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October 2014

NUCLEAR WEAPONS

Some Actions Have Been Taken to Address Challenges with the Uranium Processing Facility Design

GAO-15-126

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GAO Highlights

Highlights of GAO-15-126, a report to congressional committees

Why GAO Did This Study

NNSA conducts enriched uranium activities—including producing components for nuclear warheads—at the Y-12 National Security Complex in Tennessee. NNSA has identified key shortcomings in the Y-12 plant's current uranium operations, including rising costs due to the facility's age. In 2004, NNSA decided to build a new facility—the UPF—to consolidate and modernize its enriched uranium activities. In July 2012, the UPF contractor concluded that the UPF's processing equipment would not fit into the facility as designed, and that addressing this issue—which NNSA refers to as a "space/fit" issue—would cost an additional $540 million.

The Fiscal Year 2013 National Defense Authorization Act mandated that GAO periodically assess the UPF. This is the fourth report, and it assesses (1) factors NNSA identified that contributed to the UPF space/fit issue and (2) actions, if any, NNSA and the UPF contractor have taken to address the space/fit issue.

GAO reviewed NNSA and contractor documents, visited the Y-12 plant, interviewed NNSA and UPF contractor representatives, and observed the computer model NNSA and the UPF contractor use to track space usage within the facility.

GAO is not making any new recommendations. In commenting on a draft of this report, NNSA generally agreed with GAO's findings.

View GAO-15-126. For more information, contact David C.Trimble at (202) 512-3841 or trimbled@gao.gov.

What GAO Found

In January 2013, the National Nuclear Security Administration (NNSA) completed a review to identify the factors that contributed to the space/fit issue with the Uranium Processing Facility (UPF), and identified a number of factors within both NNSA and the contractor managing the UPF design at that time. NNSA's review identified shortcomings in 1) federal oversight of the project, 2) design integration, 3) communications, and 4) the UPF contractor's management processes and procedures. For example, NNSA determined that it did not have adequate federal staff to perform effective oversight of the project, and that the design inputs for the computer model the contractor used to allocate and track space utilization within the facility were not well integrated. NNSA also found that communications shortcomings occurred because the contractor did not always provide timely notification to the NNSA project office of emerging concerns, and that the contractor's management processes and procedures did not formally identify, evaluate, or act on technical concerns in a timely manner.

NNSA and the UPF contractor took actions to address the factors that contributed to the space/fit issue, and NNSA has begun to share lessons learned from the space/fit issue, consistent with both Department of Energy (DOE) guidance and GAO's prior recommendation to ensure that future projects benefit from lessons learned. Specifically, NNSA has taken actions to improve its oversight of the project by increasing federal staffing levels for the UPF project office from 9 full-time equivalents (FTE) in 2012 to more than 50 FTEs as of January 2014. According to NNSA officials, these additional staff enabled NNSA to conduct more robust oversight of the contractor's design efforts than was previously possible. The contractor also took steps to better integrate the efforts of the four subcontractors that are conducting design and engineering work on different elements of the facility. For example, in late 2012 the contractor hired an engineer to integrate the subcontractors' design work and ensure that all design changes were incorporated into the contractor's computer model. The contractor also improved design integration by developing a monthly assessment process to evaluate and report on space utilization in the facility. In addition, according to an NNSA official, communications between NNSA and the contractor significantly improved after the space/fit issue was identified as the contractor kept NNSA better informed of emerging concerns and its plans to address them. The contractor also developed formal management processes for identifying and tracking the status of major technical and engineering issues. For example, the contractor implemented processes for tracking the identification and resolution of both technical and non-technical issues during the design process. In addition, NNSA has recently begun to share lessons learned from the space/fit issue, consistent with DOE guidance and our prior recommendation to ensure that future projects benefit from lessons learned. For example, in July 2014, the UPF federal project director conducted a presentation on lessons learned from the UPF project, including lessons learned from the space/fit issue, at a training session for NNSA federal project directors.

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Abbreviations

APM	Office of Acquisition and Project Management
B&W	Babcock & Wilcox Technical Services Y-12, LLC
CD	critical decision
CNS	Consolidated Nuclear Security, LLC
DOE	Department of Energy
DPO	Differing Professional Opinion
FTE	full-time equivalent
NNSA	National Nuclear Security Administration
Parsons	Parsons Infrastructure and Technology Group, Inc.
UPF	Uranium Processing Facility
WTP	Waste Treatment and Immobilization Plant

