Standards for Internal Control in the Federal Government*, federal agencies are to employ internal control activities, such as functional reviews by management of projects and programs to compare actual performance to planned or expected results throughout the organization and analyze significant differences. Such reviews, which may include reviews of program cost estimates, are to help ensure that management's directives are carried out and to determine if agencies are effectively and efficiently using resources.[28]

[28]GAO, *Standards for Internal Control in the Federal Government*, GAO/AIMD-00-21.3.1 (Washington, D.C.: November 1999).

DOE and NNSA Cost Estimating Requirements and Guidance Generally Do Not Reflect Best Practices for Developing Cost Estimates

DOE and NNSA cost estimating requirements and guidance for projects and programs generally do not reflect best practices for developing cost estimates. For projects, DOE requires one best practice, and DOE's cost estimating guide does not fully reflect cost estimating best practices, and is not mandatory. For programs, DOE does not require the use of any of the best practices to develop cost estimates, and NNSA has taken steps to close gaps in the existing cost estimating framework for programs, such as creating a cost analysis office, but these steps have not included a requirement to use best practices.

Projects Are Not Required to Meet Most Best Practice Steps, and Guidance Describes Most Best Practice Steps but Is Not Mandatory

DOE and NNSA cost estimating requirements and guidance for projects generally do not reflect best practices for developing cost estimates. DOE's 2010 project management order requires the use of only 1 of the 12 cost estimating best practice steps. Specifically, the order requires an ICE be prepared at CD-2 and CD-3 for projects with an estimated cost of $100 million or greater. The order requires the development of an ICE at CD-3 if warranted by risk and performance indicators or as designated by DOE or NNSA management. In addition, NNSA's 2014 requirement for an ICE or independent cost review could subject additional projects with an estimate of a cost of less than $100 million to an ICE, but this would depend on whether NNSA chooses to conduct an ICE rather than the less rigorous independent cost review. None of the other cost estimating requirements in the order, such as the need for a cost estimate at each CD point, ensure that project cost estimates will be prepared in accordance with cost estimating best practices. For example, the order does not require any of the other 11 best practice steps such as conducting a risk and uncertainty analysis, identifying ground rules and assumptions, documenting the estimate, developing a point estimate, or determining the estimating structure. According to the DOE officials responsible for developing DOE's project management order, DOE has chosen to not require all cost estimating best practices in the order and instead includes suggested approaches for developing cost estimates in the DOE cost estimating guide that accompanies the order. However, because neither DOE nor NNSA requires the use of most cost estimating best practices for its projects, it is unlikely that NNSA and its contractors will consistently develop reliable cost estimates.

DOE's 2011 cost estimating guide describes most best practices, but it is not mandatory and it is not referenced in the order. We found that the

guide fully or substantially describes 10 of the 12 best practices. However, the guide only partially or minimally contains information about the other 2 best practice steps—determining the estimating structure and conducting a sensitivity analysis.[29] For the estimating structure, the guide only partially describes how to develop this structure, which primarily involves establishing an adequate WBS. For example, we found that the guide describes the need for a WBS, but it does not describe the need for a product-oriented WBS and does not provide enough information on how to create a WBS.[30] For the sensitivity analysis, the guide only minimally describes the information needed. For example, the guide suggests briefing management on the results of a sensitivity analysis, but it does not address the best practice steps on how to perform a sensitivity analysis. As a result, DOE and NNSA have not provided its contractors with all the detailed guidance needed to consistently develop reliable cost estimates. When we discussed our analysis of this guide and the shortcomings we found in regard to the guide with the DOE officials responsible for developing the guide, they said that they would review our analysis and consider revisions to the guide as appropriate. Appendix I provides a comparison of the extent to which DOE's cost guide contains information on the 12 best practice steps.

In addition to the shortcomings in the description for two of the best practices, the use of the guide is not mandatory and, as a result, neither NNSA staff nor its contractors who develop cost estimates are required to use it. The guide states that it does not impose any new cost estimating requirements or establish departmental policy; it describes only suggested recommended approaches for preparing cost estimates. Further, DOE's cost estimating guide is not referenced in the order. To supplement DOE's project management order, DOE has issued a series of guides that provide suggested approaches to meeting the

[29]The ratings we used in this analysis are as follows: "Fully" means that the guide included information that satisfied the best practice; "Substantially" means that the guide included the majority of the information to satisfy the best practice; "Partially" means that the guide included information satisfying part of the best practice; "Minimally" means that the guide included information satisfying a minor part of the best practice; and "Not" means that the guide did not include any information that satisfied the best practice.

[30]OAPM issued a WBS handbook in August 2012 to provide federal project directors and contractors suggested guidance and best practices for developing a product-oriented WBS that should be used for all projects within DOE. However, the handbook is not referenced in DOE's project management order and, as noted in the handbook, it does establish any new project requirements.

requirements, some of which are specified in the order. There are a total of 18 separate guides, including guides that provide suggested approaches on topics such as systems engineering, earned value management systems, and project closeout.[31] The order references some of these guides as appropriate so that the user of the order is made aware of the existence of the suggested approaches that are included in the guides. However, because the cost guide was issued in 2011, a year after DOE's latest version of the order was issued, the order contains no reference to this guide that a preparer of a cost estimate could use in developing an estimate, or that a reviewer could use in reviewing one, and users of the order may not be aware of the guide's availability and may not benefit from its usefulness.

