



441 G St. N.W.
Washington, DC 20548

October 25, 2013

Congressional Committees

Nuclear Weapons: Information on Safety Concerns with the Uranium Processing Facility

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 NNSA is a separately organized agency within the Department of Energy (DOE). According to NNSA, the Y-12 plant's current enriched uranium operations, which are conducted in four separate buildings, have key shortcomings including (1) an inefficient workflow; (2) continually rising operations and maintenance costs due to facility age; and (3) processes that could expose workers to radiological contamination, among other things. To address these issues, in 2004, NNSA decided to construct a new Uranium Processing Facility (UPF).² According to NNSA, the UPF will

- consist of 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.

The work carried out at several of DOE's defense nuclear facilities involves dangerous nuclear materials and hazardous chemicals.³ For example, the UPF will process highly enriched uranium as well as beryllium, a hazardous metal essential for nuclear operations. Contractors are responsible for safely designing, constructing, and operating DOE's defense nuclear facilities. DOE's oversight of how these facilities' safety systems are designed and operated is critical to ensuring the health and safety of workers, the public, and the environment.⁴ To assess

¹NNSA owns the buildings, equipment, and the components produced at the Y-12 plant, but the site is operated under contract to NNSA by Babcock & Wilcox Technical Services Y-12, LLC (B&W), a partnership of the Babcock & Wilcox Company and Bechtel Corporation.

²B&W is the contractor managing the UPF design and has subcontracted portions of the design work to four other contractors.

³DOE's defense nuclear facilities are located at 13 sites, including 7 NNSA sites.

⁴We have previously reported on challenges with DOE's safety oversight. See 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) and GAO, *Modernizing the Nuclear Security Enterprise: Observations on DOE's and NNSA's Efforts to Enhance Oversight of Security, Safety, and Project and Contract Management*, [GAO-13-482T](#) (Washington, D.C.: Mar. 13, 2013).

safety conditions at DOE's defense nuclear facilities, Congress created the Defense Nuclear Facilities Safety Board (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.⁵

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 required to submit quarterly reports on the UPF.⁶ Our first report was issued in July 2013 and found that (1) key assumptions contained in multiple cost estimates proved to be inaccurate and were the primary factors that contributed to the UPF's cost increase from \$1.1 billion in 2004 to \$6.5 billion in 2012, and (2) the UPF contractor did not adequately manage and integrate the design work subcontracted to four other contractors and therefore the UPF's roof will have to be raised 13 feet to ensure the processing equipment would fit into the facility, which resulted in approximately \$540 million in additional costs.⁷ Based on discussions and agreement with your offices, our objective for this second report was to identify the concerns, if any, that the Safety Board has raised with the UPF and the actions, if any, NNSA has taken to address those concerns.

To do this work, we reviewed key DOE management orders and standards that establish project management and safety requirements for constructing new nuclear facilities. In addition, we reviewed UPF safety-related documents prepared by DOE, NNSA, and the UPF contractor as well as multiple safety assessments of the UPF conducted by the Safety Board. We interviewed UPF contractor representatives responsible for developing key safety documents as well as NNSA officials who oversee this process. In addition, we visited the Y-12 plant and received safety-related briefings from NNSA and contractor officials. We also interviewed and received briefings from Safety Board staff responsible for conducting oversight of the UPF.

We conducted this performance audit from April 2013 to October 2013 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

The Safety Board exercises broad oversight over DOE facilities. Specifically, the Safety Board

- reviews DOE's safety and design documentation to ensure that DOE is complying with its own requirements and processes for integrating safety into the design process;

⁵The Safety Board consists of five members appointed by the President and confirmed by the Senate and is supported by approximately 100 technical, legal, and administrative staff.

⁶The National Defense Authorization Act for Fiscal Year 2013 renamed UPF as the Uranium Capabilities Replacement Project. NNSA uses the new nomenclature in its fiscal year 2014 budget request.

⁷GAO, *Nuclear Weapons: Factors Leading to Cost Increases with the Uranium Processing Facility*, [GAO-13-686R](#) (Washington, D.C.: July 12, 2013).

- issues "project letters" to DOE at major project milestones to document the results of these reviews and communicate significant safety issues; and
- holds occasional public hearings to address concerns about DOE's safety practices, including an October 2012 hearing on the UPF in Knoxville, Tennessee.

In 1990, we first designated DOE program management as an area at high risk of fraud, waste, abuse, and mismanagement.⁸ In January 2009, to recognize the 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.⁹ In February 2013 we issued our most recent high-risk update, in which we narrowed this focus to major projects (i.e., projects over \$750 million) at NNSA and the Office of Environmental Management.¹⁰ DOE has taken some steps to address our concerns, including developing an order in 2010 that defines DOE's project management principles and process for executing a capital asset construction project.¹¹ NNSA is required to manage the UPF 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:

- 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 June 2012, the Deputy Secretary of Energy reaffirmed CD 1 for the UPF and approved a phased approach to the project, which will defer significant portions of the facility's original scope. This deferral was due, in part, to the project's increased cost estimate and to accelerate the completion of the highest priority scope. Table 1 shows the UPF's phases, scope of work, cost estimate as of June 2012, and key project dates.

