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

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700 Washington, D.C. 20004-2901
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April 29, 2010

Mr. Mark B. Whitaker, Jr.
Departmental Representative to the DNFSB
U. S. Department of Energy
1000 Independence Avenue, SW
Room 3G-092
Washington, DC 20585

Dear Mr. Whitaker, Jr.,

The Defense Nuclear Facilities Safety Board (Board) is pleased to enclose a printed copy of its Twentieth Annual Report to Congress which describes the Board's health and safety activities relating to the Department of Energy's defense nuclear facilities during the calendar year 2009.

Sincerely,

Peter. S. Winokur, Ph.D.
Chairman

Enclosure: as stated

TWENTIETH ANNUAL REPORT TO CONGRESS

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

APRIL 2010

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April 16, 2010

To the Congress of the United States:

The Defense Nuclear Facilities Safety Board is pleased to submit to Congress its Twentieth 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 2009, assesses improvements in the safety of defense nuclear facilities, and identifies remaining health and safety problems.

Respectfully submitted,

Peter S. Winokur
Chairman

John E. Mansfield
Vice Chairman

Joseph F. Bader
Member

Larry W. Brown
Member

Jessie H. Roberson
Member

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 18 defense nuclear facilities (this does not include projects currently on hold or deferred) with a total project cost of about $20 billion, including $12.2 billion for the Hanford Waste Treatment Plant. The Board believes it is critical that outstanding safety issues associated with defense nuclear projects are resolved early in the design phase.

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Responses to Congressional Direction

Certification of Chemistry and Metallurgy Research Replacement Project

The Duncan Hunter National Defense Authorization Act for Fiscal Year 2009, Public Law 110-417, enacted a limitation on funding for the Chemistry and Metallurgy Research Replacement project at Los Alamos National Laboratory until the Board and the National Nuclear Security Administration (NNSA) each certify that certain design issues reported by the Board have been resolved. The pertinent language reads as follows:

> Sec. 3112. Limitation On Funding For Project 04-D-125 Chemistry And Metallurgy Research Replacement Facility Project, Los Alamos National Laboratory, Los Alamos, New Mexico. Of the amounts appropriated pursuant to an authorization of appropriations in this Act or otherwise made available for fiscal year 2009 for Project 04-D-125 Chemistry and Metallurgy Research Replacement (in this section referred to as "CMRR") facility project, Los Alamos National Laboratory, Los Alamos, New Mexico, not more than $50,200,000 may be made available until (1) the Administrator for Nuclear Security and the Defense Nuclear Facilities Safety Board have each submitted a certification to the congressional defense committees stating that the concerns raised by the Defense Nuclear Facilities Safety Board regarding the design of CMRR safety class systems (including ventilation systems) and seismic issues have been resolved; and (2) a period of 15 days has elapsed after both certifications under paragraph (1) have been submitted.

The Board submitted its certification report to Congress on September 4, 2009. The Board applied significant resources toward accomplishing this certification, consuming about 6,500 hours of Board and staff effort. Working with NNSA, the Board identified specific concerns and the actions necessary to resolve them prior to certification. As discussed in detail in the Board's certification report, NNSA has revised or agreed to revise the preliminary design, design requirements, and design processes to address the Board's concerns. NNSA has also committed to implement detailed designs during final design consistent with the design requirements agreed to as part of the certification review. The Board will continue to review the facility design as it develops to ensure that it remains consistent with the commitments made by NNSA. The certification is discussed further in Section 4.6 of this report.

Waste Treatment Plant Project at Hanford

The Senate Armed Services Committee offered the direction below in regard to the Board's review of the Waste Treatment Plant:

> The committee is aware of a design review that EM is carrying out at the Waste Treatment Plant (WTP) at the Department of Energy Hanford Site in Richland, Washington. The purpose of this review is to simplify the operations of the pretreatment facility. One aspect of the review is a reassessment of the material at risk (MAR), to determine if the level of radioactivity in the waste to be treated is in fact as high as was previously assumed. This review will also look at the application of the integrated safety

management process and determine if certain of the safety systems could be downgraded, if the MAR is modified. The EM office is currently developing a schedule to review, modify, and approve the MAR, the pre-treatment plant design revision, the equipment design modification, and a plan for procurement, fabrication, and installation of equipment. Simplification of operations is a laudable goal but the Committee is very concerned about this entire process and the possibility that in the long run the changes made could reduce operational or environmental safety, complicate long term operations, and possibly increase the overall cost of the WTP or delay the schedule for the waste treatment plant. The Committee notes that EM has recently committed to take a more cautious approach than originally planned and will use an independent review panel to look at the technical, safety, near- and long-term operational effects, and cost and schedule implications of any changes or revisions.