Programs Are Not Required to Meet Any Cost Estimating Best Practices

DOE and NNSA programs are not required to meet any cost estimating best practices. NNSA officials explained that NNSA cost estimating practices for programs are limited, de-centralized, and inconsistent, and are not governed by a cost estimating policy or single set of NNSA requirements and guidance. According to these officials, each NNSA program office uses different practices and procedures for the development of cost estimates that are included in the NNSA annual budget. In addition, these officials also explained that, while there are no specific requirements on how program cost estimates should be developed or reviewed, all NNSA programs must follow DOE's budget formulation order and NNSA's PPBE process, but the order does not require, and the PPBE process does not direct the use of best practices in developing cost estimates. In 2012, we reported on NNSA's PPBE process, and we noted significant deficiencies in NNSA's implementation of its PPBE process.[32] Specifically, we found that the process does not ensure the development of fully credible program cost estimates, and that the review of the cost estimates supporting DOE's budget was not sufficiently thorough to ensure the credibility and reliability of NNSA's budget estimates. We also found that NNSA was not following DOE's budget formulation order that requires that budget requests be based on

[31]An earned value management system compares the value of the work accomplished during a given period with the value of the work scheduled to be accomplished during that period. Differences from the scheduled work plan are measured in both cost and schedule variances. Such a system tracks whether completed activities are costing more or less than expected.

[32]GAO-12-806.

cost estimates that have been thoroughly reviewed and deemed reasonable by the cognizant program organization. NNSA officials told us that they do not follow DOE's budget formulation order because it expired in 2003. Additionally, according to NNSA officials, NNSA's trust in its contractors minimizes the need for formal review of its budget estimates.

In our 2012 report on the NNSA's PPBE process we recommended that, among other things, DOE update the departmental order for budget reviews, improve the formal process for reviewing budget estimates, and reinstitute an independent analytical capability to provide senior decision makers with independent program reviews. The agency agreed in principle with these recommendations, but it has not taken action to fully implement them. According to NNSA officials, as of August 2014, NNSA has suspended the budget review process and several options for replacing this process are under review.

In the absence of a DOE or NNSA requirement for programs to follow cost estimating best practices, we found that managers for the programs we reviewed—the B61 LEP and the Plutonium Disposition Program—used different processes in developing cost estimates for these programs. Specifically:

- **B61 LEP.** NNSA managers for the B61 LEP use the Phase 6.X Process which, among other things, involves the direction to establish a cost and schedule baseline for the program. However, according to the NNSA B61 LEP project manager, since the Phase 6.X Process does not define how cost estimates should be developed, the B61 management team developed an approach for developing cost estimates for the program using various sources, including direction under the Phase 6.X Process, as well as DOE's project management order and cost guide and our cost-estimating guide. This effort resulted in the management team producing a document that defines the strategy and provides guidance for completing the cost estimate for the B61 LEP. We reviewed this document and found that it does not stipulate that NNSA program managers or its contractors must follow any DOE or NNSA requirements or guidance for the development of a program cost estimate when developing the estimate for the B61 LEP.
- **Plutonium Disposition Program.** In February 2014, we found that NNSA's life-cycle cost estimate for the Plutonium Disposition Program

did not follow all key steps for developing high-quality cost estimates in part because it did not have a requirement to develop a life-cycle cost estimate[33]. According to NNSA officials, DOE's project management order includes requirements for development of cost and schedule estimates for a capital asset project, such as the MOX facility or Waste Solidification Building, but does not specify equivalent requirements for a program like Plutonium Disposition, which includes multiple projects as well as supporting activities. As a result, when developing the life-cycle cost estimate for the Plutonium Disposition Program, NNSA officials used an ad hoc approach to adapt DOE requirements for managing projects in DOE's project management order. NNSA officials also said that its April 2013 life-cycle cost estimate did not include all the steps of a high-quality, reliable estimate in part because NNSA considered the estimate to be draft and therefore had not fully implemented plans for developing it. We recommended in this report that DOE conduct a root cause analysis of the Plutonium Disposition Program's cost increases and ensure that future estimates of the program's life-cycle cost and schedule for the program meet all best practices for reliable estimates. We also recommended that DOE revise its project management order to require life-cycle cost estimates covering the full cost of programs that include both construction projects and other efforts and activities not related to construction. DOE concurred with recommendations to analyze the programs cost increases and revise and update the program life-cycle cost estimate following best practices. DOE did not agree to update its project management order to require life-cycle cost estimates of programs. However, we continue to believe that this recommendation has merit and should be fully implemented.

