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**TWENTY-FIRST ANNUAL REPORT  
TO CONGRESS**

**DEFENSE NUCLEAR FACILITIES  
SAFETY BOARD**

**FEBRUARY 2011**

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

Washington, DC 20004-2901



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To the Congress of the United States:

The Defense Nuclear Facilities Safety Board is pleased to submit to Congress its Twenty-First Annual Report. The Board is an independent executive branch agency responsible for providing advice and recommendations to the Secretary of Energy, and to the President if necessary, regarding public health and safety issues at the Department of Energy's defense nuclear facilities.

As required by statute, the Board's report summarizes activities during calendar year 2010, assesses improvements in the safety of defense nuclear facilities, and identifies remaining health and safety problems.

Respectfully submitted,

Peter S. Winokur  
Chairman

Jessie H. Roberson  
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## **PREFACE**

Congress created the Defense Nuclear Facilities Safety Board as an independent agency within the Executive Branch (42 U.S.C. § 2286, *et seq.*) to identify the nature and consequences of potential threats to public health and safety at the Department of Energy's (DOE's) defense nuclear facilities, to elevate such issues to the highest levels of authority, and to inform the public. The Board is required to review and evaluate the content and implementation of health and safety standards, including DOE's orders, rules, and other safety requirements, practices, and events relating to system design, construction, operation, and decommissioning of DOE's defense nuclear facilities. The Board makes recommendations to the Secretary of Energy that the Board believes are necessary to ensure adequate protection of public health and safety. The Board is also empowered to conduct investigations, issue subpoenas, hold public hearings, and establish reporting requirements.

The Board is required by law to submit an annual report to the Committees on Armed Services and Appropriations of the Senate and to the Speaker of the House of Representatives. This report is to include all recommendations made by the Board during the preceding year, and an assessment of: (1) the improvements in the safety of DOE's defense nuclear facilities during the period covered by the report, (2) the improvements in the safety of DOE's defense nuclear facilities resulting from actions taken by the Board or taken on the basis of the activities of the Board, and (3) the outstanding safety problems, if any, of DOE's defense nuclear facilities.

The Board is currently evaluating the design of 16 defense nuclear facilities (this does not include projects currently on hold or deferred) with a total project cost of about \$28 billion, including \$12.3 billion for the Hanford Waste Treatment and Immobilization Plant. The Board believes it is critical that outstanding safety issues associated with defense nuclear projects are identified and resolved early in the design phase.



## Table of Contents

<b>Responses to Congressional Direction</b> .....	7
<b>2010 Annual Report Highlights</b> .....	9
<b>Summary of Accomplishments in 2010</b> .....	11
<b>Outstanding Safety Problems</b> .....	23
<b>Section 1: Introduction</b> .....	29
1.1 Mission .....	30
1.2 Oversight Strategy .....	30
1.3 Strategic Plan.....	31
<b>Section 2: Nuclear Weapon Operations</b>	
2.1 Safe Conduct of Stockpile Management .....	33
2.1.1 Pantex Plant .....	33
2.1.2 Y-12 National Security Complex .....	35
2.2 Safe Conduct of Stockpile Stewardship .....	37
2.2.1 Los Alamos National Laboratory .....	37
2.2.2 Lawrence Livermore National Laboratory .....	39
2.2.3 Nevada National Security Site.....	40
2.2.4 Sandia National Laboratories .....	42
2.2.5 NNSA Governance Reform Initiative .....	42
<b>Section 3: Nuclear Material Processing and Stabilization</b>	
3.1 Stabilization and Storage of Remnant Materials .....	45
3.1.1 Complex-Wide Program.....	45
3.1.2 Plutonium .....	46
3.1.3 Uranium.....	47
3.2 Stabilization of Spent Nuclear Fuel.....	47
3.2.1 Idaho National Laboratory .....	47
3.2.2 Savannah River Site .....	47
3.2.3 Hanford Site .....	48
3.3 Waste Management .....	48
3.3.1 High-Level Waste.....	48
3.3.2 Low-Level and Transuranic Waste .....	50
3.4 Facility Deactivation and Decommissioning.....	52
3.4.1 Hanford Site .....	52
3.4.2 Idaho National Laboratory .....	53
3.4.3 Savannah River Site .....	53
<b>Section 4: Nuclear Facilities Design and Infrastructure</b>	
4.1 Introduction .....	55
4.2 Safety in Design .....	55
4.3 Hanford Site .....	56
4.4 Savannah River Site .....	59
4.5 Y-12 National Security Complex .....	60
4.6 Los Alamos National Laboratory .....	61
4.7 Oak Ridge National Laboratory .....	62
4.8 Idaho National Laboratory .....	62

4.9	Filter Test Facility .....	63
4.10	Seismic Hazard Analysis.....	63
4.11	Recommendation 2008-1.....	64

**Section 5: Nuclear Safety Programs and Analysis**

5.1	Federal Oversight .....	67
5.1.1	Overview .....	67
5.1.2	Recommendation 2004-1.....	67
5.1.3	Nuclear Safety Research and Development .....	68
5.1.4	Criticality Safety Engineers.....	69
5.1.5	Facility Representatives.....	69
5.1.6	Work Planning.....	69
5.1.7	Safety Basis Controls .....	70
5.2	Health and Safety Directives .....	70
5.2.1	Oversight of Directives .....	70
5.2.2	Safety and Security Reform Plan .....	71
5.2.3	Hazard Categorization.....	72
5.2.4	Recommendation 2010-1.....	72
5.3	Safety Programs.....	73
5.3.1	Administrative Controls .....	73
5.3.2	Active Confinement Systems .....	73
5.3.3	Recommendation 2009-1.....	74
5.3.4	Criticality Safety.....	74
5.3.5	Readiness Reviews .....	75
5.3.6	Justifications for Continuing Operations .....	75
5.3.7	Recommendation 2007-1.....	76
5.3.8	Conduct of Operations.....	76
5.3.9	Safety Basis and Safety System Reviews.....	77
5.3.10	Emergency Planning and Preparedness.....	77
5.3.11	Fire Protection Programs.....	78

**Section 6: Public Outreach and Agency Administration**

6.1	Board Visits to Sites .....	79
6.2	Responding to Public Requests .....	79
6.3	Access to Information.....	79
6.4	Inquiries into Health and Safety Issues .....	79
6.5	Suspect and Counterfeit Parts.....	79
6.6	Investigation of Negative Feedback .....	80
6.7	Site Representative Activities.....	80
6.8	Human Resources.....	80
6.9	Information Technology and Security.....	81
6.10	Dispute Resolution Programs .....	81
6.11	Financial Management .....	81

**Appendices**

A.	Recommendations 2010-1, 2010-2.....	83
B.	Recommendations Cited.....	93
C.	Reporting Requirements.....	95
D.	Correspondence .....	97

## **Responses to Congressional Direction**

### **Periodic Reports**

The Board continues to provide periodic reports to Congress and DOE on the status of significant unresolved technical differences between the Board and DOE on the design and construction of DOE's defense nuclear facilities. The Board receives positive feedback from Congressional staff on these reports and believes they serve the useful purpose of keeping all parties apprised of the Board's concerns with new designs. The Board issued three periodic reports covering calendar year 2010.

On September 10, 2010, the Board issued a separate report to Congress on DOE's aging and degrading defense nuclear facilities. DOE continues to rely on aging facilities to carry out hazardous production missions. Examples of this persistent problem include the 9212 Complex at the Y-12 National Security Complex (portions of which are more than 60 years old), the Chemistry and Metallurgy Research Facility at Los Alamos (nearly 60 years old), and the first high-level waste tanks built at the Hanford and Savannah River Sites (up to 66 years old). There are other examples of degrading and aging facilities that will require significant capital expenditures for replacement or for repair and upgrade of key systems. The Board understands that, in several instances, replacement facilities have been authorized by Congress to address this aging infrastructure. However, these new facilities may not be available for another decade.

The Board plans to issue this report to Congress on DOE's aging and degrading defense nuclear facilities annually, or more frequently if circumstances demand, to provide the status of significant unresolved safety issues raised by DOE's reliance on such facilities.





## 2010 Annual Report Highlights

The activities highlighted below are particularly noteworthy in terms of both the extent of Board resources devoted to them during 2010 and the positive progress made in each case. More work is to be done and each area will continue to draw significant Board attention and resources until fully resolved.

**Governance Initiatives.** DOE initiated a number of reform activities in 2010 to expedite the review, modification, and/or cancellation of directives, including those pertaining to safety at defense nuclear facilities. Consistent with its statutory mandate to review and evaluate the content and implementation of DOE's "orders, regulations, and requirements" relating to the design, construction, operation, and decommissioning of defense nuclear facilities, the Board worked closely with DOE to understand the reform effort. The Board held a public hearing on March 24, 2010 to explore the methods and criteria DOE was applying to its reform activities. The Board sought to ensure that DOE followed a rigorous process to assess the content of each directive, the value of each requirement, and the consequences of each requirement's removal or modification. As a result, DOE's reform effort has produced revisions that strengthen and improve directives, and a separate NNSA reform effort has been brought into DOE's established directives review system.

**Safety in Design.** The Board reviewed the design of planned major facilities such as the Uranium Processing Facility at the Y-12 National Security Complex, the Chemistry and Metallurgy Research Replacement Project at Los Alamos National Laboratory, the Salt Waste Processing Facility at the Savannah River Site, the Waste Treatment and Immobilization Plant (the Waste Treatment Plant) at the Hanford Site, among others, to ensure that DOE considers safety as early as possible in design. This approach results in a high degree of safety engineered into the facilities' structures, systems, and components, and helps avoid unplanned costs associated with retrofitting or redesigning facilities to address safety issues recognized belatedly.

In particular, the Board extensively reviewed the design and safety analyses for the Waste Treatment Plant in 2010, driven by a significant redesign that DOE began in 2009 when the Waste Treatment Plant's design was more than two-thirds complete. The Board documented concerns regarding the new control strategy for flammable gas in process systems and the effectiveness of mixing and transfer systems integral to the safe operation of the Waste Treatment Plant. During the Board's public hearing on these topics on October 7 and 8, 2010, in Kennewick, Washington, DOE and its contractors acknowledged the need for large-scale testing of the Waste Treatment Plant's mixing systems and committed to complete the required testing before installing process vessels in the Waste Treatment Plant Pretreatment Facility. The Board issued Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*, to guide DOE in developing a test plan that considers all technical issues that need to be addressed to ensure completion of the plant's decades-long mission.

**Los Alamos National Laboratory Plutonium Facility.** DOE accepted the Board's Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*, in early 2010. The Board's staff worked with NNSA to develop an Implementation Plan defining near- and long-term actions to reduce the risk posed by a seismic event. NNSA began near-term

actions in 2010 including: designing an automatic equipment shutdown to reduce ignition sources in a seismic event, eliminating unnecessary ignition sources inside gloveboxes, installing fire-rated safes to protect special nuclear material, testing containers to demonstrate their ability to protect nuclear material in a fire, scoping seismic upgrades to fire suppression and active confinement ventilation systems, repairing the main Plutonium Facility fire barrier wall, and robustly packaging or dispositioning some 700 kilograms of special nuclear material.

**Chemistry and Metallurgy Research Facility.** Until 2010, the safety basis for the Chemistry and Metallurgy Research facility at Los Alamos National Laboratory was a 1998 basis for interim operation. The Board raised significant safety issues in letters to NNSA in 2007 and 2008, and requested that NNSA provide a safety rationale if it continued operations beyond 2010. NNSA approved a revised documented safety analysis and technical safety requirements for this facility in June 2010, but did not remedy a post-seismic fire scenario with mitigated dose consequences exceeding DOE's Evaluation Guideline of 25 rem at the site boundary. Following Board review of this safety basis, NNSA approved a safety basis strategy that will further control material-at-risk and ensure compliance with the Evaluation Guideline.

**Work Planning.** The Board completed reviews of work planning and control across the DOE defense nuclear complex, consistently finding inadequacies in defining and controlling the scope of work, in hazard analysis, and in feedback and improvement mechanisms. (Work planning and control is the implementation of integrated safety management at the activity level.) Individual sites made enhancements in response to the Board's letters on this subject; more importantly, DOE and its contractors initiated a project to improve work planning and control at all sites.

## Summary of Accomplishments in 2010

The nuclear weapons program operated by DOE and the National Nuclear Security Administration (NNSA) is a complex and hazardous enterprise. Missions include maintenance of the national nuclear arsenal, dismantlement of surplus weapons, stabilization and storage of surplus nuclear materials, disposition and disposal of hazardous waste, and cleanup of surplus facilities and sites. Some of these missions are carried out with aging facilities while others necessitate construction of new facilities. The Board's constant vigilance is required to ensure that all of these activities are carried out in a manner that protects the public, workers, and the environment.

During the past year, actions by the Board resulted in numerous health and safety improvements that are summarized briefly below and in more depth in the main body of this report. These improvements are described in accordance with the Board's four strategic areas of concentration: Nuclear Weapon Operations, Nuclear Material Processing and Stabilization, Nuclear Facilities Design and Infrastructure, and Nuclear Safety Programs and Analysis. Clearly, for DOE this is a period of significant transition, accompanied by billions in new construction projects and a huge portfolio of work funded by the American Recovery and Reinvestment Act of 2009 (Recovery Act). The Board believes it is prudent to proactively address safety issues at DOE's defense nuclear facilities to ward off threats to public health and safety and to resolve safety concerns early in the design process.

### **Nuclear Weapon Operations**

The Board's strategic performance goal for this area is to ensure that DOE operations directly supporting the nuclear stockpile and defense nuclear research are conducted in a manner that provides adequate protection of the health and safety of the workers and the public. The Board's safety oversight activities focus on assembly and disassembly of weapons; processing and storage of uranium, plutonium, and tritium; and research, development, manufacturing, and testing.

As a result of the Board's efforts during 2010, DOE has taken actions to upgrade the safety of these activities. These actions include improving safety systems and controls in aging facilities, safe packaging of nuclear weapon materials, improving the formality of nuclear explosive and nuclear processing operations, enhancing the quality of engineered safety systems, and correcting deficiencies in the safety bases for new and ongoing activities. Specific examples of safety improvements in weapon operations made by DOE in consequence of the Board's work are given below. (Sections cited below provide additional discussion of the subject matter.)

#### **Pantex Plant (Sec. 2.1.1):**

- The Board identified weaknesses in the development and implementation of technical procedures for nuclear and nuclear explosive operations. To improve in these areas, NNSA implemented measures to increase the frequency of line observations by engineers, and to reduce ambiguities and inconsistencies in technical procedures. (Board letter dated October 15, 2009; staff-to-staff meetings)

- The Board found hazard analysis reports to be noncompliant with DOE Standard 3016-2006, *Hazard Analysis Reports for Nuclear Explosive Operations*, because the reports did not serve as a final safety basis integration document and did not fully document the adequacy of controls for nuclear explosive operations. NNSA is pursuing a hazard analysis improvement effort. (Board letter dated July 6, 2010)
- The Board identified the need to understand and mitigate the potential threat from certain lightning hazards. During 2010, subject matter experts from Pantex and the nuclear weapons laboratories evaluated and dispositioned potential lightning protection issues. The Board engaged experts in the field of lightning effects to validate the analyses. (Board letter dated March 30, 2007; staff-to-staff meetings)
- The Board expressed concern that NNSA had allowed W76-1 assembly operations to continue for several months without fully understanding the hazards associated with using a nuclear safety component that did not meet military requirements. NNSA conducted a causal factors analysis of this event and subsequently requested all of its nuclear weapon laboratories to review their processes for similar deficiencies. (Board letter dated January 25, 2010)
- NNSA completed Nuclear Explosive Safety studies of the B53 and W84 dismantlement programs and authorized operations using Seamless Safety for the 21<sup>st</sup> Century safety protocols. The Seamless Safety program has now been applied to all systems undergoing operations at Pantex. (staff-to-staff meetings)

#### **Y-12 National Security Complex (Section 2.1.2):**

- NNSA successfully started up the Highly Enriched Uranium Materials Facility, which resulted in a significant improvement in the Y-12 safety posture. In response to the Board's concerns, NNSA simplified criticality safety postings and formalized the use of a computer program as an operator aid for containerization activities. (staff-to-staff meetings)
- In response to the Board's position that regular assessments of the safety of continued operations in the aging 9212 Complex are needed, NNSA completed its third annual assessment and provided a report and briefing to the Board on results and actions taken, including the initiation of a line-item facility improvement project. (Board letter dated March 13, 2007; NNSA briefing April 2010)
- The Y-12 contractor, responding to the Board's identification of weaknesses in the nuclear criticality safety program, performed an extent-of-condition review on all active nuclear criticality safety evaluations and changed programmatic procedures to implement the process analysis requirement of the applicable national consensus standard. (Board letter dated January 23, 2009)
- In response to the Board's concerns, the Y-12 contractor created and staffed a new Nuclear Facilities Quality Assurance organization that reports directly to the company

president in order to improve the execution of quality assurance throughout the engineering, procurement, and construction organizations. (staff-to-staff meetings)

- NNSA conducted a readiness review prior to the start of B53 disassembly operations and developed a more rigorous protocol to be used by production engineering personnel when giving work instructions. (staff-to-staff meetings)
- The Board identified systemic weaknesses in Y-12 procedures. In response, the Y-12 contractor took action to improve use categorization, reduce complexity, and reduce the backlog of pending revisions. (staff-to-staff meetings)
- In response to the Board's concern with concrete degradation at the 9204-2E facility, the Y-12 contractor performed tests to determine the extent of damage to a floor slab caused by exposure to chemical leaks. The results of the testing program demonstrated that the concrete strength was satisfactory, and the Y-12 contractor appropriately implemented a structural monitoring program to address concerns with corrosion of reinforcing steel. (staff-to-staff meetings)
- The Board identified weaknesses in NNSA's safety strategy for executing Recovery Act work at Y-12. To correct these weaknesses, NNSA required facility operations personnel to oversee the start of new operations involving subcontractors in addition to conducting periodic operational oversight. (staff-to-staff meetings)

#### **Los Alamos National Laboratory (Sec. 2.2.1):**

- On July 13, 2010, DOE provided the Board with an implementation plan in response to Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*. The Board accepted the plan, and NNSA completed a series of near-term actions designed to reduce the probability or consequence of seismic accident scenarios for the Plutonium Facility. (Recommendation 2009-2; Board letter dated December 17, 2010; staff-to-staff meetings)
- In response to issues raised by the Board in 2009, NNSA completed a campaign to address over-pressurization for a large population of containers storing plutonium-238. (Board letter dated April 7, 2009; Board letter dated August 16, 2010; staff-to-staff meetings)
- The Board identified opportunities to reduce the actual and allowed quantities of material-at-risk present in the Chemistry and Metallurgy Research Building. In response, NNSA has significantly changed the approach to managing and controlling material-at-risk in the facility such that offsite dose consequences from postulated accident scenarios can no longer exceed the DOE Evaluation Guideline. (Board letter dated December 7, 2010; staff-to-staff meetings)
- The Board closely evaluated laboratory efforts to safely restart operations at the Weapons Engineering Tritium Facility. Board oversight included observation of an NNSA

Operational Readiness Review performed to independently verify readiness to restart programmatic operations. (staff-to-staff meetings)

- The Board continued to follow closely actions to improve the laboratory's ability to respond to fires and other emergencies. Responder training and nuclear facility awareness initiatives appear to have significantly improved the capability for fire and emergency response to the laboratory's nuclear facilities. (Board letter dated December 8, 2008; staff-to-staff meetings)
- The Board observed three Integrated Nuclear Planning meetings focused on waste management capabilities, programmatic activities and safety posture improvements for the Plutonium Facility, and other high-priority laboratory facilities and projects. These planning meetings, encouraged by the Board, continue to contribute value and improve coordination between NNSA and the laboratory. (staff-to-staff meetings)

#### **Lawrence Livermore National Laboratory (Sec. 2.2.2):**

- The Board reviewed the readiness assessment preceding operation of the Tritium Process Station and identified several opportunities to strengthen the hazards analysis. In response, NNSA developed and implemented a justification for continued operations, while the laboratory contractor revised and resubmitted the documented safety analysis. (Board letter dated January 27, 2010)
- Concerns raised by the Board over the effective use of work planning led to an increase in oversight of work planning by management and NNSA. The laboratory is undertaking long-term improvements to its processes for planning work to incorporate suggestions made by the Board. (Board letter dated June 14, 2010)
- The Board evaluated the initial completion of implementation of DOE Standard 3016 by observing its use in development of the weapon response for the W-84 Seamless Safety for the 21<sup>st</sup> Century project. The Board identified opportunities for improving laboratory processes governed by this standard. (staff-to-staff meetings)

#### **Nevada National Security Site (Sec. 2.2.3):**

- In 2010, the Board reviewed the safety basis, instrumentation and controls, and readiness for startup of the Criticality Experiments Facility at the Device Assembly Facility. The Board noted deficiencies in the accident analysis, control set, safety system design, and formality of operations. NNSA will address the Board's issues during startup activities in 2011. (Board letter dated August 5, 2010)

#### **Sandia National Laboratories (Sec. 2.2.4):**

- The Board reviewed the facility hazard categorization of the Z machine, where the laboratory plans to perform isentropic compression experiments involving plutonium. The laboratory performed calculations to address the Board's concerns and implemented

engineered and administrative controls to ensure public and worker safety for the plutonium experiments. (Board letter dated May 21, 2010)

- The Board reviewed the Basis for Interim Operations for repackaging of nuclear materials in the Auxiliary Hot Cell Facility. The Board concluded that some form of radiological confinement was required. NNSA committed to implement radiological confinement for containers that require opening prior to being placed into the hot cell. (staff-to-staff meetings)

#### **NNSA Governance Reform Initiative (Sec. 2.2.5):**

- The Board evaluated the requirements analysis used by NNSA as the basis for granting exemptions to requirements contained in DOE directives related to nuclear safety to the contractors at the Nevada National Security Site and Sandia National Laboratories. After the Board identified deficiencies in NNSA's requirements analysis, the Deputy Secretary of Energy issued a letter restricting the scope of this initiative; on December 29, 2010, the Deputy Secretary directed that the initiative be "expedited." The Board is working with DOE to ensure that "expedited" directives continue to provide adequate protection of the public health and safety. (staff-to-staff meetings; Board letter dated December 7, 2010)

#### **Nuclear Material Processing and Stabilization**

The Board continued to focus significant resources on the efforts of DOE activities to stabilize remnant materials from past nuclear facility operations, package and store those materials, and safely dispose of the materials in waste repositories. The Board also monitored DOE's efforts to deactivate and decommission retired nuclear facilities.

DOE's treatment and disposal efforts encompass many material types including high-level radioactive wastes, spent nuclear fuel, special nuclear materials (uranium and plutonium), low-level wastes, and transuranic wastes. The Board focused its reviews on careful work planning, facility safety bases, safe operations, and equipment monitoring and maintenance. Specific examples of safety improvements made by DOE in response to the Board's actions are given below.

#### **Savannah River Site (Sec. 3.1.3, 3.2.2, 3.3.1, 3.3.2):**

- The Board requested DOE develop a prioritized funding outlook for infrastructure upgrades at the H-Canyon facility to ensure continued safe operation. (Board letter dated April 29, 2010)
- The Board reviewed the development and implementation of a new documented safety analysis for the H-Canyon facility. Based on this review, the Board sought changes related to technical safety requirements, hydrogen explosions, and ammonium nitrate explosions. (staff-to-staff meetings)

- The Board encouraged DOE to reconsider the planned rigor of the readiness review for restart of spent nuclear fuel processing at H-Canyon; DOE agreed and implemented a more thorough review. (staff-to-staff meetings)
- The Board commented on Revision 5 of the implementation plan for Recommendation 2001-1, *High-Level Waste Management at the Savannah River Site*, and requested improved milestones. DOE made significant changes and transmitted Revision 6 of the plan in November 2010. (Board letters dated January 7, 2010; May 27, 2010)
- The Board suggested that DOE improve non-destructive evaluation techniques to evaluate the integrity of high-level waste tanks. In response, DOE advanced the development of the electromagnetic acoustic transducer system to speed tank integrity inspections. (Board letter dated January 6, 2010)
- The Board led DOE to improve preparations for emergency response to severe natural phenomena and major accidents. To address weaknesses identified by the Board, DOE improved coordination among the contractors at the site, began conducting additional drills, and is planning to conduct large-scale integrated drills involving multiple facilities. (staff-to-staff interaction)

**Hanford Site (Sec. 3.2.3, 3.3.1, 3.4.1):**

- The Board reviewed the conceptual design for the Sludge Treatment Project and identified several deficiencies. The Board continues to work with DOE to resolve these issues. (Board letter dated December 22, 2010)
- The Board identified a number of deficiencies in the revised safety basis at the Tank Farms. Most significantly, DOE had downgraded the safety-related ventilation systems to less than safety-significant. DOE is working to resolve this open issue. (Board letter dated August 5, 2010)
- At the Tank Farms, the Board noted deficiencies in the contractor's process for analyzing hazards, revising work documents, following work instructions, and implementing feedback and improvement. In response, DOE developed and implemented corrective actions. In a follow-up review, the Board continued to observe deficiencies in the development and use of work instructions. DOE is working to correct these weaknesses. (Board letter dated March 12, 2010)
- The Board identified a number of weaknesses in the Plateau Remediation contractor's work planning and control process. Problems included an insufficient focus on task-specific hazards and an incomplete integration of the hazards and associated controls in the work instructions. DOE began work to address these concerns. (Board letter dated September 23, 2010)



### **Waste Isolation Pilot Plant (Sec. 3.3.2):**

- The Board noted deficiencies in the electrical safety program and deficiencies involving maintenance and testing of aging electrical components. In response, DOE began corrective actions to address these issues and is working to complete the remaining corrective actions in 2011. (Board letter dated September 22, 2010)
- The Board identified deficiencies in the contractor's conduct of operations and its work planning and control processes that indicated incomplete implementation of integrated safety management. The Board also noted deficiencies in DOE oversight of these areas. (Board letter dated October 22, 2010)

### **Nuclear Facilities Design and Infrastructure**

The Board's strategic performance goal for this area is to ensure that new defense nuclear facilities and major modifications to existing defense nuclear facilities are designed and constructed in a manner that provides adequate protection of the health and safety of workers and the public. In the past few years, DOE has undertaken a substantial number of design and construction projects for defense nuclear facilities. Design and construction projects under the Board's jurisdiction presently have a projected total cost of about \$28 billion. The Board continues to devote extensive resources to ensure that safety is integrated early in the design process and that designs for defense nuclear facilities incorporate multiple layers of safety controls commensurate with the hazards. Specific examples of safety improvements in design and infrastructure accomplished as a result of the Board's work are given below.