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Washington, DC 20548

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Congressional Committees

The Y-12 National Security Complex in Oak Ridge, Tennessee, is the National Nuclear Security Administration's (NNSA) site for conducting enriched uranium activities, producing uranium-related components for nuclear warheads and bombs, and processing nuclear fuel for the U.S. Navy.[1] According to NNSA documents, the Y-12 plant's current enriched uranium operations, which are conducted in four separate facilities, have key shortcomings including: (1) an inefficient workflow; (2) continually rising operations and maintenance costs due to facility age; and (3) hazardous processes that could expose workers to radiological contamination, among other things. To address these shortcomings, in 2004, NNSA decided to construct a new Uranium Processing Facility (UPF).[2] NNSA planned to construct a single, consolidated facility less than half the size of existing facilities; reduce costs by using modern processing equipment; and incorporate features to increase worker protection and environmental health and safety.[3]

In November 2011, the UPF contractor identified a concern that the facility might not have adequate space to accommodate all processing equipment and, in April 2012, when the UPF contractor assessed the facility's design to be 76 percent complete and planned to begin construction in 2014, the contractor informed NNSA of its space concerns and began working to resolve the issue. By July 2012, the UPF contractor concluded that the UPF's processing equipment would not fit into the

[1] NNSA is a separately organized agency within the Department of Energy (DOE). NNSA owns the buildings, equipment, and the components produced at the Y-12 plant, but the site is operated under contract to NNSA by Consolidated Nuclear Security, LLC (CNS), which is comprised of member companies Bechtel National, Inc., Lockheed Martin Services, Inc., ATK Launch Systems Inc., and SOC LLC, with Booz Allen Hamilton, Inc., as a teaming subcontractor.

[2] CNS is the contractor managing the UPF design. However, prior to July 2014, the UPF design was managed by Babcock & Wilcox Technical Services Y-12, LLC (B&W), a partnership of the Babcock & Wilcox Company and Bechtel National, Inc.

[3] As discussed later in this report, NNSA is reevaluating its Enriched Uranium Infrastructure Strategy. Part of this re-evaluation includes analyzing alternatives to replacing enriched uranium operations at the Y-12 plant with a single facility.

facility as designed, and that, as a result, the roof of the planned 388,000 square foot facility would have to be raised 13 feet. In July 2013, we reported that addressing this issue, which NNSA referred to as a "space/fit issue," would require substantial design rework, cost an additional $540 million, and delay the start of facility operations by 13 months, according to NNSA.[4] NNSA estimated in 2012 that completing the first phase of the UPF project will cost between $4.2 and $6.5 billion. Based on the space/fit issue, NNSA rated the contractor's fiscal year 2012 UPF performance as "unsatisfactory," and agency officials told us that NNSA denied the contractor $5 million out of $5.7 million in award fees for its UPF work in fiscal year 2012.

At the request of the Senate Appropriations Committee, Subcommittee on Energy and Water Development, and in accordance with the Fiscal Year 2013 National Defense Authorization Act, GAO is to report periodically on the UPF.[5] We issued our first report in July 2013, which found that key assumptions contained in multiple cost estimates for the UPF were inaccurate and were the primary factors that contributed to the increase in the upper bound of UPF's cost estimate from $1.1 billion in 2004 to $6.5 billion in 2012.[6] We issued our second report in October 2013, which found that the Defense Nuclear Facilities Safety Board—an independent executive branch agency created by Congress in 1988 to assess safety conditions at DOE's defense nuclear facilities—had identified safety concerns with the UPF's design, and that NNSA had taken actions to address most of these concerns.[7] We issued our third report in April 2014, which identified risks associated with the development of new technologies for the UPF, and NNSA's actions to address those risks.[8] Our objectives for this fourth report are to determine (1) what factors NNSA identified that contributed to the UPF space/fit issue and (2) what

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

[5] The National Defense Authorization Act for Fiscal Year 2013 renamed UPF as the Uranium Capabilities Replacement Project.

[6] GAO-13-686R.

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

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

actions, if any, NNSA and the UPF contractor have taken to address the space/fit issue.

To do this work, we reviewed NNSA and contractor documents related to the space/fit issue, including root cause analyses prepared by NNSA and the UPF contractor, corrective action plans and monthly fit assessment reports prepared by the UPF contractor, and a space/fit oversight review prepared by NNSA.[9] In addition, we interviewed NNSA and UPF contractor representatives responsible for monitoring and addressing space/fit issues. We also visited the Y-12 plant, received briefings from NNSA officials and UPF contractor representatives, and observed a 3D model NNSA and the UPF contractor used to track space usage within the facility.