The Defense Nuclear Facility Safety Board (DNFSB), as the statutory review body for operational nuclear safety at DOE defense nuclear facilities, must also have adequate time to review fully all aspects of this process, including all documents and the results of all studies, including the results of the independent review before any changes are adopted or implemented. Only after complete review will the DNFSB be in a position to make a recommendation on the advisability of any proposed changes or modifications. The Committee expects this whole process to be carried out expeditiously but also thoroughly and expects to be kept informed by both DOE and the DNFSB as the effort progresses.

(Senate Report 111-35, *National Defense Authorization Act for Fiscal Year 2010,* July 2, 2009, p. 252.)

Sincc late 2008, when DOE began to modify the safety strategy based on changes in radiological inventory and control of hydrogen in pipes, the Board has endeavored to work with and advise DOE on potential safety issues associated with these proposals. The Board made these reviews a priority so these issues would be resolved expeditiously, with minimal cost and schedule impact to the project.

However, DOE has continued to approve changes related to the classification and design of safety-related systems and components without fully resolving these issues, preferring to grant conditional approval in areas involving significant technical uncertainty. In its approval of the safety design strategy for hydrogen in pipes, DOE assessed the uncertainties associated with the unresolved issues and concluded that design and procurement could proceed. The Board does not share DOE's confidence that these technical issues will be readily resolved without impact to the facility's design.

The Board is continuing to work with DOE to resolve these issues and arrive at a defensible path forward. The Board has kept Congress informed of its safety concerns by briefings for committee staff and by Quarterly Reports (described immediately below). Section 4.3 of this report provides details of the Board's oversight activities for the Waste Treatment Plant during 2009. See also the Outstanding Safety Issue Titled "Changes in Safety Design for the Hanford Waste Treatment Plant" below.

Periodic (Quarterly) Reports

The Board has provided to Congress periodic reports 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 for defense nuclear facilities. The Board intends to continue issuing these reports to DOE and Congress. The Board issued three periodic reports covering calendar year 2009, in addition to the certification report on the Chemistry and Metallurgy Research Replacement project at Los Alamos National Laboratory.

Summary of the Board's Accomplishments in 2009

The nuclear weapons program operated by DOE and 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, including tritium production; and research, development, manufacturing, and testing.

As a result of the Board's efforts during 2009, 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 weapons 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 weapons 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. NNSA implemented measures to improve the flowdown of safety-related requirements into procedures, the procedure validation process, and the level of detail in technical procedures. (Board letter dated October 15, 2009; staff-to-staff meetings)

- The Board found deficiencies in safety basis actions and documentation, including inadequate detail in technical safety requirements. In 2008 and 2009, NNSA reviewed the safety basis documentation, implementation, and level of detail in technical safety requirements. In a related effort, NNSA evaluated whether administrative controls needed to be recategorized per DOE Standard 1186-2004, *Specific Administrative Controls.* (Board letter dated July 30, 2007)

- The Board identified the need to reduce uncertainties and mitigate lightning hazards. During 2009, NNSA utilized subject matter experts from Pantex and the nuclear weapons laboratories to evaluate and disposition potential lightning protection issues. The Board engaged experts in the field of lightning effects to validate the analyses. (Board letter dated March 30, 2007)

- The Board expressed concern that NNSA had allowed W76-1 assembly operations to continue for several months using a nuclear safety component that did not meet military requirements. When the possible consequences of this course of action were understood, NNSA suspended these operations and conducted a causal factors analysis of this event. (Board letter dated January 25, 2010)

- The Board encouraged NNSA to continue diligent oversight of the development of technical data for use in the safety basis. (Recommendation 98-2, *Safety Management of the Pantex Plant*; Board letter dated December 16, 2008)

- The Board urged NNSA to perform overdue master studies essential to verifying the continued adequacy of nuclear explosive facilities and operations. During 2009, NNSA completed the last of five overdue master studies. (staff-to-staff meetings)

- The Board found that the quality and fidelity (realism) of weapon trainer units had degraded over time. Pantex evaluated approximately half of its weapon system trainers and completed upgrades on two W88 trainer units. (Board letter dated July 8, 2008)