### **Hanford Site - Waste Treatment Plant (Sec. 4.3):**

- The Board communicated concerns to DOE in a January 6, 2010, letter after becoming aware of project management's intent to reduce conservatism in the acceptance criteria for adequate mixing in process vessels. The concerns included DOE's adoption of an approach that (1) bases the functional requirements for mixing on average properties instead of bounding properties of the waste to be processed, and (2) relies on mathematical models that have not been appropriately validated through testing for this application. (Board letter dated January 6, 2010; and Periodic Reports to Congress dated April 15, 2010; September 3, 2010; and December 30, 2010)
- On October 7 and 8, 2010, the Board conducted a public hearing to review mixing concerns, and on December 17, 2010, issued Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*, to address unresolved technical concerns. (Board public hearing, October 7-8, 2010; Board recommendation dated December 17, 2010)
- The Board reviewed the structural steel design of Waste Treatment Plant facilities and found that the analytical models did not reflect the as-designed facility configuration. In response, DOE provided structural reports demonstrating the adequacy of the structural steel design for the High-Level Waste and Pretreatment facilities. The Board reviewed

these reports and now considers the design of the structural steel portions of the facilities adequate. (Board letter dated December 2, 2009; Periodic Reports to Congress dated April 15, 2010; and December 30, 2010)

- The Board continued its review of proposed changes to the safety basis of the Pretreatment facility resulting from reducing the assumed radiological inventory in the facility. Previously, the Board found that the contractor made unrelated changes to its analyses that the Board believes inappropriately reduced the calculated consequences of accidents. Several significant issues remain unresolved, including the deposition rate of radionuclides following a postulated accidental release, the analysis of releases associated with leaks and spills, and the need to credit the safety function of the primary confinement boundary of process systems. Actions during the past year include:
  - The Board issued two letters to DOE questioning the deposition velocity value used for the Waste Treatment Plant and offering a derivation of a deposition velocity that the Board concluded was reasonably conservative. In a November 5, 2010 response, DOE committed to issue a complex-wide Information Notice and provide interim guidance and long-term plans to ensure appropriately conservative control selection decisions are made. (Board letters dated May 21, 2010 and August 26, 2010; Periodic Report to Congress dated September 3, 2010; staff-to-staff meetings)
  - DOE has agreed that the methodology currently specified for analysis of spray leaks is not appropriate and is developing a new methodology. (staff-to-staff meetings)
  - The Board questioned the basis for not requiring a higher seismic design specification for the primary confinement boundary of the process systems. DOE suggested a control strategy involving isolation of systems and stopping pumps in the event of a leak. The Board agrees that this option would be acceptable, provided the safety classification of the systems and components is consistent with DOE Standard 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, and the detailed safety functions and functional design criteria for systems and components isolating the piping and vessels and stopping the pumps are adequate. (Periodic Report to Congress dated September 3, 2010; staff-to-staff meetings)
  - The Board continued to evaluate DOE's evolving strategy for controlling hydrogen in smaller diameter piping and ancillary vessels in hot cells. DOE agreed with a Board suggestion that an independent evaluation of the strategy should be considered. The Hydrogen in Piping and Ancillary Vessels Independent Review Team—chartered by DOE's Office of River Protection and the Waste Treatment Plant contractor in April 2010—issued its final report on July 12, 2010. The Board reviewed the construction contractor's plan for resolving the team's findings and recommendations and is following these actions, planned to be completed in March 2011. (Periodic Reports to Congress dated April 15, 2010;

September 3, 2010; and December 30, 2010; Board public hearing October 7-8, 2010; staff-to-staff meetings)

**Savannah River Site - Salt Waste Processing Facility (Sec. 4.4):**

- The Board reviewed the design, testing, and controls associated with the air pulse agitators used for mixing the contents of process vessels in the Salt Waste Processing Facility. Given appropriate controls and operational parameters, the air pulse agitators should fulfill the functions assumed in the safety basis. However, the Board identified shortcomings with the testing and modeling performed for these devices that the project team should consider in the selection of controls and operational parameters. (Board letter dated October 15, 2009; Periodic Report to Congress dated April 15, 2010)
- Following design changes by the project, the Board concluded that the design of the confinement ventilation system now is consistent with DOE Standard 1066-99, *Fire Protection Design Criteria*, for protection of final high-efficiency particulate air filters. (Board letter dated February 10, 2009; Periodic Report to Congress dated September 3, 2010; staff-to-staff meetings)

**Savannah River Site - Waste Solidification Building (Sec. 4.4):**

- The Board reviewed the project's quality assurance program and identified areas for improvement. NNSA provided the Board with additional information as follow-up to this review; this information is currently under review. (staff-to-staff meetings)

**Y-12 National Security Complex - Uranium Processing Facility (Sec. 4.5):**

- The Board identified several issues related to the geotechnical and structural analysis of the Uranium Processing Facility. These technical issues need to be resolved early in the design process to enable the project to proceed expeditiously. The Board also noted that the NNSA civil/structural oversight team was understaffed and had not been chartered to independently review the project. NNSA revised the project approach to ensure that a preliminary documented safety analysis will be developed before construction is authorized. (Board letter dated March 15, 2010; Periodic Report to Congress dated April 15, 2010)

**Los Alamos National Laboratory (Sec. 4.6):**

- The Chemistry and Metallurgy Research Replacement Project has developed a detailed structural model to assess the complex structural behavior of the project's nuclear facility. The development of this model is a step forward that should ultimately lead to an adequate seismic design for the facility. The Board has worked with the project team to ensure that seismic design inputs for this mostly buried facility are properly defined. (staff-to-staff meetings)

- The Board reviewed the resolution of outstanding issues as well as the 80 percent design for the Radioactive Liquid Waste Treatment Facility Upgrade Project. The review determined that the federal oversight and integration of safety in design had improved. However, the facility design and supporting calculations had significant shortcomings related to criticality safety, protection from accidents resulting from leaks of natural gas, and spills of hydrochloric acid that could occur during a seismically induced fire. (staff-to-staff meetings)
- The Board reviewed the revised conceptual design for the Transuranic Waste Facility project and identified safety deficiencies, including the absence of controls to mitigate the design basis aircraft crash accident, as well as incorrect application of accident analysis parameters from DOE technical standards to the seismic evaluation. NNSA specified resolution of the Board's concerns as a condition of approval in the Conceptual Safety Validation Report. The project subsequently developed corrective actions to address the concerns. (Board letter dated September 29, 2010)

**Oak Ridge National Laboratory (Sec. 4.7):**

- The Board evaluated the Preliminary Safety Design Report for the Uranium-233 Downblending project and informed DOE that the document did not fully address safety basis deficiencies noted in the Board's Periodic Report to Congress on the design and construction of DOE's defense nuclear facilities. (staff-to-staff meetings)

**Idaho National Laboratory (Sec. 4.8):**

- The Board reviewed the safety basis for the new facility as described in the *Integrated Waste Treatment Unit Draft Documented Safety Analysis* and determined that the safety strategy might not provide adequate protection for facility workers during a seismic event. DOE subsequently modified the design and the documented safety analysis to resolve Board concerns. (staff-to-staff meetings)
- The Board reviewed proposed modifications to the safety instrumented systems for the Integrated Waste Treatment Unit and determined that additional changes were required to ensure the independence of multiple systems that protect facility and co-located workers from the effects of mercury vapor and nitrogen oxides during fires or over-temperature events in the granular activated carbon bed. (staff-to-staff meetings)

**Filter Test Facility (Sec. 4.9):**

- In a letter dated March 17, 2008, the Board expressed concerns with degradation in quality of the nuclear air filters as reported by the Filter Test Facility. On April 16, 2010, DOE provided the Board with the final report documenting actions to identify and address quality problems with the manufacture of high-efficiency particulate air filters. (Board letter dated March 17, 2008; staff-to-staff discussion)

## Nuclear Safety Programs and Analysis

The Board's strategic performance goal for this area is to ensure that DOE develops, maintains, and implements regulations, contract requirements, guidance, and safety programs that ensure adequate protection of the health and safety of workers and the public. The Board's oversight activities in this area focus on safety standards and on issues affecting a variety of defense nuclear facilities.

As a result of the Board's efforts during 2010, DOE has taken actions to strengthen the technical competence of its federal employees, establish and implement safety standards, and improve guidance related to maintaining the integrity of safety systems. Specific examples of improvements in nuclear safety programs and analysis made in consequence of the Board's work are given below.

- The Board requested the Secretary of Energy to clarify the specific criteria DOE was using to analyze individual directives under the *Department of Energy 2010 Safety and Security Reform Plan*, which had the objective of reviewing and revising, canceling, or consolidating 107 of DOE's safety and security directives on an extremely aggressive schedule. DOE responded by providing a *Project Management Plan* that outlines a rigorous and disciplined process for DOE to carefully assess the content of each directive, the value of each requirement, and the consequences of each requirement's removal or modification. As a result, the health and safety directives reform effort has proceeded in a deliberate manner that thus far has produced revisions strengthening and improving the directives.
- The Board issued Recommendation 2010-1, *Safety Analysis Requirements for Defining Adequate Protection of the Public and the Workers*, on October 29, 2010, to clarify and make legally enforceable certain aspects of DOE Standard 3009-94, considered to be the "safe harbor" for compliance with the Nuclear Safety Management rule, 10 CFR Part 830. (Recommendation 2010-1; Section 5.2.4)
- DOE issued a complex-wide Information Notice outlining expectations regarding the use of risk assessment in the defense nuclear complex as part of its actions in response to the Board's Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities*. To further this effort, DOE chartered an expert working group to assist in the review of selected risk assessment applications, and is preparing a revised Nuclear Safety Policy Statement and supporting standard. (Recommendation 2009-1; Section 5.3.3)
- DOE continues to carry out the implementation plan for Recommendation 2007-1, *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*. In 2010, DOE identified best practices for nondestructive assay programs and also identified gaps and areas of improvement for nondestructive assay programs. (Recommendation 2007-1; Section 5.3.7)
- DOE completed its evaluation of all defense nuclear facilities in accordance with the guidance provided in its implementation plan for the Recommendation 2004-2, *Active*

*Confinement Systems.* This evaluation identified five facilities that needed modifications or upgrades to their active confinement ventilation systems to meet the performance criteria in the DOE guide that was prepared for this purpose. In a letter to the Board dated October 1, 2010, DOE committed to the upgrades and promised to brief the Board within one year on the progress made in enhancing the reliability of those systems. (Recommendation 2004-2; Section 5.3.2)

- The Board held a public hearing on May 12, 2010, on federal safety oversight at defense nuclear facilities, in part to address actions taken by NNSA and DOE to alter their oversight practices per departmental memoranda issued in late 2009. DOE and NNSA affirmed their commitment to maintain adequate levels of oversight at defense nuclear facilities. (Board Public Hearing, May 12, 2010; Recommendation 2004-1; Section 5.1.2)
- DOE promulgated additional guidance and expectations for the implementation of specific administrative controls and designated such controls as a focus area for headquarters review efforts. In 2010, DOE initiated an effort to conduct independent field reviews at all Environmental Management sites; DOE plans to conduct similar reviews at selected NNSA sites. These reviews are expected to be completed in early 2011. (Recommendation 2002-3; Section 5.3.1)
- In response to the Board's concerns, DOE developed revised guidance for development and implementation of justifications for continuing operations. This guidance was embodied in a revision to DOE Guide 424.1, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*, issued on April 8, 2010. (Board letter dated April 19, 2007; Section 5.3.6)
- In early 2010, the Board pressed DOE to complete guidance for verification of safety basis controls. In April, DOE issued revised draft guidance and started formal evaluations. The Board provided comments, and DOE issued the final guidance in November. (Board letter dated February 5, 2008; Section 5.1.7)
- The Board discovered that some of the controls identified as defense-in-depth might not be adequately maintained and considered as part of the safety basis of defense nuclear facilities at the Savannah River Site. Such controls could have been eliminated or not maintained under a configuration control program. DOE responded to the Board on November 23, 2010, committing to revise site procedures to ensure that those defense-in-depth controls are identified in facility safety bases. (Board letter to NNSA dated July 16, 2010, Section 5.3.9)

## Outstanding Safety Problems

### Changes in Safety Design for the Hanford Waste Treatment and Immobilization Plant

The Board continues to be concerned that changes to the design of the Hanford Waste Treatment and Immobilization Plant are being implemented prior to the resolution of numerous outstanding technical issues. These changes are being contemplated at a very late stage in the project and are being pursued with great urgency. DOE's prevailing attitude that substantial reductions in safety-class controls are essential has appeared at many points to override the questioning attitude that DOE needs to maintain in order to function effectively as a regulator. The Board is expending a significant portion of its resources evaluating the continuously-evolving changes proposed by DOE and expects this workload to continue for the foreseeable future.

In 2009, DOE initiated efforts to make significant changes in the safety strategy and controls for the Waste Treatment Plant, on the grounds that some safety-class controls required by the original strategy would unduly complicate future operations. The proposed changes fall into two principal categories: changes in the radionuclide content assumed for the feed material to the plant (and corresponding changes in the accident analyses), and changes in the controls for hydrogen explosions.

The Board set forth its concerns with these changes in a public hearing held near the Hanford Site on October 7 and 8, 2010. While the Board has no objection to using more realistic assumptions for the feed material, DOE's contractor made changes to the accident analyses *unrelated* to the feed material changes, and on that basis concluded that a relaxation of safety controls was justified. The Board's review of the revised accident analysis found several areas of nonconservatism. Based on staff-to-staff interactions and issuance of Board correspondence, DOE has agreed that the assumed value for a parameter—deposition velocity—used in models to predict public dose consequences from postulated accidents was not technically defensible, and that the methodology for evaluating spray leaks from process piping was not valid.

DOE and its contractor presented revised hydrogen safety strategies in early 2009 that would allow extensive explosions and even rupture of piping to occur in the plant. Based on comments from the Board, DOE agreed to prevent explosions in the inaccessible black cells in the Pretreatment facility and in piping larger than four inches in diameter in hot cells. However, DOE is still pursuing elimination of controls that prevent explosions in smaller diameter piping; the piping may be permanently deformed but will not be allowed to rupture. DOE's testing approach for evaluating the adequacy of in-line process system components has not been clearly defined. The Board believes that DOE's design approach is questionable and is particularly concerned that DOE's strategy does not credit the safety function of the primary confinement boundary consisting of piping, vessels, and related components, to prevent release of radioactive material.

The Board remains concerned about the use of quantitative risk analysis as part of the hydrogen control strategy for the Waste Treatment Plant. The use of quantitative risk analysis as a risk assessment and design tool is a first use for DOE. There are no DOE standards and

requirements for the use of quantitative risk analysis, nor for controlling the assumptions that underpin the quantitative risk analysis in the safety basis. The impact of quantitative risk analysis on the safety basis of the Waste Treatment Plant remains uncertain.

### **Mixing and Transfer Systems at the Hanford Waste Treatment and Immobilization Plant**

The Board issued Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*, to address unresolved technical concerns related to process equipment that is essential to the safe and successful operation of the facility. This plant is needed to treat legacy wastes from decades of plutonium production at Hanford. The Board believes that testing and analysis completed to date has been insufficient to establish, with confidence, that the pulse jet mixing and transfer systems will perform adequately at full scale.

The Board previously expressed concerns with mixing to DOE's Assistant Secretary for Environmental Management that were consistent with advice provided to DOE by its independent experts from the Consortium for Risk Evaluation and Stakeholder Participation and from Pacific Northwest National Laboratory. Unresolved issues remain with the small-scale pulse jet mixing test program, computer modeling of pulse jet mixing performance, waste feed characterization and certification, and planned modifications to the plant's process vessels.

During the Board's public hearing in October 2010, DOE committed to conduct a large-scale test to better assess the performance of the pulse jet mixing system. The Board believes that the large-scale tests will demonstrate the actual characteristics of the mixing system. The technical issues with the performance of the mixing and transfer systems need be fully addressed and resolved early to enable DOE to meet its commitment to begin plant operation in 2019. The Board's recommendation will guide DOE in developing a test plan that resolves all technical issues and should help minimize future delays. DOE is required to formally accept or reject the Board's recommendation in early 2011.

### **Directives Reform**

Maintaining a system of safety directives requires a steady effort to incorporate lessons learned from implementation and to keep up with the state of the art of the broad range of topics covered by the directives. As such, the Board expects consistently to devote a significant portion of its resources to the evaluation of proposed changes to DOE's safety directives to satisfy its duties under the Atomic Energy Act of 1954, as amended.

However, the year 2010 represented a sharp increase in the demand for such reviews. Under the *Department of Energy 2010 Safety and Security Reform Plan*, DOE undertook to review and revise, cancel, or consolidate 107 safety and security directives maintained by DOE's Office of Health, Safety and Security on an extremely aggressive schedule. The plan and its associated "End-State Vision" contemplated reducing health and safety directives by 50 percent in about 6 months. Later in the year, under its "Governance Reform Initiative," NNSA bypassed DOE's established directives review system to conduct its own line-by-line evaluation of the contractor requirements of selected directives, including directives related to nuclear safety. NNSA attempted to identify requirements as duplicative, overly prescriptive, inconsistent,



and/or unclear and then authorized its site offices to delete them (in some cases, deleting the entire Contractor Requirements Document) from site contracts, starting with the Nevada National Security Site and Sandia National Laboratories.

The Board could not ascertain a need for the extremely compressed schedules directed for these reform efforts. DOE and NNSA were unable to articulate any specific problem in the field, and the Board was unable to find problems caused by the existing safety directives or significant deficiencies in their requirements. On May 5, 2010, the Board requested the Secretary of Energy to clarify the specific criteria DOE was using to analyze individual directives to determine cancellation and consolidation and the steps that DOE was taking to improve and strengthen its directives. On May 20, 2010, DOE responded to the Board's request by providing a *Project Management Plan for the Safety and Security Reform Plan* that outlines a rigorous and disciplined process for the Office of Health, Safety and Security to use to carefully assess the content of each directive, the value of each requirement, and the consequences of each requirement's removal or modification. As a result, the health and safety directives reform effort had proceeded in a deliberate manner that thus far produced revisions that strengthen and improve the directives.

The Board was briefed on NNSA's Governance Reform Initiative by senior DOE management in November 2010. Subsequently, the Deputy Secretary of Energy issued direction to restrict the scope of this initiative and so informed the Board in a letter dated November 19, 2010. NNSA has changed the focus of its directives improvement initiative and is using its resources to work more effectively within the established DOE directives review system. However, on December 29, 2010, the Deputy Secretary of Energy signed a memorandum entitled "Expedited Processing of Directives." This memorandum instructed the Office of Management to further expedite the normal review and comment process for a select group of safety directives that were scheduled for review under the *Department of Energy 2010 Safety and Security Reform Plan*.

These are just the most recent of the numerous directives revision efforts DOE has embarked on during the past 20 years. The core requirements needed to adequately protect the public, workers, and environment at defense nuclear facilities have not appreciably changed after each of DOE's directive reform efforts. History has shown that requirements governing nuclear safety need to be prescriptive to prevent incidents and accidents, and nuclear safety requirements will usually need to dictate process as well as outcome in order to provide the required degree of safety. It is not apparent that accelerated directives reform efforts yield benefits commensurate with the demands they place upon the finite resources at DOE, NNSA, and the Board.

## **Disposition of Nuclear Materials**

DOE faces several challenges related to nuclear materials that have been declared surplus to national security needs or are otherwise no longer needed. These materials exist in many chemical and physical forms and include large inventories of spent nuclear fuel, plutonium, uranium, and other highly radioactive isotopes. More materials are being added to these inventories as DOE ends Cold War era programs, decommissions old nuclear facilities, and produces additional wastes during work funded by the Recovery Act.

Three main challenges exist: (1) DOE must provide safe interim storage for the large inventory of nuclear materials, (2) DOE must develop timely disposition plans for the materials to limit the risks to workers and the public, and (3) DOE must identify the facility and infrastructure requirements that will support safe completion of the disposition mission.

Regarding storage, DOE is working to implement key elements of the Board's Recommendation 2005-1, *Nuclear Material Packaging*. This effort has progressed slowly, but should result in the development of robust containers for the interim storage of certain nuclear materials. The Board urges continued focus on and integration of this work by DOE's Office of Health, Safety and Security. However, this effort does not address spent nuclear fuel. DOE is faced with a serious challenge to define and implement safe storage for spent nuclear fuel held in water-filled basins at a number of DOE sites. This problem is intensified if DOE decides not to process the fuel using the Savannah River Site's H-Canyon facility. DOE's "Blue Ribbon Commission on America's Nuclear Future" has as one of its charges the task to address this challenge.

Regarding disposition planning, DOE has defined the disposition paths for some of its excess nuclear materials, but other materials have no defined disposition path. DOE's new Office of Nuclear Materials Integration made strides in defining disposition paths by completing a draft *National Strategic Plan for Nuclear Materials*. DOE's continuing challenge is to improve communication and cross-program integration to ensure all surplus or excess nuclear materials are identified, safely stored, then safely disposed of.

For many nuclear materials, DOE's preferred method of disposition has been chemical processing through the H-Canyon facility. However, it is not clear to the Board that DOE will remain committed to operating H-Canyon and maintaining the facility in a high state of readiness as it ages. The Board believes it is imperative that DOE clearly define its long-term processing needs based on real options and supported by a sound technical and cost basis, before shutting down H-Canyon to achieve near-term cost savings. DOE's long-term planning also should include facility and infrastructure needs to support all current and future nuclear material disposal requirements.

### **Management of Liquid High-Level Wastes**

At the Idaho, Hanford, and Savannah River Sites, DOE is responsible for managing and disposing of tens of millions of gallons of high-level waste held in underground storage tanks. DOE faces the significant challenge of safely retrieving these wastes and transferring them to treatment plants to immobilize the wastes for disposal. The properties of high-level waste vary among the tanks and often vary within a single tank, requiring a variety of tools for successful retrieval. DOE is developing new waste retrieval technologies, especially for thick and dense wastes that make pumping difficult. DOE needs to continue research and development efforts to improve waste retrieval and treatment.

At the Hanford and Savannah River sites, DOE faces the additional challenges of limited tank space and aging tanks that still contain high-level wastes. The Board believes DOE must address these risks and develop sound and workable risk mitigation strategies. A strong tank

integrity program, which includes corrosion control, inspection and monitoring, and structural analysis, is essential to increase confidence in continued safe operation of the waste tanks. The Board continues to emphasize the need for maintaining and strengthening this program.

### **Transuranic Waste Processing**

Although DOE has completed the packaging and disposal of many thousands of drums of transuranic waste, much remains to be done. Many of the containers of transuranic waste remaining to be addressed are in poor condition and contain much higher quantities of radioactive and hazardous materials than containers already processed. These hazards make DOE's continuing task significantly more risky. This fact was made clear in 2010 by incidents at the Idaho National Laboratory and the Savannah River Site. Several workers at Idaho experienced uptakes of plutonium dust when an old waste container unexpectedly fell apart, and a worker at the Savannah River Site suffered a contaminated puncture wound while handling radioactive materials from an old waste container.

A large portion of DOE's remaining work to exhume, sort, and repackage its inventory of transuranic waste will include similar hazards. During its visits to DOE's facilities, the Board has urged DOE to reexamine these hazards and carefully identify and implement appropriate safety controls. The work practices of the past, which relied heavily on administrative controls, will have to be improved and supported by more robust engineered controls.