We conducted this performance audit from December 2013 to October 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

In 1990, we designated DOE program and contract management as an area at high risk of fraud, waste, abuse, and mismanagement.[10] In January 2009, to recognize progress made at DOE's Office of Science, we narrowed the focus of the high-risk designation to two DOE program elements—NNSA and the Office of Environmental Management.[11] In February 2013, our most recent high-risk update, we further narrowed this focus to major projects (i.e., projects over $750 million) at NNSA and the Office of Environmental Management.[12]

[9] Although we reviewed the findings of the root cause analyses prepared by NNSA and the UPF contractor, we did not assess the quality of either analysis.

[10] GAO, *Government Financial Vulnerability: 14 Areas Needing Special Review,* GAO/OCG-90-1 (Washington, D.C.: Jan. 23, 1990). We update our high-risk list every 2 years.

[11] GAO, *High-Risk Series: An Update*, GAO-09-271 (Washington, D.C.: January 2009).

[12] GAO, *High-Risk Series: An Update*, GAO-13-283 (Washington, D.C.: February 2013).

DOE has taken some steps to address our concerns, including developing an order in 2010 (Order 413.3B) that defines DOE's project management principles and process for executing a capital asset construction project, which can include building or demolishing facilities or constructing remediation systems.[13] NNSA is required by DOE to manage the UPF construction project in accordance with this order. The project management process defined in Order 413.3B requires DOE projects to go through five management reviews and approvals, called "critical decisions" (CD), as they move forward from project planning and design to construction to operation. The CDs are as follows:

- CD 0: Approve a mission-related need.
- CD 1: Approve an approach to meet a mission need and a preliminary cost estimate.
- CD 2: Approve the project's cost, schedule and scope targets.
- CD 3: Approve the start of construction.
- CD 4: Approve the start of operations.

In August 2007, the Deputy Secretary of Energy originally approved CD 1 for the UPF with a cost range of $1.4 to $3.5 billion. In June 2012, prior to the UPF contractor's August 2012 determination that the facility would need to be enlarged due to the space/fit issue, the Deputy Secretary of Energy reaffirmed CD 1 for the UPF with an estimated cost range of $4.2 to $6.5 billion and approved a phased approach to the project, which deferred significant portions of the project's original scope.[14] According to NNSA documents, this deferral was due, in part, to the multibillion dollar increase in the project's cost estimate and to accelerate the completion of the highest priority scope. In July 2013, NNSA decided to combine CD 2 and CD 3 for the first phase of UPF, with approval planned by October

[13] Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, DOE O 413.3B (Washington, D.C.: Nov. 29, 2010).

[14] Order 413.3B requires reaffirmation if the original CD 1 cost range increases by more than 50 percent.

2015.[15] Table 1 shows the UPF's phases, scope of work, cost estimate as of June 2012, and proposed start of operations.

Table 1: Uranium Processing Facility (UPF) Phases, Scope of Work, Cost Estimate as of June 2012, and Proposed Start of Operations

Phase	Scope of work	Cost estimate as of June 2012	Proposed start of operations
Phase I	UPF building exterior, all support systems and Building 9212 capabilities (uranium purification and casting)	$4.2 to $6.5 billion	2025
Phase II	Building 9215 capabilities (machining) and Building 9998 capabilities (product certification)	NNSA did not establish a cost estimate.	from 2030 to 2036[a]
Phase III	Building 9204-2E capabilities (assembly and dismantlement)	NNSA did not establish a cost estimate.	from 2030 to 2036[a]

Source: NNSA. | GAO-15-126

[a]In a December 2013 testimony before the Defense Nuclear Facilities Safety Board, the NNSA Acting Administrator said that the agency does not expect to move out of the facilities that house machining operations (Building 9215), as well as assembly and dismantlement operations (Building 9204-2E), until 2038 due primarily to budget constraints. NNSA previously estimated that these capabilities would be operational in the UPF no later than 2036. NNSA is currently taking risk reduction activities to extend the lives of these facilities, such as replacing cooling water distribution systems, ventilation systems, and electrical components.

NNSA's Associate Administrator for Acquisitions and Project Management (APM) is responsible for NNSA's execution and oversight of the UPF project. A UPF Federal Project Director, supported by a UPF project office located at the Y-12 site, implements APM's project management responsibilities and provides the first level of NNSA oversight. The UPF project office consists of a full-time staff of subject matter experts and support personnel, along with additional staff from other organizations as needed. Additionally, there is a program management office within NNSA that is responsible for establishing the project requirements and obtaining the necessary funding to execute the work, according to NNSA.