Y-12 National Security Complex (Section 2.1.2):

- In response to the Board's position that regular assessments of operations in the aging 9212 Complex were needed, NNSA completed its annual assessment and provided a report and briefing to the Board of results and actions taken. (Board letter dated March 13, 2007; NNSA briefing March 2009)

- The Board identified deficiencies in nuclear criticality safety evaluations for the Highly Enriched Uranium Materials Facility; certain credible abnormal conditions for operations were not analyzed, and other aspects of the evaluations were not consistent with the governing DOE standard. In response, NNSA took action to revise criticality safety evaluations and review evaluations at other Y-12 facilities for similar problems. (Board letter dated January 23, 2009).

- The Board pointed out the need for improvements in activity-level planning and

controlling of hazardous work. NNSA took action to correct deficiencies noted by the Board. (Board letter dated January 22, 2009)

- In response to Board concerns with operational errors and inconsistencies in procedure use during hazardous operations, NNSA developed and implemented formal use requirements (e.g., reader-worker, continuous use, reference as needed) for nuclear operating procedures. (staff-to-staff meetings)

- In response to the Board's concern with degradation of concrete from chemical leaks in the 9204-2E facility, NNSA carried out a test plan to assess the extent of degradation. The results are under review. (staff-to-staff meetings)

- To prevent recurrence of fire suppression system degradation from freezing weather, the Board urged NNSA to revise the Y-12 freeze protection protocols. In response, NNSA revised the protocols to clearly define freeze protection responsibilities and preplan facility-specific actions to be taken during the onset of freezing weather. (staff-to-staff meetings)

Los Alamos National Laboratory (Sec. 2.2.1):

- On October 26, 2009, the Board issued Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*, to bring about a reduction in risk to workers and the public. (Board letters dated January 13, 2009, April 21, 2009; Recommendation 2009-2)

- The Board found problems with the storage of plutonium-238 in the vault water bath at the Plutonium Facility. Many of the containers lacked manufacturing information and data on the contents to determine whether the materials were stored safely. In response, the laboratory developed a plan to repack or overpack all questionable containers into robust packaging by June 2010. (Board letter dated April 7, 2009; staff-to-staff meetings)

- The Board continued to follow closely the laboratory's ability to respond to fires and other emergencies. NNSA responded to a Board letter with a schedule and plan to implement the improvements identified in the 2008 Baseline Needs Assessment. (Board letter dated December 8, 2008)

- In response to the Board's concern that prolonging operations in the 55-year-old Chemistry and Metallurgy Research facility is a serious safety risk, NNSA commenced a plan to reduce the material-at-risk by relocating some activities to its Plutonium Facility (Technical Area 55). The Board reviewed the laboratory's proposed safety basis for operations beyond 2010, identified inconsistent or inadequate assumptions in the safety analysis, and pointed out opportunities to improve safety by further reducing material at risk. (staff-to-staff meetings)

- The Board conducted a review of nuclear criticality safety to assess the sufficiency of corrective actions following the resumption of fissile material operations in the

Plutonium Facility. No significant issues were identified. (staff-to-staff meetings)

- The Board observed three Integrated Nuclear Planning meetings focused on Technical Area-55 programs, facilities and projects, and enduring waste management. These planning meetings encouraged by the Board continue to contribute value and improve coordination between NNSA and the laboratory. (staff-to-staff meetings)

- The Board closely monitored laboratory efforts to restart the Weapons Engineering Tritium Facility, which ceased operations in October 2008. The laboratory identified several additional deficiencies during the year and startup has slipped to 2010. (staff-to-staff meetings)

- The Board reviewed the processes used at the activity level to plan and control hazardous work. Deficiencies were identified in work planning and control directives, defining roles and responsibilities for work planning, hazard analysis processes, and document control. The Board issued a letter requesting a report on actions planned to correct the identified deficiencies. (Board letter dated December 2, 2009)

- The Board continued to closely monitor progress at the Plutonium Facility with the implementation of Recommendation 2004-2, *Active Confinement Systems*, and efforts to evaluate the feasibility of seismically qualifying the fire suppression and ventilation systems. On October 26, 2009, the Board issued Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*, to bring about a reduction in risk to workers and the public. (Board letters dated January 13, 2009, April 21, 2009; Recommendations 2004-2 and 2009-2)