### **Protracted Reliance on Structurally Unsound Facilities**

NNSA continues to rely on structurally unsound facilities to carry out hazardous production missions. Examples of this persistent problem include the 9212 Complex at Y-12 (portions of which are more than 60 years old) and the Chemistry and Metallurgy Research building at Los Alamos (nearly 60 years old). The 9212 Complex cannot meet existing requirements for Hazard Category 2 nuclear facilities, while the Chemistry and Metallurgy Research building remains seismically fragile and poses a continuing risk to the public and workers.

To its credit, NNSA has taken actions to reduce the radioactive material-at-risk in these facilities. These actions include reducing the inventory of bottled uranium solutions at the 9212 Complex and committing to relocate some activities from the Chemistry and Metallurgy Research building to a more robust facility at Los Alamos. In addition, NNSA initiated a line-item project to upgrade certain facility systems in the 9212 Complex based on a facility risk review and is consolidating operations in the Chemistry and Metallurgy Research building into wings of the structure that do not lie directly above a seismic fault. These are, however, stop-gap measures. The facilities are structurally unsound and are unsuitable for protracted use.

The Board is investing significant effort into reviewing the designs of the proposed replacement facilities—the Uranium Processing Facility at Y-12 and the Chemistry and Metallurgy Research Replacement facility at Los Alamos. Unfortunately, completion of these facilities has been delayed, and both will be subjected to external scrutiny regarding cost, scope, and programmatic need. The Board continues to drive safety improvements at the existing

facilities while at the same time pressing NNSA to remain committed to building replacement facilities without undue delay.

### **Safety Initiatives Requiring Increased Management Focus and Staff Support**

DOE accomplished a wide variety of safety improvements across the defense nuclear complex during 2010. However, little progress was made toward carrying out several important safety initiatives responding to the Board's recommendations from prior years. All of these initiatives are straightforward and could be accomplished in a timely manner, given appropriate management focus, staff support and funding. The most prominent of these stalled initiatives are related to the implementation of the Board's Recommendation 2004-1, *Oversight of Complex, High-Hazard Nuclear Operations*.

The Board conducted a public hearing on May 12, 2010, addressing selected aspects of the recommendation and plans follow-up hearings in 2011. Three areas are languishing and need management attention: (1) limited progress was made in response to the sub-recommendation on nuclear safety research and development, (2) DOE is more than three years behind schedule in issuing a guide to complement Order 226.1A, *Implementation of Department of Energy Oversight Policy*, and (3) NNSA continues to lag behind DOE's Office of Environmental Management in implementing a corporate approach toward quality assurance for safety aspects of defense nuclear facilities. NNSA's poor performance in developing and implementing quality assurance plans, as required by DOE Order 414.4C, *Quality Assurance*, continues to be a particular concern.

## 1. Introduction

The year 2010 marks the twentieth full year of the Board's operations, and it proved to be a year filled with difficult challenges requiring sustained and intense efforts by the Board and its dedicated professional staff. Some of these challenges—such as the complex design problems arising at the \$12 billion Waste Treatment and Immobilization Project at Hanford—have been a focus of the Board's work for a number of years, and will continue to be so in the future. Other challenges were new: in 2010 the Department of Energy and the National Nuclear Security Administration embarked on yet another in a series of initiatives to revise and streamline safety standards and requirements, which lie at the heart of the Board's statutory mission. The Board concentrated much attention and resources in an effort to ensure that this initiative yielded an improved and strengthened set of standards and requirements.

The Board made full and extensive use of its statutory tools in 2010. During the year the Board held two public hearings, one in May on federal safety oversight of defense nuclear facilities, and another in October to fully explore, in a public forum, critical safety decisions for the Waste Treatment and Immobilization Project. The Board also issued two recommendations to the Secretary of Energy. In Recommendation 2010-1, the Board sought to strengthen the Department of Energy's nuclear safety requirements embodied in federal rules mandated by Congress in 1988. And in Recommendation 2010-2, the Board followed up on its October hearing at Hanford by recommending a number of measures to ensure that the Waste Treatment and Immobilization Project will operate both safely and effectively. The full text of these recommendations can be read in Appendix A to this report.

In addition to formal recommendations, the Board employed its reporting requirement authority on twenty occasions to obtain information from the Department of Energy and the National Nuclear Security Administration. A list of these letters can be found in Appendix C to this report. As has always been the case, the Board members themselves traveled to a number of sites and facilities for onsite briefings and inspection tours of operating facilities, facilities under construction, and waste processing and storage facilities. The Board's staff also traveled widely and constantly to monitor activities in the field and to meet face to face with technical counterparts. The Board's eleven site representatives provide the Board with a steady flow of safety information that can only be obtained by continuous presence and a deep understanding of each site's facilities, management, and operations.

The Board is fully cognizant of the immense tasks that lie before the Department of Energy and the National Nuclear Security Administration and is well aware that tight federal budgets make these tasks more difficult. The Board views its mission as one of ensuring that while critical projects and operations move forward, the public, the workers and the environment are protected as required by law. To achieve this end, the Board uses all of the tools provided in its legislation, and endeavors to spend every budgeted dollar to ensure that dangerous and complex federal programs are conducted safely.

In this report, we explain to the Congress how we have carried out our mandate in 2010. Section 1 summarizes the Board's mission, oversight strategy, and strategic plan. Sections 2, 3, 4, and 5 describe progress in the four major areas of the Board's operations: Nuclear Weapon Operations, Nuclear Material Processing and Stabilization, Nuclear Facilities Design and Infrastructure, and Nuclear Safety Programs and Analysis. Section 6 explains the Board's

interactions with the public and reports on administrative matters. Appendix A reprints the Board's Recommendations 2010-1 and 2010-2, Appendix B lists all recommendations cited in this report, Appendix C lists all reporting requirements sent to DOE in 2010, and Appendix D contains a complete list of the Board's 2010 correspondence.

## **1.1 Mission**

The Defense Nuclear Facilities Safety Board is an independent federal agency, established by Congress in 1989 to provide sound technical safety oversight of DOE's defense nuclear weapons facilities and operations. The Board is composed of respected experts in the field of nuclear safety, and it has, in turn, assembled a permanent staff with broad experience and competence in all major aspects of safety. This level of expertise is needed because the nuclear weapons program remains a complex and hazardous operation. DOE must maintain in readiness a nuclear arsenal, dismantle surplus weapons, dispose of excess radioactive materials, maintain aging facilities, clean up surplus facilities, and construct new, complex, one-of-a-kind, high-hazard facilities for many purposes. All of these functions must be carried out in a manner that protects the public, workers, and environment.

The Board has established site offices at six high-priority defense nuclear sites: Pantex Plant in Texas, Los Alamos National Laboratory in New Mexico, Y-12 National Security Complex in Tennessee, Savannah River Site in South Carolina, Hanford Site in the State of Washington, and Lawrence Livermore National Laboratory in California. The site offices provide the Board with a continuous presence and oversight at these locations. At other locations, the Board maintains safety oversight by means of regular onsite reviews by members of its technical staff.

During the Board's 21 years of operation, its priorities have evolved with changes in the nuclear weapons program. The Board employs its Strategic Plan, required by the Government Performance and Results Act, to ensure that its limited resources remain focused on the most significant health and safety challenges and keep pace with shifts in those challenges from year to year. The Board's health and safety oversight activities are closely tied to goals and objectives embodied in this plan.

## **1.2 Oversight Strategy**

Maintaining an effective safety oversight program that fulfills the broad mandates of the Board's enabling legislation requires continuing reassessment of health and safety conditions throughout DOE's defense nuclear complex. The Board concentrates its resources on the most hazardous operations and complex safety issues, guided by its Strategic Plan and the following principles:

**Oversight Role** - As an oversight but not a regulatory agency, the Board uses a variety of statutory powers to ensure adequate protection of the public and worker health and safety. While the Board is empowered to identify current and potential safety problems and to recommend solutions, DOE remains responsible for taking actions based on the Board's advice.

**Risk-Based Oversight** - The Board's safety oversight activities are prioritized predominantly on the basis of risk to the public and workers, types and quantities of nuclear and hazardous material at hand, and hazards of the operations involved.

**Technical Expertise** - The Board has endeavored since its inception to ensure that DOE obtains and maintains the high level of technical expertise essential to the management of nuclear activities.

**Line Management** - Primary responsibility for safety resides in DOE and contractor management. Safety oversight can reinforce but not substitute for the commitment of line management and workers to safe work planning and performance.

**Clear Expectations** - Effective safety management demands that safety expectations be clearly defined and tailored to hazards existing in the workplace. Work instructions that are clear, succinct, and relevant to the work are more likely to be embraced by workers.

**Effective Transition Planning** - The Board ensures that other federal agencies and affected state governments are informed of its safety oversight activities at defense nuclear facilities to ensure a smooth transition from facility construction and startup to deactivation and decommissioning to environmental regulation.

The Board is provided by statute with a number of tools to carry out its mission. Among these are recommendations (typically broad and comprehensive in nature), reporting requirements (focused on specific safety issues), and public hearings (used to obtain information from DOE, other expert sources, and the public at large). Since 1989 when the Board began operations, it has issued 54 formal recommendations, comprising 250 individual sub-recommendations. In that same period of time, the Board has issued 246 reporting requirement letters and held 99 public hearings.

### **1.3 Strategic Plan**

The Board organizes its safety work by merging the broad health and safety mandate of its statute with the requirements of the Government Performance and Results Act. The Board's Strategic Plan addresses the serious hazards of handling nuclear weapons and weapons materials, and disposing of aging and surplus facilities. These hazards include:

- Complex operations at the Pantex Plant to assemble, disassemble, dismantle, and maintain weapons.
- Tons of radioactive and toxic materials throughout the defense nuclear complex, some stored in an unstable state.
- Aging facilities that require ever-increasing maintenance and surveillance to assure safety.

- Accidental releases caused by inadequate safety controls, human errors, equipment malfunctions, chemical reactions, building fires, detonations, and criticality events.
- Natural phenomena such as wildfires, earthquakes, extreme winds, floods, and lightning.

Given these hazards, safety can be assured by the adoption of a conservative engineering philosophy that hinges on reliable systems and multiple layers of protection. This concept is called “defense in depth,” and it has been a precept of nuclear safety in the United States for many decades.

The Board’s Strategic Plan sets forth four general goals:

- *Nuclear Weapon Operations*: Operations that directly support the nuclear stockpile and defense nuclear research are conducted by DOE in a manner that ensures adequate protection of the health and safety of workers and the public.
- *Nuclear Material Processing and Stabilization*: Processing, stabilizing, and disposing of hazardous nuclear materials are performed by DOE in a manner that ensures adequate protection of the health and safety of workers and the public.
- *Nuclear Facilities Design and Infrastructure*: New defense nuclear facilities and major modifications to existing facilities are designed and constructed by DOE in a manner that ensures adequate protection of the health and safety of workers and the public.
- *Nuclear Safety Programs and Analysis*: Regulations, requirements, guidance, and safety management programs adequate to protect public health and safety, including workers, are developed and implemented by DOE.



## 2. Nuclear Weapon Operations

### 2.1 Safe Conduct of Stockpile Management

Stockpile management refers to programs and infrastructure required to maintain the nation's nuclear weapons stockpile. Examples of the Board's activities to improve health and safety in stockpile management are discussed in the following subsections.

#### 2.1.1 Pantex Plant

The Pantex Plant, located near Amarillo, Texas, serves a central role in stockpile management. Operations at the site include assembly, disassembly, dismantlement, and surveillance of weapons, as well as interim storage of special nuclear material removed from retired weapons. In 2010, the Board sought health and safety improvements in areas such as technical procedures, nuclear explosive operations, safety basis, lightning protection, and requirements for the evaluation of weapon response to external stimuli.

**Technical Procedures.** In 2008 and 2009, the Board conducted a series of procedure reviews by observing operations on three weapon programs. In a letter dated October 15, 2009, the Board provided examples of issues related to the development and implementation of technical procedures for nuclear and nuclear explosive operations at Pantex. In 2010, NNSA took several measures in response to this letter. To ensure that process engineers spend a sufficient amount of time observing operations, the Pantex contractor instituted a performance element requiring process engineers to observe at least one evolution of the process to which they have been assigned in a given year. The contractor has drafted and expects to publish in 2011 a revised manual to eliminate the inconsistencies and ambiguities identified in the Board's letter.

**Safety Basis.** The Board issued a letter on July 6, 2010, detailing specific issues concerning Pantex's compliance with DOE-NA-STD-3016-2006, *Hazard Analysis Reports for Nuclear Explosive Operations*. NNSA has approved a plan setting forth the expectation that all hazard analysis reports at Pantex should serve as the final safety basis integration document and should fully describe why the approved control set is acceptable. The Board also conducted reviews of the implementation of this standard at weapons laboratories, focusing on how the standard was used to prepare weapons response documents for the B53 and W84 programs.

**Lightning Protection.** The Board issued a letter on March 30, 2007, identifying work needed to mitigate the indirect effects of a lightning strike on nuclear facilities at Pantex. Subsequently, the Board encouraged NNSA to characterize and control potential lightning threats to nuclear explosive operations. NNSA responded by forming the Nuclear Weapons Complex Electromagnetic Committee to analyze both lightning and electrostatic discharge hazards and by applying resources to understand and mitigate the potential threat from a lightning strike. The Board engaged experts in the field of lightning effects to validate the analyses.

The committee is addressing the Board's concerns systematically and, in turn, improving the understanding of lightning safety at Pantex. In 2010, the committee demonstrated that the

electromagnetic environment generated by the design basis lightning strike is not a threat to the detonator cable assemblies for all weapon programs, absent any coupling effects from nearby tooling. Also, NNSA began testing facilities to ensure that facility penetrations, or the wires that bond the penetrations to the Faraday cage, cannot carry sufficient lightning current to compromise established standoff distances.

**W76-1 Activities.** In January 2009, NNSA determined that W76-1 units being assembled at Pantex did not meet military requirements due to a concern with performance of a nuclear safety component. While delivery of units to the military was suspended, Pantex was allowed to continue operations on units that would be utilized by NNSA for quality assurance purposes. In June 2009, all W76-1 operations with components deemed questionable for use by the military were suspended after Pantex determined that the nuclear explosive safety impacts of this issue had not been reviewed.

In a letter dated January 25, 2010, the Board expressed concern that the lack of timely review and communication of new information from design agency personnel to those qualified to assess its safety impacts resulted in operations being performed without a complete understanding of the hazards involved. NNSA conducted a causal factors analysis of this event and determined that a number of changes were needed at Pantex, Sandia National Laboratories, and NNSA. Practices at Sandia led NNSA to request that Los Alamos and Lawrence Livermore National Laboratories review weapon support processes for lessons learned related to the necessary changes.

**Nuclear Explosive Safety.** In 2010, the Board evaluated eight Nuclear Explosive Safety studies, operational safety reviews, or nuclear explosive safety change evaluations conducted at Pantex, including the B53 and W84 Nuclear Explosive Safety studies and the W78 and B61 operational safety reviews. All systems approved for nuclear explosive operations at Pantex have now implemented Seamless Safety for the 21<sup>st</sup> Century processes.

In its 2008 letter closing Recommendation 98-2, *Safety Management at the Pantex Plant*, the Board stated its concern that Nuclear Explosive Safety studies of operations at Pantex suggested the Nuclear Explosive Safety process was not functioning properly. Of particular concern was the interface between the safety study groups and NNSA management. In response to the Board's letter, NNSA developed criteria to ensure that NNSA management and Nuclear Explosive Safety experts have a common understanding of when shortcomings identified in Nuclear Explosive Safety studies should be categorized as pre-start or post-start findings. While still in draft form, these criteria were formally used for evaluating potential findings during the Nuclear Explosive Safety studies and operational safety reviews conducted in 2010.

**Special Tooling.** Because of safety incidents in 2003 and 2004 involving the use of special tools, the Board issued a letter to NNSA on June 18, 2004, detailing concerns about systemic weaknesses in the Special Tooling Program at Pantex. NNSA continues to implement a Tooling Improvement Plan to improve the design, fabrication, control, and use of special tools in nuclear explosive operations. In 2010, the Board conducted a review to evaluate the Special Tooling Program, the flow-down of safety basis requirements into design documentation, and the

adequacy of the design documentation that supports tooling functionality. The Board noted an improvement in the overall program but identified areas that need continued focus.

### **2.1.2 Y-12 National Security Complex**

The Y-12 National Security Complex is a manufacturing facility located in Oak Ridge, Tennessee. For six decades, Y-12 has been and remains a national center for handling, processing, and storing highly enriched uranium. Stockpile management activities include production, maintenance, refurbishment, dismantlement, evaluation, and storage of certain components of nuclear weapons. The Board's most recent efforts to provide oversight and improve safety at Y-12 involve the following operations and projects.

**Highly Enriched Uranium Materials Facility.** In January, NNSA satisfactorily resolved the findings identified during the Operational Readiness Review for startup of the Highly Enriched Uranium Materials Facility and commenced nuclear operations in this new storage facility. NNSA subsequently transferred thousands of drums and containers of nuclear material from other Y-12 storage facilities to the new facility. These NNSA initiatives significantly improved both the safety and security posture of Y-12.

The Board closely observed NNSA's preparations to start up this facility. To improve the safety of operations, the Board urged NNSA to reduce the complexity of its criticality safety postings and to provide more formal control of the computer program used during containerization operations. To address the Board's concerns, NNSA simplified the postings and designated the computer program as a formal operator aid.

**9212 Complex.** The 9212 Complex is a collection of hazardous facilities overdue for replacement (some more than 60 years old) for processing highly enriched uranium. NNSA has identified numerous structural deficiencies and other non-compliances that prevent the 9212 Complex from meeting current requirements for Hazard Category 2 nuclear facilities. During the last several years, the Board has expressed concerns over NNSA's ability to safely operate the 9212 Complex for an extended period.

In 2007, the Board issued a letter to NNSA that advocated a regimen of increased vigilance and regular assessment of the physical condition of the 9212 Complex and requested NNSA to provide an annual report and briefing on the safety of operations. In 2010, NNSA completed its third annual assessment of the safety of operations of the 9212 Complex. NNSA provided the Board with a report and briefing on the results of this assessment and specific actions taken to improve the safety posture of Building 9212. These actions included continuing to minimize the amount of nuclear material-at-risk, replacing aging electrical panels, and establishing a program to monitor aging electrical cables. NNSA also approved Critical Decision-3A for completing part of a line-item project that will fund facility improvements over the next several years while the replacement facility, the Uranium Processing Facility, is being designed and constructed.

**Nuclear Criticality Safety.** The Board reviewed elements of the nuclear criticality safety program at Y-12, with specific focus on progress made towards resolving issues identified in the

Board's January 2009 letter to NNSA and on criticality safety non-compliances that occurred during the year. The Y-12 contractor responded to concerns raised in the Board's letter by completing an extent-of-condition review on all active nuclear criticality safety evaluations to determine if they (1) failed to identify upset conditions that were unlikely (expected to occur no more than once in the lifetime of the facility), (2) failed to use the double contingency principle appropriately, or (3) failed to analyze credible abnormal conditions. The extent-of-condition review did not identify the need for any new criticality safety controls, but did identify numerous areas for improvement, which have been incorporated into the contractor's Nuclear Criticality Safety Evaluation Upgrade Plan

The Y-12 contractor revised its programmatic procedures for nuclear criticality safety to require that nuclear criticality safety evaluations meet the process analysis requirement (subcritical under normal and credible abnormal conditions) from ANSI/ANS-8.1, *Nuclear Criticality Safety in Operations with Fissionable Material Outside Reactors*. This change represents a significant improvement compared with the previous requirement to meet only the double contingency principle.

**Quality Assurance.** In 2009, the Board expressed concerns regarding the adequacy of NNSA's corrective actions for quality assurance deficiencies identified during construction of the Highly Enriched Uranium Materials Facility. In response, NNSA committed to improve the execution of quality assurance throughout the engineering, procurement, and construction organizations at Y-12. In 2010, the Y-12 contractor created and staffed a new Nuclear Facilities Quality Assurance organization that reports directly to the president of the Y-12 contractor. NNSA issued its final lessons learned report for the Highly Enriched Uranium Materials Facility, which concluded that the specification of quality assurance requirements was insufficient and that many of the major difficulties encountered by the project could be attributed to quality assurance failures. The Board has urged DOE to incorporate the lessons learned into its planning and management of other major DOE construction projects.

**Assembly and Disassembly Operations.** While reviewing NNSA's preparations to dismantle B53 components, the Board expressed concern regarding NNSA's determination that an independent readiness review of these operations would not be required prior to startup. In response to the Board's concern, NNSA directed the contractor to perform an independent readiness review. The contractor performed its independent review and commenced B53 dismantlement operations in November 2010.

The need for additional training was made evident when operators followed verbal guidance provided by production engineering personnel and cut into the wrong section of a weapon component. NNSA conducted training that all work instructions provided to operators must be documented, peer reviewed, and concurred with by facility management. The Board urged NNSA to increase the rigor associated with this new protocol. In response, NNSA developed and implemented a form that is required to be used by production engineering personnel while directing work. This form must be peer reviewed and approved by facility management.

**Conduct of Operations.** In 2010, the Board identified the following systemic weaknesses in Y-12 procedures: (1) procedure use categories (information only, reference use, or continuous use) were not designated on some procedures, (2) numerous procedure revision requests had not yet been incorporated into active procedures despite being approved months or years earlier, and (3) excessive precautions and limitations in the front sections of some procedures diverted workers' attention from the primary hazards of the operations. In response to the Board, NNSA took the following actions: (1) verified that all active procedures were properly designated with the appropriate procedure use category, (2) reduced the backlog of unincorporated procedure revision requests by half, and (3) committed to reduce the number of upfront precautions and limitations in operating procedures.

**Building 9204-2E.** In 2008, NNSA identified instances of concrete spalling in an elevated slab in Building 9204-2E. The Board subsequently urged NNSA to develop and execute an inspection plan for determining the extent of concrete degradation. In 2009, in accordance with an inspection plan, the Y-12 contractor extracted concrete core samples from a region of the floor slab with high chemical exposure and completed testing of the concrete core samples. By early 2010, the testing results demonstrated that the concrete strength was unaffected by the chemical exposure. However, rebar corrosion is still an ongoing concern; NNSA appropriately implemented a monitoring program in January 2010.

**Recovery Act Activities.** In 2009, NNSA observed subcontractors performing Recovery Act work that failed to comply with procedural requirements. The Board expressed concern that NNSA's safety strategy for performing Recovery Act work at Y-12 did not adequately identify mechanisms for day-to-day oversight of subcontractors. In 2010, NNSA revised its strategy to require facility operations personnel to oversee the start of new operations involving subcontractors in addition to conducting periodic operational oversight of subcontractor work.

## **2.2 Safe Conduct of Stockpile Stewardship**

Stockpile stewardship refers to activities carried out in the absence of underground nuclear weapons testing to ensure confidence in the safety, security, and reliability of nuclear weapons in the nation's stockpile. Stockpile stewardship includes using past nuclear test data in combination with non-weapons test data and aggressive application of computer modeling, experimental facilities, and simulations. Safety aspects of activities at the major sites engaged in stockpile stewardship are discussed in the following subsections.

### **2.2.1 Los Alamos National Laboratory**

Los Alamos National Laboratory, located in New Mexico, is the site of many defense nuclear facilities and weapon-related activities. Work performed at Los Alamos includes stockpile stewardship and stockpile management activities such as pit manufacturing. In 2010, the Board focused its oversight on Plutonium Facility seismic safety improvements and risk reduction activities, the Chemistry and Metallurgy Research Building, efforts to restart the Weapons Engineering Tritium Facility, transuranic waste operations, fire and emergency response, nuclear planning, and integrated work management.

**Recommendation 2009-2.** On October 26, 2009, the Board issued Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*, which stressed the need for expeditious development and implementation of an effective safety strategy for seismically induced events at the Los Alamos National Laboratory's Plutonium Facility. The Secretary of Energy accepted this recommendation on February 2, 2010. NNSA submitted an implementation plan to the Board on July 13, 2010 and provided two subsequent letters clarifying proposed commitments on August 25, 2010, and November 9, 2010. The Board accepted the implementation plan on December 17, 2010.

In accordance with the implementation plan, NNSA has completed a number of actions intended to reduce the probability or consequence of Plutonium Facility seismic accident scenarios. Completed actions include: design of an automatic seismic shutdown of laboratory electrical equipment to reduce ignition sources; removal or lock-out of unnecessary ignition sources inside gloveboxes; procurement and installation of six safes with adequate fire ratings to protect special nuclear material during a fire; fire testing two container types to demonstrate their ability to protect nuclear material under fire conditions; establishment of project scoping for seismically upgrading the fire suppression system and key portions of the active confinement ventilation system; repair of deficiencies in the main Plutonium Facility fire barrier; and robustly packaging or dispositioning some 700 kilograms of special nuclear material.

**Plutonium Facility - Plutonium-238 Containerization.** In response to a 2009 Board letter, NNSA completed a campaign to address approximately 200 plutonium-238 containers that presented potential overpressurization concerns. About 160 of the containers were overpacked in robust safety class containers. Other potentially vulnerable containers were introduced into glovebox lines and vented to eliminate any overpressurization hazard.

