

Peter S. Winokur, Chairman
Jessie H. Roberson, Vice Chairman
John E. Mansfield
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**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**

Washington, DC 20004-2901



September 23, 2011

The Honorable Steven Chu
Secretary of Energy
U. S. Department of Energy
Forrestal Bldg. Room 7A-257
1000 Independence Avenue, SW
Washington, DC 20585

Dear Secretary Chu:

The Defense Nuclear Facilities Safety Board (Board) is pleased to enclose a copy of our Report to Congress on the Status of Significant Unresolved Issues with the Department of Energy's Design and Construction Projects (dated September 23, 2011). In the Conference Report accompanying the FY 2007 National Defense Authorization Act, the conferees directed the Board to provide quarterly reports until the Department of Energy (DOE) and the Board submit a joint report "on their efforts to improve the timeliness of issue resolution, including recommendations, if any, for legislation that would strengthen and improve technical oversight of the Department's nuclear design and operational activities." The joint report was submitted to the congressional defense committees on July 19, 2007. While the conferees did not require the Board to continue providing reports, the Board believes these reports provide an appropriate means to keep all parties apprised of the Board's concerns with new designs for DOE defense nuclear facilities. The Board has received encouraging feedback from Congress. As such, the Board intends to continue issuing these reports to Congress and DOE.

Sincerely,

Peter S. Winokur, Ph.D.
Chairman

Enclosure: as stated

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September 23, 2011

To the Congress of the United States:

The Defense Nuclear Facilities Safety Board (Board) provides periodic reports to Congress and the Department of Energy (DOE) on the status of significant unresolved technical differences between the Board and DOE on issues concerning the design and construction of DOE's defense nuclear facilities. This periodic report builds on earlier reports to summarize the status of issues raised through the beginning of August 2011 and identifies new issues associated with the relevant projects. The status of many issues has not changed significantly during the reporting period; however, the fact that an issue has not been resolved does not necessarily imply a lack of progress.

In this report, the phrase "unresolved issue" does not necessarily mean that the Board has a disagreement with DOE or believes DOE's path forward to resolution is inappropriate. Some of the issues noted in these reports simply await final resolution through further development of the facility design. All of the significant unresolved issues discussed herein have been communicated to DOE. Lesser issues that the Board believes can be resolved easily and for which an agreed-upon path forward exists are not included. The Board will follow these items as part of its normal design review process.

It is important to note that the Board may identify additional issues in the course of its continuing design reviews. New issues identified since the previous reports are noted below, as well as those issues the Board believes have been resolved. For this reporting period, three new issues were identified; one issue was resolved because of a change in project status; and another issue was removed from the report, also because of a change in project status. The enclosure to this report provides a concise summary of significant unresolved issues.

PROJECTS WITH THE MOST SIGNIFICANT UNRESOLVED ISSUES

The Board is again highlighting the seismic evaluation and upgrade of Los Alamos National Laboratory's (LANL) Plutonium Facility and the Hanford Site's Waste Treatment and Immobilization Plant (WTP) as those projects with the most significant unresolved safety issues.

Los Alamos National Laboratory, Technical Area-55/Plutonium Facility. On October 26, 2009, the Board issued Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*, which addressed the need to reduce the potential consequences to the public from a seismic event at the Plutonium Facility. On July 13, 2010, DOE provided the Board its Implementation Plan for the Recommendation. DOE has submitted the first eight deliverables of the Implementation Plan to the Board. This information will support the selection and execution of safety system upgrades.

In May 2007, prior to issuance of the Recommendation, LANL updated the site's Probabilistic Seismic Hazard Analysis. The update demonstrated a significant increase in the potential ground motion at the site. LANL initiated the Seismic Analysis of Facilities and Evaluation of Risk (SAFER) project to evaluate the resulting increase in seismic risk to facilities at the laboratory. The SAFER project's analysis of the Plutonium Facility's safety-class structure was included as a deliverable in the Implementation Plan. LANL completed the analysis in May 2011 and identified nine seismic vulnerabilities that could render the Plutonium Facility's structure unable to maintain its safety-class confinement function during postulated seismic events.