- Concerns raised by the Board have led to increased NNSA and laboratory management attention and improved performance metrics and criteria for assessing the implementation of these important safety programs. To this end, the laboratory contractor carried out a formality of operations initiative intended to achieve compliance with DOE requirements and contractual obligations. In 2009, the laboratory declared as successful the implementation of core elements of these programs in most facilities. (staff-to-staff meetings)

Lawrence Livermore National Laboratory (Sec. 2.2.2):

- The Board assessed the readiness to start the newly-installed Tritium Process Station and determined opportunities existed for significant improvement of the safety basis, control set, and conduct of operations. NNSA is evaluating the Board's concerns. (Board letter dated January 27, 2010)

- Following a glovebox overpressurization excursion in late December 2008, the Board has monitored development and implementation of corrective actions at the Radioactive and Hazardous Waste Management facilities. (staff-to-staff meetings)

- The Board evaluated the software quality assurance program associated with the "Collaborative Authorization Safety-Basis Total Lifecycle Environment" document intended for use with safety bases at Pantex. The Board found the processes used for the development of this software meet DOE requirements, with some opportunity for improvement. (staff-to-staff meetings)

Nevada Test Site (Sec. 2.2.3):

- The Board identified occupational safety improvements at G-Tunnel for the facility to be used for disposal of an improvised nuclear device. The Board continued to stress the need for implementing operational safety controls. (Board letter dated December 7, 2006; staff-to-staff meetings)

Sandia National Laboratories (Sec. 2.2.4):

- The Board noted continued improvement in safety basis documentation during its reviews in 2009. The Board reviewed the facility hazard categorization of the Z Machine, where the laboratory plans to perform isentropic compression experiments involving plutonium in 2010. (Board letter dated September 27, 2004; staff-to-staff meetings)

- The Board continued to follow Sandia's work on electrostatic discharge and lightning hazards for nuclear explosive operations at Pantex. (Board letter dated March 30, 2007; staff-to-staff meetings)

Nuclear Material Processing and Stabilization

The Board reviewed DOE activities to stabilize remnant materials from past nuclear facility operations, package and store those materials, and place them for disposal in approved waste repositories. The Board also monitored DOE's efforts to deactivate and decommission retired nuclear facilities. The scope of these activities expanded considerably this year due to the infusion of funds from the Recovery Act.

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 closely monitored DOE's work and focused reviews on careful work planning, safe operations, electrical safety, 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):

- The Board reviewed DOE's continuing evaluations of and upgrades to aging facilities such as H-Canyon, HB-Line, and L-Area, to ensure continued safe operation. The Board also conducted in-depth reviews of the new documented safety analysis in development for H-Canyon and provided DOE with feedback to increase facility safety. (staff-to-staff meetings)

- The Board identified electrical safety deficiencies in the H-Canyon and HB-Line facilities. DOE is working to address these problems. (Board letter dated February 6, 2009)

- The Board provided feedback to DOE on emergency preparedness and work practices during restart of transuranic waste operations at F-Canyon. (staff-to-staff meetings)

- In response to a Board letter noting weaknesses in the Tank 48 waste treatment project, DOE took action to comply with the DOE Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets*, and to perform an evaluation of the confinement ventilation system. (Board letter dated March 5, 2009)

- The Board noted the lack of appropriate DOE oversight of the maintenance programs for safety systems. DOE began hiring more oversight personnel and approved the contractor's maintenance implementation plan. (Board letter dated March 18, 2009)

- In response to Board inquiries, DOE completed a more thorough inspection for corrosion in the walls of Tank 29. While the inspection did not reveal significant corrosion or other tank integrity problems, the Board pointed out uncertainties in corrosion mechanisms and limitations with the current tank inspection techniques, and for that reason suggested to DOE that further research and development of inspection techniques would be valuable. (Board letters dated September 4, 2008, and January 6, 2010; staff-to-staff meetings)

- The Board continued to monitor DOE's efforts to implement Recommendation 2001-1, *High-Level Waste Management at the Savannah River Site*. DOE continued small-scale salt waste processing and responded to the Board's request for updated commitments to complete other waste processing initiatives. (Recommendation 2001-1; Board letter dated March 31, 2009)

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

- The Board identified an inadequacy in overpressure protection for a new pump used to transfer waste from double-shell tank AN-101. In response to Board input, DOE developed effective compensatory measures that provided an adequate and independent layer of protection. (staff-to-staff meetings)