**Chemistry and Metallurgy Research Building.** The Los Alamos site office approved a revised documented safety analysis and technical safety requirements for this facility in June 2010. This action authorizes post-2010 operations, including analytical chemistry in Wings 5 and 7 and confinement vessel cleanout operations in Wing 9. However, the safety basis included a post-seismic fire scenario with mitigated dose consequences exceeding DOE's Evaluation Guideline. The laboratory completed implementation of this safety basis in December 2010. Following Board review of this safety basis, the laboratory submitted and NNSA approved a Safety Basis Strategy that will control material-at-risk at a level that ensuring compliance with the Evaluation Guideline. This administrative control will be incorporated into the 2011 safety basis update.

**Tritium Facility Restart.** In July 2010, an NNSA Operational Readiness Review team completed its review and recommended that the facility be authorized to restart tritium gas handling operations. Successful completion of this readiness process was the culmination of nearly two years of work to correct safety system deficiencies originally identified by the Board.

**Fire and Emergency Response.** The Board continued to follow closely the laboratory's ability to respond to fires and other emergencies. Responder training and nuclear facility awareness initiatives appear to have significantly improved the capability for fire and emergency response for the laboratory's nuclear facilities.

**Work Planning.** In response to the Board's 2009 review of the processes used to plan and control hazardous work at the activity level at both the Plutonium Facility and the Radioactive Liquid Waste Treatment Facility, NNSA plans to conduct an independent assessment of work planning and control in 2011.

**Integrated Nuclear Planning.** The Board continued its oversight of NNSA's Integrated Nuclear Planning process. This process is intended to improve coordination and control among nuclear projects and was developed in response to Board concerns. In 2010, the Board observed three integrated nuclear planning meetings focused on enduring waste management capabilities, Plutonium Facility programmatic activities and safety posture improvements, and other high-priority laboratory facilities and projects. These meetings continue to contribute value and improve coordination between NNSA and the laboratory.

### 2.2.2 Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory, located 45 miles southeast of San Francisco, California, is a nuclear weapon research and development laboratory. It provides technical expertise to support stockpile stewardship and management, including consulting on the surveillance and dismantlement of nuclear weapons. Most defense nuclear activities are conducted in the Superblock complex, which includes the Plutonium Facility and the Tritium Facility. During 2010, the Board conducted reviews of implementation of requirements governing the evaluation of weapon response to external stimuli, work planning and control, emergency management, and the training program.

**Tritium Facility Documented Safety Analysis.** The Board reviewed the readiness assessment preceding operation of the Tritium Process Station and identified several opportunities to strengthen the hazards analysis. In response, NNSA developed and implemented a justification for continued operations, while the laboratory contractor revised and resubmitted the documented safety analysis. NNSA is currently reviewing the revised safety basis.

**Weapon Response.** The Board reviewed the laboratory's implementation of DOE-NA-STD-3016-2006, *Hazard Analysis Reports for Nuclear Explosive Operations*. This guidance governs the development, issuance, and implementation of the weapon response by the national laboratories for use by the Pantex Plant in developing a safety basis for a given weapon. The Board reviewed the development of the weapon response information for the W84 Seamless Safety in the 21<sup>st</sup> Century project and found opportunities for improving the NNSA oversight of weapon response development, documentation of the technical basis for weapon response, and peer review of the W84 weapon response.

**Work Planning.** The Board reviewed the work planning and control processes of the laboratory's nuclear facilities. In the course of this review, the Board identified weaknesses in the implementation of Integrated Safety Management in these processes and concluded that work planning was not being used effectively to ensure worker safety. This conclusion led to an increase in oversight of work planning by laboratory management and NNSA. The laboratory is undertaking long-term improvements to its processes for planning work to incorporate suggestions made by the Board.

**Training Program.** The Board assessed the contractor training program at the laboratory's nuclear facilities as well as NNSA's oversight of training. DOE issued Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*, in April 2010, and it was subsequently incorporated into the laboratory contract. The Board found opportunities to strengthen the effectiveness of training as the laboratory implemented the new order. The Board identified weaknesses in the flowdown of administrative requirements from the safety basis, the continuing training program, consistency of the training given to instructors, and the content and delivery of some courses.

**Emergency Management.** The Board reviewed elements of the laboratory's emergency management program, including use of facility-level drills and training for first responders, such as the fire department. The Board found that there are significant opportunities for improvement in both of these areas. In response, the laboratory contractor has formalized and strengthened the training process for first responders and has begun development of a facility-level drill program.

**Occurrence Reporting.** The Board has encouraged the laboratory to increase the reporting of management concerns via the Occurrence Reporting System in order to increase dissemination of lessons learned throughout the DOE complex. The laboratory revised its feedback and improvement plan and incorporated the Board's suggestions.

### 2.2.3 Nevada National Security Site

The Nevada National Security Site (formerly the Nevada Test site) is an extensive outdoor laboratory and national experiment center located in southern Nevada, about 75 miles northwest of Las Vegas. Activities at the site include preparations for the disposition of damaged nuclear weapons, subcritical experiments, criticality experiments, emergency response training, and waste management. While underground testing has not been conducted in many years, the site is maintained in a state of readiness should testing be resumed. During 2010, the Board focused its attention on the Device Assembly Facility, Subcritical Experiments, and G-Tunnel.

**Device Assembly Facility.** NNSA has been preparing to start operations of the Criticality Experiments Facility at the Device Assembly Facility. The Board previously reviewed and commented on the design and construction for facility modifications and on modification and testing of the critical assembly machines. In 2010, the Board reviewed the safety basis, instrumentation and controls, and readiness for startup. In a letter to NNSA on August 5, 2010, the Board noted deficiencies in the accident analysis, control set, safety system design, and formality of operations. NNSA will remedy these deficiencies during startup activities in 2011.

NNSA continues to expand the potential missions of the Device Assembly Facility. New missions include receipt and storage of special nuclear material, operations involving special nuclear material, assemblies of explosives and special nuclear material, and potential nuclear explosive operations. The Board challenged the reliability of the facility's fire suppression system in letters to NNSA on November 3, 2004, and November 28, 2005, and questioned the availability and reliability of fire protection features credited as safety-class or safety-significant in a letter to NNSA on January 18, 2008. The fire suppression system does not meet typical design features for either a safety-class or safety-significant system. The Board is especially



concerned about the continuing degradation of the underground piping that supplies water to the fire protection system. This degradation results in unacceptable amounts of debris in the water supply, which can clog fire sprinklers.

In response to the Board's 2008 letter, NNSA initiated an improvement project to assess the condition of the system, analyze and prioritize needed improvements, and prepare an implementation plan to resolve the problems. Although NNSA began improvements in 2009, the most important improvements—replacement of the water tank and degrading lead-in pipes for the water supply—are deferred indefinitely due to insufficient funds. As a result, NNSA relies on an administrative compensatory measure in lieu of repairing the fire suppression system. The Board issued a letter to NNSA on July 28, 2009, emphasizing that it is essential to fully repair the system and not allow administrative controls adopted as an interim measure to supplant a long-term engineered solution. The Board also emphasized the importance of continued commitment from NNSA, as well as long-term funding for the most significant repairs.

In 2010, leaks were discovered in lead-in pipes and reliance on an administrative compensatory measure was continued. Installation of new strainers to collect debris and documentation of the as-built configuration of the sprinkler system are halted with about half complete. Procurement of a demonstration stand-alone fire suppression unit is in progress. The Board continued to encourage timely improvements and consideration of alternative replacements.

**G-Tunnel.** The Board continued to stress the need for safety upgrades for the G-Tunnel facility, which is to be used in disposing of an improvised nuclear device. NNSA is to develop a plan for implementation of safety controls and upgrades appropriate to the scope of operations at the facility. In the meantime, NNSA continued to complete some facility improvements and implement the results of the cost/risk benefit analysis of the proposed controls and improvements, e.g., tunnel ventilation. In 2010, the Board observed modest improvements to the work area in the tunnel, process tooling improvements, and plans for implementing formality of operations. The Board expects NNSA to address operational safety issues in 2011.

**Nuclear Safety and Operations.** The Board observed numerous configuration management and conduct of operations issues at nuclear facilities, particularly at the Device Assembly Facility and during recent operational readiness reviews. In letters to NNSA on November 3, 2004, and November 28, 2005, the Board challenged the adequacy of safety management programs at the site. In 2009 and 2010, the Board questioned whether the safety bases were implemented adequately. As a result, NNSA implemented 20 orders for compensatory measures in 2010 to strengthen all aspects of nuclear operations and safety.

**Work Planning and Control.** The Board conducted a review of the processes and procedures used by NNSA to implement integrated safety management in work planning. This review identified a number of weaknesses in the methods used to plan and control work, particularly for hazard identification and analysis, definition of the scope of work activities, and the broad scope of work procedures. The review also found that lessons learned from work processes are not effectively captured and fed back into work planning. The Board is working with NNSA to correct these deficiencies.

## **2.2.4 Sandia National Laboratories**

Sandia National Laboratories are located in Albuquerque, New Mexico, and Livermore, California. Major defense nuclear facilities at Sandia are located in Technical Area V at the New Mexico site, including the Annular Core Research Reactor, Auxiliary Hot Cell Facility, Gamma Irradiation Facility, and Sandia Pulsed Reactor Facility. The Sandia Pulsed Reactor is no longer in operation; however, the facility is now used for smaller scale criticality experiments.

The Board reviewed the facility hazard categorization of the Z machine, where the laboratory plans to perform isentropic compression experiments involving plutonium. The Board found that the approved authorization basis documents did not properly establish the facility hazard categorization, a key consideration in the selection and classification of safety controls. In response to a May 21, 2010 letter from the Board, the laboratory performed calculations to address the Board's concerns and implemented engineered and administrative controls to ensure public and worker safety for the plutonium experiments.

In 2010, the Board reviewed a revised documented safety analysis prepared in support of planned materials disposition activities at the Auxiliary Hot Cell Facility. The Board reviewed the start-up of this facility in the context of DOE's implementation plan for Recommendation 2004-2, which required justification for defense nuclear facilities that would be excluded from further review of confinement systems. The Board concluded that some form of radiological confinement was required, because the building that houses the Auxiliary Hot Cell Facility provides none. NNSA committed to radiological confinement of containers that required opening prior to being placed into the hot cell.

Sandia National Laboratories is a key player in the Product Realization Process, which is a critical element of weapon life extension programs. Sandia is the custodian of the Technical Business Practices that provide methods governing the product realization process. In a letter dated January 25, 2010, the Board expressed concern that the process failed to prevent the Pantex Plant from assembling W76-1 units using nuclear safety components that did not meet military requirements and had not been evaluated for nuclear explosive safety considerations. In response, NNSA conducted a causal factors analysis of this event and determined a number of judgments of need for Pantex, Sandia, and NNSA. The Board will evaluate the effectiveness of the improvements to the product realization process resulting from the causal factors analysis.

The Board has also been examining the support Sandia provides for nuclear explosive operations at the Pantex Plant. The focus for 2011 will be on weapon response information used in Pantex hazard analysis reports.

## **2.2.5 NNSA Governance Reform Initiative**

The Board has been heavily engaged in reviewing the safety implications of a recent NNSA initiative to reform governance and oversight of the nuclear weapons complex. One of NNSA's major activities under this initiative was an effort to streamline contractor requirements in DOE directives.

In August, NNSA granted a broad exemption to requirements in certain DOE directives affecting nuclear safety to contractors at the Nevada National Security Site and Sandia National Laboratories. In its review of the exemption, the Board discovered that the requirements analysis supporting the exemption was not conducted in a rigorous manner. In particular, the Board was concerned that the basis and justification for removing and relaxing specific requirements had not been documented and could not be clearly articulated by NNSA personnel. Despite these deficiencies, NNSA planned to apply the same process to approve exemptions to contractor requirements from additional DOE directives and at other NNSA sites.

Throughout 2010, DOE's Office of Health, Safety and Security was engaged in an effort to reform its directives as part of the *DOE 2010 Safety and Security Reform Plan*. It was not clear to the Board why NNSA was expending resources on a parallel effort rather than working within the established DOE framework for improving its directives. The Board was briefed on the reform initiative by senior DOE management in November of 2010.

The Deputy Secretary of Energy subsequently directed that the scope of the initiative be narrowed; he so informed the Board in a November 2010 letter. The Board acknowledged the Deputy Secretary's action in its December 7, 2010, letter and emphasized that the Board will continue to work with DOE to strengthen and improve directives. However, on December 29, 2010, the Deputy Secretary of Energy signed a memorandum entitled "Expedited Processing of Directives." This memorandum instructed the Office of Management to expedite the normal review and comment process for a select group of safety directives. The Board will continue to work with DOE and NNSA to strengthen and improve their nuclear safety directives.



### 3. Nuclear Material Processing and Stabilization

#### 3.1 Stabilization and Storage of Remnant Materials

##### 3.1.1 Complex-Wide Program

DOE and NNSA manage a substantial inventory of nuclear materials that have been declared surplus to the nation's security needs. These materials include plutonium metal, plutonium compounds, spent nuclear fuel, enriched uranium, and other special nuclear materials. DOE and NNSA contractors continue to add to this inventory by ending Cold War era programs, declaring material surpluses, decommissioning old nuclear facilities, and uncovering or producing additional wastes. The Board continues to provide close oversight of DOE's efforts to dispose of wastes and consolidate nuclear materials at fewer sites and facilities.

DOE has identified disposition paths for many of its excess nuclear materials, but others have no defined disposition path. Furthermore, previously planned disposition paths may change due to facility and funding uncertainties. For many materials, DOE's preferred method of stabilization is chemical processing. To maintain the viability of that option, the Board believes that DOE must carefully align its inventory of surplus nuclear materials with lifecycle planning for the few and aging facilities capable of chemical processing.

**Nuclear Material Stabilization.** The Board's Recommendation 2000-1, *Prioritization for Stabilizing Nuclear Materials*, prompted DOE to pursue stabilization efforts for those materials presenting the largest hazards. Four commitments remain open under the implementation plan for the recommendation: one at Hanford and three at Los Alamos National Laboratory. The remaining open commitment at Hanford is scheduled to be completed after December 2015. Personnel at Los Alamos National Laboratory have developed a revised Project Execution Plan for completing two of three remaining commitments by December 2013. The third commitment has an uncertain completion date. DOE has not provided a revised implementation plan for this commitment. (See Section 3.1.2)

**Recommendation 2005-1.** The Board issued Recommendation 2005-1, *Nuclear Material Packaging*, to increase protection for workers involved in the storage and handling of nuclear materials. In 2010, the Board continued to provide oversight of DOE's efforts to qualify containers meeting the requirements of DOE Manual 441.1-1, *Nuclear Material Packaging Manual*. NNSA approved the first container in the DOE complex meeting the requirements of the manual, a container designed by Los Alamos National Laboratory to store plutonium-238 oxide. Los Alamos also completed development of a container designed to store (mostly) plutonium-239 based materials, and is expected to submit its safety analysis report for packaging and storage to NNSA for approval by January 2011.

**Nuclear Materials Strategic Plan.** DOE's responsibilities for consolidating and disposing of nuclear materials are described in DOE Order 410.2, *Management of Nuclear Materials*. To determine a safe and appropriate path for the disposition of nuclear materials, DOE established several committees to generate a "Nuclear Materials Strategic Plan." These committees, consisting of personnel from across the defense nuclear complex, met several times

during 2010 to discuss and refine disposition paths for nuclear materials. The committees are also responsible for identifying means of meeting various programmatic material needs, such as highly enriched uranium fuel for naval nuclear propulsion, plutonium-238 for radioisotope power supplies, and rare isotopes for research and medical purposes. DOE expects to issue an approved version of the plan in early 2011. The Board has provided feedback to DOE regarding this effort and continues to follow the updates to the plan as it matures.

**H-Canyon Operations.** The H-Canyon facility at the Savannah River Site remains the only functional chemical processing plant capable of stabilizing on a large scale certain types of spent nuclear fuel and other nuclear materials. The Board notes that if DOE continues to operate the facility to fulfill the significant demand for material disposition, DOE must also provide for continued maintenance and life extension to ensure safety. However, should DOE choose not to continue the canyon's mission, DOE needs to identify alternative methods of stabilization or long-term storage for all nuclear materials currently slated for processing at H-Canyon. Some surplus materials are not maintained in conditions suitable for long-term storage—for example, DOE's large inventory of spent nuclear fuel stored in water-filled basins (discussed further in Section 3.2).

### 3.1.2 Plutonium

**Plutonium Stabilization, Los Alamos National Laboratory.** Two material types remain to be stabilized under Recommendation 2000-1: weapons-grade plutonium and plutonium materials in large vessels. The plutonium-bearing scrap materials listed previously under a separate category have been grouped with weapons-grade plutonium. DOE made substantial progress in risk reduction by discarding or repackaging all of the very high and high risk materials into sturdier containers. The expected completion date to stabilize the remaining weapons-grade plutonium is December 2013. Site personnel proposed a new plan for cleaning out the large vessels, but a new completion date remains uncertain pending DOE's approval of the plan. The Board is awaiting a revised implementation plan from DOE and continues to provide close oversight of storage conditions and stabilization efforts.

**Plutonium Consolidation and Disposition, Savannah River Site.** The Board monitored plutonium receipt, surveillance, and processing activities at the Savannah River Site. Operators at K-Area continue to receive and store plutonium from across the complex. They also continued destructive examination of plutonium containers, which are then processed through H-Canyon facilities.

DOE's plan for surplus plutonium includes several disposition paths. The first is processing through Savannah River Site's H-Canyon and transfer to the site's high-level waste tanks for eventual vitrification at the Defense Waste Processing Facility. Another pathway is to process the material through the Mixed-Oxide Fuel Fabrication Facility, currently under construction at Savannah River Site (under NRC regulation). A proposed Pit Disassembly and Conversion project at K-Area would prepare plutonium pits and other plutonium metal for disposition in the Mixed-Oxide Fuel Fabrication Facility. Material not suited for either of these pathways may be disposed of as transuranic waste. The Board continues close oversight of these disposition paths.

### **3.1.3 Uranium**

**Savannah River Site.** DOE continued processing highly enriched uranium at the Savannah River Site's H-Canyon facility as part of the Enriched Uranium Disposition Project. The Board reviewed DOE's application of the Integrated Facilities Aging Management program to evaluate the life extension needs of the H-Canyon facility. The Board found that while the program successfully identifies aging issues, follow-up to address these issues is often lacking. The Board noted this concern in a letter to DOE dated April 29, 2010. In response, DOE and its contractor reviewed and prioritized needed facility repairs to maintain safe operations at H-Canyon. They also improved formal communication between the aging management program and safety basis personnel to evaluate potential authorization basis impacts of aging systems. Funding of facility maintenance remains a concern.

## **3.2 Stabilization of Spent Nuclear Fuel**

### **3.2.1 Idaho National Laboratory**

The Board continued to monitor the transfer of spent nuclear fuel between facilities at the Idaho National Laboratory. Site operators store much of this spent nuclear fuel in a large water basin facility. Spent fuels managed by the Office of Environmental Management were successfully transferred to dry storage by June 2010. The remaining spent fuel in the water basin is managed by the Office of Nuclear Energy and the Naval Reactors Program. Transfer of naval fuel to dry storage will be complete before 2018. The Office of Nuclear Energy plans to operate the water basin for several more years to store used test reactor fuel. The Idaho Settlement Agreement requires that all spent nuclear fuel be in dry storage by 2023.

DOE has proposed transfers of spent nuclear fuel between the Idaho National Laboratory and Savannah River to avoid building more than one packaging and handling facility at each site. DOE planned to ship aluminum-clad fuel to Savannah River and ship stainless steel-clad and zircaloy-clad fuel to the Idaho National Laboratory. Transfers were scheduled to begin in 2011; however, no funding has been provided.

### **3.2.2 Savannah River Site**

The Board reviewed DOE's preparations at H-Canyon and L-Area including implementation of a new safety analysis for H-Canyon to support resumption of spent nuclear fuel processing. The new documented safety analysis incorporates guidance from the latest DOE standards. During the development of the safety analysis, the Board provided DOE with feedback regarding hydrogen explosions, instrument uncertainty, technical safety requirements, and ammonium nitrate explosions. DOE addressed many of the Board's comments.

The Board suggested that DOE reconsider the planned level of rigor for readiness activities for spent fuel restart. DOE agreed and used a more formal contractor readiness assessment, which the Board observed and found adequate. However, DOE did not authorize starting the processing of spent fuel stored at Savannah River in 2010.

### 3.2.3 Hanford Site

The Board continued to provide close oversight of the Sludge Treatment Project at the Hanford Site, where DOE stores approximately 30 cubic meters of radioactive sludge in the K-West Basin. This sludge, which includes corrosion products of spent nuclear fuel and small pieces of fuel scrap, is the only material at Hanford within the scope of Recommendation 2000-1 remaining unstabilized. The project warrants a high priority because the K-West Basin is aging and not suitable for long-term storage.

The Board reviewed the conceptual design for the Sludge Treatment Project, which the contractor submitted in February 2010 and DOE approved in June 2010. The Board also observed the contractor's External Technical Review in February 2010 and the DOE Technical Independent Project Review in May 2010. The Board identified several issues regarding the conceptual design and relayed these concerns to DOE in a letter dated December 22, 2010.

## 3.3 Waste Management

### 3.3.1 High-Level Waste

**Hanford.** DOE stores more than 50 million gallons of radioactive waste in high-level waste tanks at Hanford. DOE plans to use these tanks until at least 2045. To decrease the environmental risk, DOE is transferring some radioactive waste from 149 aging single-shell tanks to 28 newer and sturdier double-shell tanks.

*Tank Integrity.* DOE conducts tank integrity programs for all tanks. The Board found DOE's proposed actions to extend the lives of single-shell tanks to be reasonable. Corrosion controls are in place to extend the lives of the double-shell tanks. DOE continued ultrasonic testing of the double-shell tanks to measure general corrosion, pitting, and cracks. The Board encouraged and DOE began testing of an electromagnetic-acoustic transducer system, which would provide a cost-effective inspection of much larger areas of the tank wall at Hanford and Savannah River. The Board reviewed DOE's laboratory and in situ testing of corrosion mechanisms related to the high-level waste tanks and encouraged DOE to continue the studies.

*Safety Basis.* The Board reviewed the revised safety basis at the Tank Farms. In a letter to DOE dated August 5, 2010, the Board noted a number of analytical and implementation deficiencies in the safety basis. The main inadequacy dealt with controls for potential flammable gas accidents in the double-shell tanks. The installed ventilation system for these tanks is important in preventing and mitigating flammable gas events, but DOE had downgraded the functional classification of the system to less than safety significant. DOE also did not appropriately classify a number of other installed systems that are necessary to provide accurate and reliable indications of abnormal conditions associated with flammable gas events.

DOE responded to the Board's letter by proposing a passive ventilation control that would be categorized as safety-significant. DOE planned a test program spanning several years to show passive ventilation is sufficient to prevent the accumulation of flammable gases to



hazardous levels. The Board believes this is an inadequate safety control and plans to work with DOE to resolve this issue.

*Mixing and Transfer Studies for Tank Waste.* The Board observed efforts by DOE's contractor to simulate, on a small-scale, the mixing and transfer of high-level waste from a double-shell tank to the Waste Treatment Plant. The Board closely followed this project to ensure that DOE will develop proper functional design requirements for the mixing and transfer system.

*Work Planning and Conduct of Operations.* In a letter to DOE dated March 12, 2010, the Board noted that the Tank Farms contractor did not conduct adequate analysis of hazards, did not follow its procedures to revise work documents, used less than adequate work instructions, and did not have a feedback and improvement process to prevent repeat mistakes. In response, DOE implemented corrective actions to address the Board's issues. To evaluate the effectiveness of the corrective actions, the Board reviewed work instructions and conduct of operations at the Tank Farms in November 2010. The Board is working with DOE to resolve the weaknesses.

*Waste Transfer Piping.* The Board identified DOE's incomplete analysis of the methods used to protect safety-significant waste transfer piping from freezing when the soil protecting the piping has been excavated. DOE developed new guidance to resolve the problem, and analyzed its freeze protection methods for the waste transfer piping exposed during the winter of 2010–2011.

The Board asked DOE why the waste transfer piping at the 242-A Evaporator was not classified as safety-significant. DOE began a major revision of this facility's safety basis in order to be compliant with DOE guidance for controls. In response to the Board's inquiries, DOE plans to evaluate the safety classification of the 242-A Evaporator piping.

**Savannah River Site.** DOE continued to store, remove, and treat millions of gallons of radioactive waste in large underground storage tanks at the Savannah River Site. The Board performed several oversight activities related to DOE's efforts to manage this waste.

*Implementation of Recommendation 2001-1.* Recommendation 2001-1 addressed safety risks associated with the management of high-level waste at Savannah River. In letters to DOE dated January 7, 2010, and May 27, 2010, the Board requested that DOE develop a new implementation plan providing interim milestones to better demonstrate progress. DOE transmitted Revision 6 of the plan to the Board in December 2010. This plan included interim milestones for the remaining commitments: startup of the Salt Waste Processing Facility, return of Tanks 48 and 50 to high-level waste service, and volume reduction of recycle waste streams from the Defense Waste Processing Facility.

