

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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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 reflects the status of the Board's concerns through the end of August 2009. It builds on earlier reports to summarize the status of concerns previously raised and identifies new concerns associated with the relevant projects. The status of many concerns has not changed significantly during the reporting period; however, the fact that a concern has not been resolved does not necessarily imply a lack of progress.

In this report, the term "unresolved concern" does not necessarily imply that the Board has a disagreement with DOE or believes DOE's path forward is inappropriate. Some of the concerns noted in these reports simply await final resolution through further development of the facility design. All of the significant unresolved concerns discussed herein have been communicated to DOE. Lesser concerns 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 concerns in the course of its continuing design reviews. New concerns identified since the previous report are noted below, as well as those concerns the Board believes have been resolved. For this reporting period ten issues were resolved.

PROJECTS WITH THE MOST SIGNIFICANT UNRESOLVED ISSUES

The Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, Section 3112, *Limitation on Funding for Project 04-D-125 Chemistry and Metallurgy Research Replacement Facility Project, Los Alamos National Laboratory, Los Alamos, New Mexico*, required the Board to certify that Board issues with the Chemistry and Metallurgy Research Replacement (CMRR) Project at Los Alamos National Laboratory (LANL) had been resolved. The Board submitted this certification to the Congressional defense committees in a report dated September 4, 2009. The Board is also highlighting issues regarding the adequacy of the safety strategy being applied to the LANL Plutonium Facility to improve its safety posture, and issues regarding proposed changes in safety controls for the Hanford Waste Treatment and Immobilization Plant (WTP) resulting from major changes in the design of the plant driven by a less conservative hydrogen control design strategy combined with a reduction in the assumed material-at-risk (MAR).

Los Alamos National Laboratory, Chemistry and Metallurgy Research Replacement Project. The Board worked with the National Nuclear Security Administration (NNSA) throughout the CMRR certification review process to identify the Board's concerns and the actions necessary to resolve them. As part of this process, NNSA revised or agreed to revise the preliminary design, design requirements, and design processes as more fully described in the Board's certification report. NNSA committed to implement specific design requirements in the final design. Accordingly, the Board certified to Congress on September 4, 2009, that its concerns regarding the design had been resolved. The CMRR Project has been removed from the list of projects with significant unresolved issues.

The Board's certification relies upon full implementation of these final design commitments by NNSA. The Board will continue to review the design and will reopen issues if commitments described in the certification report are not met during final design.

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*, to address the need for an improved strategy to reduce the potential consequences of a seismic event at the Plutonium Facility. The Documented Safety Analysis approved by NNSA for this facility shows the mitigated offsite consequences of a seismically induced large fire exceed DOE's evaluation guideline by more than two orders of magnitude. Given the potential consequences to the public, the Board recommended that DOE expeditiously develop a defensible safety strategy for seismically induced events and a credible near-term plan for implementing this strategy.

The Board recommended that DOE implement near-term actions and compensatory measures to achieve a significant reduction in the potential consequences of seismically induced events. The Board further recommended that DOE develop and implement a safety strategy for seismically induced events that includes the following elements:

- A technically justifiable decision logic and criteria for evaluating and selecting safety-class structures, systems, and components that can effectively prevent or mitigate the consequences to acceptably low values.
- The seismic approach for structures, systems, and components required to implement the seismic safety strategy.
- A prioritized plan and schedule for seismic analyses, necessary upgrades, and other actions to implement the seismic safety strategy.

Hanford Site, Waste Treatment and Immobilization Plant. The Board is studying the proposed changes to the safety basis of the Pretreatment Facility resulting from assuming a reduced MAR. The concentration of radionuclides in waste material transferred to WTP will be

administratively controlled using waste acceptance criteria¹ to protect the revised MAR assumption. The revised MAR was used to recalculate the consequences of postulated accidents (severity level) to demonstrate that the consequences to the public are below the evaluation guideline, which determines the need for safety-related controls. While the Board does not question reducing the MAR, the Board's review found that the contractor made other non-MAR related changes in the severity level calculations that may have inappropriately reduced the calculated consequences of accidents. The Board is evaluating these recently revised severity level calculations. Further changes to address a proposed revision to the hydrogen control strategy and mixing concerns are still several months from resolution. The resolution depends, in part, on test programs that are not yet complete.