As described by DOE in an April 2008 report on its departmentwide effort to assess underlying causes for its project management challenges, a root cause analysis is a process involving the individuals knowledgeable

[15] According to the UPF Federal Project Director, there were two reasons for this decision: (1) NNSA's delay in awarding the combined management and operating contract for the Y-12 plant and the Pantex plant in Texas and (2) NNSA needed to conduct further analysis to help ensure an optimized UPF project execution strategy.

of and directly responsible for managing DOE contracts and projects answering a challenging series of questions as to why a situation, event, or condition existed.[16] DOE's project management order does not include a requirement for a root cause analysis for projects experiencing significant cost increases or schedule delays, but according to an NNSA official, the agency made a management decision to conduct a root cause analysis for the space/fit issue to ensure a full understanding of the problems that contributed to the issue, resolve the root causes to prevent future issues from occurring, and provide accountability for the errors.[17] The official also said that DOE had previously commissioned similar analyses for the Hanford Waste Treatment and Immobilization Plant project, and found it useful to have an independent assessment of that project.[18] In addition, DOE's project management order states that lessons learned should be captured throughout the course of capital asset construction projects. The order requires these lessons learned to be formally documented and submitted to DOE at CD 3 and CD 4 to allow for the exchange of information within DOE in the context of project management and to benefit future endeavors.

Because of the project's cost increases and schedule delays, NNSA is currently reevaluating its approach to modernizing enriched uranium operations at the Y-12 plant. According to NNSA's Associate Administrator for Acquisition and Project Management, NNSA plans to use lessons learned from the space/fit issue to inform this effort. The

[16] Department of Energy, *Root Cause Analysis: Contract and Project Management* (Washington, D.C:, April 2008).

[17] In February 2014, we recommended that the Secretary of Energy revise DOE's project management order, or otherwise implement a departmentwide requirement, to require a root cause analysis of all projects that experience cost increases or schedule delays exceeding a certain threshold established by DOE in order to ensure that future projects benefit from lessons learned. 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).

[18] In 2000, DOE awarded a contract to Bechtel National, Inc. to design, construct, and commission a Waste Treatment and Immobilization Plant (WTP) to stabilize large quantities of radioactive and hazardous waste at its 586-square mile Hanford Site in southeastern Washington State, and prepare it for disposal at a permanent national geologic repository. As we reported in December 2012, the project faces significant technical challenges, and DOE's estimated cost to construct the WTP has tripled, and the scheduled completion date has slipped by nearly a decade to 2019. GAO, *Hanford Waste Treatment Plant: DOE Needs to Take Action to Resolve Technical and Management Challenges*, GAO-13-38 (Washington, D.C.: Dec. 19, 2012).

agency has recently decided to: (1) develop a strategy for maintaining the Y-12 plant's enriched uranium capabilities into the future and (2) assess alternatives to replacing enriched uranium operations at the Y-12 plant with a single facility such as the UPF. Specifically:

- **NNSA is currently developing an Enriched Uranium Infrastructure Strategy for the Y-12 plant.** In early February 2014, the NNSA Deputy Administrator for Defense Programs directed his staff to develop an Enriched Uranium Infrastructure Strategy to establish the framework of how NNSA will maintain the Y-12 plant's uranium mission capabilities into the future. Key aspects considered during the strategy's development included, among other things: (1) an evaluation of the uranium purification capabilities currently conducted in building 9212 and the throughput needed to support requirements for life extension programs and nuclear fuel for the U.S. Navy; (2) an evaluation of the alternatives to the UPF that prioritizes replacement capabilities by risk to nuclear safety, security, and mission continuity; (3) an identification of existing infrastructure as a bridging strategy until replacement capability is available in new infrastructure. A draft of the strategy was delivered to the Deputy Administrator in April 2014. NNSA is currently revising the draft, and an NNSA official said that the agency has not yet determined when it will deliver a revised version to the Deputy Administrator.

- **NNSA is currently evaluating alternatives to replacing enriched uranium operations at the Y-12 plant with a single facility.** In early January 2014, NNSA began to consider options other than the UPF for enriched uranium operations at the Y-12 plant because, according to the UPF Federal Project Director, the project is facing budget constraints, rising costs, and competition from other high-priority projects within NNSA—such as the planned B61 bomb and W78/88 warhead nuclear weapon life extension projects.[19] On April 15, 2014, NNSA completed a peer review that identified an alternative to replacing enriched uranium operations with a single facility. The results of the review, which were released to the public on May 1, 2014, included a proposed solution for replacing or relocating only Building 9212 capabilities (uranium purification and casting) by 2025

[19] In January 1996, DOE initiated the Stockpile Life Extension Program. Now administered by NNSA, this program is designed to extend the weapons' operational life for an additional 20 to 30 years and to certify the weapons' military performance requirements without underground nuclear testing.