*Tank 48 Organic Waste Processing.* The Board followed DOE's efforts to design a process for treating wastes containing organic materials in Tank 48. In a letter to DOE dated January 7, 2010, the Board requested interim milestones for the return of Tank 48 to waste service. In response, DOE completed 35 percent design in December 2010, and plans to complete 90 percent design by December 2012 and then return Tank 48 to service by December

2016. The project completion has been delayed by seven years. The Board has expressed concern over the risks caused by these delays.

*Tank Closure.* The Board observed heel removal activities in Tanks 5 and 6 and found the potential for significant worker radiation hazards during the final cleaning. The Board's observations led DOE to improve its radiological planning. The Board also observed poor work control during retrieval of a submersible mixer pump from Tank 6.

*New Treatment Technologies.* The Board reviewed the preliminary hazards analysis for the Enhanced Chemical Cleaning Technology and found it adequate for the early stage of development. The Board will continue this review as the technology matures and hazards analyses become more detailed. The Board also started its review of the conceptual design for the new Small Column Ion Exchange technology.

**Idaho National Laboratory.** DOE manages the last of its Idaho tank waste in three of the four remaining large tanks. The waste, totaling 900,000 gallons, is to be treated by a steam reforming process at the Integrated Waste Treatment Unit. The fourth large tank is a spare and not currently in use. The Board continued its oversight as DOE completed construction of the Integrated Waste Treatment Unit and began transition to testing and startup. DOE estimates that treatment of the waste will be completed by 2012. (See also Section 4.8)

### 3.3.2 Low-Level and Transuranic Waste

**National Transuranic Waste Program.** DOE continues to expend significant effort and resources to dispose of transuranic wastes at the Waste Isolation Pilot Plant—an effort started in 1999. The majority of this waste comes from the Idaho National Laboratory, the Savannah River Site, the Los Alamos National Laboratory, the Oak Ridge National Laboratory, and the Hanford site. The Board continued to address safety issues related to these efforts. The Board also monitored the activities of the DOE Transuranic Waste Corporate Board as DOE utilized funds from the Recovery Act to accelerate the recovery, characterization, and shipment of transuranic wastes to the Waste Isolation Pilot Plant for disposal.

**Savannah River Site.** The Board reviewed transuranic waste operations in F- and H-Canyons and E-Area. Topics reviewed included response to a contaminated puncture wound at F-Canyon and hazard analyses for the next phase of operations.

Following the discovery of a smoking waste can in F-Canyon, the Board discussed recovery efforts with DOE. DOE's initial response to this event was slow and unfocused. For example, the fire department's hazardous materials team was not notified until nearly 8 hours after the reaction began. The Board also challenged DOE's plans to add a sodium hydroxide solution to the material when chemical literature indicates that the chemical in the can reacts violently with water. DOE accepted the Board's feedback and successfully dealt with the damaged can.

The Board also provided DOE with feedback following a transuranic waste spill in E-Area. The Board noted that emergency actions started slowly, and adequate response

equipment was not available at the facility. As a result, DOE took actions to ensure workers are trained and that facilities have an adequate inventory of personal protective equipment, fixatives, and ventilation equipment to respond to radiological releases. DOE also improved the definition of the roles and responsibilities of the fire department and the E-area staff.

**Oak Ridge National Laboratory.** The Board verified that characterization and packaging of both contact-handled and remote-handled transuranic waste at the Transuranic Waste Processing Center was performed safely. The Board reviewed ongoing accelerated waste characterization and processing operations funded by the Recovery Act at the Transuranic Waste Processing Center. This work included observation of a DOE headquarters readiness assessment for operations to vent contact-handled transuranic waste drums.

*Tank W-1A Retrieval Project.* Tank W-1A collected radioactive wastes from analytical facilities during 1951–1986. Leakage from a pipe supplying this underground tank led to soil and groundwater contamination around the tank. Due to expected high radiation levels, the Board has provided close oversight of Tank W-1A activities, including the past soil sampling campaign, as noted in a letter to DOE dated January 17, 2006. During 2010, DOE made preparations to excavate the tank and the remaining contaminated soil. The Board reviewed the DOE-approved documented safety analysis and radiological control program and identified several problems. The Board will continue to work with DOE to resolve these issues and follow Tank W-1A activities as the project matures.

#### **Idaho National Laboratory.**

*Advanced Mixed Waste Treatment Project.* The Board made several visits to the Advanced Mixed Waste Treatment Project, DOE's largest facility engaged in the retrieval and packaging of transuranic waste. By the end of 2010, DOE had shipped more than 34,000 cubic meters of transuranic waste from the Advanced Mixed Waste Treatment Project to the Waste Isolation Pilot Plant. Many thousands of cubic meters of waste remain to be packaged and shipped. The remaining waste packages are in far worse condition than the earlier packages and present a greater hazard to facility workers. This fact was evident in two occurrences in 2010 involving the release of radioactive materials that unnecessarily exposed the workers. The Board plans close oversight of DOE's recovery actions and implementation of new engineered controls.

*Accelerated Retrieval Project.* This is a smaller project to retrieve transuranic wastes buried at the Idaho National Laboratory. DOE completed waste retrieval from the first three facilities within the project and is moving forward with construction and operations in four additional facilities. The Board continued to monitor the safety of these operations.

*Remote-Handled Waste.* DOE began the operation of a new project at Idaho to repackage remote-handled transuranic wastes. The project scope includes approximately 1,000 containers of highly radioactive materials from irradiated fuel examinations at the former Argonne National Laboratory-West (now the Materials and Fuels Complex). The Board reviewed the contractor's preparations for the repackaging project and the proposed radiological controls, and noted deficiencies in DOE's plan to hoist the waste containers from the heavily-shielded transportation

casks to the hot cells. In response to the Board's inquiries, the contractor made improvements to the design. The Board closely followed these activities to ensure the work was done safely.

**Waste Isolation Pilot Plant.** The Board continued to press for resolution of safety issues related to transuranic waste operations at this facility.

*Electrical Safety.* In a letter dated September 22, 2010, the Board noted significant weaknesses in the site's electrical safety program and material deficiencies involving motor control centers and 13.8 kV electrical cables. The Board plans to work with DOE to address the identified inadequacies.

*Work Planning and Control.* The Board conducted a review of the processes and procedures used by DOE to implement work planning and control and identified deficiencies indicating incomplete implementation of Integrated Safety Management. The Board observed that DOE oversight had not been effective at identifying and correcting these deficiencies. In a letter dated October 22, 2010, the Board requested a report on actions planned to correct the identified deficiencies.

### **3.4 Facility Deactivation and Decommissioning**

The Board observed deactivation and decommissioning activities at several DOE sites, including baseline work and work funded by the Recovery Act. Although Recovery Act funding will last to the end of fiscal year 2011, the Board plans to continue to oversee DOE's decommissioning projects beyond that date.

#### **3.4.1 Hanford Site**

The Board reviewed criticality safety evaluation reports and work packages for various activities at the Plutonium Finishing Plant. The Board noted that applicable criticality safety controls were not listed in a work package and that this approach did not meet requirements from ANSI/ANS-8.19, *Administrative Practices for Nuclear Criticality Safety*. The contractor agreed to include the criticality controls in the work package for this activity and for future work packages.

The Board also reviewed the facility's safety bases and asked project analysts to provide a technical justification for the values they used to calculate radiation doses for postulated accidents. DOE's contractor subsequently found that some dose conversion factors used to estimate dose consequences were contrary to a consensus standard and potentially non-conservative. DOE and its contractors revised the facility's safety analysis. DOE also noted this problem in the safety basis of other facilities and implemented corrective action.

The Board reviewed and found weaknesses in the hazard evaluations for various chemical decontamination agents that DOE used or planned to use at the Plutonium Finishing Plant. Subsequent to the Board's review, the contractor provided a more thorough analysis of the hazards.

*Work Planning and Control.* The Board conducted a review of the processes and procedures used by DOE to implement work planning at the Plateau Remediation and River Corridor projects.

Plateau Remediation Contractor—the Board’s review identified a number of weaknesses including an insufficient hazard analysis and an incomplete integration of the hazards and associated controls in the work instructions. The Board noted that these weaknesses directly affect the quality and level of detail contained within work instructions and their subsequent implementation in the field. In a letter dated September 23, 2010, the Board requested a report on actions planned to correct the identified deficiencies. The Board is working with DOE to resolve these issues.

River Corridor Contractor—the Board’s review identified weaknesses in the processes used to define the scope of work and to ensure consistent application of the approved hazard analysis process. Moreover, some of the weaknesses identified in the Board’s June 2008 review still existed, including a lack of integration of hazards and associated controls into work instructions and the need for improved training and training tools for work planners and supervisors. The Board is working with DOE to resolve these issues.

### **3.4.2 Idaho National Laboratory**

The Board monitored ongoing decommissioning and decontamination work at the Idaho National Laboratory. DOE completed significant facility demolition at the Idaho Nuclear Technology and Engineering Center and facility decontamination at the Materials and Fuels Complex. In 2010, DOE deactivated and decommissioned 11 industrial facilities, 11 nuclear facilities, and 19 radiological facilities.

*Work Planning and Control.* The Board conducted a follow-up review of the processes and procedures used by DOE to implement work planning. Past deficiencies included poor hazard analyses and poor implementation of controls to ensure worker safety. The Board reviewed the corrective actions in August 2010 and observed significant improvements in work planning and control.

### **3.4.3 Savannah River Site**

Using Recovery Act funds, DOE reduced the height of the ventilation stack adjacent to Building 235-F. The Board commends this action as a major risk reduction for that building. However, DOE is not planning on moving forward with additional decommissioning and decontamination of Building 235-F in the near future. The Board is evaluating the hazard of the current state of the facility and investigating whether DOE’s decision to halt additional work represents an unacceptable safety hazard.



## 4. Nuclear Facilities Design and Infrastructure

### 4.1 Introduction

The Board's strategic performance goal for this area is to ensure that new defense nuclear facilities and major modifications to existing facilities are designed and constructed in a manner providing adequate protection of the health and safety of the workers and the public. The Board is required by statute to review the design and construction of defense nuclear facilities, which must be designed and constructed in a manner that supports safe and efficient operations. The Board has made a concerted effort to ensure that its review of new design projects focuses on early recognition and resolution of safety issues, and that new DOE facilities are being constructed to acceptable industry codes and standards.

### 4.2 Safety in Design

Safety in design requires integration of safety considerations early in the design and construction process of defense nuclear facilities. Adhering to this concept should result in decreased project costs associated with retrofitting or redesigning facilities. Although the Board stressed the importance of using DOE Standard 1189-2008, *Integration of Safety into the Design Process*, DOE's implementation of the standard remains uneven, and revisions to other directives affected by the standard (e.g., DOE Guide 420.1-1, DOE-Standard-3009, DOE Guide 421.1-2, and DOE Guide 420.1-2) have languished. Individual projects have elected to implement narrow parts of the standard without regard to the broader context in which they are used. In the Board's view, the lack of progress in revising directives and the inconsistent implementation of DOE Standard 1189 indicate that DOE needs to reinvigorate its efforts in this area. Examples of problems the Board has found are summarized below:

- In its issuance of DOE Standard 1189, DOE committed to revise other directives affected by the standard. Some revised directives have been issued. The remaining directives, which represent the technical detail needed to successfully meet the expectations outlined by the Deputy Secretary of Energy in a December 5, 2005, memorandum, have not been revised. Those expectations are: a strong set of safety rules and directives that will better support DOE's ability to deliver capital assets on schedule, within budget, and fully capable of meeting mission performance and environmental, safety, and health standards.
- In the design process, DOE has frequently combined Critical Decision 2 (Approve Performance Baseline) and Critical Decision 3 (Approve Start of Construction). This procedure was followed for the Y-12 Uranium Processing Facility, the Los Alamos Chemistry and Metallurgy Research Replacement Project, and the Hanford Sludge Treatment Project. Combining these critical decisions has been done without regard to meeting the safety in design aspects of DOE Standard 1189 such as formal independent review and acceptance of the design by DOE at the end of preliminary design (which coincides with Critical Decision 2). The Board has objected to these shortcuts with varying degree of success. Suggestions to add amplifying direction into a planned revision of the applicable order, DOE Order 413.3, *Program and Project Management for the Acquisition of Capital Assets*, have not been accepted.

- DOE recently issued a revision to Order 413.3 that defers the Technical Independent Project Review from Critical Decision 1 (Approve Alternative Selection and Cost Range) until Critical Decision 2. Performance of such a review at Critical Decision 1 was a DOE commitment in the July 19, 2007 Joint Report to Congress describing actions by DOE and the Board to improve the timeliness of the resolution of safety issues. This change was made despite the Board's objections. The full implications of this change are unclear, but the Board is concerned that the outcome may be less technical rigor in the independent review process. The Board will evaluate the implications in the near future.

### 4.3 Hanford Site

**Waste Treatment and Immobilization Plant.** The Waste Treatment and Immobilization Plant is a multi-facility complex designed to treat Hanford's high-level radioactive liquid wastes. It consists of three primary nuclear facilities known as Pretreatment, Low-Activity Waste, and High-Level Waste, supported by an Analytical Laboratory. The Pretreatment facility will receive high-level waste from Hanford's tank farms and separate it into high- and low-activity streams. The low-activity portion will be transferred to the Low-Activity Waste facility, where it will be mixed with glass-forming materials and converted to a stable borosilicate glass, or "vitrified." Glass canisters from the Low-Activity Waste facility will be placed in an onsite, near-surface disposal facility.

The high-activity waste stream will be transferred from the Pretreatment facility to the High-Level Waste facility, where it is also vitrified. After vitrification, high-level waste glass canisters will be stored onsite pending eventual shipment to a high-level waste repository. Construction progress varies among the facilities. Currently, construction of the Low-Activity Waste facility is furthest along. The Board is continuing its review of design and construction of structures, systems, and components that are important to safety. During 2010, the Board's activities focused on resolving previously identified issues, evaluating a major initiative by DOE to change the safety design strategy for the project, and evaluating the mixing systems in the Pretreatment facility.

Throughout the year, the Board expressed concerns with the design of this plant. It is important to note that DOE undertook a significant redesign effort starting in 2009, even though the design of the plant was more than two-thirds complete. The redesign of the plant is now more than 80 percent complete, and construction of its Pretreatment facility is more than 30 percent complete. DOE is approving design decisions before outstanding issues are resolved. Additional cost and schedule delays could occur if technical analyses being performed by DOE yield results that are not favorable to the project's safety strategy.

In the early fall of 2010, DOE indicated to the Board that it is transitioning from design and construction to construction and commissioning. DOE has referred to this transition as "pivoting." As such, DOE plans to wrap up its design actions by establishing the final design criteria for the plant's structures, systems, and components. The pivot is intended to provide a defined path forward to finish the design of the systems and components that have not been finalized and to resolve any outstanding technical issues. The pivot is also intended to initiate the planning of activities necessary for testing, commissioning and operation of the plant.



The Board is deeply concerned that the plant may be commissioned before key technical issues are fully resolved. Once plant systems are operational and exposed to radioactive waste, options for retrofit in black and hot cells will be extremely limited and costly and will expose workers to hazardous situations. To the maximum extent possible, modifications to equipment and systems must be done before commissioning. A learn-as-we-go philosophy is not prudent for this facility.

The Board has concerns regarding safety, and the required ability of the plant to operate for decades, in these key areas:

- The control strategy for the flammable hydrogen gas generated by the high-level wastes and implementation of the associated safety controls.
- The mixing and transfer systems required to safely process the wastes after they are transferred from the Tank Farms into the plant.
- The likelihood that limitations on the operating envelope resulting from the performance of the plant's mixing and transfer systems will require the Tank Farms to deliver waste that meets restrictive waste acceptance criteria, or result in the need for alternative processing capability.

On October 7 and 8, 2010, the Board conducted a public hearing to review outstanding safety-related technical issues in the areas of mixing, hydrogen control strategy, design complexity, and changes in the safety and design bases.

*Mixing.* The Board's primary safety-related issue involves the design of the pulse jet mixing system. The Board formally communicated this issue to DOE in a January 6, 2010 letter after becoming aware of the project's intent to reduce conservatism in the acceptance criteria for adequate mixing. DOE's independent experts for the project from the Pacific Northwest National Laboratory and from the Consortium for Risk Evaluation and Stakeholder Participation have identified issues similar to those raised in the Board's letter.

In its May 17, 2010 response, DOE committed to conducting integrated pulse jet testing on a large scale. This testing could address the issues identified by the Board, but DOE's response did not include sufficient detail such as scope and schedule that the Board needed to fully evaluate the commitment. During the public hearing, DOE indicated that it will establish the test objectives and schedule for the large-scale testing by January 2011, with the objective of accomplishing the testing in time to validate the design of vessel mixing systems before their installation in the plant. The Board was recently informed that this date has slipped to March 2011.

DOE's commitment to large-scale testing is a positive development. Development of an appropriate, detailed test plan will be a key milestone. The Board believes that DOE must resolve, during the testing program, pulse jet mixing issues identified by the Board, by Pacific Northwest National Laboratory, and by the Consortium for Risk Evaluation and Stakeholder Participation. This position was formally communicated to the Secretary of Energy on December

17, 2010 through Recommendation 2010-2. The recommendation will guide DOE in developing a test plan that resolves all technical issues and should help minimize future delays.

*Hydrogen Controls.* The Hydrogen in Piping and Ancillary Vessels Independent Review Team, chartered by DOE's Office of River Protection and Bechtel National, Incorporated, in April 2010, issued its final report on July 12, 2010. On September 16, 2010, Bechtel National completed a formal closure plan to address the team's findings and recommendations. The Board reviewed this plan and subsequent revisions and is following the resolution of the team's findings. As noted in the Board's September 3, 2010 Periodic Report to Congress, many of the team's findings require a great deal of effort and time to implement properly. Bechtel National plans to finalize corrective actions in early 2011.

The Board remains concerned about the use of quantitative risk analysis as part of the hydrogen control strategy. The employment of this methodology as a risk assessment and design tool is a first use for DOE. There are no DOE standards and requirements for the use of quantitative risk analysis, nor for controlling the assumptions that underpin its employment in the safety basis. The quantitative risk analysis process will not be finalized until March 2011. The impact of using this methodology on the Waste Treatment Plant's safety basis implementation remains uncertain—for example, the project has not determined whether and how the numerous assumptions used in quantitative risk analysis would translate into functionally classified safety controls.

*Deposition Velocity.* The Waste Treatment Plant project is modifying a key input parameter to models that predict transport of radioactive plumes, and therefore public dose consequences, following accidents. The project initially adopted a deposition velocity of 0 (zero) cm/sec in severity level calculations, which is conservative. The value specified was revised by DOE in conjunction with the changes to reduce the assumed radiological inventory. The revised transport analysis now relies on the default value of 1 cm/sec in DOE's atmospheric dispersion model. This default value deviates significantly from previous values used at the Hanford Site. Changing the deposition velocity from 0 cm/sec to 1 cm/sec decreases the calculated unmitigated dose consequences to the public by about a factor of 5, inappropriately contributing to reducing the safety classification of systems and components.

In letters dated May 21, 2010 and August 26, 2010, the Board challenged DOE's deposition velocity value and offered a derivation of a deposition velocity that the Board concluded was reasonably conservative. Based on an evaluation of open technical literature and what the Board judges to be conservative values for particle size, wind speed, and surface roughness at the Hanford Site, the Board suggested that a deposition velocity between 0 cm/sec and 0.3 cm/sec can be technically justified. In a November 5, 2010 response, DOE committed to issuing an Information Notice and providing interim guidance and long-term plans to ensure appropriately conservative control selection decisions are made. The Board is continuing to evaluate resolution of this issue.

*Structural Design.* The Board has reviewed the adequacy of the structural design of Waste Treatment Plant facilities since April 2002. The Board found that the analytical models used in design of the structural steel portions of the Pretreatment and High-Level Waste facilities

did not reflect the as-designed facility configuration. For example, DOE's contractor had not considered composite behavior in its finite element analyses. Such behavior causes the loads to be distributed differently and can affect the adequacy of the structural steel design. In a letter issued on December 2, 2009, the Board informed DOE that the adequacy of the structural steel design should be evaluated to determine if changes are required and requested a report that presents DOE's assessment of the issues identified by the Board. Based on calculations incorporating more realistic modeling, Bechtel National has now demonstrated to the Board that there was adequate design margin to compensate for the inadequacies in the modeling.

#### 4.4 Savannah River Site

**Plutonium Storage and Plutonium Pit Disposition.** DOE conducted a conceptual design of a project to combine the Pit Disassembly and Conversion Facility functions and the Plutonium Preparation Project and to locate them in the K-Reactor Building. The combined project is called the Pit Disassembly and Conversion project. This project will be executed in two phases. The first phase entails installation of process equipment to provide early plutonium feed to the Mixed-Oxide Fuel Fabrication Facility. Phase 2 will entail completion of the pit disassembly and conversion function within the K-Reactor Building.

The Board reviewed two key documents for the conceptual design: the Safety Design Strategy and the Facility Design Description. The Safety Design Strategy lays out the safety of design as envisioned by DOE Standard 1189-2008. The Board provided comments to DOE on major issues such as use of geotechnical information for soft zones, the seismic design category, safety-class fire protection systems in Phase 1 of the project, and any need for retrofit of the existing facility to support adding new major processes into the K-Reactor Building. Even though the K-Reactor Building is a robust structure, it is 60 years old, and the Pit Disassembly and Conversion project would extend its mission another 30 years.

**Salt Waste Processing Facility.** The Salt Waste Processing Facility will treat salt waste from high-level waste tanks by removing highly radioactive cesium, strontium, and actinides from the bulk salt solution. During 2010, the Board continued its assessment of the design and construction of the facility.

*Fire Protection for Air Filters.* In a February 10, 2009 letter, the Board noted that the design of the confinement ventilation system was inconsistent with the criteria in DOE Standard 1066-99, *Fire Protection Design Criteria*, for protection of final high-efficiency particulate air filters. The project implemented a design change to address some of the inconsistency and developed a technical justification for concluding the design was equivalent with the remaining requirements of DOE Standard 1066. DOE approved the equivalency determinations. The Board believes that the design now provides an adequate degree of fire protection for the confinement ventilation system.

*Process Vessel Mixing Controls.* The Board reviewed the testing program for air pulse agitators used to mix vessels with substantial solids content. The Board concluded that given appropriate controls and operational parameters, the air pulse agitators should be able to fulfill the functions assumed in the safety basis. The Board pointed out that selection of controls and

parameters for the air pulse agitators should consider the limitations of the testing and modeling performed for these devices. The Board is now reviewing the selected safety controls and operating parameters, and believes additional testing may be needed to better assess them.

**Waste Solidification Building.** The Waste Solidification Building's mission is to solidify liquid waste streams from the Mixed-Oxide Fuel Fabrication Facility and the Pit Disassembly and Conversion project. The Board is currently following the construction of the facility, which is expected to be operational in 2013.

The Board performed a review of the project's quality assurance program and identified areas for improvement. NNSA provided the Board with additional information which the Board is currently reviewing. The Board in particular is evaluating the aspects of the quality assurance program related to the ongoing construction activities.

#### **4.5 Y-12 National Security Complex**

**Uranium Processing Facility.** The Uranium Processing Facility is intended to replace the aging facilities that process enriched uranium at Y-12 National Security Complex. NNSA revised the project approach to combine Critical Decision milestones for preliminary and final design. The implementation of this approach eliminated the development and formal approval of safety basis documentation associated with the preliminary design. The Board determined that the integration of safety into the preliminary design was not consistent with the expectations of DOE Standard 1189-2008. In response, NNSA revised the project plan to develop the safety-in-design documentation and conduct associated reviews at the preliminary design phase of the project.

The project developed the critical decision package to support design and construction of long-lead procurement items. Both the Board and NNSA reviewers found that the safety basis documentation did not contain sufficient detail to support fabrication due to the design and build procurement approach. NNSA revised the project approach to have this procurement activity structured into design phases which will develop a preliminary documented safety analysis before authorizing construction. The Board also provided comments on safety system design and on the adequacy of the safety basis, and is working with NNSA to resolve these concerns as part of the long-lead procurement and preliminary design reviews.

The Board's review of geotechnical and structural engineering activities identified several technical issues to be resolved. These issues were formally transmitted to NNSA in a March 10, 2010 letter. The Board worked with NNSA to define an acceptable resolution approach for these issues. Several have been resolved, while the remainder require that design calculations be completed by NNSA. Resolution of these issues has been delayed due to the complexity of the building and capacity of the analytical software.

The Board also expressed concern that the NNSA's civil/structural oversight team was understaffed and had not been chartered to independently review the project. Given the importance of this facility to future operations at Y-12, the Board encouraged NNSA to charter a

team to review the overall technical strategy, approach, and implementation for the structural analysis and design. NNSA followed the Board's advice.

#### **4.6 Los Alamos National Laboratory**

**Chemistry and Metallurgy Research Replacement Project.** The Board continued its review of the design of the Chemistry and Metallurgy Research Replacement Project. The Board's review has focused on full implementation of design commitments made by NNSA as part of the Board's certification review completed in late 2009. Enhanced preliminary design continued throughout 2010 including revisions to the preliminary documented safety analysis, process hazard analysis, and system design descriptions. The Board is reviewing this material to ensure that safety has been properly integrated into design to support the next NNSA critical decision related to infrastructure and long-lead equipment.