DOE's Offices of Environmental Management (DOE-EM) and River Protection (ORP) and WTP contractor Bechtel National briefed the Board on August 17, 2009. This briefing was devoted to explaining which structures, systems, and components (SSCs) would remain "safety-class" after taking into account the MAR reduction. Subsequent staff-to-staff discussions revealed that many important details are still being developed and the safety control strategy is still evolving. Notwithstanding the unresolved issues, the WTP contractor has requested that DOE approve an addendum to the Preliminary Documented Safety Analysis that changes the safety classification of SSCs. DOE ORP issued a Safety Evaluation Report (SER) approving the addendum, subject to conditions of approval related to the unresolved issues. The Board's staff is reviewing the SER and conditions of approval to determine whether the changes to be authorized in the safety control strategy resulting from the reduction in MAR are justified. The SER identifies issues associated with hydrogen controls and mixing controls as uncertainties and requests that the WTP contractor develop plans for addressing these uncertainties.

The current DOE strategy does not credit the safety function of the primary confinement boundary to prevent release of radioactive material. DOE Order 420.1A, *Facility Safety*, requires that nuclear facilities must have the means to confine uncontained radioactive materials to minimize their release in facility effluents during normal operations as well as during and following accidents. The Board believes it is essential that the safety strategy preserve the integrity of the primary confinement boundary rather than rely on the facility structure and ventilation system to prevent the release of material to the environment. Components forming the primary boundary need to be credited in the safety analysis and designed to confine radioactive wastes under all postulated operational and accident conditions, including natural phenomena. Thus the worker is protected as well as the public.

The evaluation and design requirements for natural phenomena are articulated in DOE Order 420.1 A and DOE Guide 420.1-2, *Guide for the Mitigation of Natural Phenomena Hazards for DOE Nuclear Facilities and Non-nuclear Facilities*. These long-standing requirements specify a higher Performance Category 3 (PC-3) seismic design for protection of the public when unmitigated off-site consequences to the public exceed the evaluation guideline.

¹ The defined MAR changes will require additional steps to be taken within the Tank Farms to maintain a fixed feed specification to the Pretreatment Facility. These steps are currently undefined.

A lower PC-2 design is allowed when the consequences are less than the evaluation guideline. However, the guide states that when safety analyses determine that local confinement of high-hazard materials is required for worker safety, a PC-3 designation may be appropriate.

In an August 27, 2004, letter to DOE, the Board requested that DOE clarify this rather ambiguous design expectation. On October 13, 2004, DOE responded with the conclusion that DOE guidance can be strengthened by providing clarification and supplemental guidance on factors that should be considered in determining whether PC-3 SSCs are appropriate for worker protection. DOE committed to revise the affected DOE directives or guidance documents. The expectations for seismic design were ultimately incorporated into Appendix A of DOE Standard 1189, *Integration of Safety into the Design Process*. This standard specifies PC-3 seismic design when the unmitigated consequences to workers exceed 100 rem total effective dose equivalent (TEDE).

The current safety design requirements for WTP comply with the expectations in DOE directives for protection of the public; however, the safety design requirements specify *a priori* a lower (PC-2) designation for protection of the workers. A higher (PC-3) designation has not been considered even when the unmitigated accident consequences to the workers may exceed 100 rem TEDE. As the WTP project proceeds toward implementing a revised safety design strategy resulting from the reduced MAR, the Board believes that the current seismic design specification for piping and vessels should not be downgraded from its higher (PC-3) designation without full consideration of the need to protect the workers consistent with Appendix A of DOE Standard 1189. Further, for those piping systems and vessels that are currently designated with a lower seismic design requirement, appropriate consideration should be given to revising the seismic design requirement to be consistent with DOE's stated expectations in the October 13, 2004, letter as articulated in Appendix A of DOE Standard 1189 (i.e., a higher seismic design requirement when needed for worker protection).

The Board is continuing to review the technical validity of the project's strategy for the safety and seismic design classification of SSCs that protect the public and workers from radiological and toxicological hazards. The Board is also reviewing the design requirements applied to the primary confinement boundary and DOE-EM's actions to ensure that no design basis event will render WTP permanently inoperative.

ISSUES RESOLVED DURING THE PERIOD

1. **Project: Hanford Waste Treatment and Immobilization Plant—Pretreatment and High Level Waste Facilities**

Issue—Structural Engineering. The Board found weaknesses in the structural design that included inadequate modeling, no clear seismic load transfer capability in the structure, and an inadequate finite element analysis. DOE developed new structural

design criteria to correct these weaknesses. The Board requested the details and results of analyses in revised structural summary reports for these facilities.

Resolution—The Board reviewed the summary structural reports issued by DOE for the Pretreatment and High Level Waste facilities. This review focused on reinforced concrete portions of the High Level Waste and Pretreatment facilities. The reports provided adequate details to assess the modeling, seismic load transfer capability of the structure, and the finite element analysis. These reports show that the reinforced concrete sections of the facilities meet structural design requirements. This closes the original Board issue regarding structural engineering.