⁸GAO, *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.

⁹GAO, *High-Risk Series: An Update*, [GAO-09-271](#) (Washington, D.C.: January 2009).

¹⁰GAO, *High-Risk Series: An Update*, [GAO-13-283](#) (Washington, D.C.: February 2013).

¹¹U.S. Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, DOE O 413.3B (Washington, D.C.: Nov. 29, 2010).

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

Phase	Scope of work	Cost estimate as of June 2012	Project dates
Phase I	UPF building exterior, all support systems, Building 9212 capabilities (uranium purification and casting)	\$4.2 to \$6.5 billion	CD 2 expected in 2015 ^a CD 3 expected in 2015 CD 4 expected in 2025
Phase II	Building 9215 (machining) and Building 9998 capabilities (product certification)	NNSA has not established a cost estimate	CD 4 expected from 2030 and 2036
Phase III	Building 9204-2E capabilities (assembly and dismantlement)	NNSA has not established a cost estimate	CD 4 expected from 2030 and 2036

Source: NNSA.

^a The project management process defined in DOE 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.

Key interim safety documents are to be completed by the contractor and approved by NNSA prior to CD 1, 2, and 3 milestones, while a final safety document is to be completed and approved prior to CD 4. According to Order 413.3B, these interim and final documents are to identify how the UPF’s nuclear material and hazardous chemicals will be handled, the potential accidents and hazards associated with the facility’s operations, and the controls employed to mitigate or prevent their impact on workers and the public. Another DOE document—DOE Standard 1189: *Integration of Safety into the Design Process*—provides guidance on how these interim and final safety documents are to be prepared, among other things. For example, it directs DOE and NNSA to analyze and address fire protection, nuclear criticality, and natural hazards, such as earthquakes.¹² According to this standard, the interim safety documents help ensure that safety issues are explicitly identified and addressed early in the design phase to reduce costly late reversals. Thus, these interim safety documents are to be used to develop the UPF’s final safety document, which provides the basis for ensuring that the facility can be operated safely with respect to workers, the public, and the environment. According to Order 413.3B, facilities cannot begin operations until their final safety documents are approved.

Results in Brief

In 2010, members of the Safety Board raised concerns that NNSA was deviating from the process established by DOE Order 413.3B and DOE Standard 1189 to develop the UPF’s CD 2 interim safety document and was, therefore, not ensuring that safety was adequately integrated into the UPF’s design. NNSA then took actions to follow the established process, and Safety Board staff stated that NNSA’s corrective actions addressed many of their concerns. As of June 2013, the Safety Board had identified 15 specific safety concerns with the UPF’s design, and NNSA has taken or agreed to take actions to address 14 of these concerns. In addition, on

¹²A nuclear criticality accident occurs when enough fissile material, such as uranium, is brought together to cause a sustained nuclear chain reaction. The immediate result of a nuclear criticality accident is the production of an uncontrolled and unpredictable radiation source that can be lethal to people who are nearby.

August 26, 2013, the Safety Board sent NNSA a letter that identified 12 additional specific safety concerns based on the CD 2 interim safety document approved by NNSA in February 2013. The Safety Board has also raised general concerns with NNSA's plans to defer the installation of some uranium processing capabilities into the UPF at a later date and after the UPF is operational.

The Safety Board Has Identified Concerns with the UPF, and NNSA Has Taken Actions to Address Most of Them

Members of the Safety Board have raised concerns that NNSA was deviating from the process established by DOE Order 413.3B and DOE Standard 1189 to develop the UPF's CD 2 interim safety document, and therefore not ensuring that safety was adequately integrated into the UPF's design. According to NNSA officials and Safety Board staff, in 2008, when DOE issued DOE Standard 1189 on how these documents are to be prepared, the UPF was to be one of the pilot projects for implementing the new standard. However, in 2009, NNSA decided to expedite the UPF by combining the CD 2 and CD 3 milestones, eliminating the development of the interim safety document for CD 2, and focusing on the development of alternative safety documents.¹³ On several occasions in 2010, members of the Safety Board expressed concerns to NNSA regarding its initial decision to cancel the CD 2 interim safety document, and, according to NNSA officials, a subsequent UPF independent project review in 2010 recommended that the project follow the safety document development process established by DOE Order 413.3B and DOE Standard 1189. In 2011, NNSA directed the UPF contractor to develop the required CD 2 interim safety document, and the contractor completed a revised version of the document in September 2012. NNSA approved the CD 2 interim safety document in February 2013 with 11 conditions that the UPF contractor must address in subsequent safety documents, such as improving the reliability and robustness of venting systems. Safety Board staff said that it is not unusual for interim safety documents to be approved with conditions, as they can be addressed in subsequent safety documents. See enclosure I for a timeline of the development of the UPF's CD 2 interim safety document.