The Board continued to follow closely the seismic design of the project's nuclear facility. During the past year, the project has developed a detailed model to assess the complex structural behavior of this facility. The development of this model is a step forward that should ultimately lead to an adequate seismic design. The Board has worked with the project to ensure that seismic design inputs for this deeply embedded facility are properly defined. The Board will review the seismic analysis calculations once they are complete.

On October 1, 2010, NNSA published a Notice of Intent to prepare a Supplemental Environmental Impact Statement for the Nuclear Facility portion of the project. The NNSA critical decision related to infrastructure and long-lead equipment will not occur until NNSA issues a Record of Decision, which can occur no sooner than 30 days after publication by the Environmental Protection Agency of a Notice of Availability of the Final Supplemental Environmental Impact Statement. NNSA plans to complete a Technical Independent Project Review of the infrastructure design package; the Board will follow the review closely.

**Radioactive Liquid Waste Treatment Facility.** The Radioactive Liquid Waste Treatment Facility Upgrade Project will replace the existing facility that processes transuranic and low-level radioactive liquid wastes.

The Board reviewed the resolution of outstanding issues and confirmed that NNSA has resolved them. Specifically, federal oversight has improved, and the project team has improved its approach to achieving safety-in-design. In a review of the facility's 60 percent design package, the Board found that the facility design and supporting safety basis have shortcomings in criticality safety, protection from accidents resulting from leaks of natural gas, and spills of hydrochloric acid that could occur during a seismically-induced fire. NNSA stopped work to resolve these issues and then suspended design efforts because of high total project cost estimates. NNSA is evaluating options that would reduce cost while still providing a long-term capability for processing the site's radioactive liquid waste. The Board will re-engage when NNSA determines a path forward and resumes work.

**Transuranic Waste Facility Project.** NNSA placed the Transuranic Waste Facility project on hold in late 2008 to reevaluate mission need and examine alternatives. The delay was

in part due to concerns raised by the Board regarding the project's safety strategy. The project resumed with a reduced scope that eliminated capabilities to process and repackage transuranic waste and load it into shipping casks for offsite disposal. The revised project maintains staging, storage, and characterization functions for this waste. Though the scope changes resolved the Board's initial concerns, the Board reviewed the revised conceptual design and identified additional safety issues. These issues included the absence of controls to mitigate the design basis aircraft crash accident, as well as incorrect application of accident analysis parameters from DOE technical standards to the seismic evaluation.

NNSA subsequently specified resolution of the Board's concerns as a condition of approval in the Conceptual Safety Validation Report. The project developed corrective actions to resolve the Board's concerns, including relocating the facility to a location where the frequency of an aircraft crash event is significantly reduced, and increasing the stored transuranic waste inventory assumed to be subject to impact from a seismic event in the analysis of radiological consequences to the public and workers.

#### **4.7 Oak Ridge National Laboratory**

**Uranium-233 Project, Building 3019.** The Board evaluated the Preliminary Safety Design Report for the project and concluded that it did not fully address safety basis deficiencies noted in the Board's Periodic Report to Congress. DOE has informed the Board that the next evolution in safety basis documentation in early 2011 would address the Board's concerns.

DOE began an alternatives analysis to reassess the need and scope of the project. The Board is evaluating this effort.

#### **4.8 Idaho National Laboratory**

**Integrated Waste Treatment Unit.** The Integrated Waste Treatment Unit will convert approximately 900,000 gallons of acidic sodium-bearing waste at the Idaho National Laboratory to a dry carbonate product. The product will be stored on site until an agreement is reached on a final disposal location.

The Board reviewed the draft documented safety analysis for the facility. The review determined that the safety strategy might not provide adequate protection for facility workers during a seismic event because of weaknesses in the confinement strategy and seismic shutdown system. The review also found that the technical safety requirements and hazard mitigation described in the safety basis must be modified to comply with DOE standards. Finally, during a review to follow up on previous concerns, the Board determined that the modified design for the safety instrumented systems could not provide the expected level of protection because redundant systems were not independent. DOE subsequently modified the design and the documented safety analysis to resolve Board concerns.

#### **4.9 Filter Test Facility**

DOE uses the Filter Test Facility to independently verify the performance of high-efficiency particulate air filters used in confinement ventilation systems throughout the complex. The Board noted an increase in the rejection rates of these filters in recent years. On March 17, 2008, the Board issued a letter to DOE identifying the need to correct root causes of the increased rejection rates and evaluate any safety impacts for filter attributes not tested at the Filter Test Facility. In response to this letter, DOE has improved the reporting process for rejected filters to ensure that corrective actions are taken. This improvement has resulted in DOE and the manufacturer identifying numerous actions to correct problems with the quality of the filters.

Despite initial corrective actions, the rejection rates continue to be unacceptably high. The major filter manufacturer for DOE is implementing a comprehensive assessment of its manufacturing process to find the underlying problems. DOE continues to be actively involved in monitoring the rejection rates, auditing the major manufacturers and filter testing organizations, and assessing corrective actions. The Board will continue to review test data from the Filter Test Facility, as well as corrective actions by DOE and filter manufacturers.

#### **4.10 Seismic Hazard Analysis**

The Board pursued its ongoing review of DOE site characterization and seismic hazard studies across the DOE complex. The Board continues to stress to DOE the importance of adequate review, including independent peer review, of both the acquisition of site-specific data and subsequent analysis to ensure that ground motions for design basis earthquakes are based on accurate scientific knowledge.

*Probabilistic Seismic Hazard Assessment.* DOE participates in a project to update the Central and Eastern United States Seismic Source Characterization for Nuclear Facilities. A draft final report for the project was released for review on July 31, 2010. The participatory peer review panel (which includes a representative from the Board's staff) provided extensive comments on the draft report. Resolution of the comments has resulted in significant changes to the earthquake catalog and recurrence relationships for all seismic sources under consideration. The final report is scheduled for release by August 2011. DOE plans to use the results from this study to update probabilistic seismic hazard assessments for Pantex, Savannah River, and Y-12.

DOE has initiated efforts to review and update site characterization data for the Savannah River Site as a precursor to formally updating the probabilistic seismic hazard assessment. The Board is reviewing this work as it proceeds. Results from this effort will be used to determine whether any modifications to the seismic sources identified as part of the Seismic Source Characterization for Nuclear Facilities project are needed. The design basis earthquake ground motion may increase relative to previous estimates as a result of shorter recurrence intervals for larger (magnitude greater than 6) earthquakes in the Charleston, South Carolina, seismic source. Sufficient margin may be achieved by the current Savannah River Site practice, encouraged by the Board and documented in the site's design standards, of increasing seismic design loads by 20 percent. DOE plans to issue the final report by October 2011.

DOE is jointly sponsoring, with the U.S. Nuclear Regulatory Commission, the U.S. Geological Survey, and the Electric Power Research Institute, a project coordinated by the Pacific Earthquake Engineering Research Center to develop the next generation of ground motion prediction equations for the Central and Eastern United States Seismic Source Characterization project. The peer review panel has provided feedback to the project on improvements that need to be made to ensure the project is successfully executed. The peer review panel also participated in a workshop to identify critical issues and data needs. As currently planned, the duration of the project is four years. The ultimate goal of this project is to develop ground motion models that can be used for probabilistic seismic hazard assessments including those at DOE sites.

*Savannah River Site Soft Zone Investigation Program.* The Savannah River Site Office, in partnership with the Georgia Institute of Technology, has undertaken investigations aimed at improving the assessment of soft zone soils at the Savannah River Site. At the site, soft zone soils have been identified between about 80 and 140 feet below the ground surface. The engineering evaluation of potential soft zone collapse and resulting surface settlement has been an ongoing design challenge. Ongoing geologic mapping studies at the Vogtle nuclear power plant excavation about 9 miles from the center of the Savannah River Site are having a profound impact on the understanding of soft zones at Savannah River Site. The Vogtle excavation is deep enough to directly observe soft zones. A wide range of conditions has been observed within the geologic formation that contains soft zones, including extensive pockets of very soft material, dissolution features including caves, and collapse features indicating failure, either onto a preexisting soft zone or into a preexisting opening.

The observations at Vogtle have directly affected the DOE soft zone research at the Georgia Institute of Technology. Institute personnel are attempting to understand the processes that created the soft soils and dissolution features at Vogtle as part of their research work for the Savannah River Site. DOE continues to work with Georgia Tech in an attempt to obtain soft zone samples at the Savannah River Site. Collapse features observed at Vogtle indicate that differential settlement at Savannah River Site is a significant design consideration. DOE may need to consider soil remediation for new facilities at the Savannah River Site to address the potential for large differential settlements that result from soft zone collapse. The Board will continue to follow the university research closely.

#### **4.11 Recommendation 2008-1**

Recommendation 2008-1, *Safety Classification of Fire Protection Systems*, identified the need for standards that would apply to the design and operation of fire protection systems relied upon as a primary means of protecting the public and workers from radiological hazards at DOE defense nuclear facilities. DOE accepted the recommendation and provided an acceptable implementation plan on July 23, 2008. The first major deliverable of the implementation plan was the issuance of interim guidance for the design and operation of wet pipe sprinkler systems and supporting water supplies. This guidance was intended to be used by ongoing projects to design wet pipe fire protection systems, which are typical in DOE defense nuclear facilities.



Pursuant to the implementation plan, the guidance was to be issued by the end of 2008, but its development took far longer than DOE expected. In February 2010, DOE and NNSA issued interim guidance for wet pipe sprinkler systems; separate guidance for supporting water supplies was issued in March 2010. Several projects are now using this guidance in preparing their designs. The Board issued a letter to DOE in July 2010 pointing out that, although the interim guidance provides useful information for current and future projects, it does not define the comprehensive set of attributes of safety-related fire protection systems that the Board recommended to be incorporated into DOE directives. DOE continues to work on the guidance and convened a workshop in October 2010 to obtain additional input from DOE and contractor subject matter experts. DOE now plans to complete the final directives by May 2011. The Board is working with DOE to complete the effort.



## 5. Nuclear Safety Programs and Analysis

### 5.1 Federal Oversight

#### 5.1.1 Overview

To meet its statutory health and safety mandate, the Board must continuously assess DOE's ability to carry out adequate oversight of contractor work. Oversight, in this context, includes federal line management assessment of contractors, contractor self-assessment, and independent assessments of both the federal line management and contractor efforts by DOE's Office of Health, Safety and Security. For much of the work conducted in the defense nuclear complex, DOE relies upon contractors to perform inherently risky activities in government-owned facilities. These activities are nevertheless governed by nuclear safety requirements promulgated by the government. Thus, DOE fills three simultaneous roles: owner, customer, and regulator. Preventing conflict among these roles requires a complex oversight system with competing demands that must be reconciled to ensure that the overall mission is achieved safely.

#### 5.1.2 Recommendation 2004-1

In Recommendation 2004-1, *Oversight of Complex, High-Hazard Nuclear Operations*, the Board sought to ensure that proposed changes in DOE's and NNSA's organizational structure and practices, particularly those related to safety oversight, did not "degrade nuclear safety." The Board cautioned that if any changes were made, they must be made formally and deliberately, with due attention given to unintended safety consequences that could increase "the likelihood of a serious accident, facility failure, construction problem, or nuclear incident ... as a result of well-intentioned changes."

On May 12, 2010, the Board conducted a public hearing to examine current oversight practices and assess the commitment of DOE's and NNSA's senior leadership to maintaining the needed levels of safety oversight at defense nuclear facilities. The hearing was convened in response to actions taken by DOE and NNSA to alter oversight practices as outlined in memoranda issued by senior management in late 2009. In the public hearing, DOE and NNSA re-affirmed commitments to continue and improve federal oversight of nuclear safety.

The Board continues to monitor DOE's efforts to accomplish the remaining open commitments from DOE's implementation plan, all of which are significantly past due. These open commitments include:

- Issue a DOE guide to complement DOE Order 226.1A, *Implementation of Department of Energy Oversight Policy*—originally scheduled for completion in May 2007.
- Develop processes to identify safety research and development needs across DOE and NNSA and to determine if and to what extent those research needs are being addressed through current plans and budgets—originally scheduled for completion in April 2007.

- Develop a method to ensure that nuclear safety research and development needs are identified and integrated into DOE's and NNSA's programming, planning, budgeting, and execution processes, including methods to share the results of completed research and development—originally scheduled for completion in April 2008.
- Conduct an effectiveness review of all areas related to establishing a robust Federal Assurance Capability—originally scheduled for completion in October 2008.
- Verify effectiveness of DOE's Operating Experience Program—originally scheduled for completion in April 2008.

### **5.1.3 Nuclear Safety Research and Development**

DOE has not yet established a coordinated effort to identify research needs in nuclear safety. As noted above, DOE is more than three years overdue on completing the associated commitments in its implementation plan for Recommendation 2004-1. Currently, NNSA is the DOE lead for these actions; this has resulted in an NNSA-centered approach, with limited progress toward identification of cross-cutting nuclear safety research and development needs. To its credit, NNSA has taken actions to increase the number of nuclear safety research proposals submitted for funding and has solicited a broader range of subject areas for funding in fiscal year 2011. However, DOE has not created an effective mechanism to identify, prioritize, and fund cross-cutting nuclear safety research.

In 2010, DOE began to reevaluate its approach to this issue and to develop a more centralized and coordinated effort, but a revised approach has not been approved. As part of this effort, DOE met with another government agency to understand how other agencies identify, prioritize, coordinate, and fund nuclear safety research and development needs. The Board will continue to press DOE to adopt and implement an effective approach toward meeting these needs.

The Board evaluated research and development activities funded by DOE to provide key data needed for nuclear safety analysis and nuclear facility safety systems. Examples include the following research activities:

- The Board reviewed the Y-12 contractor's test plan and test apparatus for obtaining data on airborne release fraction and respirable fraction for uranium metal in a fire environment. As a result of the Board's reviews, the test plan was revised and the Y-12 contractor subjected the test plan and apparatus to peer review.
- The Board reviewed DOE-sponsored research on the structural performance and loading characteristics of radial flow high-efficiency particulate air filters to be used at the Hanford Waste Treatment and Immobilization Plant. Initial test results indicated that the filters can accommodate less particulate loading than was expected. The unanticipated outcome of the tests illustrates the need for and benefits of continued research in this area.

#### **5.1.4 Criticality Safety Engineers**

The Board evaluated progress made by DOE in nuclear criticality training and staffing for oversight of nuclear criticality safety at DOE site offices. Some site offices lost personnel this past year, exacerbating the staffing issues noted in previous reports to Congress. Resources from central organizations (NNSA Service Center and DOE Headquarters) are increasingly being called upon for assistance as a stopgap measure. Most site offices have at least one engineer engaged in oversight of activities involving fissionable materials; all of these engineers have met the requirements in DOE Standard 1173-2009, *Criticality Safety Functional Area Qualification Standard*. Yet DOE still does not have a defined methodology for determining the number of criticality safety personnel needed at each site to provide effective oversight. The Board continues to require annual reporting by DOE on staffing and other topics related to nuclear criticality safety.

#### **5.1.5 Facility Representatives**

For nearly 20 years, the Board has consistently emphasized the importance of DOE facility representatives in providing federal line management oversight of safety at the activity level. DOE recognizes the key role of the facility representatives, as shown by its continuing support of the annual DOE Facility Representative Workshop and the associated Safety System Oversight meeting. In 2010, the 17th Facility Representative Workshop highlighted best practices as presented through success stories from the past year and provided an example of institutional learning across DOE's varied mission areas. During the workshop, a panel of three facility representatives and three safety system oversight engineers gave their perspectives on the roles of personnel within their organizations, the value of cooperation, and the need to integrate their respective functions as much as possible for mutual benefit. The Board is encouraged by such information exchanges and continuance of the annual workshop. Increasing and retaining the cadre of facility representatives needs to remain a priority for DOE's senior management.

#### **5.1.6 Work Planning**

The Board continues to emphasize the implementation of the core functions and guiding principles of integrated safety management as essential to planning work effectively and executing it safely. During 2010, the Board conducted six reviews of work planning and control and issued four letters to DOE detailing observed deficiencies and requesting reports. The Board consistently found inadequacies in clearly defining and controlling the scope of work, in hazard analysis, and in developing effective feedback and improvement mechanisms. Individual sites have made enhancements in response to the Board's letters, but additional improvement is needed. DOE and its contractors have recently initiated a project to improve work planning and control at all sites. The Board will follow this much-needed effort and will particularly emphasize the need for a DOE directive to govern the planning and control of work at defense nuclear facilities.

### 5.1.7 Safety Basis Controls

The process of independently verifying the proper implementation of safety basis controls is vitally important to nuclear safety. Several DOE sites have protocols for performing such reviews, but complex-wide requirements and guidance that would require and define such reviews are lacking. The Board issued a letter to DOE in 2008 identifying this deficiency and requesting DOE to evaluate the need for such requirements and guidance. In response, DOE noted that general quality assurance program requirements call for such reviews but that additional guidance in this area was needed and would be developed.

In 2009, DOE drafted guidance on such reviews, termed “Implementation Verification Reviews,” but progress to conduct formal internal evaluations and issue the new guidance stalled at the end of the year. In early 2010, the Board pressed DOE to complete the new guidance. In April, DOE issued revised draft guidance and started formal evaluations; in the following month, the Board provided comments on the guidance. DOE issued the new guidance in November in a revision to DOE Guide 423.1-1, *Implementation Guide for Use in Developing Technical Safety Requirements*. The Board will review DOE’s utilization of the new guidance in ensuring the proper implementation of safety basis controls at defense nuclear facilities.

## 5.2 Health and Safety Directives

### 5.2.1 Oversight of Directives

The Board is required to review and evaluate the content of the standards relating to the design, construction, operation, and decommissioning of defense nuclear facilities (including all applicable DOE orders, regulations, and requirements). In 2010, as part of its ongoing review of new and revised DOE directives, the Board and its staff evaluated and provided constructive critiques of 48 directives affecting safety at defense nuclear facilities. At year’s end, the Board was working to resolve issues on 23 pending directives to improve the content, clarity, and consistency in safety requirements and guidance, and was in the process of reviewing 14 directives. Work was completed on 25 DOE directives; examples are listed below.

- DOE Order 413.3B, *Program and Project Management for the Acquisition of Capital Assets*
- DOE Order 422.1, *Conduct of Operations*
- DOE Order 426.2, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities*
- DOE Guide 423.1-1A, *Implementation Guide for Use in Developing Technical Safety Requirements*
- DOE Standard 1158-2010, *Self-Assessment Standard for DOE Contractor Criticality Safety Programs*

## 5.2.2 Safety and Security Reform Plan

The Board continues to expend significant effort reviewing changes to existing DOE directives and proposed cancellation of directives that affect safety at defense nuclear facilities. On March 16, 2010, the Deputy Secretary of Energy issued the *Department of Energy 2010 Safety and Security Reform Plan*. The plan directs the Office of Health, Safety and Security to review and revise, cancel, or consolidate 107 safety and security directives. The Deputy Secretary of Energy initially set very aggressive completion milestones.

DOE directives, in conjunction with DOE safety rules, provide the bedrock upon which adequate protection of the public, the environment, and workers is built and provide assurance that DOE contractors will safely conduct operations at defense nuclear facilities. Any effort to overhaul the directives system should be undertaken with the objective of strengthening and improving the system while continuing to ensure adequate levels of protection and prevent accidents or incidents at defense nuclear facilities. The end-state vision of the Deputy Secretary of Energy's directives reform contemplated dramatic reductions in the number of DOE directives without ensuring a rigorous review of each DOE directive. Therefore, on May 5, 2010, the Board requested the Secretary of Energy to provide clarification of the specific criteria DOE is using to analyze individual directives to determine cancellation and consolidation, and the steps that DOE is taking to improve and strengthen its directives.

On May 20, 2010, DOE responded to the Board's request by providing a project management plan for its reform effort. The plan outlines a rigorous and disciplined process for use by the Office of Health, Safety and Security to carefully assess the content of each directive, the value of each requirement, and the consequences of each requirement's removal or modification. However, on December 29, 2010, the Deputy Secretary of Energy signed a memorandum entitled "Expedited Processing of Directives." This memorandum instructed the Office of Management to expedite the normal review and comment process for a select group of safety directives.

At the end of 2010, the Board had reviewed or was in the process of reviewing the following draft directives resulting from this effort:

- DOE Policy 226.X, *Department of Energy Oversight Policy*
- DOE Order 226.1B, *Implementation of Department of Energy Oversight Policy*
- DOE Order 414.1X, *Quality Assurance*
- DOE Order 225.1B, *Accident Investigations*
- DOE Order 252.1A, *Technical Standards Program*
- DOE Order 360.1C, *Federal Employee Training*
- DOE Order 450.X, *Integrated Safety Management*
- DOE Policy 450.X, *Integrated Safety Management* (this revised policy combines the following existing DOE policies: DOE Policy 411.1, *Safety Management Functions, Responsibilities, and Authorities*, DOE Policy 441.1, *Department of Energy Radiological Health and Safety*, DOE Policy 450.2A, *Identifying, Implementing and Complying with Environment, Safety and Health Requirements*, DOE Policy 450.4, *Safety Management System*, DOE Policy 450.7, *Environment, Safety and Health (ESH) Goals*)

During the past twenty years, DOE has embarked on numerous directives revision efforts. The Board has noted that the requirements needed to adequately protect the public, workers, and environment at defense nuclear facilities have not appreciably changed after each of these directives revision efforts. The Board expects DOE's most recent initiative to last through 2011 and consume significant time and resources to ensure that the directives system remains adequate for safety at defense nuclear facilities. (See Outstanding Safety Issue, p. 22.)

### **5.2.3 Hazard Categorization**

In a letter dated June 26, 2006, the Board requested that DOE review and address issues associated with the implementation of Standard 1027-92, *Hazard Categorization and Accident Analysis Techniques for Compliance with DOE Order 5480.23, Nuclear Safety Analysis Reports*, Change Notice 1. The letter described specific problems observed throughout the complex, including inappropriate exclusion of sealed sources from facility inventories. Improper application of the standard can result in nonconservative facility hazard categorization and an improperly reduced set of safety requirements and controls.

In response to the Board's letter, DOE formed a working group to thoroughly evaluate the standard and identify weaknesses that required additional guidance. On May 7, 2007, DOE issued supplemental guidance to further clarify issues identified by the Board and the working group, with the intent of revising the standard to incorporate this guidance. However, this supplemental guidance was not formally issued and has been largely disregarded by the sites.

In 2010, NNSA drafted a Supplemental Directive that would modify some of the existing standard's guidance for NNSA sites only. The Board provided comments on these proposed changes to NNSA. NNSA has proposed resolutions for most of the comments, which the Board is currently reviewing. NNSA has not yet issued the Supplemental Directive.

DOE has begun work on a revision to the standard, as promised in its 2007 letter to the Board. The Board will continue to monitor progress on this initiative and work to resolve its comments on the NNSA Supplemental Directive in the coming year.

### **5.2.4 Recommendation 2010-1**

The Board issued Recommendation 2010-1, *Safety Analysis Requirements for Defining Adequate Protection of the Public and the Workers*, on October 29, 2010, to strengthen DOE's system of nuclear safety requirements. The recommendation arose from the Board's observation that the underlying problem leading to issuance of Recommendation 2009-2 on Los Alamos National Laboratory was the lack of clarity and legal force of DOE's nuclear safety directives and standards.

The Board first explored this problem in a letter to the Deputy Secretary of Energy on March 15, 2010. In that letter, the Board sought to determine whether DOE's interpretation of 10 CFR Part 830, *Nuclear Safety Management*, and DOE Standard 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, provided adequate protection of the public, workers, and the environment from nuclear hazards. The



Board's letter expressed concern that DOE's interpretation of the rule implied that the offsite exposure Evaluation Guideline of 25 rem established in DOE Standard 3009-94 did not have to be met.

In its June 10, 2010 response, DOE argued that its interpretation of DOE Standard 3009-94 had not changed since issuance of 10 CFR Part 830. DOE took the position that Standard 3009-94 "was not written as a prescriptive item-by-item requirements document; rather it provides an overall approach and guidance for preparing a DSA (Documented Safety Analysis)." This view would permit discretionary use of the Evaluation Guideline, a result that the Board regarded as directly contrary to the safety mandate of the Atomic Energy Act.

The Board subsequently issued Recommendation 2010-1 to ensure that DOE's standards-based regulatory system has a clear and unambiguous set of nuclear safety requirements to ensure that adequate protection of the public, workers, and the environment is provided. The recommendation also addresses the need for DOE to provide clear direction to its safety basis approval authorities to ensure that, if nuclear safety requirements cannot be met prior to approval of a documented safety analysis, DOE imposes clear conditions of approval for compensatory measures for the short term and facility modifications for the longer term to achieve the required safety posture. DOE is required to formally accept or reject the Board's recommendation in early 2011.