Note: The issue discussed above was associated with the reinforced concrete portions of the facilities. The upper portions of the facilities are mostly structural steel with concrete slab floors. The analysis and design of the structural steel portions of the facilities are now essentially complete, and the Board has initiated its review. A number of concerns have been noted by the Board's staff and are now being discussed with the project team.

Issue—Fire Safety Design for Ventilation Systems. This issue concerns development of an alternative means of protecting the final exhaust, high-efficiency particulate air (HEPA) filters of the confinement ventilation systems by means equivalent to those described in DOE Standard 1066, *Fire Protection Design Criteria*.

Resolution—As noted in the June 22, 2009, report to Congress, the Board believed there was an acceptable path forward for providing adequate fire protection, but was waiting for formal DOE-EM approval of the design changes and approach. On July 9, 2009, DOE-EM gave its approval. The Board considers this issue closed.

2. **Project: Los Alamos National Laboratory, Chemistry and Metallurgy Research Replacement Project**

As noted above, the Board certified to the defense committees of Congress that Board issues had been resolved. With that certification, the Board closes the following issues:

- Site characterization and seismic design,
- Safety-significant active ventilation system,
- Safety-class fire suppression system,
- Safety-class and safety-significant container design, and
- Deficiencies in draft Preliminary Documented Safety Analysis.

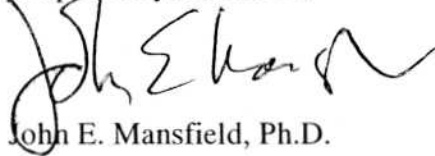
3. Project: Savannah River Site, Salt Waste Processing Facility

Issue—Structural Evaluation. The Central Process Area building is subject to design loads, including natural phenomena hazards and earthquake-induced differential soil settlement effects. Initial reviews of the structural design documentation for this building revealed several significant errors and deficiencies in the structural analysis. The structural layout of the building does not provide good structural load paths to accommodate seismic and settlement-induced design loads.

Resolution—Appropriate structural design expertise and DOE oversight have been brought to bear on the project. Changes to the structural design methodology and the structural design have been made. DOE issued summary structural reports that provide adequate details to assess the modeling, seismic load transfer capability of the structure, and the finite element analysis. These reports show that the Central Process Area building meets the structural design requirements. The Board considers this issue closed.

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

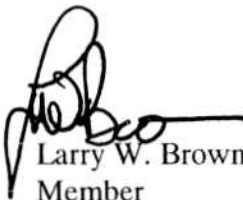
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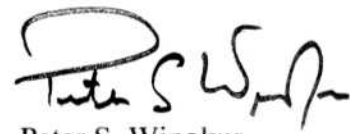
John E. Mansfield, Ph.D.
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Enclosure

ENCLOSURE

**DECEMBER 2009 REPORT
SUMMARY OF SIGNIFICANT UNRESOLVED ISSUES
WITH NEW DEFENSE NUCLEAR FACILITIES**

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES ^b
			Critical Decision Approved	Design Completion ^a	Construction Completion	
Hanford Site	Waste Treatment and Immobilization Plant	12,263			<i>(Operational 2019)</i>	
	a. Pretreatment Facility		CD-3	76%	27%	<ol style="list-style-type: none"> 1. Seismic ground-motion—<i>resolved (Feb 08)</i> 2. Structural engineering—<i>resolved (Dec 09)</i> 3. Chemical process safety—<i>resolved (Oct 07)</i> 4. Fire safety design for ventilation systems—<i>resolved (Dec 09)</i> 5. Hydrogen gas control
	b. High Level Waste Treatment Facility		CD-3	81%	22%	<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
	c. Low Activity Waste Facility		CD-3	90%	55%	<ol style="list-style-type: none"> 1. Fire protection—<i>resolved (Jun 09)</i> No open issues remain
	d. Analytical Laboratory		CD-3	78%	53%	<ol style="list-style-type: none"> 1. Fire protection—<i>resolved (Jun 09)</i> No open issues remain

a. Percent of design complete is an estimate of completion for the particular stage of design, i.e., if CD-0 is approved the percent represents the completion of conceptual design, if CD-1 is approved the percent represents the completion of preliminary design, if CD-2 is approved the percent represents the completion of final design, if CD-3 is approved the design is typically 90% or greater of the final design.

b. Dates in parentheses indicate the report in which an issue was considered resolved or a new issue was identified.