As of June 2013, the Safety Board also identified 15 specific safety concerns with the UPF's design, and NNSA has taken actions—or has agreed to take actions—to address 14 of these concerns.¹⁴ See enclosure II for a description of the Safety Board's concerns, NNSA's actions to address the concerns, and the status of the safety concerns. Safety Board staff and NNSA officials agreed that none of the 15 concerns should prevent the UPF from reaching CD 2 in 2015 as scheduled. According to NNSA officials and Safety Board staff, 1 of these concerns—that the contractor had not developed an adequate corrective action plan to address structural engineering issues, among other things, previously identified by the Safety Board—has been fully addressed. For 7 other concerns, NNSA has presented evidence that the Safety Board's staff believe is reasonable to fully address the concerns, and the Safety Board is currently in the

¹³UPF contractor representatives told us that they were going to develop two alternate safety-related documents—a preliminary hazard analysis and a preliminary documented safety analysis—as these documents were DOE's safety requirements prior to the issuance of DOE Standard 1189.

¹⁴Of the 15 concerns identified by the Safety Board, NNSA officials said that the agency identified 8 similar concerns during an internal review of UPF safety that concluded in January 2012. In addition, NNSA officials told us that the agency required the UPF contractor to take corrective action to address 6 of these concerns.

final stages of reviewing the agency's actions.¹⁵ Six other concerns remain open while NNSA is completing the corrective actions, which Safety Board officials said they will review once the actions are completed.¹⁶ For the final concern—about the methodology used to calculate the rate at which radioactive material would settle out of the atmosphere in the event of an accident—Safety Board staff and NNSA officials said that they are not likely to agree on a path to resolution, and NNSA has conducted additional analyses to clarify its position.

On August 26, 2013, the Safety Board sent NNSA a letter that acknowledged the agency's progress in addressing the Safety Board's previously identified concerns with the UPF. However, the Safety Board said that NNSA must continue to improve the effectiveness of the UPF's safety controls and strengthen oversight to ensure planned controls can reliably perform their safety functions. In addition, the Safety Board identified 12 additional specific safety concerns, such as those related to potential fire and explosion scenarios, based on the CD 2 interim safety document approved by NNSA in February 2013. See enclosure III for a description of these 12 additional concerns. According to NNSA officials, the agency is currently reviewing the Safety Board's letter and preparing a response. Safety Board staff said that additional concerns may be raised as UPF completes final design and moves into construction.

In addition to the specific safety concerns raised above, the Safety Board has also raised general concerns with NNSA's plans to defer the installation of some uranium processing capabilities into the UPF at a later date and after the UPF is operational. As discussed above, NNSA currently plans to install uranium processing capabilities into the UPF in phases, after the building's exterior, support systems, and some processing capabilities have been completed. However, NNSA officials said that the agency does not plan to complete final design and safety work for the deferred capabilities until after the initial phase of the UPF is operational, which NNSA expects to occur in 2025. Safety Board staff stated that if NNSA encounters any challenges while finalizing the design and safety controls for the deferred scope, it will have much less flexibility to address them since the building will already have been constructed. Currently, NNSA plans to begin and complete subsequent UPF phases between 2030 and 2036. Safety Board staff stated that this project execution strategy introduces safety-related risks that will challenge the project's ability to integrate safety into the design. For example, at an October 2012 public hearing on the UPF, a senior Safety Board staff member noted that other DOE projects that have attempted similar complex execution strategies, such as the Hanford Waste Treatment Plant, which chose a strategy that allowed construction to begin prior to completing design, have had little or no success. In the UPF project, NNSA has decided to defer scope for key manufacturing and machining operations and will add them back to UPF sometime after it is built, which the senior Safety Board staff member said was similar to the Hanford Waste Treatment Plant decision to begin construction before completion of design, and magnified the impacts on the plant's cost and schedule when safety-related issues were

¹⁵For example, the Safety Board raised concerns about NNSA's methodology for analyzing fires resulting from an earthquake, and in response, NNSA conducted a new analysis providing additional details on its methodology.

¹⁶For example, the Safety Board raised concerns that NNSA's project office is understaffed to perform effective oversight, with many officials sharing project management and technical oversight responsibilities. In response, NNSA developed a staffing plan and the project has recently been approved to fill an additional 10 specialist positions, such as fire safety engineers and criticality engineers.

discovered late in the design process.¹⁷ According to NNSA officials and the UPF contractor, the UPF project team plans to continue developing the design of the deferred scope capabilities to a level of maturity that will ensure all process equipment will fit into the building and the proper safety controls for the entire facility are identified. As noted in our July 2013 report, a failure to ensure that the UPF contained sufficient space for all the processing equipment already resulted in approximately \$540 million in additional costs.¹⁸