### **5.3 Safety Programs**

#### **5.3.1 Administrative Controls**

In January 2007, DOE informed the Board that all commitments in the implementation plan for Recommendation 2002-3, *Requirements for the Design, Implementation, and Maintenance of Administrative Controls*, had been completed and proposed that the recommendation be closed. The Board conducted a number of site reviews to assess the effectiveness of DOE's implementation. Because the Board found a number of implementation weaknesses and deficiencies, it determined that additional efforts were warranted on the part of DOE prior to closure of the recommendation. In response, DOE committed to additional field verification reviews to fully identify and correct the implementation deficiencies.

In 2010, DOE initiated an effort to conduct independent field reviews at all Environmental Management sites. DOE plans to conduct similar reviews at selected NNSA sites. These reviews are expected to be completed in early 2011, after which DOE plans to revisit whether sufficient progress has been made to close the Board's recommendation.

#### **5.3.2 Active Confinement Systems**

DOE completed its evaluation of all defense nuclear facilities in accordance with the guidance provided in the implementation plan for Recommendation 2004-2, *Active Confinement Systems*, in the summer of 2010. DOE's Office of Environmental Management studied the results of these evaluations and prioritized potential facility upgrades according to their safety enhancement and cost effectiveness. This evaluation identified five Environmental Management

facilities that needed modifications or upgrades to active confinement ventilation systems in order to meet the performance criteria determined in the applicable DOE Guide. In a letter to the Board dated October 1, 2010, DOE committed to make the upgrades for those five facilities and to brief the Board within one year on the progress made toward enhancing the reliability of those systems. These modifications will significantly improve the safety performance of the active confinement ventilation systems by more reliably filtering any release that may occur during an accident.

The Board continued its review of the design of new facilities such as Uranium Processing Facility at Y-12, to make sure that the concept of active confinement is maintained in the design stage of those facilities. As a result of such reviews, the Board discovered that some activities to be performed in the Auxiliary Hot Cell facility at Sandia National Laboratories did not provide active confinement of the potential releases. NNSA committed to provide a temporary active confinement ventilation system for those activities to prevent unfiltered releases of radioactive materials.

### **5.3.3 Recommendation 2009-1**

Previously, the Board conducted a comprehensive assessment of DOE's policies, programs, processes, and procedures on the use of quantitative risk assessment and related methodologies. This review found that DOE widely employed quantitative risk assessment, but without adequate controls over quality and applicability. DOE responded by agreeing to develop a policy governing the use of risk assessment methodologies at defense nuclear facilities; however, no substantive action had been taken in following through on this response.

On July 30, 2009, the Board issued Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities*. The Board recommended that DOE move forward to develop appropriate policy and guidance documents to govern the development and application of risk assessment in the defense nuclear complex. The Board also recommended that DOE evaluate the current uses of risk assessment to determine whether interim guidance or quality measures were appropriate. The Secretary of Energy accepted the Board's recommendation and forwarded an implementation plan to address the Board's concerns.

In 2010, DOE issued a complex-wide Information Notice outlining expectations for the use of risk assessment in the defense nuclear complex and chartered an expert working group to assist in the review of selected risk assessment applications. DOE is nearing completion of a revised DOE policy on nuclear safety that will further define the use of risk assessment throughout the complex and developing a DOE standard to support the policy.

### **5.3.4 Criticality Safety**

The Board continued to assess DOE's progress in improving nuclear criticality safety programs. In October, 2010, the Board reviewed criticality safety at the Y-12 National Security Complex. This review examined actions taken by NNSA in response to the Board's January 2009 letter on nuclear criticality safety evaluations for the Highly Enriched Uranium Materials Facility. These actions included a review of active nuclear criticality safety evaluations and

various improvements to the nuclear criticality safety program. The actions taken by NNSA appear to have resolved the primary concerns expressed by the Board.

At Savannah River, the Board reviewed the methodology used to determine if nuclear criticality controls should be elevated to the documented safety analysis and technical safety requirements, which would ensure enhanced implementation and surveillance. The Board provided feedback to DOE during 2010 that led to improvements in the criteria used for determining which controls should be elevated.

The Board reviewed DOE's annual report on criticality safety for 2009 (issued on January 19, 2010) and was briefed on the report by DOE. Overall, the report was found to be adequate as measured by Recommendation 97-2, *Continuation of Criticality Safety at Defense Nuclear Facilities in the Department of Energy*.

DOE's nuclear criticality safety program continues to provide a source of stable funding for many essential activities related to criticality safety. As an example, machines needed to conduct criticality experiments have been relocated to the Critical Experiments Facility at the Nevada National Security Site. Criticality experiments are scheduled to begin in 2011.

### **5.3.5 Readiness Reviews**

The Board continues to review directives related to startup and restart of nuclear facilities, as well as their implementation at defense nuclear facilities. In 2010, DOE approved DOE Order 425.1D, *Verification of Readiness to Start Up or Restart Nuclear Facilities*, and DOE Standard 3006-2010, *Planning and Conduct of Operational Readiness Reviews*. These revised directives provide clearer requirements for readiness reviews for startup and restart of defense nuclear facilities. The Board expects DOE Order 425.1D to be fully implemented at each defense nuclear facility in early 2011. The Board provided oversight of multiple readiness activities at defense nuclear facilities in 2010, including the following:

- Highly Enriched Uranium Materials Facility Operational Readiness Review at Y-12 National Security Complex
- Weapons Engineering Tritium Facility Operational Readiness Review at Los Alamos National Laboratory
- Critical Experiments Facility Operational Readiness Review at Nevada National Security Site
- Transuranic Waste Processing Center Drum Venting Operational Readiness Review at Y-12 National Security Complex
- Auxiliary Hot Cell Facility Operational Readiness Review at Sandia National Laboratories

### **5.3.6 Justifications for Continuing Operations**

The Board had previously documented weaknesses in this important area in a letter to DOE dated April 19, 2007. To correct these weaknesses, DOE established a working group that collected data showing a need for additional emphasis and oversight in this area.

During 2009 and 2010, DOE developed revised guidance for use in the field in the development and implementation of justifications for continuing operations. This guidance was embodied in a revision to DOE Guide 424.1, *Implementation Guide for Use in Addressing Unreviewed Safety Question Requirements*, issued on April 8, 2010. The Board will evaluate the effectiveness of the improved guidance in the coming year.

### **5.3.7 Recommendation 2007-1**

As a result of incidents across the DOE complex involving inaccurate measurements of radioactive material using in situ nondestructive assay, the Board issued Recommendation 2007-1, *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*, on April 25, 2007. DOE accepted the recommendation in June 2007 and submitted an implementation plan in October 2007; the Board accepted the plan in April 2008.

DOE is carrying out the implementation plan on schedule. With the aid of the Technical Support Group, comprising senior DOE and contractor personnel with significant experience in nondestructive assay, DOE completed the following commitments in 2010:

- Identified good practices and best practices from sites within the scope of the plan for the areas of interest (training and qualification, design of new facilities, standards, research and development, roles and responsibilities, directives, quality assurance, and oversight),
- Identified needs for in situ nondestructive assay programs for each of the eight areas of interest, and
- Identified gaps and areas for improvement for in situ nondestructive assay programs in the eight areas of interest.

These accomplishments represent progress, but continued work is needed. DOE did not identify simple interim measures that could close some of the gaps and address some of the needs. Likewise, DOE identified research and development needs but did not identify funding sources to allow them to be pursued. Addressing such research and development needs also falls under Recommendation 2004-1. DOE cited the absence of requirements for applying consensus standards to in situ nondestructive assay but has not taken action to address this gap.

### **5.3.8 Conduct of Operations**

In 2010, the Board reviewed conduct of operations at Idaho National Laboratory's Advanced Mixed Waste Treatment Plant, the Hanford Plutonium Finishing Plant, and the Hanford Tank Farms. Workers generally knew their job responsibilities, but the Board observed numerous weaknesses in work practices and instances where operations were not conducted in a formal and rigorous manner. The Board also found procedures that lacked the level of detail necessary to minimize the potential for errors during execution and cases where the workers did not follow the procedure step-by-step, as required. In some cases, operators deviated from work

procedures because they could not be implemented as written. The Board provided its findings to DOE for consideration.

### **5.3.9 Safety Basis and Safety System Reviews**

The Board evaluated safety bases and safety systems at a number of defense nuclear facilities and identified issues that were communicated to DOE for resolution.

*Hanford Tank Farms.* The Board identified a wide array of deficiencies at the Hanford Tank Farms, including: engineered safety systems downgraded without a sound technical basis, ineffective specific administrative controls, use of non-credited equipment for safety related applications, and other weaknesses in the accident analysis. Of greatest concern was the Board's observation that inadequate controls existed to address flammable gas hazards in the high-level waste tanks. The Board's observations and concerns were documented in a letter to DOE dated August 5, 2010.

*Lawrence Livermore National Laboratory.* At Lawrence Livermore National Laboratory, the Board noted a number of weaknesses associated with the hazard analysis and selection of controls associated with the Tritium Processing Station. These concerns were outlined in a letter to DOE dated January 27, 2010.

*Savannah River Site.* The Board reviewed corrective actions taken at the Savannah River Site to address past concerns regarding the formality of hazard controls in facility safety bases. The Board found that controls identified in the hazard analyses might not be treated as part of the facility's safety basis if they were categorized as defense-in-depth. This could allow the safety posture of those facilities to deteriorate with time, since those controls could have been eliminated or not maintained under a configuration control program. The Board relayed this concern to DOE in a letter dated July 16, 2010. DOE responded on November 23, 2010, committing to revise the site procedures to ensure that appropriate defense-in-depth controls are identified in the safety bases of the facilities. This action would extend the Unreviewed Safety Question determination process to those controls and would significantly enhance the safety posture of the facilities.

### **5.3.10 Emergency Planning and Preparedness**

The Board reviewed preparations for responding to severe natural phenomena and major accidents at the Savannah River Site. The Board noted that DOE had not been performing drills for many high consequence events, had not adjusted drill programs for existing facilities with new hazards, and had failed to include interfaces between the multiple contractors in the site's drill program. The Board communicated these concerns to DOE; in response, DOE began conducting additional drills and is planning to conduct large-scale integrated drills involving multiple facilities. The site's contractors have formed an interface team to help coordinate this effort. The Board will continue to encourage DOE to improve the emergency response program at Savannah River.

### **5.3.11 Fire Protection Programs**

In 2010, the Board evaluated fire protection programs at Savannah River Site, Y-12 National Security Complex and Oak Ridge National Laboratory. In regard to Savannah River, the Board sent a letter to DOE on January 20, 2010, indentifying weaknesses in firefighting equipment, management of exemptions and equivalencies to fire protection requirements, and staffing for the program. DOE cured some of these weaknesses by purchasing new fire trucks and improving fire protection management practices. Adequate staffing remains an issue, however.

The Board also reviewed the fire protection programs at the Y-12 National Security Complex and Oak Ridge National Laboratory. The Board identified several areas for improvement but concluded that the programs at both sites were adequate to protect the health and safety of workers and the public.

## **6. Public Outreach and Agency Administration**

### **6.1 Board Visits to Sites**

In 2010, the Board's nationwide site visits were preceded by invitations to local unions and public interest groups to present their concerns. These invitations were accepted on a number of occasions and resulted in additional information of value to the Board's work. This practice will be continued in 2011 and future years.

### **6.2 Responding to Public Requests**

The Board answered numerous informal public requests for documents and information and responded to 15 formal requests filed under the Freedom of Information Act. The average response time for Freedom of Information Act requests was 7 working days, as compared with the statutory requirement of 20 working days. The Board's website ([www.dnfsb.gov](http://www.dnfsb.gov)) contains a complete list of Freedom of Information Act requests processed since 2005.

### **6.3 Access to Information**

The Board posts essential, publicly-releasable documents on its website in a timely manner in a format suitable for downloading. The Board also mails paper copies of certain documents (annual reports, technical reports, public hearing notices, and others) to a list of nearly 370 addressees.

### **6.4 Inquiries into Health and Safety Issues**

The Board often receives information regarding potential health and safety hazards from private citizens or from employees at defense nuclear facilities. The Board treats these matters with the utmost seriousness by assigning members of its legal and technical staffs to investigate or inquire further. These inquiries, which may involve interviews, reviews of documents, and site visits, are continued until the Board is able to reach a technical judgment on the issues raised. The Board informs DOE of any health and safety hazards and then closely monitors DOE's corrective actions. When the Board receives information on matters outside its jurisdiction, such as alleged criminal activities or unlawful personnel practices, it refers the information to the appropriate federal agency for action. During 2010, the Board conducted an inquiry into health and safety issues at the Waste Treatment Plant on the Hanford Site. This inquiry is continuing into 2011.

### **6.5 Suspect and Counterfeit Parts**

Following the Board's direction, the staff continued its review of DOE's suspect and counterfeit items and parts program. Staff interviewed personnel from DOE's Health, Safety and Security, Environmental Management, Inspector General, and Counterintelligence programs, as well as NNSA, to gain a better understanding of supply chain issues, including suspect and counterfeit items and parts. The Board identified several broad categories to assist in further understanding DOE's and NNSA's programs: programmatic; gathering, analyzing, and

disseminating information regarding suspect and counterfeit items and parts to both federal line organizations and contractors; and timeliness of determining suspect parts, vendors, and supply chain. The Board has also encouraged DOE and NNSA to join the Board in working closely with the microelectronics working group formed by the U.S. Attorney's Office for the District of Columbia. The Board's staff will continue reviewing information provided by DOE and NNSA and conducting further inquiries into DOE's and NNSA's systems to analyze information flow regarding suspect and counterfeit items and parts and identify programmatic concerns.

## **6.6 Investigation of Negative Feedback**

From time to time, the Board receives feedback from outside parties such as members of the public, other federal agencies, or Congress. The Board takes such feedback seriously and endeavors to determine in each case whether improvements are needed in the Board's oversight policies and objectives.

## **6.7 Site Representative Activities**

The Board enhances its onsite health and safety oversight of defense nuclear facilities by assigning experienced technical staff members to full-time duty in the field. As of December 31, 2010, there were two site representatives at the Pantex Plant near Amarillo, Texas; two at the Hanford Site near Richland, Washington; two at the Savannah River Site near Aiken, South Carolina; two at the Y-12 National Security Complex in Oak Ridge, Tennessee; two at Los Alamos National Laboratory in New Mexico; and one at Lawrence Livermore National Laboratory in Livermore, California.

Site representatives conduct first-hand assessments of nuclear safety management to identify health and safety concerns promptly. They meet with the public, union members, Congressional staff members, and public officials from federal, state, and local agencies. The Board receives weekly reports and regular briefings from its site representatives and maintains continuous contact with them using all available communication media.

## **6.8 Human Resources**

During fiscal year 2010, the Board increased its staff from 102 to 106 government personnel. Eight engineers, one new Board Member, and two General Schedule support staff employees joined the Board during the year. Jessie Roberson was confirmed on March 19, 2010 to fill a vacant Board position; she was subsequently appointed Vice Chairman on June 24, 2010. One of the current Board members, Dr. Peter Winokur, was named Chairman on March 19, 2010, completing the leadership positions of the Board. However, the Board lost seven personnel to retirement or attrition. The Board is authorized to reach a staffing level of 120 by the end of fiscal year 2011.

The Board has assembled a professional staff of exceptional technical capability. Staff members' expertise covers all major aspects of nuclear safety: nuclear, mechanical, electrical, chemical, fire protection, and structural engineering, as well as physics and metallurgy. Most mid- to senior-level technical staff members possess practical nuclear experience gained from



duty in the United States Navy nuclear propulsion program, the nuclear weapons complex, or the civilian nuclear reactor industry. The Board expects its engineers and scientists to maintain the highest level of technical knowledge, encouraging them to improve their skills continually through academic study. Eighty-seven percent of the Board's technical staff holds advanced science and engineering degrees, with 24 percent at the doctoral level.

Junior technical staff members continue to be recruited through the Board's Professional Development Program. Entry-level employees recruited into this three-year program receive graduate education and intensive on-the-job training guided by experienced technical mentors. Currently, there are six entry-level employees in this program, with four more expected to enter the program in June 2011. The Board will continue its vigorous recruitment program to attract the brightest engineering students from colleges and universities across the country.

## **6.9 Information Technology and Security**

The Board continued strengthening its internal controls and verifying compliance with the requirements of the Federal Information Security Management Act and related information security guidance. The Board once again received an unqualified audit opinion with no reportable conditions.

The Board furthered its deployment of Homeland Security Presidential Directive 12 credentials, and as of December 31, 2010, the Board has issued 120 credentials to employees and contractors. The Board has also acquired a Light Activation Station, a device that allows on-site badge activation, certificate and PIN updates, and other identification services, which formerly had to be dealt with in DOE's offices.

The Board is currently developing a new public website that will more effectively provide information to the public, consistent with the President's Open Government Directive. The new website is being built exclusively with open source tools.

## **6.10 Dispute Resolution Programs**

The Board, like other federal agencies, is required by the Administrative Dispute Resolution Act of 1996 to provide an alternative dispute resolution program for use in resolving appropriate disputes. The Board maintains such a program, making use of cooperative agreements with other agencies to resolve workplace and contract disputes economically.

## **6.11 Financial Management**

The Board received a fifth consecutive unqualified audit opinion on its financial statements from an independent auditor. The auditor found that the Board complied with all applicable federal laws and regulations and had no material weaknesses in its financial control system.



## Appendix A

### RECOMMENDATION 2010-1 TO THE SECRETARY OF ENERGY

#### *Safety Analysis Requirements for Defining Adequate Protection for the Public and the Workers*

#### Pursuant to 42 U.S.C. § 2286a(a)(5) Atomic Energy Act of 1954, As Amended

**Dated: October 29, 2010**

### **Background**

The Department of Energy's (DOE) nuclear safety regulations were developed as a result of a mandate by Congress in the Price Anderson Act Amendments of 1988. These regulations now appear in Parts 820, 830, and 835 of Title 10 in the Code of Federal Regulations (CFR). In this Recommendation, the Defense Nuclear Facilities Safety Board (Board) addresses recent changes in DOE's "interpretation" of certain critical provisions of Title 10 CFR Part 830, *Nuclear Safety Management* (10 CFR Part 830), provisions that are intended to provide adequate protection of public health and safety. As explained below, in the Board's view this revised interpretative posture weakens the safety structure the rule is designed to hold firmly in place.

10 CFR Part 830 imposes a requirement that a documented safety analysis (DSA) is to be prepared for every DOE nuclear facility. This DSA, once approved by DOE, forms the regulatory basis for safety of the facility or operation. 10 CFR Part 830 does more, however: its Appendix A provides "safe harbors" for the preparation and approval of DSAs. These safe harbors are, in the main, references to detailed guidance issued by DOE. A DSA that is prepared following applicable guidance found in safe harbors should be found acceptable, meaning that the facility's safety systems are adequate to protect public health and safety from nuclear hazards.

One of the key safe harbor guides for the preparation of DSAs is DOE Standard 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Safety Analysis Reports*.<sup>1</sup> First issued in July of 1994, this Standard was intended to provide guidance on meeting the requirements imposed by DOE Order 5480.23, *Nuclear Safety Analysis Reports*, a set of nuclear safety requirements that preceded and were supplanted by 10 CFR Part 830. The Standard stated that "Technical Standards, such as this document, support the guides by providing additional guidance into how the requirements [of Orders and Rules] should be met." As such, it did not contain any nuclear safety requirements. Five years after its initial issuance, DOE amended Standard 3009-94 by the addition of Appendix A, currently entitled "Evaluation Guideline." The guideline applies a dose criterion to the results of accident calculations found in DSAs. Stated broadly, the Standard mandates that safety class systems, structures, and components (SSCs) be installed if in a potential accident the unmitigated dose consequence calculations for a release scenario at the site boundary approach the Evaluation Guideline numerical value. The Evaluation Guideline value established in DOE-STD-3009-94 Appendix A

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<sup>1</sup> When DOE issued Change Notice 2, the title of this Standard was revised to *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*.

is 25 rem Total Effective Dose Equivalent (TEDE). The Standard further states that although 25 rem is not considered an acceptable public exposure, it is generally accepted as a value indicative of no significant health effects.

When 10 CFR Part 830 was promulgated in final form in early 2001, the version of DOE Standard 3009-94 incorporated into Appendix A of the rule as a safe harbor included the Evaluation Guideline. This combination of the rule's requirement for an approved DSA and the application of the Evaluation Guideline of DOE Standard 3009-94 formed the basis upon which adequate protection of the public health and safety would be gauged. Whenever dose consequence calculations showed that an accident scenario would result in offsite doses approaching 25 rem TEDE, the expectation was that safety related SSCs would function as designed, ensuring that public doses would never exceed a small fraction of the Evaluation Guideline.

### **Developments Since 2001**

As a safe harbor for 10 CFR Part 830, the Evaluation Guideline described in DOE Standard 3009-94 has been enforced and met for the majority of DOE's defense nuclear facilities, assuring adequate protection of the public, workers, and the environment. However, in December 2008, the National Nuclear Security Administration (NNSA) approved a DSA for the Plutonium Facility at Los Alamos National Laboratory that represented a significant departure from the accepted methodology, as discussed in the Board's Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*. The Board followed up its Recommendation with a letter to the Deputy Secretary of Energy on March 15, 2010, that sought to determine whether DOE's current interpretation of 10 CFR Part 830 and DOE Standard 3009-94 still supports the principles of providing adequate protection of the public, workers, and the environment from the hazards of operating DOE's defense nuclear facilities. The Board's letter particularly expressed concern regarding the appearance that DOE's present interpretation is that the nuclear safety Evaluation Guideline established in DOE Standard 3009-94 does not have to be met.

DOE's June 10, 2010, response to the Board's letter states that DOE's utilization and implementation of DOE Standard 3009-94 has not changed since issuance of 10 CFR Part 830. DOE's response observes that DOE Standard 3009-94 "was not written as a prescriptive item-by-item requirements document; rather it provides an overall approach and guidance for preparing a DSA." DOE's response states that the Standard describes steps that the contractor may take if the postulated accident consequences cannot be mitigated below the Evaluation Guideline. DOE's response also cites guidance for DOE approval authorities contained in DOE Standard 1104-2009, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*, and notes that the Safety Basis Approval Authority may prescribe interim controls and planned improvements if the Evaluation Guideline is exceeded. DOE's response closes by stating that its managers "are expected to carefully evaluate situations that fall short of expectations and only provide their approval of documented safety analyses when they are satisfied that operations can be conducted safely..., that options to meet DOE expectations have been evaluated, and that adequate commitments to achieve an appropriate safety posture in a timely manner have been made."

The lack of definitive statements in DOE's June 10, 2010, response illustrates the difficulties inherent in applying a guidance document as a safe harbor for implementing the requirements of a regulation. Furthermore, NNSA's approval of the DSA for the Los Alamos National Laboratory's Plutonium Facility in December 2008 demonstrates that, despite DOE's stated expectations, it is not always true that DOE's managers will ensure safety by imposing conditions of approval that address inadequacies in the safety basis. This is illustrated to a lesser extent at the other NNSA facilities—described in follow-up correspondence NNSA issued to the Board on June 30, 2010—which have not implemented controls or compensatory measures sufficient to reduce accident consequences below the Evaluation Guideline. DOE Standard 1104-2009 serves as a source of guidance for DOE Safety Basis Approval Authorities, but it, too, is a guidance document, unequivocally stating, “This Standard does not add any new requirements for DOE or its contractors.”

DOE's standards-based regulatory system needs a clear and unambiguous set of nuclear safety requirements to ensure that adequate protection of the public, workers, and the environment is provided. Further, it is imperative that DOE provide clear direction to its Safety Basis Approval Authorities to ensure that, if nuclear safety requirements cannot be met prior to approval of a DSA, DOE imposes clear conditions of approval for compensatory measures for the short term and facility modifications for the longer term to achieve the required safety posture. This acceptance of risk and commitment to future upgrades must be approved at a level of authority within DOE that is high enough to control both the resources needed to accomplish the upgrades as well as the programmatic decision-making involved in determining that the risk of continuing operations is offset by sufficiently compelling programmatic needs.

Item 4 of the Recommendation below deserves a further word of explanation. The Board does not recommend lightly a change to DOE's nuclear safety regulations. But as explained above, DOE has chosen over the past several years to drift away from the principles that underlay the rule as originally intended. The Board has chosen to recommend a rule change because this action would tend, in the long run, to prevent future shifts in DOE safety policy that would once again have to be challenged and argued against. For these reasons, the Board recommends that the nuclear safety rule, 10 CFR Part 830, be amended as stated below.

## **Recommendation**

Therefore, the Board recommends that DOE:

1. Immediately affirm the requirement that unmitigated, bounding-type accident scenarios will be used at DOE's defense nuclear facilities to estimate dose consequences at the site boundary, and that a sufficient combination of SSCs must be designated safety class to prevent exposures at the site boundary from approaching 25 rem TEDE.
2. For those defense nuclear facilities that have not implemented compensatory measures sufficient to reduce exposures at the site boundary below 25 rem TEDE, direct the responsible program secretarial officer to develop a formal plan to meet this requirement within a reasonable timeframe.