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES ^b
			Critical Decision Approved	Design Completion ^a	Construction Completion	
Hanford Site (continued)	Demonstration Bulk Vitrification System Project	224	CD-1	95% On hold	On hold	1. Confinement strategy —resolved (May 08) No open issues remain
	Interim Pretreatment System	182–310	CD-0	<5% On hold	On hold	No issues identified
	K-Basin Closure Sludge Treatment Project	220 Estimated using new conceptual design	Returned to CD-0	0%	(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
	Large Package and Remote Handled Waste Packaging Facility	390	CD-0	0%	Deferred (Operational to be determined, post-2016)	No issues identified
	Tank Retrieval and Waste Feed Delivery System	1,140	One subproject 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
	Immobilized High-Level Waste Interim Storage Facility	100	CD-3	90%	Deferred (Operational to be determined)	No issues identified
Idaho National Laboratory	Integrated Waste Treatment Unit Project	570.9	CD-3	>95%	30% (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

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Los Alamos National Laboratory	Chemistry and Metallurgy Research Replacement Project—Nuclear Facility	>2,000 Being reevaluated	CD-1	100% Preliminary design	Some ground work <i>(Operational to be determined)</i>	<ol style="list-style-type: none"> 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)—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
	Technical Area-55 Safety System Upgrades	72	Phase A: CD-2; Phase B: CD-0	Various degrees of completion	<i>(Complete 2010)</i> <i>(Complete 2015)</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 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	119–172	CD-1	60%	<i>(Operational 2014)</i>	<ol style="list-style-type: none"> 1. Weak project management and federal project oversight 2. Weak integration of safety into the design process
	New Solid Transuranic Waste Facility Project	133–199	CD-0	60% On hold	<i>(Operational on hold)</i>	<ol style="list-style-type: none"> 1. Inadequate integration of safety into the design process
	Nuclear Material Safeguards and Security Upgrades Project, Phase 2	240	CD-1	30%	<i>(Operational 2013)</i>	No detailed review completed
	Technical Area-55 Radiography Project	38	CD-0	90% On hold	<i>On hold</i>	No detailed review completed

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES ^b
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Nevada Test Site	Device Assembly Facility—Criticality Experiments Facility	150	CD-3	100%	>90% <i>(Operational 2010)</i>	1. Structural cracks— <i>resolved (Feb 09)</i> 2. Deficiencies in fire protection system
Oak Ridge National Laboratory	Building 3019—Uranium-233 Downblending and Disposition Project	477	CD-2/3A	60%	<i>(Operational 2012)</i>	1. Deficiencies in Preliminary Documented Safety Analysis
Pantex Plant	Weapon Surveillance Facility (previously called Component Evaluation Facility)	112	CD-0	On hold	<i>(Operational on hold)</i>	No detailed review completed
Savannah River Site	Pit Disassembly and Conversion Facility	2,400–3,200	CD-1	50%	<i>(Operational being evaluated)</i>	1. Assumption on combustible loading for seismically induced fire
	Salt Waste Processing Facility	1,340	CD-3	95%	12% <i>(Operational 2015)</i>	1. Geotechnical investigation— <i>resolved (Feb 08)</i> 2. Structural evaluation— <i>resolved (Dec 09)</i> 3. Quality assurance— <i>resolved (Jun 07)</i> 4. Hydrogen generation rate— <i>resolved (Jun 09)</i> 5. Flammable gas control 6. Fire protection for final HEPA filters 7. Operator actions following a seismic event
	Tank 48 Treatment Process Project	100–150 Being evaluated	CD-1	60% Being evaluated	<i>(Operational 2012)</i> Being evaluated	1. Project delays
	Plutonium Preparation Project	340–540	CD-1A	10% On hold	<i>(Operational on hold)</i>	No issues identified
	Waste Solidification Building	345	CD-2/3	90%	Construction started <i>(Operational 2013)</i>	1. Structural design— <i>resolved (Jun 09)</i> 2. Deficiencies in Preliminary Documented Safety Analysis— <i>resolved (Feb 09)</i> No open issues remain

SITE	FACILITY	TOTAL PROJECT COST (\$M)	STATUS			ISSUES ^b
			Critical Decision Approved	Design Completion ^a	Construction Completion	
Y-12 National Security Complex	Highly Enriched Uranium Materials Facility	549	CD-3	100%	100% <i>(Operational 2010)</i> Equipment performance testing and preparation for readiness reviews is in progress	1. Water supply for fire protection system— <i>resolved (Sep 08)</i> No open issues remain
	Uranium Processing Facility	1,400–3,500	CD-1	40%	<i>(Operational 2017)</i>	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> No open issues remain