In addition, Safety Board staff stated that performing a major modification to an operating nuclear facility can present safety issues if not carefully planned and executed. The UPF Federal Project Director, in testimony at the Safety Board's October 2012 public hearing on the UPF, generally agreed with this concern and said that NNSA will need to address a number of safety risks during subsequent phases of the project, such as risks to the facility's fire protection, ventilation, and criticality safety systems, as well as risks associated with additional construction workers operating in close proximity to hazardous materials and processes. According to NNSA officials, the UPF project team will need to conduct and document additional safety analyses to ensure that construction activities meet DOE's safety requirements. Safety Board officials said that they are monitoring NNSA's efforts to perform the engineering work necessary to safely incorporate the deferred scope into the UPF's design, and may raise additional specific safety issues as the design progresses.

While we are currently not making any recommendations for congressional consideration or agency action, we will continue to review the UPF as required by the National Defense Authorization Act for Fiscal Year 2013, and may make recommendations in the future if warranted.

Agency Comments

We provided a draft of this report to NNSA and the Safety Board for review and comment. NNSA provided technical comments, which we incorporated into the report as appropriate. NNSA's written comments are reproduced in enclosure IV. On October 3, 2013, we received technical comments via email from the Safety Board's UPF Project Lead, which we incorporated into the report as appropriate.

- - - - -

We are sending copies of this report to the appropriate congressional committees, the Secretary of Energy, the Administrator of NNSA, the Chairman of the Safety Board, and other interested parties. This report also is available at no charge on the GAO website at <http://www.gao.gov>.

¹⁷ According to NNSA's Associate Administrator for Acquisition and Project Management, the agency's approach to executing the UPF project is distinctly different than any other project within DOE, and is specifically designed to reduce the problems experienced with the Hanford Waste Treatment Plant and other DOE and NNSA projects. For example, agency officials said that the UPF is the first major project that is implementing DOE Standard 1189 to help ensure safety is adequately integrated into design.

¹⁸GAO-13-686R.

If you or your staff members have questions concerning 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. Key contributors to this report were Jonathan Gill, Assistant Director; Patrick Bernard; and Will Horton.

A handwritten signature in black ink that reads "David C. Trimble". The signature is written in a cursive style with a large, prominent 'D' and 'T'.

David C. Trimble
Director, Natural Resources and Environment

Enclosures—4

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
United States Senate

The Honorable Howard P. "Buck" McKeon
Chairman
The Honorable Adam Smith
Ranking Member
Committee on Armed Services
House of Representatives

The Honorable Rodney P. Frelinghuysen
Chairman
The Honorable Marcy Kaptur
Ranking Member
Subcommittee on Energy and Water Development
Committee on Appropriations
House of Representatives

Enclosure I: Timeline of the Development of the Uranium Processing Facility's Critical Decision 2 Interim Safety Document

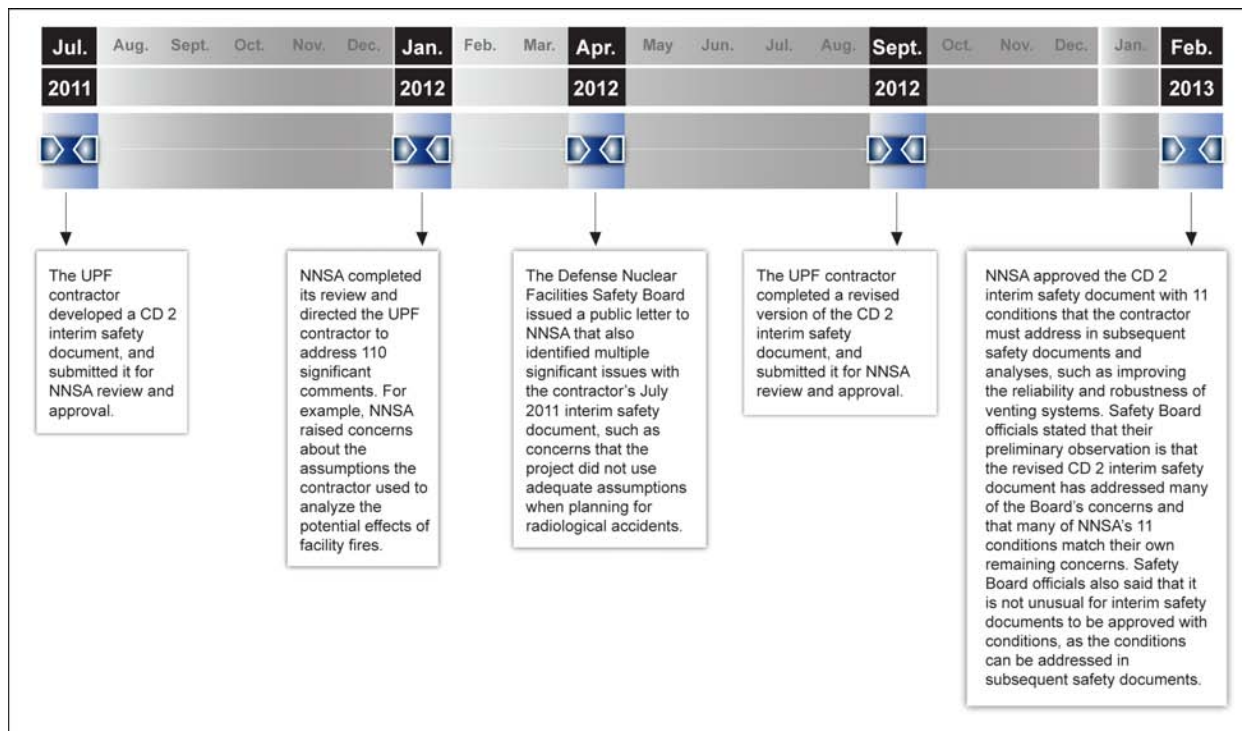
The National Nuclear Security Administration (NNSA)—a separately organized agency within the Department of Energy (DOE)—is required to manage the Uranium Processing Facility (UPF) project in accordance with DOE Order 413.3B, which establishes the agency's project management principles and process, including protocols for planning and executing a project.¹⁹ This process requires DOE projects to go through five management reviews and approvals as they enter each new phase of work, called "critical decisions" (CD). Key interim safety documents are to be completed by the contractor and approved by NNSA prior to CD 1, 2, and 3 milestones, while a final safety document is to be completed and approved prior to CD 4. According to Order 413.3B, facilities cannot begin operations until their final safety documents are approved.