3. Revise DOE Standard 3009-94 to identify clearly and unambiguously the requirements that must be met to demonstrate that an adequate level of protection for the public and workers is provided through a DSA. This should be accomplished, at a minimum, by:
  - a. Clearly defining methodologies and providing acceptability criteria for controls, parameters, processes, analytical tools, and other data that should be used in preparation of a DSA,
  - b. Delineating the criteria to be met for identification and analyses of an adequate set of Design Basis Accidents (for new facilities), or Evaluation Basis Accidents (for existing facilities),
  - c. Providing criteria that must be met by the safety-class SSCs to (i) mitigate the consequences to a fraction of the Evaluation Guideline, or (ii) prevent the events by demonstrating an acceptable reliability for the preventive features, and
  - d. Establishing a process and path forward to meeting (a) through (c) above through compensatory measures and planned improvements if the DSA cannot demonstrate compliance.
4. Amend 10 CFR Part 830 by incorporating the revised version of DOE Standard 3009-94 into the text as a requirement, instead of as a safe harbor cited in Table 2.
5. Formally establish the minimum criteria and requirements that govern federal approval of a DSA, by revision to DOE Standard 1104-2009 and other appropriate documents. The criteria and requirements should include:
  - a. The authorities that can be delegated, the required training and qualification of the approval authority, and the boundaries and limitations of the approval authority's responsibilities,
  - b. Actions to be taken if conditions are beyond the delegated approval authority's specified boundaries or limitations,
  - c. The organization or the individual who can approve a DSA that is beyond the delegated approval authority's specified boundaries or limitations,
  - d. The regulatory process that must be followed if conditions are beyond the delegated approval authority's specified boundaries or limitations, and any compensatory actions to be taken, and
  - e. The criteria an approval authority must use to quantify the acceptance of risk for continued operations when offsite dose consequences approach the Evaluation Guideline.

6. Formally designate the responsible organization and identify the processes for performing oversight to ensure that the responsibilities identified in Item 5 above are fully implemented.

Peter S. Winokur, Ph.D., Chairman

**RECOMMENDATION 2010-2 TO THE SECRETARY OF ENERGY**  
*Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*  
**Pursuant to 42 U.S.C. § 2286(a)(5)**  
**Atomic Energy Act of 1954, As Amended**

**Dated: December 17, 2010**

**Introduction**

Legacy wastes from decades of nuclear weapons production by the Department of Energy (DOE) and its predecessor agencies include high-level radioactive waste stored in 177 underground tanks at the Hanford Site. The risk posed by the continued storage of wastes in these tanks is considerable. Many of the tanks have a history of leakage, several are more than 60 years old, and most will be far beyond their intended service life by the time the wastes are retrieved and processed into stable forms. DOE must ensure that the Hanford Waste Treatment and Immobilization Plant (WTP) in conjunction with the Hanford tank farm waste feed delivery system will operate safely and effectively for many decades to eliminate the safety hazards posed by the wastes. This imperative requires that the pulse jet mixing and transfer systems relied upon in the WTP design perform reliably and effectively for decades of WTP operations, and that technical issues with the performance of these components be resolved in time to enable DOE to meet its existing commitment to begin WTP operation in 2019.

**Background**

In a letter to DOE's Assistant Secretary for Environmental Management dated January 6, 2010, the Defense Nuclear Facilities Safety Board (Board) summarized its concerns related to WTP's mixing and transfer systems; specifically, that the pulse jet mixers (PJM) lacked sufficient power to mix adequately and to transfer the most rapidly settling particles expected to be present in the Hanford waste inventory. In its letter, the Board identified three significant safety issues related to pulse jet mixing: (1) retention of fissile materials in vessel heels would present a criticality safety concern, (2) retention of flammable gas due to the presence of solids in vessel heels, and (3) the presence of a large solids inventory could have a detrimental effect on the vessel level instrumentation, which is required to control the PJMs.

In its May 17, 2010, response to the Board's letter, DOE committed to take actions to increase confidence in successful operation of WTP. These actions included integrated testing of vessel mixing and transfer systems at a larger scale. However, DOE did not provide details such as the scope and schedule for this effort.

On July 1, 2010, the Consortium for Risk Evaluation and Stakeholder Participation (CRESP), an independent technical review team under contract to DOE, issued a report that identified concerns similar to the Board's. Specifically, CRESP found that there was uncertainty in PJM performance and that the absence of full-scale or near full-scale testing represented a large risk for the WTP program. The CRESP report presented DOE with thirteen recommendations that addressed topics of Board concern, e.g., large-scale testing, reliance upon



computational fluid dynamics modeling, functional performance specifications for inspecting and accessing vessel bottoms, heel removal needs and operating strategies, and criticality safety.

On October 7–8, 2010, the Board held a public hearing on WTP issues, of which one session focused on evaluating the state of the PJM design. In advance of the public hearing, the Board asked DOE to respond to written questions related to PJMs. These questions focused on the scope of integrated testing at larger scale and DOE's actions to address the concerns raised by CRESP. DOE provided written responses to the Board's questions on September 8, 2010, but did not provide insight into the scope or schedule of the large-scale testing. DOE's responses stated that the objectives and schedule for the large-scale testing were projected to be established by the end of calendar year 2010; this has since been revised to January 2011. DOE's response also stated that DOE and its contractors would address the recommendations from the CRESP report, but that schedules for addressing most of the recommendations had not yet been established.

The Board's written questions also asked DOE to describe each open safety issue related to PJM performance. DOE responded that the primary safety-related issue that remained open was associated with performance of the integrated mixing and transfer system, which includes the PJM mixing system and associated controls, the suction line, and the vessel sampling system. DOE did not identify any concerns related to accumulation of solids in WTP vessels.

In response to the questions posed by the Board, DOE included a response from Pacific Northwest National Laboratory (PNNL) providing its expert opinion on the adequacy of the PJM design. PNNL has performed considerable testing and analysis in support of the WTP mixing system design. PNNL noted in part:

- Phase 1 testing performed by PNNL predicted inadequate mixing in some vessels. The WTP project team subsequently changed the mixing criterion from complete off-bottom suspension to a bottom-clearing metric. This change represents a significant reduction of the mixing criterion.
- The WTP project team commissioned additional testing to this new criterion using waste simulants. PNNL has several concerns related to the simulants used in the WTP project team's tests, as the simulants were not necessarily physically representative or bounding of actual waste. PNNL expressed the concern that mixing performance observed in the WTP project team's tests may be better than actual plant performance.
- The current design lacks an adequate scaling basis to relate small-scale test results to full-scale plant performance. The scaling of the mixing, transfer system, and pump-down process is complex. The absence of an experimentally validated scaling basis for pump-down represents a significant weakness of the current design basis.

During the Board's public hearing, DOE and its contractors acknowledged the need for large-scale testing and committed to complete relevant portions of such testing before installing process vessels in the WTP Pretreatment Facility, which is currently under construction at the Hanford Site. DOE informed the Board that development of suitable waste simulants would

likely be the most time-consuming aspect of the preparations for large-scale testing. DOE's commitment to complete applicable portions of a large-scale testing program prior to installation of the Pretreatment Facility vessels is a positive development.

## **Unresolved Concerns**

The Board believes that the testing and analysis completed to date have been insufficient to establish, with confidence, that the pulse jet mixing and transfer systems will perform adequately at full scale. The Board's unresolved technical concerns are summarized below:

*Limitations of the small-scale testing program*—The small-scale testing program did not investigate the performance limits of the PJM design. Rather, it demonstrated that the mixing system met a reduced mixing criterion using simple simulant materials that were not fully representative of the characteristics of Hanford's high-level wastes. The testing program did not evaluate the entire range of WTP operating conditions, used non-prototypic equipment for much of the testing, and did not include multi-batch test runs to establish whether the mixing and transfer systems could operate for long periods under a variety of operating conditions. The program did not address the behavior of non-Newtonian wastes, such as the effects of variations of viscosity within a vessel, or the unique arrangement of PJMs in vessels containing these wastes. Pump-out testing did not include prototypic simulant or transfer system components, and lacked a well-established scaling basis. Large-scale testing would remedy this issue.

*Modeling of mixing performance*—Computer simulations of mixing performance, such as the Low Order Accumulation Model, have not been verified and validated, yet have been used to advance the WTP mixing design. DOE plans to use computer simulations in validating the final WTP mixing design and is working to verify and validate a computational fluid dynamics code (FLUENT) for this purpose. Any use of computer simulations must be technically defensible, and the limits of each computational fluid dynamics simulation need to be well understood to prevent potential safety issues from arising during operations.

*Waste characterization and feed certification*—The WTP safety strategy depends upon obtaining representative samples from the high-level waste feed tanks to support WTP's waste feed certification requirements, and from WTP process vessels to ensure safety-related criteria are met. This capability has not been demonstrated in the Hanford Tank Farms or WTP process vessels. Obtaining samples that are sufficiently representative to support bounding estimates of the composition and properties of both the solid and liquid fractions of the high-level waste is required in order to demonstrate that the WTP can be operated safely (e.g., prevent inadvertent criticality and plugging of transfer lines).

The WTP project team has altered its mixing performance criterion and made changes to the waste acceptance criteria, such as reducing the allowable solids concentration for WTP feed to address unfavorable mixing test results. DOE and its contractors have not yet been able to explain the full impact of these changes on DOE's ability to qualify WTP feed and process the entirety of Hanford's high-level waste using WTP. Additionally, DOE and its contractors have not been able to explain how representative samples from PJM-mixed tanks will be obtained.

*Planned WTP process vessel modifications*—DOE is planning to add capabilities for heel dilution, vessel pump-out, and visual inspection to address potential risks and uncertainties remaining from small-scale testing; however, the specifications for and capabilities of these systems have not been established.

*Limitations of PJM controller and instrumentation testing*—DOE has not performed PJM controller and instrumentation tests with a combination of (1) a prototypic simulant; (2) a full-scale PJM system driven by jet pump pairs; and (3) prototypic level/density instrumentation and controllers. Pretreatment Engineering Platform testing revealed that the level/density probes provided spurious data because of plugging and interference resulting from hydrodynamic pressures from the PJMs and transfer pumps. In addition, PNNL stated that the PJM controller testing performed in 2009 had several limitations and that “any extrapolation of the data above and beyond the scope of the present work should be done with extreme caution.”

## **Recommendation**

Therefore, the Board recommends that DOE:

1. Develop a large-scale test plan, including a schedule and milestones that addresses the issues raised by the Board in this recommendation, by CRESO in its letter reports addressing pulse jet mixing, and by PNNL. The objective of the test plan should be to define the limits of the WTP pulse jet mixing and transfer systems given the complete range of physical properties for the high-level waste stored in the Hanford Tank Farms. The elements of the test plan should include: (1) design of simulants; (2) design of the prototypic mixing systems, including PJM control and tank level control systems, and the transfer system for the large-scale test; and (3) criteria for review and interpretation of the large-scale test results. The test plan schedule should be constructed such that results from the testing can be used to inform WTP process vessel design decisions. The large-scale test platform must integrate the scaling of the mixing and transfer systems such that the scaling of the test platform is technically defensible.
2. Develop waste simulants for the mixing and transfer system testing that envelope the complete range of physical properties for the high-level waste stored in the Hanford Tank Farms. The simulant selection should include simulants representative of the waste’s Newtonian and non-Newtonian properties and particle shape, e.g., irregularly shaped simulant particles. The physical properties selected for each simulant must reflect uncertainties in the existing characterization of the high-level wastes.
3. Complete verification and validation of any computational models used by the WTP project team (e.g., Low Order Accumulation Model and FLUENT) based on the results from the large-scale testing.
4. Demonstrate the ability to obtain representative samples of the solids and liquids in all of WTP’s vessels, including demonstrating that representative samples can be obtained even if the assumed WTP design particle size or density is exceeded. This will ensure that the sampling system does not exclude large, dense particles and artificially bias the measured

particle size and density distribution. The representativeness of these samples must be statistically defensible and meet appropriate confidence limits given the significance of the safety-related issues in WTP.

5. Define the impact on the waste retrieval, feed delivery, and feed certification processes due to any limitations of the WTP mixing and transfer systems, and demonstrate the ability to obtain adequately representative samples from the waste feed tanks to ensure the WTP waste acceptance criteria can be reliably enforced.
6. Establish functional design criteria for the heel dilution, heel pump-out, and visual inspection functions, and demonstrate the capabilities and limits of these systems through the large-scale testing.
7. Identify the technical and safety-related risks that remain unresolved upon completion of the large-scale testing and establish suitable risk management strategies to ensure that each remaining risk will have little, if any, potential impact on DOE's ability to begin WTP operations safely and consistent with existing commitments.

In order to preclude unnecessary delay in the WTP project, the Board urges the Secretary to avail himself of the authority under the Atomic Energy Act (U.S.C. § 2286d(e)) to “implement any such recommendation (or part of any such recommendation) before, on, or after the date on which the Secretary transmits the implementation plan to the Board under this subsection.”

Peter S. Winokur, Ph.D., Chairman

## Appendix B: Recommendations Cited

Number	Date	Title
97-2	May 19, 1997	Continuation of Criticality Safety at Defense Nuclear Facilities in the Department of Energy
98-2	September 30, 1998	Safety Management at the Pantex Plant
2000-1	January 14, 2000	Prioritization for Stabilizing Nuclear Materials
2001-1	March 23, 2001	High-Level Waste Management at the Savannah River Site
2002-3	December 11, 2002	Requirements for the Design, Implementation, and Maintenance of Administrative Controls
2004-1	May 21, 2004	Oversight of Complex, High-Hazard Nuclear Operations
2004-2	December 7, 2004	Active Confinement Systems
2005-1	March 10, 2005	Nuclear Material Packaging
2007-1	April 25, 2007	Safety-Related In Situ Nondestructive Assay of Radioactive Materials
2008-1	January 29, 2008	Safety Classification of Fire Protection Systems
2009-1	July 30, 2009	Risk Assessment Methodologies at Defense Nuclear Facilities
2009-2	October 26, 2009	Los Alamos National Laboratory Plutonium Facility Seismic Safety
2010-1	October 29, 2010	Safety Analysis Requirements for Defining Adequate Protection for the Public and the Workers
2010-2	December 17, 2010	Pulse Jet Mixing at the Waste Treatment and Immobilization Plant



### Appendix C: Reporting Requirements

<b>Date</b>	<b>Addressee</b>	<b>Site or Topic</b>
January 6	Assistant Secretary for Environmental Management	Inadequate Pulse Jet Mixing, Hanford Waste Treatment and Immobilization Plant
January 7	Secretary of Energy	Implementation Plan for Recommendation 2001-1
January 25	Administrator, NNSA	W76 Mod 1 Components Joint Causal Factors Analysis
January 27	Administrator, NNSA	Tritium Process Station Readiness Assessment, Lawrence Livermore
March 12	Assistant Secretary for Environmental Management	Work Planning and Control Deficiencies, Hanford Tank Farms
March 15	Deputy Secretary of Energy	Status of DOE Standard 3009
April 29	Assistant Secretary for Environmental Management	Aging Management Integrated Facility Program, Savannah River Site
May 5	Assistant Secretary for Environmental Management	Quality Assurance, Hanford Waste Treatment and Immobilization Plant and across DOE Environmental Management Sites
May 5	Secretary of Energy	Directives Reform Initiatives
May 21	Administrator, NNSA	Z Machine Hazard Categorization, Sandia
May 21	Under Secretary of Energy and Chief Health, Safety and Security Officer	Deposition Velocity, Hanford Waste Treatment and Immobilization Plant, and Complex-wide Use of Default Values
June 14	Administrator, NNSA	Work Planning and Control Deficiencies, Lawrence Livermore
July 6	Administrator, NNSA	Hazard Analysis Reports Review, Pantex
July 16	Administrator, NNSA	Procedures for Safety Bases, Savannah River Site
August 5	Assistant Secretary for Environmental Management	Documented Safety Analysis, Hanford Tank Farms

**Reporting Requirements (cont.)**

August 5	Administrator, NNSA	Review of Criticality Experiments Facility, Nevada Test Site
August 6	Deputy Secretary of Energy	Design and Construction of Hanford Waste Treatment and Immobilization Plant
September 22	Assistant Secretary for Environmental Management	Electrical System and Electrical Safety Program, Waste Isolation Pilot Plant
September 23	Assistant Secretary for Environmental Management	Work Planning and Control Deficiencies, Hanford
October 22	Assistant Secretary for Environmental Management	Work Planning and Control Deficiencies, Waste Isolation Pilot Plant



## **Appendix D: Correspondence**

### **Hanford**

January 6 letter to the Assistant Secretary for Environmental Management establishing a 60-day reporting requirement addressing safety issues associated with inadequate pulse jet mixing.

March 12 letter to the Assistant Secretary for Environmental Management establishing a 90-day reporting requirement on work planning and control deficiencies.

May 5 letter to the Assistant Secretary for Environmental Management establishing a 60-day reporting requirement regarding quality assurance and safety concerns at the Waste Treatment Plant and across DOE Environmental Management Sites.

May 12 letter to the Assistant Secretary for Environmental Management expressing concern with the Independent Review Team's review of the Waste Treatment and Immobilization Plant.

May 21 letter to the Under Secretary of Energy and the Chief Health, Safety and Security Officer establishing a 120-day reporting requirement to develop a technically defensible basis for deposition velocity, to be used in accident calculations for the Waste Treatment and Immobilization Plant, and for complex-wide use of default values.

August 5 letter to the Assistant Secretary for Environmental Management establishing a 60-day reporting requirement to address deficiencies identified in the Documented Safety Analysis review.

August 6 letter to the Deputy Secretary of Energy establishing a 30-day reporting requirement to respond to questions in preparation for the October 7-8 public hearing and meeting.

August 26 letter to the Under Secretary of Energy and the Chief Health, Safety and Security Officer regarding acceptable deposition velocity for use in safety strategy calculations.

September 23 letter to the Assistant Secretary for Environmental Management establishing a 90-day reporting requirement on work planning and control deficiencies.

December 15 letter to Mr. Stang declining his request for interviews concerning the Waste Treatment and Immobilization Plant.

December 17 letter to the Secretary of Energy forwarding Recommendation 2010-2.

December 22 letter to the Assistant Secretary for Environmental Management regarding the design and safety basis of the Sludge Treatment Project.

### **Idaho National Laboratory**

September 23 letter to Mr. Sullivan acknowledging receipt and review of his letters asking the Board to initiate an investigation of health and safety matters at the Advanced Test Reactor.

### **Lawrence Livermore National Laboratory**

January 27 letter to the Administrator, NNSA, establishing a 60-day reporting requirement regarding hazard analysis and control, and conduct of operations deficiencies for the Tritium Process Station.

June 14 letter to the Administrator, NNSA, establishing a 90-day reporting requirement on work planning and control deficiencies.

### **Los Alamos National Laboratory**

January 6 letter to the Snake River Alliance, stating that its December 1, 2009 letter regarding Recommendation 2009-2 will be forwarded to the Department of Energy.

August 16 letter to the Administrator, NNSA, congratulating NNSA on the timely completion of repackaging plutonium-238 enriched materials.

September 29 letter to the Administrator, NNSA, acknowledging approval of the Critical Decision-1 milestone for the Transuranic Waste Facility project.

December 7 letter to the Administrator, NNSA, transmitting Board staff concerns regarding the Chemistry and Metallurgy Research Facility Documented Safety Analysis review.

December 17 letter to Secretary of Energy accepting the implementation plan for Recommendation 2009-2.

### **Nevada National Security Site**

August 5 letter to the Administrator, NNSA, establishing a 90-day reporting requirement regarding schedule and milestones, contractor support capability, and contractor and NNSA technical expertise at the Criticality Experiments Facility.

### **Oak Ridge National Laboratory**

October 1 letter to Dr. Snyder acknowledging receipt of correspondence regarding the safe, secure storage of uranium-233.

## **Pantex Plant**

July 6 letter to the Administrator, NNSA, establishing a 60-day reporting requirement regarding issues identified in the review of Hazard Analysis Reports for several nuclear explosive operations.

## **Sandia National Laboratories**

January 25 letter to the Administrator, NNSA, establishing a 30-day reporting requirement regarding components used in the W76 Mod 1 program, findings of the joint casual factors analysis, and actions being taken.

May 21 letter to the Administrator, NNSA, establishing a 45-day reporting requirement regarding technical justification for the current hazard categorization of the Z machine for plutonium isentropic compression experiments.

July 12 letter to the Executive Director, Citizen Action New Mexico, expressing appreciation for its March 3, 2010 presentation and May 27, 2010 correspondence.

## **Savannah River Site**

January 7 letter to the Secretary of Energy establishing a 60-day reporting requirement regarding the implementation plan for Recommendation 2001-1, delays in operation of a full-scale processing facility for salt waste, and associated risks.

January 20 letter to the Assistant Secretary for Environmental Management regarding fire protection and replacing aging equipment.

April 29 letter to the Assistant Secretary for Environmental Management establishing a 90-day reporting requirement regarding a schedule for completing known upgrades necessary to support the H-Canyon mission, and plans for evaluating and addressing age-related degradation.

May 27 letter to the Assistant Secretary for Environmental Management accepting a revised implementation plan for Recommendation 2001-1.

July 16 letter to the Administrator, NNSA, and the Assistant Secretary for Environmental Management establishing a 90-day reporting requirement regarding corrective actions to bring procedures into compliance with the requirements of 10 CFR Part 830, *Nuclear Safety Management*.

## **Waste Isolation Pilot Plant**

September 22 letter to the Assistant Secretary for Environmental Management establishing a 90-day reporting requirement regarding actions to address inadequacies in the electrical safety program, deficiencies related to the Motor Control Center, and other issues.

October 22 letter to the Assistant Secretary for Environmental Management establishing a 90-day reporting requirement on work planning and control deficiencies.

### **Y-12 National Security Complex**

March 15 letter to the Administrator, NNSA, requesting a briefing on the strategy for developing and implementing an independent, self-directed peer review process for the Uranium Processing Facility civil/structural analysis and design.

April 22 letter to the Secretary of Energy congratulating DOE, NNSA, Babcock & Wilcox Technical Services Y-12, and others who contributed to the design, construction, and startup of the Highly Enriched Uranium Materials Facility.

### **Other Correspondence**

January 6 letter to the Assistant Secretary for Environmental Management regarding Non-Destructive Examination Independent Review for exploring faster and improved inspection techniques for high-level waste tanks.

March 9 letter to Mr. Lewis thanking him for his contributions to the Board's mission.

March 15 letter to the Deputy Secretary of Energy establishing a 30-day reporting requirement regarding the regulatory status of DOE Standard 3009; and establishing a 60-day reporting requirement to provide site specific information on Standard 3009 implementation.

April 2 letter to Dr. McKamy, NNSA, recognizing him as the recipient of the *Victor Stello, Jr. Award for Safety Leadership*.

April 14 letter to the Secretary of Energy closing Recommendation 2002-1.

April 15 letter to the Secretary of Energy transmitting the Quarterly Report to Congress.

April 16 letter to Congress forwarding the Twentieth Annual Report to Congress.

April 29 letter to the Secretary of Energy transmitting the Twentieth Annual Report to Congress.

May 5 letter to the Secretary of Energy establishing a 15-day reporting requirement to clarify the specific criteria to be used to analyze, cancel, consolidate, and strengthen directives.

May 26 letter to the Secretary of Energy accepting the revised implementation plan for Recommendation 2009-1.

June 10 letter to the Administrator, NNSA, thanking him for his testimony at the May 12, 2010 public meeting and hearing.

June 10 letter to the Chief of Nuclear Safety thanking him for his testimony at the May 12, 2010 public meeting and hearing.

June 10 letter to the Chief Health, Safety and Security Officer thanking him for his testimony at the May 12, 2010 public meeting and hearing.

July 1 letter to the Secretary of Energy expressing concern with commitment 5.3.2 of the implementation plan for Recommendation 2008-1 regarding DOE Standard 1066.

July 16 letter to the Assistant Secretary for Environmental Management regarding changes made to the Hydrogen in Pipes and Ancillary Vessels Independent Review Team charter.

July 16 letter to the Secretary of Energy congratulating Mr. McAnulty as the recipient of the 2009 Department of Energy Safety System Oversight Annual Award.

July 26 letter to the Secretary of Energy congratulating Mr. Krepps as the 2009 Department of Energy Facility Representative of the Year.

July 27 letter to the Secretary of Energy informing the Department of Energy of a Board investigation into health and safety concerns and requiring preservation of material information.

September 3 letter to the Secretary of Energy forwarding the quarterly Report to Congress on the Status of Significant Unresolved Issues with the Department of Energy's Design and Construction Projects.

September 10 letter to the Secretary of Energy forwarding the first periodic Report to Congress on Infrastructure Needs in the Department of Energy's Aging Defense Nuclear Facilities.

October 29 letter to the Secretary of Energy forwarding Recommendation 2010-1.

December 7 letter to the Deputy Secretary of Energy regarding NNSA's initiative to remove health and safety requirements from management and operating contracts at defense nuclear facilities.

December 30 letter to the Secretary of Energy forwarding the quarterly Report to Congress on the Status of Significant Unresolved Issues with the Department of Energy's Design and Construction Projects.