NNSA took some actions to improve independent review and analysis of program estimates. For example, in April 2013, NNSA created the Office of Program Review and Analysis. According to NNSA, this office is intended to improve NNSA's ability to plan and budget by providing senior leadership independent advice on resource allocations to ensure the best use of the agency's resources, including evaluating cost estimates of NNSA projects and programs.

DOE and NNSA began taking some actions to improve cost estimating. For example, DOE OAPM has embarked on a Cost Estimating and

[33]GAO-14-231.

Scheduling Initiative to systematically improve DOE's policies and guidance. Some of the near term efforts include development of a Life-Cycle Cost handbook, a Key Performance Parameters and Statement of Work handbook, and Analysis of Alternatives guidance. In addition, NNSA's Office of Defense Programs has taken steps to fill the existing gaps in the cost estimating framework for programs. For example, in 2011, Defense Programs established an Office of Cost Policy and Analysis to provide it with a cost analysis capability. In March 2014, NNSA's Office of Program Integration issued a cost estimating improvement plan, which includes proposed guidance for conducting cost estimate briefings to the Office of Defense Programs Assistant Deputy Administrator, establishing a defense programs database, and implementing various process improvements to improve cost accounting and performance. While these efforts are intended to improve, among other things, cost estimating practices, none of these efforts include establishing requirements to follow cost estimating best practices.

Project Reviews Indicate Cost Estimating Weaknesses and Program Reviews Are Not Required and Therefore the Extent of Weaknesses Is Largely Unknown

NNSA's project and program reviews for fiscal years 2009 to 2014 identified cost estimating weaknesses that can be attributed to not following best practices. DOE and NNSA require reviews of projects, including reviews of cost estimates at various CD points and at the discretion of project managers; however, because DOE and NNSA do not require reviews of program cost estimates, the extent of weaknesses in program cost estimates is largely unknown.

Project Reviews Identified Cost Estimating Weaknesses That Can Be Attributed to Not Following Best Practices

Of the 50 NNSA project reviews conducted from February 2009 through February 2014, 39 identified a total of 113 cost estimating weaknesses. We determined that 71 of the 113 weaknesses—or about 63 percent—can be attributed to not following 4 of the 12 best practice steps. These four steps are:

- determining the estimating structure,
- identifying ground rules and assumptions,

- conducting risk and uncertainty analysis, and
- documenting the estimate.

For example, as part of this review, we examined NNSA's 2012 independent review of the Nuclear Material Safeguards and Security Upgrades Project at Los Alamos National Laboratory and it identified three weaknesses, one of which can be attributed to not following the best practice of updating the estimate to reflect actual costs and changes. In particular, the review found deficiencies in the estimate that could lead to an inaccurate cost and schedule estimate for the project. In another example, a 2012 review of NNSA's Waste Solidification Building identified four weaknesses, including not following the best practice of conducting risk and uncertainty analysis. Several other reviews that we examined found similar weaknesses in project cost estimating. For example, the 2012 Independent Project Review of the MOX Fuel Fabrication Facility at the Savannah River Site identified flaws in the project's cost estimate that include: (1) basic assumptions concerning project reserves and contingency cost; (2) data reliability of cost information considering the design maturity of the project; (3) the sensitivity analysis; and (4) the project risk analysis. The review also concluded that the most significant risk to the project's success was NNSA's under-estimation of the cost to complete the facility.

We also found that the remaining 42 weaknesses could be attributed to not following seven other best practice steps. These best practices are

- developing an estimating plan,
- defining program characteristics,
- obtaining data,
- developing a point estimate and comparing it to an ICE,
- conducting a sensitivity analysis,
- presenting the estimate to management for approval, and
- updating the estimate to reflect actual costs and changes.

Appendix II includes the cost estimating weaknesses we identified for each of the project reviews we assessed and the best practice step not followed to which the weakness can be attributed to not following.

Program Reviews Are Limited to LEPs So the Extent of Cost Estimating Weaknesses in NNSA Programs Is Largely Unknown

DOE and NNSA do not require reviews of programs, including reviews of program cost estimates. As a result, reviews of cost estimates for programs are limited, and the extent to which program cost estimates have weaknesses is largely unknown. While program reviews are not required, we identified and analyzed three LEP program reviews from the beginning of fiscal year 2009 through February 2014, two of which were reviews of the B61 LEP. These identified several weaknesses in the cost estimates for this program that can be attributed to not following three best practice steps: (1) obtaining data, (2) defining program characteristics, and (3) determining the estimating structure. For example, both reviews identified weaknesses in obtaining the data needed to compile the B61 cost estimate. In addition, one of the reviews noted that the estimate was not based on a sound program definition, while the other review stated that a standard WBS was not used to develop the B61 LEP cost estimate. Both reviews concluded that the B61 cost estimate is inaccurate, with one review noting that the program will cost approximately $3.6 billion more than NNSA's 2011 $6.5 billion Weapon Design and Cost Report estimate.