However, in 2009, NNSA decided to expedite the UPF by combining several CD milestones, eliminating the development of the interim safety document for CD 2, and focusing on the development of alternative safety documents.²⁰ After members of the Defense Nuclear Facilities Safety Board—an independent executive branch agency created by Congress to assess safety conditions and operations at DOE's defense nuclear facilities—raised concerns that NNSA was deviating from the process established by DOE Order 413.3B, NNSA directed the UPF contractor to develop an interim safety document for CD 2. Figure 1 describes the timeline by which the required CD 2 interim safety analysis was developed by the UPF contractor and reviewed and approved by NNSA.

¹⁹U.S. Department of Energy, *Program and Project Management for the Acquisition of Capital Assets*, DOE O 413.3B (Washington, D.C.: Nov. 29, 2010)

²⁰UPF contractor representatives told us that they were going to develop two alternate safety-related documents—a preliminary hazard analysis and a preliminary documented safety analysis—as these documents were DOE's prior safety requirements.

Figure 1: Development of the Uranium Processing Facility’s Required CD 2 Interim Safety Analysis



Source: GAO analysis of NNSA information.

Note: DOE’s Office of Health, Safety, and Security, among other things, develops safety policy and conducts independent oversight of compliance with DOE’s safety regulations and directives, and enforcement activities. In addition, this office conducted an independent review of the UPF’s CD 2 interim safety document. The review concurred with the overall conclusions of NNSA’s review, including the decision to approve the document subject to additional conditions for proceeding to the next stage of design. See U.S. Department of Energy, *Independent Oversight Appraisal of the Uranium Processing Facility Safety Basis Preliminary Safety Design Report Process at the Y-12 National Security Complex* (Washington, D.C.: May 2013).

Enclosure II: Safety Concerns Identified by the Defense Nuclear Facilities Safety Board with the Uranium Processing Facility as of June 2013 and Actions Taken by the National Nuclear Security Administration to Address Those Concerns

Safety concern number	Safety concern identified by the Defense Nuclear Facilities Safety Board (Safety Board) with the Uranium Processing Facility (UPF)	Actions taken by the National Nuclear Security Administration (NNSA) to address safety concern
Status of one safety concern where NNSA has completed corrective action		
1	The UPF contractor had not developed an adequate corrective action plan to address structural engineering issues, among other things, previously identified by the Safety Board.	According to the Safety Board staff, the UPF contractor took appropriate actions—such as identifying the controls needed to prevent internal explosions—to address the Safety Board’s concern.
Status of seven safety concerns where the Safety Board’s technical staff believes there is reasonable evidence that NNSA has fully addressed these concerns, and the Safety Board is currently in the final stages of reviewing the agency’s actions		
2	Some potential facility hazards were not analyzed, or the frequency or consequences of these hazards were assumed to be limited. ^a	NNSA, among other things, revised its analyses of the UPF’s hazards to address the Safety Board’s concerns by, for example, identifying additional safety controls for fires.
3	The project lacks a defensible methodology for analyzing fires resulting from an earthquake.	NNSA conducted a new analysis providing additional details on its methodology.
4	The scenario for accidents involving a nuclear criticality is not reasonably conservative. ^b	NNSA clarified and revised the amounts of radiation that were assumed in its criticality accident scenario, and identified an additional safety system to provide shielding for workers located near UPF who could be exposed to dangerous radiation levels during a criticality accident.
5	The analysis of one accident scenario is not adequate, as it does not consider all plant conditions, such as explosions initiated by a fire, that could increase the dispersal of hazardous materials. ^c	NNSA provided additional information on, among other things, the impact of potential explosions on the fire scenario.
6	The UPF project downgraded the ventilation system’s seismic rating, meaning that the ventilation system will not be designed to ensure confinement of hazardous materials	NNSA upgraded a portion of the ventilation system to ensure confinement in the event of an earthquake.