at a cost not exceeding $6.5 billion. This proposed solution would require NNSA to (1) construct two new, smaller facilities to house casting and other processing capabilities, (2) upgrade existing facilities at the Y-12 plant to house other uranium processing capabilities currently housed in Building 9212, and (3) appoint a senior career executive within NNSA's Office of Defense Programs with the responsibility and authority to coordinate the agency's overall enriched uranium strategy. As of July 2014, NNSA was still evaluating the review's recommendations, but the NNSA Acting Administrator previously stated that NNSA does not plan to continue full operations in Building 9212, which has been operational for over 60 years, past 2025 because the building does not meet modern safety standards, and increasing equipment failure rates present challenges to meeting required production targets. In addition, according to NNSA officials, while NNSA was conducting its review, the UPF project team suspended some design, site preparation, and procurement activities that could potentially be impacted by the range of alternatives being considered.

NNSA Identified a Number of Factors That Contributed to the Space/Fit Issue

In January 2013, NNSA completed a review to identify the factors that contributed to the space/fit issue.[20] This review took into account the actions completed by the contractor or in progress since the space/fit issue was identified, input from the contractor, and NNSA's own experience with and knowledge of the project. NNSA identified a number of factors that contributed to the space/fit issue within both the contractor and NNSA organizations.[21] Specifically:

[20] According to NNSA, in February 2012, NNSA awarded Parsons Infrastructure and Technology Group, Inc. (Parsons) a contract to provide ongoing project management support services at multiple NNSA sites. These services include, among other things, ensuring project management requirements are consistently followed, improving federal oversight of contractors, and strengthening accountability for performance of capital construction projects. In November 2012, NNSA directed Parsons to conduct its review for the UPF project to identify the factors that contributed to the space/fit issue.

[21] In January 2013, Parsons reported to NNSA that five root causes contributed to the space/fit issue. After reviewing the Parsons report, NNSA directed the UPF contractor to address four causal factors that contributed to the space/fit issue. We analyzed the five root causes identified in the Parsons review and the four causal factors that NNSA directed the contractor to address and grouped them into four categories: NNSA oversight, design integration, communications, and management processes and procedures.

- **NNSA oversight.** NNSA identified limitations in its oversight of the project. Specifically, NNSA determined that it did not have adequate staff to perform effective technical oversight of the project, and requests and directives from NNSA to the UPF contractor were not always implemented because NNSA did not always follow up. According to NNSA officials, when the space/fit issue was identified in 2012, the UPF project office was staffed by nine full-time equivalents (FTE). The Defense Nuclear Facilities Safety Board also raised concerns on several occasions prior to the space/fit issue about whether this level of staffing was adequate to perform effective oversight of the contractor's activities.[22]

- **Design integration.** NNSA found that the design inputs from subcontractors for the contractor's 3D computer model, used to allocate and track space usage within the facility, were not well integrated. In 2008, the UPF contractor subcontracted portions of the design work, such as glovebox and process area design, to four subcontractors, and to track how these design elements fit together, the UPF contractor developed a model management system that generates a 3D computer model of the facility as the design progresses. This 3D model was intended to, among other things, allow the contractor to determine whether there is adequate space in the building's design for all processing equipment and utilities, or whether changes to the design are necessary to provide additional space. However, according to NNSA officials, prior to the space/fit issue, the design work of the four subcontractors was not well integrated into the model, and as a result, the model did not accurately reflect the most current design.

- **Communications.** NNSA identified communications shortcomings throughout the project. For example, the contractor did not always provide timely notification to the NNSA project office of emerging

[22] To assess safety conditions at DOE's defense nuclear facilities, Congress created the Defense Nuclear Facilities Safety Board—an independent executive branch agency—in 1988. The Safety Board has broad oversight responsibilities regarding these facilities but does not have the authority of a regulator. In an August 2007 letter to NNSA, the Safety Board raised concerns that federal staffing for the UPF project—which at the time consisted of a Federal Project Director and a team of part-time personnel—was not sufficient to provide appropriate technical oversight of the project. In an April 2012 letter to NNSA, the Safety Board found that the project continued to be understaffed, particularly in technical areas such as project engineering, nuclear safety engineering, and criticality safety engineering.

concerns and did not engage NNSA in development of plans to address these concerns. NNSA found that there was reluctance on the part of the contractor to share information with NNSA without first fully vetting the information and obtaining senior management approval. In addition, NNSA found that a "chilled" work environment had developed within the UPF contractor organization, and that, as a result, communications from the working level and mid-level managers up to senior management were limited because of concerns of negative consequences. Furthermore, communications between the NNSA project office, the UPF contractor, and NNSA headquarters were limited by a complex chain of command. According to NNSA officials, prior to 2013, the UPF project was managed by NNSA's Y-12 Site Office, and the UPF Federal Project Director reported to NNSA at a relatively low level. NNSA officials said that, as a result, any concerns with the UPF project had to compete for attention with many other issues facing the Y-12 site as a whole.