In June 2011, LANL published a Justification for Continued Operations (JCO) requesting approval by the National Nuclear Security Administration (NNSA) for continued operations in the Plutonium Facility through December 9, 2011. The request included a plan for addressing the structure's seismic vulnerabilities. NNSA approved the JCO on July 15, 2011. The Board's staff is closely reviewing these efforts to fully understand the seismic vulnerabilities of the Plutonium Facility's structure, as well as the compensatory actions and upgrades necessary to mitigate this increased seismic risk in order to ensure adequate protection of the public and workers.

Hanford Site, Waste Treatment and Immobilization Plant. During this reporting period, the Board focused on issues at WTP in the following areas: mixing in process vessels, hydrogen in piping and ancillary vessels (HPAV), and spray leak analysis.

During the past 2 years, the Board has raised a number of safety-related design issues that came to light after DOE and/or Bechtel National, Incorporated (BNI) changed the WTP design late in the design process. In several instances, BNI has reanalyzed aspects of its safety-related design basis to support a proposed design change, performed additional laboratory testing to support changing the WTP design basis, or embarked on new design strategies entirely. One example is the first-time use of quantitative risk analysis in revising the HPAV design approach; DOE has used probabilistic methods in the past, but this approach was not applied to the complex WTP piping design. Other examples include Pacific Northwest National Laboratory's (PNNL) spray leak testing in support of the WTP-specific spray leak methodology, and heat transfer calculations supporting the removal of safety-class mixing controls. In addition, the Board is aware that BNI is conducting experimental testing to resolve issues associated with design changes to the process vessel ventilation and confinement ventilation systems.

The Board acknowledges that unresolved design issues are inevitable in light of DOE's decision to pursue a fast-track, design-build strategy for this one-of-a-kind facility. However, the Board is deeply concerned that DOE is creating additional safety-related design issues by altering aspects of the WTP design without adequately understanding the technical difficulties, complexities, or project risks involved.

The Board believes that in electing to pursue design changes, DOE must not underestimate the technical challenges associated with altering the safety-related design bases at this late stage of the WTP project, particularly while continuing to aggressively pursue design and fabrication activities consistent with the current construction schedule.

Mixing in Process Vessels

On December 17, 2010, the Board issued Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*, to address potential nuclear safety hazards arising from inadequate pulse jet mixing at WTP. Recommendation 2010-2 focused on the conduct of large-scale tests to demonstrate the performance limits of the vessel mixing and transfer systems using representative simulants. On May 20, 2011, consistent with the criteria set forth in the Board's Policy Statement 1, *Criteria for Judging the Adequacy of DOE Responses and Implementation Plans for Board Recommendations* (October 19, 1990), the Board found that the Secretary of Energy's response "...says it is an acceptance, but by its language or terms in fact rejects part of the Recommendation." Specifically, the Board concluded that DOE rejected Sub-recommendations 3 and 4, which involve verifying and validating the computational fluid dynamics model of full-scale WTP mixing systems using the results of large-scale testing, and demonstrating the capability to obtain representative samples from WTP's vessels, respectively. The Board also reaffirmed Recommendation 2010-2 in its entirety.

On June 20, 2011, the Secretary of Energy again accepted Recommendation 2010-2 and communicated DOE's intent to develop an Implementation Plan that would meet its underlying objectives for safety improvement.

Hydrogen in Piping and Ancillary Vessels

Based on information from DOE, the Board anticipated that BNI would complete the actions necessary to formally close findings and recommendations made by the HPAV Independent Review Team (HIRT) by June 2011. On June 16, 2011, however, BNI again revised its closure plan and subsequently delayed the completion of corrective actions. On August 2-3, 2011, the HIRT met with BNI to review actions taken by BNI to resolve findings and recommendations from the HIRT's 2010 report. The HIRT also raised new issues during these discussions. BNI and the HIRT have since developed a path forward for addressing unresolved issues from the HIRT's 2010 report and the discussions of August 2011.

As noted in its previous periodic reports to Congress, the Board remains concerned about the use of quantitative risk analysis as part of the hydrogen control strategy for WTP. The impact of quantitative risk analysis on implementation of the WTP safety basis remains unknown.