Safety concern number	Safety concern identified by the Defense Nuclear Facilities Safety Board (Safety Board) with the Uranium Processing Facility (UPF)	Actions taken by the National Nuclear Security Administration (NNSA) to address safety concern
	following an earthquake.	
7	The UPF project downgraded the seismic rating of the facility's criticality prevention controls, meaning that the controls will not be designed to reliably survive an earthquake and prevent a criticality accident.	NNSA committed to upgrade the seismic rating of certain criticality prevention controls.
8	The UPF project team has stated its intent to implement Institute of Electrical and Electronics Engineers standards for the reliability of safety controls used to prevent explosions but has not formally detailed this approach in the project's planning documents.	NNSA clarified that these standards are included in UPF design documents.
	Status of six safety concerns where NNSA is completing the corrective action, which Safety Board officials said they will review once the actions are completed	
9	The UPF project downgraded the seismic rating of the criticality accident alarm system, meaning that the system will not be designed to function during and following an earthquake, relying instead on fire alarms to initiate evacuation after an earthquake. ^d	NNSA clarified that it expects the contractor to ensure worker response to an earthquake would be the same as worker response to a criticality alarm.
10	The structural engineering design is robust, but a Safety Board letter raised a technical and quality assurance concern associated with a computer program, which is in use at multiple projects across DOE, including the UPF, for analyzing soil-structure interaction.	NNSA is conducting multiple studies that are intended to resolve technical and quality issues with the computer program.
11	The fire suppression system was assumed to be sufficient to protect against both large and small fires. However, small fires may not provide sufficient heat to activate the fire suppression system, or may be located in gloveboxes—a containment system of secured gloves attached to a box that allows workers to process nuclear material inside the box without risk of contamination—where the suppression system will not provide coverage.	NNSA conducted a new analysis of fire scenarios, including, among other things, limiting the quantities of hazardous materials in certain gloveboxes. The Safety Board staff communicated further concerns with this analysis, such as the potential for concurrent fires in multiple gloveboxes and NNSA's failure to demonstrate that the fire suppression system will control hazardous material releases from smaller fires occurring outside of gloveboxes. In response, NNSA committed to performing additional analyses to address the Safety Board's concerns.

Safety concern number	Safety concern identified by the Defense Nuclear Facilities Safety Board (Safety Board) with the Uranium Processing Facility (UPF)	Actions taken by the National Nuclear Security Administration (NNSA) to address safety concern
12	The functional requirements for the fire suppression system are incomplete and do not address the potential for reactive materials contained in gloveboxes getting wet in the event of an earthquake, potentially causing explosions.	NNSA committed to (1) demonstrating that an explosion is not credible in this scenario, or (2) providing additional safety controls, such as water-tight containers for water-reactive materials.
13	The UPF project office is understaffed for providing effective safety oversight of the project, with many personnel sharing project management and technical oversight responsibilities.	<p>NNSA (1) committed to filling seven key management positions in 2012; (2) hiring specific subject matter experts in 2013-2014, such as in fire protection, ventilation, criticality, quality assurance, and construction oversight; and, (3) prepared a detailed staffing plan.</p> <p>According to an NNSA official, as of March 2013 the project hired additional safety personnel, and had been approved to fill an additional 10 specialist positions, such as fire safety engineers and criticality engineers.</p>
14	Several assumptions used in the UPF's engineering models could result in a design subject to localized structural failure during an earthquake. Such failure could affect the operability of safety systems attached to the structure.	NNSA revised the document describing its approach to validating the assumptions used, and the Safety Board staff is reviewing NNSA's revisions.
Status of one safety concern where the Safety Board and NNSA are not likely to agree on a path to resolution, and NNSA has conducted additional analyses to clarify its position		
15	When calculating the rate at which radioactive material would settle out of the atmosphere onto the surrounding area in the event of an accidental release, NNSA concluded the material would settle more quickly, and thus pose less of a safety concern to the public, than could be the case using more conservative assumptions.	NNSA conducted a review that validated its analysis. Safety Board staff provided NNSA with a written explanation of their specific areas of disagreement, and NNSA is evaluating this explanation.

Sources: GAO analysis of NNSA and Safety Board data.

^a For example, fires were assumed to be limited to a single process area instead of the full facility because it was assumed that fire barriers would prevent their spread.