While we did not identify any additional reviews of cost estimates for NNSA programs, we reported in February 2014 on the results of our review of the cost estimates for the Plutonium Disposition Program.[34] We concluded that the life-cycle cost estimate for the overall program was not reliable and found that it did not fully reflect the characteristics of high-quality, reliable estimates as established by best practices. Specifically, in developing its April 2013 draft life-cycle cost estimate of $24.2 billion for the Plutonium Disposition Program, we found that NNSA followed several cost estimating best practices; including obtaining the data, defining the estimate's purpose, and defining the program's characteristics. However, we also found that NNSA did not follow other key steps such as conducting an independent cost estimate and, as a result, the estimate was not reliable. We recommended, among other things, that NNSA revise and update the program's life-cycle estimate using cost estimating best practices, including conducting an independent cost estimate. NNSA agreed with this recommendation.

Without a requirement for conducting program reviews, NNSA does not have the appropriate internal controls necessary for assessing program

[34] GAO-14-231.

performance. According to the *Standards for Internal Control in the Federal Government*, federal agencies are to employ internal control activities, such as functional reviews by management of projects and programs to compare actual performance to planned or expected results throughout the organization and analyze significant differences. Such reviews are to help ensure that management's directives are carried out and to determine if agencies are effectively and efficiently using resources.

Conclusions

DOE and NNSA have taken action in recent years to improve cost-estimating practices, including the corrective actions that were implemented as part of the department's 2008 root-cause analysis, which DOE later reported as having effectively mitigated most of the root causes of the most significant contract and project management challenges. Nonetheless, NNSA continues to struggle with significant cost overruns on its major projects. Because DOE does not require the use of most of the 12 cost estimating best practices for its projects and programs, it is unlikely that NNSA and its contractors will consistently develop reliable cost estimates. In addition, while DOE has developed a cost estimating guide, it does not fully describe all 12 cost estimating best practices. As a result, DOE and NNSA have not provided its contractors with all the detailed guidance needed to consistently develop reliable cost estimates. Also, because DOE Order 413.3B has not been updated since 2010, it omits reference to the supplemental cost estimating guide; users of the order may not be aware of the guide's availability and may not benefit from its usefulness. Finally, without a requirement for conducting reviews of programs with project-like characteristics, including the life-cycle cost estimates of these programs, neither DOE nor NNSA have appropriate internal controls to assess the quality of program performance over time.

Recommendations for Executive Action

To enhance NNSA's ability to develop reliable cost estimates for its projects and for its programs that have project-like characteristics, we recommend the Secretary of Energy take the following five actions:

- Revise DOE's project management order to require that DOE, NNSA, and its contractors develop cost estimates in accordance with the 12 cost estimating best practices.
- Revise DOE's cost estimating guide so that it fully reflects the 12 cost estimating best practices.

- Revise DOE's project management order to include references to the DOE cost estimating guide, where applicable.
- Revise DOE directives that apply to programs to require that DOE and NNSA and its contractors develop cost estimates in accordance with the 12 cost estimating best practices, including developing life-cycle cost estimates for programs.
- Revise DOE requirements and guidance that apply to programs to ensure that program reviews are conducted periodically, including reviews of the life-cycle cost estimates for programs.

Agency Comments

We provided DOE with a draft of this report for its review and comment. In its written comments, reproduced in appendix III, DOE agreed with the report's recommendations. In regard to the report's first recommendation—revise DOE's project management order to require that DOE, NNSA, and its contractors develop cost estimates in accordance with the 12 cost estimating best practices—DOE stated in its written comments that DOE's order for project management (DOE O 413.3B) will be assessed for revision following the issuance of the revision to DOE-STD-1189, Integration of Safety into the Design Process, currently scheduled for November 2016. DOE stated that it has established a log of issues to be addressed when revising Order 413.3B, which includes this recommendation. DOE also stated that this recommendation will be fully considered during this revision process. In the interim, DOE stated that its cost estimating guide incorporates the 12 cost estimating best practices, albeit not in the same format as our guidance. DOE also stated that it has begun internal efforts for the publication of a Departmental Cost Estimating and Schedule Policy and that the policy will complement existing cost estimating guidance and will incorporate our cost estimating guidance. DOE stated that the time frame for this policy to be issued is still to be determined. Further, DOE stated that DOE's Office of Acquisition and Project Management will continue to incorporate the 12 cost estimating best practices in its independent cost estimating activities. Additionally, DOE explained that the curriculum of the Project Management Career Development Program requires cost and schedule estimating courses and that this training incorporates the 12 cost estimating best practices. We are pleased that DOE agreed with our recommendation and that it has interim measures to improve cost estimating before it plans to implement the recommendation. However, while these may be useful interim measures, the unspecified, open-ended date for updating the project management order that contains requirements (i.e., sometime after November 2016) and the statement that the cost estimating best practices will be considered, not

incorporated, may indicate DOE's lack of urgency or concern about the need to implement this recommendation.

In regard to the report's second recommendation—revise DOE's cost estimating guide so that it fully reflects the 12 cost estimating best practices—DOE stated in its written comments that it will begin updating the cost estimating guide in the first quarter of fiscal year 2015. The update efforts are to elevate the significance of the 12 cost estimating best practices within the content of the guide, although DOE did not specify when it might complete this update. We are pleased that DOE agreed with our recommendation and that it plans to take action during the current quarter of this fiscal year. However, we are concerned that in its written comments DOE did not specify whether it plans to revise the guide to better include the two areas in the guide we found were deficient and that the lack of a completion date may indicate DOE's lack of urgency or concern about the need to implement this recommendation.