Spray Leak Analysis

In a letter to DOE dated April 5, 2011, the Board identified issues related to the WTP-specific methodology for estimating radiological consequences to the offsite receptor from spray leak accidents. On June 3, 2011, DOE responded to the Board's letter and committed to reducing the uncertainty in the spray leak methodology; improving the methodology in preparation for the development of the Documented Safety Analysis (DSA); performing spray leak testing at PNNL; and, upon completion of this testing, evaluating the new information and incorporating the results into the WTP design, DSA, and Technical Safety Requirements. On August 4, 2011, representatives from DOE's Office of River Protection and PNNL discussed the technical details of the test approach with the Board's staff. Based on these discussions, the Board anticipates that PNNL's testing will begin by September 2011, and a final report will be available by March 2012. DOE's letter to the Board also stated that DOE's Office of Health, Safety and Security will address this issue across the defense nuclear complex.

NEW ISSUES IDENTIFIED DURING THE PERIOD**1. Project: Hanford Site, Waste Treatment and Immobilization Plant—Low Activity Waste Facility**

New Issue—Instrumentation and Control System Design. In a May 5, 2011, letter to DOE, the Board pointed out that instrumented controls were not independent of the initiating events for certain hazards. As a result, the controls would be ineffective in performing their required functions during some accident scenarios. In addition, the Board found that the safety basis failed to account for the existence or performance of structures, systems, and components used to support design assumptions for other safety-significant instrumentation and control systems. In its July 1, 2011, response, DOE agreed with the Board's findings and identified an acceptable path forward that, when effectively completed, would be adequate to address the issues raised by the Board. DOE's path forward notably included a commitment to performing a comprehensive review of the WTP hazard analysis process, modifying existing procedures, and ensuring that appropriate controls are selected for each hazardous condition. DOE also committed to incorporating the necessary design information into the safety basis to ensure that the operation of safety-significant instrumentation and controls would be consistent with the assumed design basis. The Board will evaluate the effectiveness of DOE's actions once they have been completed.

2. Project: Hanford Site, Waste Treatment and Immobilization Plant—Pretreatment Facility

New Issue—Use of Low-Order Accumulation Model. In a June 7, 2011, letter to DOE, the Board expressed its belief that the Low-Order Accumulation Model (LOAM) was not suitable for predicting the accumulation of solids in either Newtonian or non-Newtonian full-scale vessels because it underpredicts the accumulation of solids and has no sound physical basis. The Board noted that DOE’s Office of River Protection had used results obtained from this model as a basis for partial closure of issues concerning solids accumulation associated with the External Flowsheet Review Team’s Major Issue 3 (M3), “Inadequate Design of Mixing Systems.”

In its August 5, 2011, response, DOE’s Office of Environmental Management informed the Board that the LOAM would not be used for further design work, that there were no plans to verify and validate the model, and that large-scale integrated testing would be used to complete confirmation and performance testing for the WTP vessel design consistent with DOE’s Implementation Plan for the Board’s Recommendation 2010-2. The Board concurs with DOE’s determination that the LOAM should not be used for further design work; however, the Board notes that BNI used this model to “inform” other aspects of the WTP project subsequent to the Board’s letter and prior to DOE’s response. For example, BNI used the LOAM to help justify welding the vessel heads on non-Newtonian vessels and as recently as this month used LOAM in developing proposed steps for sludge treatment. The Board is evaluating BNI’s continued use of the LOAM as an informational tool in light of these deficiencies.

3. Project: Hanford Site, Waste Treatment and Immobilization Plant—Pretreatment Facility

New Issue—Heat Transfer Analysis for Process Vessels in the Pretreatment Facility. In a letter dated August 3, 2011, the Board formally communicated to DOE issues related to heat transfer calculations that provide input to subsequent calculations for post-accident hydrogen generation in process vessels in the Pretreatment Facility. Based on these calculations, the WTP project team downgraded safety-class mixing controls for nine Pretreatment Facility process vessels, replacing active engineered features with a specific administrative control that directs operators to restore mixing within a calculated time following a design basis accident.

The Board believes that the analyses performed to date are not reasonably conservative and do not support decisions to downgrade mixing controls. The Board believes BNI should (1) select a suitable model with the accuracy and precision needed to predict the highly complex heat transfer phenomena within WTP process vessels, and (2) properly verify and validate the model consistent with applicable consensus standards for this application.