- **Management processes and procedures.** NNSA found that the contractor's management processes and procedures did not formally identify, evaluate, or act on technical concerns in a timely manner. In addition, NNSA found that the UPF contractor's project management procedures had shortcomings in areas such as risk management, design integration, and control of the technical baseline documents. Specifically, some of the contractor's procedures were not project-specific and could not be used for work on the UPF project without authorizing deviations or providing additional instructions. According to NNSA, these shortcomings led in part to inadequate control of the design development process, as the contractor did not document interim decisions to deviate from the design baseline, adequately describe the design, or maintain it under configuration control.

NNSA and the UPF Contractor Have Taken Some Actions to Address Factors That Contributed to the Space/Fit Issue, and NNSA Has Begun to Share Lessons Learned

In response to NNSA's review of the factors that contributed to the space/fit issue, NNSA and the UPF contractor have both taken some actions to address the factors identified by the review. In addition, NNSA has begun to share lessons learned from the UPF project consistent with both DOE's project management order, which states that lessons learned should be captured throughout the course of capital asset construction projects, as well as our prior recommendation to ensure that future projects benefit from lessons learned.[23] The specific actions NNSA and the contractor have taken include the following:

- **NNSA oversight.** NNSA has taken actions to improve its oversight of the UPF project to ensure that it is aware of emerging technical issues and the steps the contractor is taking to address them by, among other things, increasing staffing levels for the UPF project office from 9 FTEs in 2012 to more than 50 FTEs as of January 2014. According to NNSA officials, many of the additional staff members are technical experts in areas such as engineering and nuclear safety, and these additional staff have enabled NNSA to conduct more robust oversight of the contractor's design efforts than was previously possible. For example, in July 2013, NNSA used some of these additional staff to conduct an in-depth assessment of the UPF contractor's design solution for the space/fit issue. This assessment found that, among other things, as of July 2013, the facility design and 3D model were not sufficiently complete to determine whether there was adequate space remaining in parts of the facility to accommodate all required equipment while still providing adequate margin for future design changes during construction and commissioning. The assessment also found that the contractor's monthly space/fit assessment reports, developed to evaluate and report on space utilization in the facility, were providing an overly optimistic view of space/fit, leading to a low level of senior management engagement in resolving these issues. According to NNSA officials, as of January 2014, the UPF contractor had taken actions to address many of the assessment's findings, and the agency plans to continue to monitor the contractor's performance closely in these areas through its normal oversight activities, such as attending periodic meetings to review the 3D model.

- **Design integration.** According to NNSA and UPF contractor officials, the UPF contractor took steps to better integrate the efforts of the

[23] GAO-14-231.

subcontractors conducting design and engineering work on different elements of the facility. For example, in late 2012, the UPF contractor hired a model integration engineer to integrate the subcontractors' design work and ensure that all design changes are incorporated into the model so that it accurately reflects the most current design. The model integration engineer also manages a team of subject matter experts who monitor space utilization in each individual process area as the design progresses and conduct monthly assessments of the space margins remaining in each area. In addition, the UPF contractor also developed a formal change control process to define and manage space within the 3D model. Under this process, design changes made by the individual design teams must be submitted to the model integration engineer for approval to ensure that they do not exceed the boundaries established for each process area or interfere with other equipment. Furthermore, changes that have a significant impact on equipment layout must be approved by a review board prior to being accepted and integrated into the model. According to contractor officials, as of January 2014, the subcontractor teams had submitted 111 change requests, and 75 requests had been approved. The officials said that they are working to reduce the remaining backlog.

According to NNSA, the contractor also developed a monthly space/fit assessment process to evaluate and report on space utilization in the facility. As part of this process, the model integration team evaluates the space remaining in each process area of the facility to determine whether each area has (1) no space/fit challenges, (2) no current space/fit challenges but the potential for challenges in the future as a result of the design being less complete than other areas, or (3) confirmed space/fit challenges, i.e., areas where design changes are necessary to ensure that all equipment will fit into the space allotted to it. The model integration team then prepares a report and briefs senior project management on its findings. According to a UPF contractor document, as of December 2013, 26 process areas had no space/fit challenges, 13 process areas had no challenges but had the potential for challenges in the future, and 2 process areas had confirmed space/fit challenges. NNSA and UPF contractor officials said that, as of January 2014, they were confident that these remaining space/fit challenges can be addressed within the current size parameters of the facility, but that the project will not have absolute certainty about space/fit until the design is fully complete. Instead, the project will only be able to gradually reduce the amount of space/fit uncertainty and risk as the detailed design progresses. However, the officials said that, prior to CD 2/3 approval, the contractor is required to conduct a

detailed review of the 3D model to ensure there is adequate space for all equipment and utilities, and NNSA plans to assess the results of this review.