In regard to the report's third recommendation—revise DOE's project management order to include references to the DOE cost estimating guide, where applicable—DOE stated in its written comments that its project management order will be assessed for revision following the issuance of the revision to DOE-STD-1189, currently scheduled for November 2016, and that this recommendation will be fully considered during the order revision process. In the interim, DOE stated that its directives website points to the guides that accompany Order 413.3B as the best practices guidance for implementation of Order 413.3B requirements. We are pleased that DOE agreed with our recommendation and that its website includes links to the guides that accompany the project management order. However, our report noted the deficiencies associated with the existing cost estimating guide, and DOE did not specify plans for addressing those deficiencies. In addition, we are concerned that the unspecified, open-ended date for updating the project management order that contains requirements (i.e., sometime after November 2016) and the statement that referencing the cost estimating guide will be considered, not completed, may indicate DOE's lack of urgency or concern about the need to implement this recommendation.

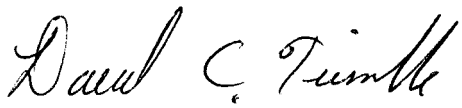
In regard to the report's fourth recommendation—revise DOE directives that apply to programs to require that DOE and NNSA and its contractors develop cost estimates in accordance with the 12 cost estimating best practices, including developing lifecycle cost estimates for programs—DOE stated in its written comments that it is in the process of substantially revising the existing 1995 DOE Order 130.1, Budget

Formulation, and that as part of this effort, DOE will assess the requirement for program cost estimates and will revise the order to provide more specificity on the cost estimating requirements. Further, DOE stated that the revised order will (1) define which DOE and NNSA program budget requests require cost estimates and (2) clarify that cost estimates for program budget submissions shall be conducted in accordance with the DOE cost estimating guide (or its successor policy). DOE estimated that it would complete this process in September 2016. We are pleased that DOE agreed with our recommendation.

In regard to the report's fifth recommendation—revise DOE requirements and guidance that apply to programs to ensure that program reviews are conducted periodically, including reviews of the lifecycle cost estimates for programs—DOE again stated that it is in the process of substantially revising the existing DOE Order 130.1, and that as part of this effort, the department will assess requirements for program reviews and the linkage between program reviews and the budget formulation process. Further, DOE stated that the revised order will clarify requirements for program reviews and specify how such reviews—to include lifecycle cost estimates—can best support the budget formulation process. NNSA is to review these requirements and adjust NNSA-specific policies and guidance as appropriate. DOE estimated that it would complete this process in September 2016. We are pleased that DOE agreed with our recommendation.

We are sending copies of this report to the appropriate congressional committees; the Secretary of Energy; the Director, Office of Management and Budget; and other interested parties. In addition, the report is available at no charge on the GAO website at http://www.gao.gov.

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



David C. Trimble
Director, Natural Resources and Environment

Appendix I: Comparison of DOE Cost Guide to GAO's Best Practices for Cost Estimating

12 key steps/best practices	Fully	Substantially	Partially	Minimally	Not
Define estimate's purpose, scope, and schedule.	•				
Develop the estimating plan.	•				
Define the program.		•			
Determine the estimating approach—work breakdown structure (WBS).			•		
Identify the ground rules and assumptions.		•			
Obtain the data.		•			
Develop the point estimate and compare it to an independent cost estimate.	•				
Conduct sensitivity analysis.				•	
Conduct risk and uncertainty analysis.		•			
Document the estimate.	•				
Present the estimate to management.		•			
Update the estimate to reflect actual costs and changes.	•				

Source: GAO analysis of DOE Guide 413.3-21 (2011) | GAO-15-29

Note: The ratings we used in this analysis are as follows: "Fully" means that the guide included information that satisfied the best practice; "Substantially" means that the guide included the majority of the information to satisfy the best practice; "Partially" means that the guide included information satisfying part of the best practice; "Minimally" means that the guide included information satisfying a minor part of the best practice; and "Not" means that the guide did not include any information that satisfied the best practice.

Appendix II: Cost Estimating Weaknesses Identified in All Completed NNSA Project Reviews February 2009 - February 2014 and GAO's Best Practices for Cost Estimating

