

Peter S. Winokur, Chairman  
Jessie H. Roberson, Vice Chairman  
John E. Mansfield  
Joseph F. Bader

**DEFENSE NUCLEAR FACILITIES  
SAFETY BOARD**

Washington, DC 20004-2901



June 15, 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 June 15, 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 quarterly 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,

A handwritten signature in black ink, appearing to read "Peter S. Winokur".

Peter S. Winokur, Ph.D.  
Chairman

Enclosure: as stated

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June 15, 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 end of April 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, four new issues were identified, and one issue was resolved. The enclosure to this report provides a concise summary of significant unresolved issues.

### **PROJECTS WITH THE MOST SIGNIFICANT UNRESOLVED ISSUES**

The Board continues to highlight Los Alamos National Laboratory's (LANL) Plutonium Facility and the Hanford Site's Waste Treatment and Immobilization Plant (WTP) as the 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 Recommendation 2009-2, setting forth the long-term safety strategy for the facility. DOE has submitted the first six Implementation Plan deliverables to the Board. This information will support the selection and execution of safety system upgrades.

Recently, LANL identified vulnerabilities with the Plutonium Facility's structure that indicate an increase in the likelihood of failure during a seismic event. LANL is working to better understand these vulnerabilities as well as to identify and implement compensatory actions and upgrades to mitigate the increased seismic risk.

***Hanford Site, Waste Treatment and Immobilization Plant.*** The Board's most significant concerns with WTP during this reporting period are in the areas of mixing in process vessels, hydrogen in piping and ancillary vessels, and the project-specific methodology for evaluating the consequences of spray leak accidents.

### *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 focuses on conducting large-scale tests to demonstrate the performance limits of the vessel mixing and transfer systems using representative simulants. The Board believes DOE should establish waste acceptance criteria based on these performance limits, which requires the ability to obtain representative samples of waste slurries from these systems. The following are key elements of Recommendation 2010-2:

- Large-scale testing must be done at the proper scale to demonstrate the limits of performance of the vessel mixing and transfer systems. These tests must be conducted using appropriate waste simulants with properties that conservatively envelope the properties of the high-level wastes stored in Hanford's tank farms.
- Large-scale testing must demonstrate that pulse-jet mixed vessels can be adequately operated using prototypic equipment (e.g., control systems) in multi-batch operations.
- Large-scale testing must demonstrate that representative samples can be taken from waste feed delivery tanks to meet waste acceptance criteria, and from WTP process vessels to meet safety-related operating requirements.
- The heel removal and cleanout systems must be designed and tested as early as practicable; the performance limits for these systems must be established; and the limits of operation must be factored into the development of waste acceptance criteria and the operating envelope of WTP.

The Board believes the strategy outlined in Recommendation 2010-2 allows for continued design and construction in conjunction with large-scale testing. The Board believes further that upon completion of the large-scale tests, DOE will have obtained adequate knowledge of the mixing, sampling, and transfer systems to develop conservative waste acceptance criteria, and if necessary, to determine whether other capabilities are needed to complete its cleanup mission at

Hanford's tank farms. The Board believes that potential issues arising from performance limitations of the mixing, sampling, or transfer systems should be addressed as soon as practicable and not after the initiation of WTP operations.

On February 10, 2011, DOE accepted Recommendation 2010-2, but with clarifications that the Board interpreted as a rejection of several elements of the recommendation. Specifically, the Board concluded that DOE rejected Sub-recommendation 3, which involves verifying and validating the computational fluid dynamics (CFD) model of full-scale WTP mixing systems using the results of large-scale testing. DOE's clarification states that verification and validation of the model will be completed prior to large-scale testing activities. This approach is inconsistent with the Board's finding that, given the complexities involved in simulating multi-phase, transient, and non-Newtonian mixing and transport systems, DOE should obtain data from near-full-scale tests to establish that the CFD model is an accurate representation of the full-scale mixing systems.

The Board also concluded that DOE rejected Sub-recommendation 4, which relates to demonstrating the capability to obtain representative samples from WTP's vessels. DOE's clarification suggests that the WTP sampling systems need only have the ability to obtain sample material but does not specify that this material must be representative of the waste in Hanford's high-level waste tanks. The Board believes that obtaining representative samples of process slurries at WTP, as well as feed from the Hanford tank farms, is a prerequisite for meeting safety-related aspects of the WTP waste acceptance criteria and for managing criticality hazards consistent with nuclear safety requirements in DOE Order 420.1B, *Facility Safety*.