- The Board continued to follow deactivation and decommissioning work at the Plutonium Finishing Plant. The Board reviewed hazard evaluations and controls for chemicals used

to decontaminate equipment at the facility. As a result of the Board's involvement, the contractor put in place additional controls to protect facility workers. (staff-to-staff meetings)

- The Board observed conceptual design activities for the Sludge Treatment Project, including alternatives analysis, a technical readiness assessment, and value engineering sessions. In response to Board inquiries, DOE improved project management practices, and project personnel submitted a new Project Execution Plan and Safety Design Strategy. (staff-to-staff meetings)

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, the number of design and construction projects under the Board's jurisdiction has substantially increased. DOE has undertaken design and construction projects with a projected total cost of about $20 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):

- In March 2009, DOE revised the confinement ventilation system design and fire protection features to protect the high-efficiency particulate air filters from the effects of fire. DOE subsequently provided the Board a supplement to the ventilation system evaluation previously submitted in response to Recommendation 2004-2. The Board now believes that the confinement ventilation design is adequate. (Quarterly Reports to Congress dated June 22, 2009, and December 7, 2009)

- DOE provided summary structural reports demonstrating the adequacy of the reinforced concrete design for the High-Level Waste and Pretreatment facilities. The Board reviewed these reports and now considers the design of the reinforced concrete portions of the facilities adequate. (Quarterly Report to Congress dated December 7, 2009)

- The Board reviewed the adequacy of the structural steel design of the facilities and found that the analytical models used to support the design did not reflect the as-designed facility configuration. The Board informed DOE that the adequacy of the structural steel design should be evaluated to determine if design changes are required, and requested a report that presents DOE's assessment of the issues identified by the Board. (Board letter dated December 2, 2009)

- The Board reviewed proposed changes to the safety basis of the Pretreatment facility resulting from assuming a reduced radiological inventory in the facility. The Board found

that the contractor made unrelated changes to its analyses that may have 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 accidental releases associated with leaks and spills, and the need to credit the safety function of the primary confinement boundary of process systems. (Quarterly Report to Congress dated December 7, 2009; staff-to-staff meetings)

- The Board reviewed proposed revised strategies for control of hydrogen that would allow explosions to occur in the plant. Based on comments from the Board, DOE agreed that system piping and components in the inaccessible black cells in the Pretreatment facility and piping larger than 4 inches in diameter in hot cells would be designed to prevent hydrogen explosions. The Board is continuing to evaluate DOE's evolving strategy for controlling hydrogen in smaller piping in hot cells. (Quarterly Report to Congress dated June 22, 2009; staff-to-staff meetings)

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

- The Board pointed out deficiencies in the analysis of the facility's ability to resist natural phenomena hazards. DOE issued summary structural reports that show the building meets structural design requirements. (Quarterly Report to Congress dated December 7, 2009)

- As a result of reviews by the Board, DOE took action to improve the procedures and quality control associated with the concrete and rebar used in the facility. (staff-to-staff meetings)

- Testing accomplished by Idaho National Laboratory demonstrated that the hydrogen generation rate assumed in the facility design adequately bounds the cumulative hydrogen generation rate, including the effect of thermolysis. (Quarterly Report to Congress dated June 22, 2009)

- The Board found the structural analysis of process piping inadequate with regard to potential flammable gas explosions. Heat generated in process vessels during mixing must be considered in calculations used to establish requirements for purge air flow rate and high-temperature interlocks. (Board letter dated February 10, 2009; Quarterly Report to Congress dated June 22, 2009; staff-to-staff meetings)

- The Board concluded that the design of the confinement ventilation system does not implement or demonstrate equivalency to DOE Standard 1066-99, *Fire Protection Design Criteria*, for protection of final high-efficiency particulate air filters. (Board letter dated February 10, 2009; Quarterly Report to Congress dated June 22, 2009; staff-to-staff meetings)

- The Board's review revealed that the design of the facility does not ensure that all operator actions necessary after an earthquake can be readily accomplished. Non-conservative assumptions were used in calculating heatup of the process vessel following

a loss of cooling. (Board letters dated February 10, 2009, and October 15, 2009; Quarterly Report to Congress dated June 22, 2009; staff-to-staff meetings)

- In response to Board findings, DOE improved practices for commercial-grade dedication, traceability of requirements, software quality assurance, and assessment of suppliers, and is working on design features and software to enhance the instrumentation and control system. (Board visits; staff-to-staff meetings)