#	Review type	Review date	GAO 12 steps (see table legend)												Total weak-nesses
			1	2	3	4	5	6	7	8	9	10	11	12	
Idaho National Laboratory															
Material Security and Consolidation Project															
1	Independent project review	2009			●					●	●				3
Kansas City Plant															
Responsive Infrastructure Manufacturing & Sourcing & National Secure Manufacturing Center Occupancy Project															
2	Peer review	2011													0
Los Alamos National Laboratory															
Chemistry and Metallurgy Research Replacement Facility															
3	Independent project review	2010													0
4	Independent project review	2011					●				●				2
Los Alamos Neutron Science Center Refurbishment Project															
5	Independent project review / independent cost review	2009					●				●	●			3
Nuclear Materials Safeguards and Security Upgrades Project Phase I & II															
6	Independent project Review	2009													0
7	Peer review	2011							●					●	2
8	Peer review	2012					●	●						●	3
9	Peer review	2013					●				●				2
Radioactive Liquid Waste Treatment Facility Upgrades Project															
10	Independent cost estimate	2010						●				●			2
11	Independent project review	2010			●	●	●				●				4
12	Independent cost review	2012			●		●		●	●		●		●	6
13	Independent project review	2012									●				1
TA-55 Reinvestment Project - Phase II															
14	Independent project review	2009		●	●	●			●			●			5
Transuranic (TRU) Waste Facility															
15	Independent project review	2010		●		●	●				●				4
16	Independent project review	2011					●							●	2
17	Independent cost estimate	2013							●						1
Sanitary Effluent Reclamation Facility Expansion															
18	Independent project review	2009													0
Science and Engineering Complex															
19	Independent project review	2009		●	●	●			●	●					5

#	Review type	Review date	GAO 12 steps (see table legend)												Total weak-nesses
			1	2	3	4	5	6	7	8	9	10	11	12	
Nevada National Security Site															
Device Assembly Facility Argus Installation Project															
20	Independent cost review	2013			●						●				2
Pantex Plant															
High Explosives Pressing Facility															
21	Peer review	2012									●				1
22	Peer review	2013													0
Operations Systems Development and Integration Project															
23	Independent project review	2009			●	●	●	●			●	●			6
24	Independent project review	2010					●					●			2
Pantex Renewable Energy Project															
25	Independent project review	2009			●	●	●			●	●	●			6
26	Independent project review	2009				●	●								2
Sandia National Laboratory															
Test Capabilities Revitalization Project															
27	Independent project review	2011										●	●	●	3
Savannah River Site															
Mixed Oxide (MOX) Oxide Fuel Fabrication Facility Project															
28	Independent project review	2009				●					●				2
29	Peer review	2011					●			●				●	3
30	Independent project review	2012					●	●		●	●			●	5
31	Peer review	2012					●				●				2
Pit Disassembly and Conversion Project															
32	Independent project review	2010			●	●					●				3
Waste Solidification Building Project															
33	Independent project review	2010													0
34	Peer review	2011		●		●						●			3
35	Peer review	2012					●	●			●	●			4
36	Peer review	2012					●	●				●			3
37	Construction project review	2012					●								1
38	Construction project review	2013				●	●				●	●			4
Y-12 Security Complex															
Nuclear Facility Risk Reduction Project															
39	Independent project review	2009				●	●								2
40	Independent project review	2010													0
41	Independent project review	2011													0

#	Review type	Review date	GAO 12 steps (see table legend)												Total weak-nesses
			1	2	3	4	5	6	7	8	9	10	11	12	
42	Construction project review	2013									●				1
Security Improvements Project															
43	Independent project review	2009			●	●									2
Uranium Processing Facility															
44	Independent cost estimate	2010				●	●				●				3
45	Independent project review	2010					●			●	●				3
46	Independent cost estimate	2011				●	●	●				●			4
47	Independent project review	2011								●					1
48	Independent project review	2012													0
49	Other	2012													0
50	Peer review	2013													0
	Total Weaknesses		**0**	**4**	**10**	**15**	**23**	**7**	**5**	**8**	**20**	**13**	**1**	**7**	**113**

Source: GAO analysis of National Nuclear Security Administration project reviews. | GAO-15-29.

[a]The 2013 Independent Cost Estimate (ICE) review of the Transuranic (TRU) Waste Facility did not identify the lack of a point estimate and comparison of the estimate to an independent cost estimate as a weakness. However, in our analysis of the ICE review, we found that this step was not completed and have therefore identified it as a weakness.