#### *Hydrogen in Piping and Ancillary Vessels*

On September 16, 2010, Bechtel National, Incorporated (BNI) completed a formal closure plan addressing findings and recommendations from the Hydrogen in Piping and Ancillary Vessels Independent Review Team (HIRT). BNI subsequently revised the plan three times to address delays in completing corrective actions. BNI anticipates providing final design basis documents to the HIRT in June 2011 for review. The Board is concerned that the lack of a completed design basis for the Hydrogen in Piping and Ancillary Vessels effort may compromise the intent and benefit of this critical review. As noted in its previous periodic reports to Congress, the Board remains concerned about the use of quantitative risk analysis (QRA) as part of the hydrogen control strategy for WTP. The impact of QRA on implementation of the WTP safety basis remains unknown.

**NEW ISSUES IDENTIFIED DURING THE PERIOD****1. Project: Hanford Site, Waste Treatment and Immobilization Plant—Pretreatment and High-Level Waste Facilities**

***New Issue—Inadequacies in the Spray Leak Methodology.*** In an April 5, 2011, letter, the Board formally communicated to DOE issues related to the WTP-specific methodology for estimating radiological consequences to the offsite receptor from spray leak accidents. The Board found that the WTP-specific spray leak methodology is not reasonably conservative and that safety-class structures, systems, or components may be required to mitigate accident scenarios involving spray leaks in the hot cell region of WTP. The WTP project needs to provide a well-formulated spray leak analysis that accounts for uncertainty and reduces the potential for non-conservative results. The Board notes that DOE's Office of Environmental Management (EM) also concluded that the airborne release fraction and respirable fraction for spray leak accident scenarios in DOE Handbook 3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, were not conservative. Since this handbook is used for complex-wide applications related to spray leak analysis, EM communicated this deficiency to DOE's Office of Health, Safety and Security. The Board understands that this office is currently addressing the issue for WTP, as well as complex-wide.

**2. Project: Hanford Site, K-Basin Closure Sludge Treatment Project**

The Board previously identified issues associated with the adequacy of project management and engineering supporting the K-Basin Closure Sludge Treatment Project, which DOE resolved by formally implementing the requirements of DOE Order 413.3, *Program and Project Management for the Acquisition of Capital Assets*, and the expectations of DOE Standard 1189, *Integration of Safety into the Design Process*. The Board has continued to monitor the project's development, and has discovered unacceptable implementation of these requirements. The Board formally communicated these issues to DOE in a letter dated December 22, 2010.

***New Issue—Inadequacies in Integration of Safety into the Design Process.*** The K-Basin Closure Sludge Treatment Project's design documentation for the Modified KW Basin Annex contains insufficient information with which to verify the ability of safety systems to perform their safety functions adequately. Through application of a "tailoring strategy" that combines the Critical Decision-2 and Critical Decision-3 milestones, the project has eliminated key safety-in-design deliverables.

***New Issue—Inadequacies in Safety Basis Development.*** The project's development of safety basis information for the Modified KW Basin Annex lacks adequate rigor and conservatism to ensure selection of the appropriate type and level of controls to protect the public and the environment from potential hazards.

### 3. Cross Cutting Issue

*New Issue—Deficiencies with the SASSI Computer Software.* The DOE complex uses the computer program SASSI (A System for the Analysis of Soil-Structure Interaction) to evaluate soil-structure interaction (SSI) effects between nuclear facility structures and their supporting soils. In August 2010, LANL identified significant technical issues with this software. Specifically, LANL identified issues with the SASSI subtraction method, which is a particular solution subroutine in the software used extensively in DOE's design and construction projects. In an April 8, 2011, letter to DOE, the Board highlighted its concern that these issues could lead to erroneous conclusions that affect safety-related structural and equipment design at DOE defense nuclear facilities. The Board also noted other technical issues, software quality assurance deficiencies, and concerns with the composition and scope of the SSI team convened by DOE to develop a complex-wide solution to issues associated with the SASSI subtraction method.

## ISSUES RESOLVED DURING THE PERIOD

### 1. Project: Savannah River Site, Tank 48 Treatment Process Project

*Issue—Project Delays.* In a March 5, 2009, letter to DOE, the Board expressed concern regarding DOE's delay in recovering and returning Tank 48 to service, which was adversely impacting high-level waste cleanup at the Savannah River Site and posed safety risks to workers and the environment. The Board further highlighted uncertainty regarding DOE's selection of a technology to treat the waste in Tank 48 as a concern.