CHANGE IN PROJECT STATUS**1. Project: Nevada National Security Site, Device Assembly Facility—Criticality Experiments Facility**

The Criticality Experiments Facility (CEF) project at the Nevada National Security Site is maintaining DOE's unique capability to perform criticality experiments. The project team modified areas within the Device Assembly Facility to accept criticality experiment assemblies formerly located at LANL. The Board previously had identified safety issues associated with the fire protection water supply to the Device Assembly Facility, including the susceptibility of the system to single-point failure, use of unlisted components, and deterioration of the lead-in supply lines. These deficiencies affected multiple areas within the Device Assembly Facility, including the area for the CEF project. NNSA completed an evaluation of the water supply system and developed recommendations for correcting these deficiencies. The Board found the condition assessment and proposed improvement plan to be acceptable. NNSA has implemented interim compensatory measures to help address the issues raised by the Board until the corrective actions have been completed.

The CEF project has been completed, and NNSA authorized startup on May 9, 2011. The Board is therefore removing this project from the list in the enclosure to this report. NNSA has begun work on improvements to the fire protection water supply system. Notably, NNSA granted approval of the Critical Decision-0 milestone for the Lead-in Line Replacement Project on May 18, 2011. The Board will continue to report on deficiencies of the fire protection water supply in its *Annual Report to Congress: Summary of Significant Safety-Related Infrastructure Issues at Operating Defense Nuclear Facilities*.

2. Project: Oak Ridge National Laboratory, Building 3019—Uranium-233 Downblending and Disposition Project

The original scope of the Uranium-233 Downblending and Disposition Project was to downblend and stabilize the entire inventory of uranium-233 in Building 3019 at Oak Ridge National Laboratory. In April 2011, DOE-Headquarters directed DOE's Oak Ridge Operations Office to proceed with direct disposition of a portion of the uranium-233 materials stored in Building 3019 and to continue an alternatives analysis to identify the preferred alternative(s) for processing the remaining inventory. This direction has effectively eliminated the Uranium-233 Downblending and Disposition Project as originally envisioned. The safety basis issue identified by the Board therefore is no longer relevant to the altered disposition activities, which will require new safety

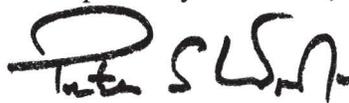
basis documentation. This issue is therefore closed. The Board will continue to review storage and disposal activities for the uranium-233 material at Oak Ridge National Laboratory.

3. Project: Savannah River Site, Tank 48 Treatment Process Project

The Tank 48 Treatment Process Project was intended to enable the Savannah River Site to return Tank 48 to service by destroying tetraphenylborate in the tank using a fluidized bed steam reforming process. DOE suspended the project on July 29, 2011, because of budget constraints, identification of a promising new technology for treating the waste, and an improved outlook on high-level waste tank space resulting from enhancements at the Defense Waste Processing Facility. The Board therefore is removing the Tank 48 Treatment Process Project from the list in the enclosure to this report. The Board understands that DOE is planning to investigate a near-tank chemical destruction process to replace fluidized bed steam reforming. When DOE begins to move forward again with a project to treat the waste in Tank 48 using this or an alternative technology, the Board will track the project's progress and communicate outstanding safety issues through subsequent reports.

As directed by Congress, the Board will continue to exercise its existing statutory authority.

Respectfully submitted,



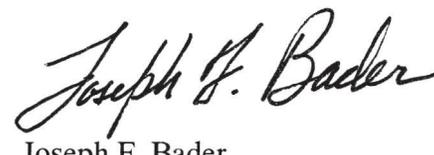
Peter S. Winokur, Ph.D.
Chairman



Jessie H. Roberson
Vice Chairman



John E. Mansfield
Member



Joseph F. Bader
Member

Enclosure

ENCLOSURE

**SEPTEMBER 2011 REPORT
SUMMARY OF SIGNIFICANT UNRESOLVED ISSUES
WITH NEW DEFENSE NUCLEAR FACILITIES**

| SITE | FACILITY | TOTAL PROJECT COST (\$M) | STATUS | | | ISSUES ^b |
|--------------|--|--------------------------|---------------------------------|--------------------------------|---------------------------|---|
| | | | Critical Decision (CD) Approved | Design Completion ^a | Construction Completion | |
| Hanford Site | Waste Treatment and Immobilization Plant (WTP) | 12,263 | | | <i>(Operational 2019)</i> | |
| | a. WTP Pretreatment Facility | | CD-3 | 80% Final Design | 38% | <ol style="list-style-type: none"> 1. Seismic ground-motion —resolved (Feb 08) 2. Structural engineering —resolved (Dec 09) 3. Chemical process safety —resolved (Oct 07) 4. Fire safety design for ventilation systems —resolved (Dec 09) 5. Hydrogen gas control 6. Structural steel analysis and design —resolved (Dec 10) 7. Inadequate mixing 8. Deposition velocity 9. Inadequacies in the spray leak methodology 10. Use of Low-Order Accumulation Model —new issue (Sep 11) 11. Heat transfer analysis for process vessels —new issue (Sep 11) |