- **Communications.** According to an NNSA official, communications between NNSA and the contractor significantly improved after the space/fit issue was identified, and the contractor kept NNSA better informed of emerging concerns and its plans to address these concerns. In addition, NNSA held a partnering session with the contractor in June 2014, which included management representatives from NNSA and the contractor in functional areas such as engineering, nuclear safety, and procurement, and included discussions on defining federal and contractor roles, managing change, and mapping the path forward for the project. On July 15, 2014, NNSA and the contractor signed a formal partnering agreement to enhance (1) clarity and alignment on mission and direction, (2) transparency, (3) responsiveness, and (4) effectiveness in meeting commitments, among other things. The agreement also included a commitment to meet quarterly to discuss progress made toward achieving these goals.

  NNSA and UPF contractor officials also said that the contractor took steps to enhance communications between working-level employees and senior management and improve its organizational culture after the space/fit issue was identified. For example, the contractor established a Differing Professional Opinion (DPO) process through which employees can raise concerns to project management, began conducting annual surveys of the project's safety culture to determine the extent to which employees are willing to raise concerns, and formally defined its safety culture policy to conform to guidelines established by the Nuclear Regulatory Commission. According to NNSA and UPF contractor officials, the contractor's annual surveys showed a steady improvement in employees' willingness to bring concerns and issues to management since the space/fit issue was identified. In addition, the contractor also brought in additional senior project and engineering managers from outside the UPF project in order to foster greater communication between senior managers and working-level employees.

  In addition, NNSA recently reorganized its management of major construction projects, including the UPF, resulting in more direct communications between the UPF project office and NNSA headquarters. Specifically, in 2012, the UPF FPD began reporting directly to APM, rather than reporting to NNSA at a relatively low level

through the Y-12 Site Office, and NNSA officials said that this new organizational structure has streamlined NNSA's management of the project by increasing the FPD's control over project resources and functions, as well as the FPD's responsibility and accountability for achieving project goals.

- **Management processes and procedures.** According to the UPF contractor, it developed formal processes for identifying and tracking the status of major technical and engineering issues. For example, according to NNSA and contractor officials, the contractor implemented a process for tracking the project's highest-priority action items, as determined by the project's management team, including certain issues related to space/fit. Specifically, as of January 2014, these items included actions to ensure that technical changes are fully reviewed so that their impact on the project's design, procurement activities, and construction is understood. In addition, according to UPF contractor officials, the contractor implemented a separate system to track the identification and resolution of significant technical issues during the design process, and any employee can submit a technical issue for inclusion in this system if they believe that it is serious enough to require management attention. After an issue is added to the system, the corrective actions implemented to address it are tracked until they are completed, and technical issues affecting space/fit are placed into a separate, higher-priority category within the system. As of January 2014, there were nine technical issues affecting space/fit in this higher-priority category, and three of those issues had been resolved. For example, in August 2013, the project identified a technical issue in which one processing area did not contain enough space to accommodate the replacement of a component, but the project developed a solution that resolved the issue in October 2013.

  In addition, according to NNSA and the UPF contractor, the contractor uses a separate system to track the status of non-technical issues that are identified by project reviews. The contractor uses this system to formally assign responsibility for any corrective actions to the appropriate contractor personnel and to monitor the status of each action until completion. In order for a corrective action to be closed out in this system, the personnel responsible for the corrective action must provide evidence of completion. For example, in April 2013, the contractor identified nine corrective actions needed to address a number of the contributing factors for the space/fit issue, and began using this system to track their status. As of January 2014, six of these actions had been completed, two were in process, and one had

been cancelled. For example, the contractor was still in the process of reviewing and evaluating the procedure set used for the project to identify any improvements necessary, and the cancelled corrective action—the development of a communication partnering policy between NNSA and the contractor—was replaced by the June 2014 partnering session discussed above.