*Resolution—*On November 24, 2010, DOE transmitted to the Board its revised Implementation Plan for Recommendation 2001-1, *High-Level Waste Management at the Savannah River Site*. DOE is helping to mitigate many of the risks associated with Tank 48 delays by implementing compensatory actions such as making Tank 50 available for high-level waste service by December 2012. The Board therefore considers this issue to be closed. The Board will continue to track closely the progress of the Tank 48 Treatment Process Project.

## CHANGE IN PROJECT STATUS

### 1. Project: Hanford Site, Large Package and Remote Handled Waste Packaging Facility

The Large Package and Remote Handled Waste Packaging Facility will handle solid wastes at Hanford that cannot be processed using current site capabilities, as well as increase throughput for waste currently being treated. The Board is removing the facility from the listing of projects in the enclosure to this report based on the project's plan to place conceptual design activities in abeyance until 2013. When DOE begins to move forward with the design, the Board will again track the project's progress and




communicate significant safety issues through this report. DOE will continue to process some of the waste inventory originally planned for this project using existing site capabilities or minor projects.

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

Respectfully submitted,



Peter S. Winokur, Ph.D.  
Chairman

  
**for** Jessie H. Roberson  
Vice Chairman  
John E. Mansfield  
Member  
Joseph F. Bader  
Member

Enclosure

ENCLOSURE

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

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES <sup>b</sup>
			Critical Decision (CD) Approved	Design Completion <sup>a</sup>	Construction Completion	
Hanford Site	Waste Treatment and Immobilization Plant (WTP)	12,263			(Operational 2019)	
	a. WTP Pretreatment Facility		CD-3	77% Final Design	35%	<ol style="list-style-type: none"> <li>1. Seismic ground motion —resolved (Feb 08)</li> <li>2. Structural engineering —resolved (Dec 09)</li> <li>3. Chemical process safety —resolved (Oct 07)</li> <li>4. Fire safety design for ventilation systems —resolved (Dec 09)</li> <li>5. Hydrogen gas control</li> <li>6. Structural steel analysis and design —resolved (Dec 10)</li> <li>7. Inadequate mixing</li> <li>8. Deposition velocity</li> <li>9. Inadequacies in the spray leak methodology —new issue (Jun 11)</li> </ol>
	b. WTP High-Level Waste Facility		CD-3	86% Final Design	33%	<ol style="list-style-type: none"> <li>1. Seismic ground motion —resolved (Feb 08)</li> <li>2. Structural engineering —resolved (Dec 09)</li> <li>3. Fire protection —resolved (Jun 09)</li> <li>4. Fire safety design for ventilation systems —resolved (Dec 09)</li> <li>5. Hydrogen gas control</li> <li>6. Structural steel analysis and design —resolved (Dec 10)</li> <li>7. Deposition velocity</li> <li>8. Inadequacies in the spray leak methodology —new issue (Jun 11)</li> </ol>

<sup>a</sup>The percent of design completion is an estimate for the particular stage of design (conceptual, preliminary, and final).

<sup>b</sup>Dates 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 <sup>a</sup>	Construction Completion	
Hanford Site (continued)	c. WTP Low-Activity Waste Facility		CD-3	90% Final Design	62%	1. Fire protection —resolved (Jun 09) 2. Structural steel analysis and design —resolved (Dec 10) No open issues remain
	d. WTP Analytical Laboratory		CD-3	80% Final Design	65%	1. Fire protection —resolved (Jun 09) No open issues remain
	K-Basin Closure Sludge Treatment Project	268	Phase 1: CD-1  Phase 2: CD-0	Phase 1: 50% Preliminary Design  Phase 2: 7% Conceptual Design	Phase 1: (Operational 2013)  Phase 2: (Operational to be determined)	1. Completeness of Preliminary Documented Safety Analysis —review terminated; document not relevant to new conceptual design (Oct 07) 2. Adequacy of project management and engineering —resolved (Sep 10) 3. Inadequacies in integration of safety into the design process —new issue (Jun 11) 4. Inadequacies in safety basis development —new issue (Jun 11)
	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 —resolved (Oct 07) No open issues remain
Idaho National Laboratory	Integrated Waste Treatment Unit Project (IWTU)	570.9	CD-3	100% Final Design	94% (Operational 2011)	1. Pilot plant testing —resolved (Feb 09) 2. Waste characterization —resolved (Feb 09) 3. Distributed control system design —resolved (Feb 09) No open issues remain
	Calcine Disposition Project	600-900	CD-0	< 30% Conceptual Design	Will utilize portions of IWTU (Operational 2022)	No issues identified