^b A nuclear criticality accident occurs when enough fissile material, such as uranium, is brought together to cause a sustained nuclear chain reaction. The immediate result of a nuclear criticality accident is the production of an uncontrolled and unpredictable radiation source that can be lethal to people who are nearby. While the UPF will

process the same types of materials that are currently being processed in other facilities at the Y-12 National Security Complex, the criticality analysis supporting existing operations assumes higher amounts of resulting radiation than are used in the analysis for the UPF.

^c According to the Safety Board, the accident of concern is categorized as being beyond the UPF's design requirement. However, DOE Standard 3009: *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses* directs that these types of accidents be analyzed to provide a perspective of the remaining risk associated with operating the facility.

^d According to the Safety Board, the use of the fire alarm does not adequately protect the UPF's workers because the appropriate responses for the two potential accident conditions are inherently different.

Enclosure III: Twelve Additional Safety Concerns Identified by the Defense Nuclear Facilities Safety Board with the Uranium Processing Facility as of August 2013

On August 26, 2013, the Defense Nuclear Facilities Safety Board (Safety Board) sent the National Nuclear Security Administration (NNSA) a letter that acknowledged the agency's progress in addressing the Safety Board's previously identified concerns (i.e., the 15 specific safety concerns identified by the Safety Board in enclosure II) with the design of the UPF. However, the letter stated that NNSA must continue to improve the effectiveness of the UPF's safety controls and strengthen oversight to ensure planned controls can reliably perform their safety functions. In addition, the Safety Board identified 12 additional specific safety concerns with the design of the UPF. According to NNSA officials, the agency is currently reviewing the Safety Board's letter and will provide a report and briefing to the Safety Board by November 22, 2013, describing NNSA's plan and schedule for addressing the issues.

The 12 additional UPF-related safety concerns identified by the Safety Board are as follows:

- *Fires in certain process areas:* For certain fire scenarios, the fire protection system would not actuate or actuation would be delayed and therefore may not prevent a significant release of toxicological material.
- *Glovebox fires:* Under normal operating conditions, certain gloveboxes—a containment system of secured gloves attached to a box that allows workers to process nuclear material inside the box without risk of contamination—are provided with an inert gas atmosphere that does not allow combustion. However, if the inert environment is lost (e.g., due to an earthquake), oxygen intrusion into the glovebox could cause the material inside to ignite. Since fire protection sprinklers are located outside of the gloveboxes, they cannot be relied upon to protect against such fires.
- *Aircraft crashes:* NNSA analyzed aircraft crash scenarios for the main UPF building but did not analyze the aircraft crash scenario for ancillary UPF structures, such as the loading dock and truck bay.
- *Natural disasters and man-made external events:* The UPF structure is designed to provide protection against a specific set of natural disasters and man-made external events, such as vehicle impacts and wildfires. However, the UPF safety analysis does not clearly link the associated functional requirements and performance criteria for the UPF structure to the specific accidents. The Safety Board concluded that important structural attributes may not be effectively captured and incorporated into the UPF's design.
- *Concurrent releases of multiple hazardous materials:* Some fire scenarios in the UPF can concurrently release multiple hazardous chemicals. However, the UPF's safety controls are designed to prevent or mitigate hazards based solely on the potential release of any single chemical exceeding the applicable thresholds. This could result in the need for additional safety controls when the cumulative effects of concurrently released chemicals are evaluated.
- *Dust explosions:* Certain uranium processing activities in gloveboxes can generate dusts, which could produce explosions that could seriously injure facility workers. Under normal operating conditions, the affected gloveboxes are provided with an inert gas

atmosphere to prevent dust explosions. However, the safety features that provide this inert atmosphere could be compromised under certain accident scenarios.

- *Violent chemical reactions:* Certain chemical processing activities can result in violent chemical reactions that forcefully expel heated chemicals from process vessels. However, the UPF project has not identified any credited controls to protect facility workers from resulting chemical burns.
- *Combustible materials in certain processing equipment:* During a specific uranium processing operation, potentially combustible materials might be present. When certain processing equipment is heated to its normal operating temperature (approximately 1400 degrees Celsius), the potentially combustible material could release enough energy to rupture the equipment and injure facility workers. The UPF project has not identified a control to prevent the introduction of potentially combustible material into certain processing equipment.
- *Steam overpressure in casting furnaces:* Potential water intrusion into a furnace that casts highly enriched uranium during high-temperature operations can cause a violent steam overpressure event that could seriously injure facility workers. The current UPF safety strategy has not demonstrated how the credited safety control can prevent the water intrusion.
- *Hydrogen explosions (1):* A hydrogen explosion could occur in the enriched uranium purification and metal production process under certain conditions. The current UPF safety strategy relies on operator action to prevent a hydrogen explosion but does not treat this operator action as a formal safety control, even though it is relied upon to prevent an event that could result in serious facility worker injuries.
- *Hydrogen explosions (2):* Hydrogen would be released if water reacted with certain compounds used in the UPF assembly process area. The UPF safety analysis did not evaluate the potential for a hydrogen explosion.
- *Damage to enriched uranium in storage:* For earthquake-induced fires, the UPF safety analysis assumes that 10 percent of enriched uranium located in the UPF's storage racks would be damaged. This 10 percent assumption is based on a series of experiments conducted at Los Alamos National Laboratory under controlled laboratory conditions. The Safety Board said that the unmitigated earthquake-induced UPF fire environment could exhibit conditions that are different than the conditions used in the Los Alamos experiments. As such, the Safety Board stated that the UPF project does not have adequate data to support its 10 percent damage ratio.