^aThe percent of design completion is an estimate for the particular stage of design (conceptual, preliminary, or final).

^bDates in parentheses indicate the periodic report in which an issue was considered resolved or a new issue was identified.

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| | | | Critical Decision (CD) Approved | Design Completion ^a | Construction Completion | |
| Hanford Site (continued) | b. WTP High-Level Waste Facility | | CD-3 | 88% Final Design | 35% | <ol style="list-style-type: none"> 1. Seismic ground motion —<i>resolved (Feb 08)</i> 2. Structural engineering —<i>resolved (Dec 09)</i> 3. Fire protection —<i>resolved (Jun 09)</i> 4. Fire safety design for ventilation systems —<i>resolved (Dec 09)</i> 5. Hydrogen gas control 6. Structural steel analysis and design —<i>resolved (Dec 10)</i> 7. Deposition velocity 8. Inadequacies in the spray leak methodology |
| | c. WTP Low-Activity Waste Facility | | CD-3 | 90% Final Design | 64% | <ol style="list-style-type: none"> 1. Fire protection —<i>resolved (Jun 09)</i> 2. Structural steel analysis and design —<i>resolved (Dec 10)</i> 3. Instrumentation and control system design —<i>new issue (Sep 11)</i> |
| | d. WTP Analytical Laboratory | | CD-3 | 80% Final Design | 65% | <ol style="list-style-type: none"> 1. Fire protection —<i>resolved (Jun 09)</i> No open issues remain |
| | K-Basin Closure Sludge Treatment Project | 268 | Phase 1: CD-1 Phase 2: CD-0 | Phase 1: 80% Preliminary Design Phase 2: 33% Conceptual Design | Phase 1: <i>(Operational 2013)</i> Phase 2: <i>(Operational to be determined)</i> | <ol style="list-style-type: none"> 1. Completeness of Preliminary Documented Safety Analysis —<i>review terminated; document not relevant to new conceptual design (Oct 07)</i> 2. Adequacy of project management and engineering —<i>resolved (Sep 10)</i> 3. Inadequacies in integration of safety into the design process 4. Inadequacies in safety basis development |

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| | | | Critical Decision (CD) Approved | Design Completion ^a | Construction Completion | |
| Hanford Site (continued) | Waste Feed Delivery System | 469 | Most subprojects not using the formal CD process | Various degrees of completion | Various degrees of completion and operations | 1. Design pressure rating of waste transfer system <i>—resolved (Oct 07)</i> No open issues remain |
| Idaho National Laboratory | Integrated Waste Treatment Unit Project (IWTU) | 570.9 | CD-3 | 100% Final Design | 97% (Operational 2011) | 1. Pilot plant testing <i>—resolved (Feb 09)</i> 2. Waste characterization <i>—resolved (Feb 09)</i> 3. Distributed control system design <i>—resolved (Feb 09)</i> No open issues remain |
| | Calcine Disposition Project | 600-900 | CD-0 | < 30% Conceptual Design | Will utilize portions of IWTU (Operational 2022) | No issues identified |
| Los Alamos National Laboratory | Chemistry and Metallurgy Research Replacement Project—Nuclear Facility | 3,710-5,860 Undergoing DOE Review | CD-1 | 100% Preliminary Design | Some ground work (Operational to be determined) | 1. Design build acquisition strategy <i>—resolved (Jun 07)</i> 2. Site characterization and seismic design <i>—resolved (Dec 09)</i> 3. Safety significant active ventilation system <i>—resolved (2) reopened due to issue 6 (Oct 07)</i> <i>—resolved (Dec 09)</i> 4. Safety class fire suppression system <i>—resolved (Dec 09)</i> 5. Safety class and safety significant container design <i>—resolved (Dec 09)</i> 6. Deficiencies in Draft Preliminary Documented Safety Analysis <i>—resolved (Dec 09)</i> No open issues remain |