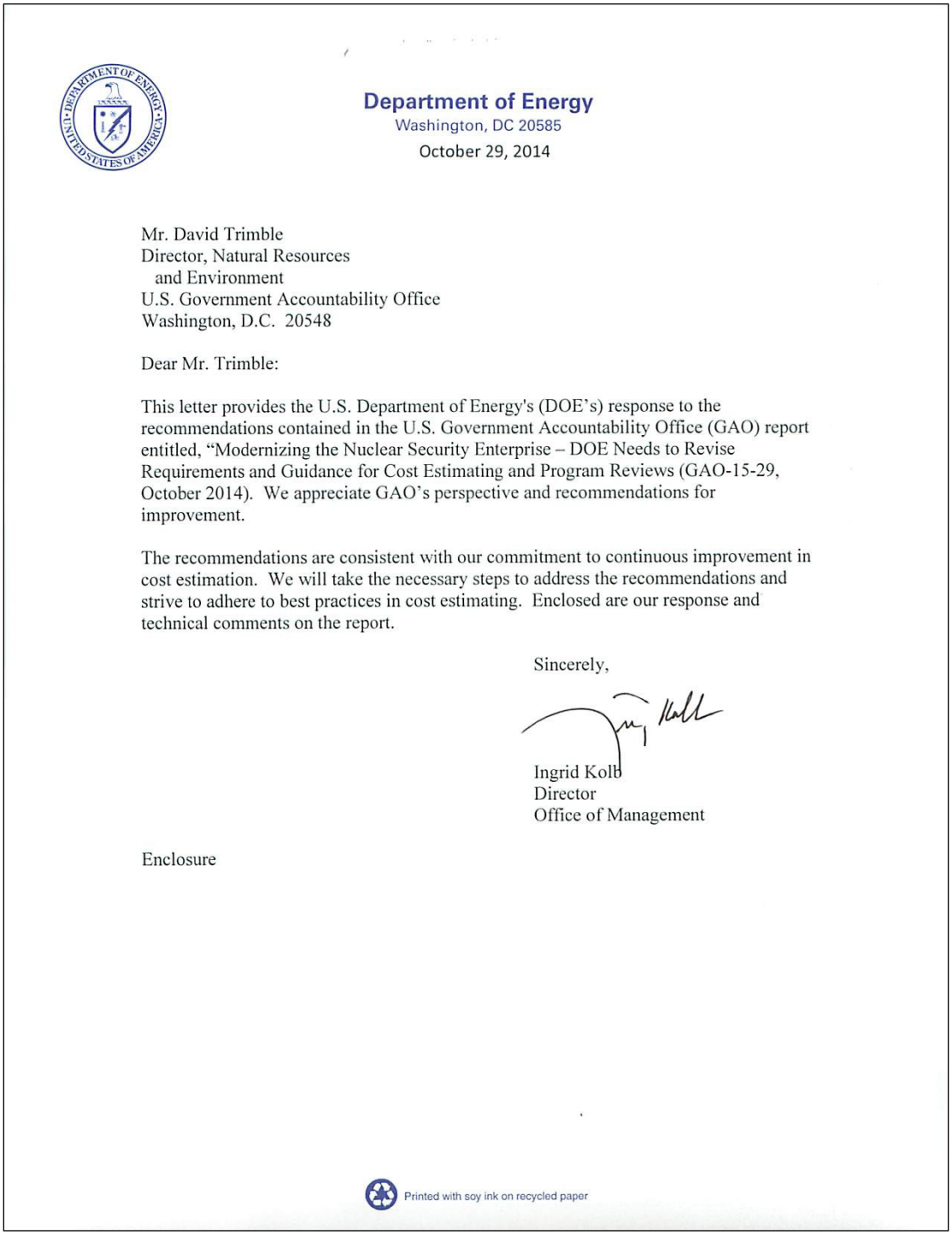
Legend: GAO 12 Best Practice Cost Estimating Steps

Step	Description	Summary of associated tasks
1.	Define estimate's purpose.	Determine purpose, scope, required level of detail of estimate, as well as who will receive estimate.
2.	Develop estimating plan.	Determine cost estimating team, schedule, and outline tasks in writing.
3.	Define program characteristics.	Identify technical characteristics of planned investment, quality of data needed, and plan for documenting and updating information.
4.	Determine estimating structure (WBS).	Define the elements of the cost estimate, including best method for estimating costs and potential cross-checks, and standardized structure.
5.	Identify ground rules and assumptions.	Define what the estimate will include and exclude, key assumptions (such as life-cycle of investment), schedule or budget constraints, and other elements that affect estimate. Assumptions should be measurable, specific, and consistent with historical data. Assumptions should be based on expert and technical judgment.
6.	Obtain data.	Create data collection plan, identify sources, collect valid and useful data, analyze data for cost drivers and other factors, and assess data for reliability and accuracy.
7.	Develop a point estimate and compare it to an independent cost estimate.	Develop cost estimation model and calculate estimate, in constant dollars for investments that occur over multiple years, and other cross checks and validation, and compare estimate to an independent estimate and previous estimates. Update as more data are available.
8.	Conduct sensitivity analysis.	Test the sensitivity of cost elements to changes in input values, ground rules, and assumptions.

Step	Description	Summary of associated tasks
9.	Conduct risk and uncertainty analysis.	Determine which cost elements pose technical, cost, or schedule risks; analyze those risks; and recommend a plan to track and mitigate risks. A range of potential costs, based on risks and uncertainties, should be identified around a point estimate.
10.	Document the estimate.	Document all steps used to develop the estimate so it can be recreated, describing methodology, data, assumptions, and results of risk, uncertainty, and sensitivity analysis.
11.	Present estimate to management for approval.	Develop briefing on results, including information on estimation methods and risks, making content clear and complete so those unfamiliar with analysis can comprehend estimate and have confidence in it.
12.	Update the estimate to reflect actual costs and changes.	As technical aspects of project change, the complete cost estimate should be regularly updated and, as project moves forward, cost and schedule estimates should be tracked.