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			Critical Decision (CD) Approved	Design Completion <sup>a</sup>	Construction Completion	
Los Alamos National Laboratory	Chemistry and Metallurgy Research Replacement Project—Nuclear Facility	3,710–5,860 (Under Review)	CD-1	100% Preliminary Design	Some ground work <i>(Operational to be determined)</i>	<ol style="list-style-type: none"> <li>1. <del>Design-build acquisition strategy</del> —resolved (Jun 07)</li> <li>2. <del>Site characterization and seismic design</del> —resolved (Dec 09)</li> <li>3. <del>Safety-significant active-ventilation system</del> —resolved (2)-reopened due to issue 6 (Oct 07) —resolved (Dec 09)</li> <li>4. <del>Safety-class fire-suppression system</del> —resolved (Dec 09)</li> <li>5. <del>Safety-class and safety-significant container design</del> —resolved (Dec 09)</li> <li>6. <del>Deficiencies in Draft Preliminary Documented Safety Analysis</del> —resolved (Dec 09)</li> </ol> No open issues remain
	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"> <li>1. Adequacy of safety-systems —resolved (Sep 08)</li> <li>2. Inadequate approach to ensure timely improvements to the safety posture</li> </ol>
	Upgrades to Pit Manufacturing Capability at Technical Area-55	Annual funding	Not formally implementing CD process	Various degrees of completion	Work ongoing	<ol style="list-style-type: none"> <li>1. Lack of adherence to DOE Order 413.3A —resolved (Sep 08)</li> </ol> No open issues remain
	Radioactive Liquid Waste Treatment Facility Upgrade Project	Under Review	CD-1	99% Preliminary Design	On hold <i>(Operational to be determined)</i>	<ol style="list-style-type: none"> <li>1. Weak project-management and federal-project oversight —resolved (Sep 10)</li> <li>2. Weak integration of safety into the design-process —resolved (Sep 10)</li> </ol> No open issues remain

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			Critical Decision (CD) Approved	Design Completion <sup>a</sup>	Construction Completion	
Los Alamos National Laboratory (continued)	Transuranic Waste Facility	71-124	CD-1	Phase A: 82% Preliminary Design Phase B: 27% Preliminary Design	<i>(Operational 2015)</i>	1. Inadequate integration of safety into the design process —issue not relevant to revised project scope (Sep 10) No open issues remain
Nevada National Security Site	Device Assembly Facility—Criticality Experiments Facility	150	CD-3	100% Final Design	100% <i>(Operational 2011)</i>	1. Structural cracks —resolved (Feb 09) 2. Deficiencies in fire protection system water supply
Oak Ridge National Laboratory	Building 3019—Uranium-233 Downblending and Disposition Project	477	CD-2/3A	85% Final Design	<i>(Operational 2014)</i>	1. Deficiencies in Preliminary Documented Safety Analysis
Savannah River Site	Pit Disassembly and Conversion Project (in existing K-Area facilities)	Under evaluation	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	32% <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

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			Critical Decision (CD) Approved	Design Completion <sup>a</sup>	Construction Completion	
Savannah River Site (continued)	Tank 48 Treatment Process Project	156-181	CD-1	54% Preliminary Design	(Operational 2016)	1. Project delays —resolved (Jun 11)
	Waste Solidification Building	345	CD-2/3	100% Final Design	56% (Operational 2013)	1. Structural design —resolved (Jun 09) 2. Deficiencies in Preliminary Documented Safety Analysis —resolved (Feb 09) No open issues remain
Y-12 National Security Complex	Uranium Processing Facility	4,200-6,500 (Under Review)	CD-1	50% Preliminary Design	(Operational 2022)	1. Preliminary hazards-analysis development —resolved (Jun 07) 2. Nonconservative values for airborne release-fraction and respirable-release fraction —resolved (Sep 08) 3. Structural and geotechnical engineering
Multiple	Multiple	N/A	N/A	N/A	N/A	1. Deficiencies with the SASSI computer software —new issue (Jun 11)