Enclosure IV: Comments from the Department of Energy



Department of Energy
National Nuclear Security Administration
Washington, DC 20585
October 3, 2013



Mr. David Trimble
Director
Natural Resources and Environment
Government Accountability Office
Washington, DC 20458

Dear Mr. Trimble:

Thank you for the opportunity to review the Government Accountability Office (GAO) draft report titled "*Safety Concerns on the Uranium Processing Facility Project*", GAO-14-79R. I understand the GAO is required to report quarterly on the Uranium Processing Facility (UPF) in response to a request made by the Senate Appropriations Committee, Subcommittee on Energy and Water Development, and in accordance with the requirements contained in the National Defense Authorization Act for Fiscal Year 2013. This is the second quarterly report of the UPF report series.

In response to the draft report, NNSA provides the following technical comments for GAO's consideration:

- 1) Page 6, first full paragraph, third sentence: For accuracy, please revise the third sentence to read as follows:

"However, in 2009, NNSA decided to expedite the UPF by combining the CD 2 and CD 3 milestones, eliminating the development of the interim safety document for CD 2 (a Preliminary Safety Design Report) and focusing on the development of the Preliminary Documented Safety Analysis Reports to support the CD 3 deliverables"

- 2) Page 6 footnote number 13: For consistency with current plans, please revise the footnote to read as follows:

"UPF contractor representatives told us that they were going to develop 3 Preliminary Documented Safety Analysis (PDSA) to support the CD 3 deliverables."



Printed with soy ink on recycled paper

If you have any questions regarding this response, please contact Dean Childs, Director,
Office of Audit Coordination and Internal Affairs, at (301) 903-1341.

Sincerely,

A handwritten signature in black ink, appearing to read "Cynthia Lersten". The signature is written in a cursive style with a prominent horizontal stroke at the end.

Cynthia A. Lersten
Associate Administrator
for Management and Budget

This is a work of the U.S. government and is not subject to copyright protection in the United States. The published product may be reproduced and distributed in its entirety without further permission from GAO. However, because this work may contain copyrighted images or other material, permission from the copyright holder may be necessary if you wish to reproduce this material separately.

GAO's Mission

The Government Accountability Office, the audit, evaluation, and investigative arm of Congress, exists to support Congress in meeting its constitutional responsibilities and to help improve the performance and accountability of the federal government for the American people. GAO examines the use of public funds; evaluates federal programs and policies; and provides analyses, recommendations, and other assistance to help Congress make informed oversight, policy, and funding decisions. GAO's commitment to good government is reflected in its core values of accountability, integrity, and reliability.

Obtaining Copies of GAO Reports and Testimony

The fastest and easiest way to obtain copies of GAO documents at no cost is through GAO's website (www.gao.gov). Each weekday afternoon, GAO posts on its website newly released reports, testimony, and correspondence. To have GAO e-mail you a list of newly posted products, go to www.gao.gov and select "E-mail Updates."

Order by Phone

The price of each GAO publication reflects GAO's actual cost of production and distribution and depends on the number of pages in the publication and whether the publication is printed in color or black and white. Pricing and ordering information is posted on GAO's website, <http://www.gao.gov/ordering.htm>.

Place orders by calling (202) 512-6000, toll free (866) 801-7077, or TDD (202) 512-2537.

Orders may be paid for using American Express, Discover Card, MasterCard, Visa, check, or money order. Call for additional information.

Connect with GAO

Connect with GAO on [Facebook](#), [Flickr](#), [Twitter](#), and [YouTube](#). Subscribe to our [RSS Feeds](#) or [E-mail Updates](#). Listen to our [Podcasts](#). Visit GAO on the web at www.gao.gov.

To Report Fraud, Waste, and Abuse in Federal Programs

Contact:

Website: www.gao.gov/fraudnet/fraudnet.htm

E-mail: fraudnet@gao.gov

Automated answering system: (800) 424-5454 or (202) 512-7470

Congressional Relations

Katherine Siggerud, Managing Director, siggerudk@gao.gov, (202) 512-4400, U.S. Government Accountability Office, 441 G Street NW, Room 7125, Washington, DC 20548

Public Affairs

Chuck Young, Managing Director, youngc1@gao.gov, (202) 512-4800 U.S. Government Accountability Office, 441 G Street NW, Room 7149 Washington, DC 20548