Source: GAO-09-3SP | GAO-15-29

Appendix III: Comments from the Department of Energy



Department of Energy
Washington, DC 20585
October 29, 2014

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

Dear Mr. Trimble:

This letter provides the U.S. Department of Energy's (DOE's) response to the recommendations contained in the U.S. Government Accountability Office (GAO) report entitled, "Modernizing the Nuclear Security Enterprise – DOE Needs to Revise Requirements and Guidance for Cost Estimating and Program Reviews (GAO-15-29, October 2014). We appreciate GAO's perspective and recommendations for improvement.

The recommendations are consistent with our commitment to continuous improvement in cost estimation. We will take the necessary steps to address the recommendations and strive to adhere to best practices in cost estimating. Enclosed are our response and technical comments on the report.

Sincerely,

Ingrid Kolb
Director
Office of Management

Enclosure

Printed with soy ink on recycled paper

Attachment 1: DOE Responses to Recommendations

The Department has the following responses regarding the draft report's five recommendations.

1. Recommendation: Revise DOE's project management order to require that DOE, NNSA, and its contractors develop cost estimates in accordance with the 12 cost estimating best practices.

   Response: The Departmental order for project management (DOE Order 413.3B) will be assessed for revision following the issuance of the revision to DOE-STD-1189, *Integration of Safety into the Design Process*, currently scheduled for November 2016. The Department has established a log of issues to be addressed when revising Order 413.3B, which includes GAO's recommendation. The recommendation to require that cost estimates follow the GAO best practices will be fully considered during this revision process.

   The DOE cost estimating guide (DOE Guide 413.3-21) already incorporates the twelve cost estimating best practices, albeit not in the same format as the GAO Guidance. The crosswalk to the GAO twelve cost estimating best practices is found in Appendices J and L of the Guide. Additionally, DOE has begun internal efforts for the publication of a Departmental Cost Estimating and Schedule Policy. This policy will complement the existing cost estimating guidance and will incorporate GAO's cost estimating guidance. The timeframe for the Policy to be finalized through the Department's directives process is still to be determined.

   DOE's Office of Acquisition and Project Management (OAPM) will continue to incorporate the twelve cost estimating best practices in its independent cost estimating activities. Currently, the standard operating procedures for independent cost estimates, independent cost reviews and external independent reviews within OAPM incorporate the twelve cost estimating practices. Additionally, the curriculum of the Project Management Career Development Program requires cost and schedule estimating courses for individuals pursuing certification as Federal Project Directors; this training incorporates the twelve cost estimating best practices.

2. Recommendation: Revise DOE's cost estimating guide so that it fully reflects the 12 cost estimating best practices.

   Response: The Department will begin updating the cost estimating guide in the first quarter of FY 2015. The DOE cost estimating guide already incorporates the twelve cost estimating best practices albeit not in the same format as the GAO Guidance. The cross-walk to the GAO twelve cost estimating best practices is found in Appendices J and L of DOE Guide 413.3-21. The update efforts will elevate the significance of the twelve cost estimating best practices within the content of the guidance.

3. Recommendation: Revise DOE's project management order to include references to the DOE cost estimating guide, where applicable.

   Response: The Departmental order for project management (DOE Order 413.3B) was published before DOE Guide 413.3-21 was issued; therefore, it was not possible to reference the guide. The order will be assessed for revision following the issuance of the revision to DOE-STD-1189, *Integration of Safety into the Design Process*, currently scheduled for November 2016. This recommendation will be fully considered during the order revision process.

   In the interim, the DOE Directives website points to the DOE 413.3 Series Guides as the best practices guidance for implementation of DOE Order 413.3B requirements.

4. Recommendation: Revise DOE directives that apply to programs to require that DOE and NNSA and its contractors develop cost estimates in accordance with the 12 cost estimating best practices, including developing lifecycle cost estimates for programs.

   Response: The Department is in the process of substantially revising the existing DOE Order 130.1, *Budget Formulation*, dated September 29, 1995. As part of this effort, the Department will assess the requirement for program cost estimates and will revise the order to provide more specificity on the cost estimating requirement. The revised order will (1) define which DOE and NNSA program budget requests require costs estimates and (2) clarify that cost estimates for program budget submissions shall be conducted in accordance with the DOE cost estimating guide (or its successor policy). The estimated closure date for this GAO recommendation is September 2016.

5. Recommendation: Revise DOE requirements and guidance that apply to programs to ensure that program reviews are conducted periodically, including reviews of the lifecycle cost estimates for programs.

   Response: The Department is in the process of substantially revising the existing DOE Order 130.1, *Budget Formulation*, dated September 29, 1995. As part of this effort, the Department will assess requirements for program reviews and the linkage between program reviews and the budget formulation process. The revised order will clarify requirements for program reviews and specify how such reviews—to include lifecycle cost estimates—can best support the budget formulation process. NNSA will review these requirements and adjust NNSA-specific policies and guidance as appropriate. The estimated closure date for this GAO recommendation is September 2016.

Appendix IV: 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, Daniel Feehan, Assistant Director; Antoinette Capaccio; Jennifer Echard; Mark Braza; Mike Meleady; Alison O'Neill; and Peter Ruedel made key contributions to this report.