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| | | | Critical Decision (CD) Approved | Design Completion ^a | Construction Completion | |
| Los Alamos National Laboratory (continued) | Technical Area-55 Reinvestment Project | Phase 2: 100 | Phase 2: CD-2A | Various degrees of completion | <i>(Phase 2 Complete 2016)</i> | <ol style="list-style-type: none"> 1. Adequacy of safety systems —<i>resolved (Sep 08)</i> 2. Inadequate approach to ensure timely improvements to the safety posture |
| | Upgrades to Pit Manufacturing Capability at the Plutonium Facility (Technical Area-55) | Annual funding | Not formally implementing CD process | Various degrees of completion | Work ongoing | <ol style="list-style-type: none"> 1. Lack of adherence to —DOE Order 413.3A —<i>resolved (Sep 08)</i> No open issues remain |
| | Radioactive Liquid Waste Treatment Facility Upgrade Project | Undergoing DOE Review | CD-1 | 99% Preliminary Design | On hold <i>(Operational to be determined)</i> | <ol style="list-style-type: none"> 1. Weak project management and federal project oversight —<i>resolved (Sep 10)</i> 2. Weak integration of safety into the design process —<i>resolved (Sep 10)</i> No open issues remain |
| | Transuranic Waste Facility | 71–124 | Phase A: CD-2 Phase B: CD-1 | Phase A: 100% Final Design Phase B: 100% Preliminary Design | <i>(Operational 2015–2018)</i> | <ol style="list-style-type: none"> 1. Inadequate integration of safety into the design process —<i>issue not relevant to revised project scope (Sep 10)</i> No open issues remain |
| Oak Ridge National Laboratory | Building 3019—Uranium-233 Downblending and Disposition Project | Undergoing DOE Review | Undergoing DOE Review | Undergoing DOE Review | <i>(Operational 2014)</i> | <ol style="list-style-type: none"> 1. Deficiencies in Preliminary Documented Safety Analysis —<i>issue not relevant to revised project scope (Sep 11)</i> No open issues remain |

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| Savannah River Site | Pit Disassembly and Conversion Project (in existing K-Area facilities) | Undergoing DOE Review | CD-0 | 95% Conceptual Design | <i>(Operational being evaluated)</i> | 1. Assumption on combustible loading for seismically induced fire —review of Pit Disassembly and Conversion Facility terminated; not relevant to new conceptual design (Apr 10) No issues identified |
| | Salt Waste Processing Facility | 1,340 | CD-3 | >98% Final Design | 44% <i>(Operational 2015)</i> | 1. Geotechnical investigation —resolved (Feb 08) 2. Structural evaluation —resolved (Dec 09) 3. Quality assurance— —resolved (Jun 07) 4. Hydrogen generation rate —resolved (Jun 09) 5. Flammable gas control 6. Fire protection for final HEPA filters —resolved (Sep 10) 7. Operator actions following a seismic event 8. Mixing system controls and operational parameters |
| | Waste Solidification Building | 345 | CD-2/3 | 100% Final Design | 68% <i>(Operational 2013)</i> | 1. Structural design —resolved (Jun 09) 2. Deficiencies in Preliminary Documented Safety Analysis —resolved (Feb 09) No open issues remain |

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|---------------------------------------|------------------------------------|--------------------------------------|---------------------------------|--------------------------------|---------------------------|--|
| | | | Critical Decision (CD) Approved | Design Completion ^a | Construction Completion | |
| Y-12 National Security Complex | Uranium Processing Facility | 4,200–6,500 Undergoing DOE Review | CD-1 | 50% Preliminary Design | <i>(Operational 2022)</i> | <ol style="list-style-type: none"> 1. Preliminary hazards-analysis development —<i>resolved (Jun 07)</i> 2. Nonconservative values for airborne-release fraction and respirable release-fraction —<i>resolved (Sep 08)</i> 3. Structural and geotechnical engineering |
| Multiple Sites | Multiple Sites | N/A | N/A | N/A | N/A | <ol style="list-style-type: none"> 1. Deficiencies with the System for the Analysis of Soil-Structure Interaction (SASSI) computer software |