NNSA has also recently begun to share lessons learned from the space/fit issue. This was an original goal of NNSA's review of the factors that contributed to the space/fit issue, and is consistent with both DOE's project management order, which states that lessons learned should be captured throughout the course of capital asset construction projects, as well as our prior recommendation to ensure that future projects benefit from lessons learned.[24] NNSA officials said that lessons learned from the space/fit issue had been informally incorporated into other NNSA activities in a variety of ways, to include informing independent project reviews and cost estimates, and led to a broader recognition of the need for increased federal staffing levels to enhance NNSA's oversight activities on other projects. More recently, the UPF Federal Project Director conducted a presentation on lessons learned from the UPF project, including lessons learned from the space/fit issue, at a July 2014 training session for federal project directors. As we have noted in other work, the sharing of lessons learned is an important element of NNSA's and DOE's efforts to better inform and improve their management of other capital acquisition projects. As we reported in December 2013, NNSA estimated that it will need approximately $300 million per year between 2019 and 2038 in order to fund the construction projects it plans to undertake during that time.[25] Documenting the lessons learned as a result of the UPF space/fit issue may help prevent other costly setbacks from occurring on these other projects.

[24] GAO-14-231.

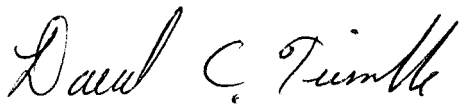
[25] Although NNSA identified the Chemistry and Metallurgy Research Replacement Nuclear Facility and the second two phases of UPF as planned projects for 2019 or later, NNSA officials told us that plans for these projects were uncertain and, therefore, not included in this estimate. See GAO, *Modernizing the Nuclear Security Enterprise: NNSA's Budget Estimates Do Not Fully Align with Plans*, GAO-14-45 (Washington, D.C.: Dec. 11, 2013).

Agency Comments and Our Evaluation

We are not making any new recommendations in this report. We provided a draft of this report to NNSA for comment. In its written comments (see appendix I), NNSA generally agreed with our findings. NNSA also provided technical comments that were incorporated, as appropriate.

We are sending copies of this report to the appropriate congressional committees, the Secretary of Energy, the Administrator of NNSA, 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 II.



David C. Trimble
Director, Natural Resources and Environment

List of Committees

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

The Honorable Dianne Feinstein
Chairwoman
The Honorable Lamar Alexander
Ranking Member
Subcommittee on Energy and Water Development
Committee on Appropriations
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The Honorable Howard P. “Buck” McKeon
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The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

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

Appendix I: Comments from the National Nuclear Security Administration

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

September 29, 2014

Mr. David C. Trimble
Director
Natural Resources and Environment
Government Accountability Office
441 G Street
Washington, DC 20548

Dear Mr. Trimble:

Thank you for the opportunity to review the Government Accountability Office's (GAO) draft report titled "*NUCLEAR WEAPONS: Some Actions Have Been Taken to Address Challenges With the Uranium Processing Facility Design, GAO-15-126,"* which is the fourth in a series of Congressionally mandated quarterly reports on the Uranium Processing Facility Project (UPF). The draft report affirms factors contributing to the space/fit issue that NNSA identified in its self-directed 2013 Root Cause Analysis, including: (1) insufficient federal oversight; (2) inadequate design and engineering subcontractor integration; (3) an organizational construct that inhibited timely, accurate, reliable and actionable information to leadership; and (4) inadequate formal processes, procedures, and project management controls. These root causes conform to challenges highlighted by other external stakeholders and Department of Energy (DOE)/NNSA internal analyses over the past several years, which resulted in the creation of NNSA's Office of Acquisition and Project Management.

The draft report also acknowledges the actions NNSA has taken to put the right people, policies, procedures, tools, and partnerships in place to understand and correct the root causes of our legacy project performance issues. To increase federal oversight and contractor accountability on UPF, we brought on a Federal Project Director (FPD) with the appropriate training, experience, and certification level to lead the project and established the UPF Project Office (UPO) with the FPD reporting directly to the Associate Administrator for Acquisition and Project Management. This streamlines NNSA's project management and oversight, increases project responsibility and accountability, and enhances communications. In addition, we increased the size and skill set of UPF's federal staff to conduct more robust oversight of the contractor's design efforts, and put systems in place to manage and control major technical and engineering issues.

As I am sure you are aware, the root causes of the UPF's space/fit problems are not unique to this project, NNSA, or even the Federal Government. We have

formally shared the lessons learned on UPF throughout the Department of Energy. These presentations have reached an audience of over 300 DOE, NNSA, and contractor personnel.

Thank you for your continued willingness to work with us in our joint effort to improve federal contract and project management and deliver the best possible value for the American taxpayers. If you have any questions regarding this response, please contact Robert Raines, Associate Administrator for Acquisition and Project Management, at (202)586-5627.

Sincerely,

Frank G. Klotz

Enclosure

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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 Gill (Assistant Director), Mike Armes, John Bauckman, Patrick Bernard, Antoinette Capaccio, Will Horton, and Steven Putansu made key contributions to this report.