- The Board reviewed the design, testing, and controls for the air pulse agitators and concluded that given appropriate controls and operational parameters, the agitators can fulfill the functions assumed in the safety basis. (Board letter dated October 15, 2009; staff-to-staff meetings)

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

- The Board found deficiencies in controls for hydrogen and chemicals in the preliminary documented safety analysis. NNSA directed project personnel to correct these deficiencies and modify the preliminary documented safety analysis. The Board considers the issue closed. (Quarterly Report to Congress dated June 22, 2009)

Y-12 National Security Complex - Highly Enriched Uranium Materials Facility (Sec. 4.5):

- During construction, significant honeycombing and large voids were discovered in the concrete structure. This problem necessitated demolition of portions of the facility. The Board brought in outside experts to review the results of the nondestructive evaluation of the remaining concrete problems. The Board's review concluded that the remaining areas of honeycombing do not compromise the strength of the structure. (staff-to-staff meetings)

- The Board evaluated substantial problems in quality assurance in the procurement and installation of safety class storage racks and other safety related equipment. In response, NNSA evaluated quality assurance requirements and implementation and is now taking actions to improve quality assurance at the site. (staff-to-staff meetings)

- The Board reviewed startup testing of safety-significant systems for secondary confinement and electrical distribution. The Board concluded that the test plans captured functional requirements for the systems and that the facility has a formal, robust process to review and approve test acceptance criteria, procedures, and results. (staff-to-staff meetings)

- The Board questioned the adequacy of the water supply to the facility's safety-significant fire suppression system. In response, NNSA proposed configuration control of the water supply as a near-term measure until the system can be tied into a new safety-significant water supply to be constructed for the Uranium Processing Facility. The Board accepted this approach. (Board letter dated February 6, 2008; staff-to-staff meetings)

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

- The Board challenged the design approach and technical adequacy of the geotechnical and structural engineering work. The Board is working with NNSA to resolve these deficiencies. (staff-to-staff meetings)

Los Alamos National Laboratory (Sec. 4.6):

- The Board's review of the preliminary design and draft preliminary documented safety analysis for the Chemistry and Metallurgy Research Replacement project uncovered weaknesses in safety strategy and selection of safety controls. Congress directed the Board to submit a certification regarding whether its concerns raised had been resolved by NNSA. The Board submitted its certification report to Congress as required. (Board certification report to Congress dated September 4, 2009)

- The Board reviewed the enhanced preliminary design of the Radioactive Liquid Waste Treatment Facility Upgrade Project; the review revealed that previously-identified problems with integration of the safety and design processes and weak DOE and NNSA oversight remain unresolved. (Board letter dated February 6, 2009)

- The Board found inadequate integration of safety into the conceptual design of the Transuranic Waste Facility. The Board noted inconsistencies between controls identified in the conceptual design package and the preliminary safety basis, the ability of the design to meet required safety functions, the lack of engineered controls for worker protection, and the thoroughness of the required independent review of nuclear safety. (Quarterly Report to Congress dated February 9, 2009)

Idaho Cleanup Project (Sec. 4.8):

- The Board reviewed the design of the safety instrumented system for the Integrated Waste Treatment Unit and identified concerns with the strategy for a fire in the granular activated carbon bed. (staff-to-staff meetings)

Nevada Test Site (Sec. 4.9):

- The Board evaluated the condition assessment and proposed improvement plan completed by NNSA to address numerous, long-standing deficiencies in the fire suppression system at the Device Assembly Facility. The Board stated its concern with the level of commitment and emphasis by NNSA and with the potential for an administrative measure to serve as a long-term substitute for a reliable engineered control. (Board letter dated July 28, 2009)

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 2009, 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.

- On July 30, 2009, the Board issued Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities*. The Board recommended that DOE develop policy and guidance documents to govern the development and application of quantitative risk assessment in the defense nuclear complex. (Recommendation 2009-1, Section 5.3.4)

- DOE developed revised guidance for 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*. (Board letter dated April 19, 2007; Section 5.3.7)

- DOE continues to accomplish on schedule the implementation plan for Recommendation 2007-1, *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*. DOE conducted state-of-practice reviews for nondestructive assays this year at the three sites (Savannah River, Y-12, and Hanford) per the implementation plan. (Recommendation 2007-1, Section 5.3.8)

- DOE made commitments to repackage a large number of containers of heat source plutonium at Los Alamos National Laboratory to mitigate vulnerabilities identified by the Board. This effort is on track to be completed by June 2010. (Board letter dated April 7, 2009; Section 5.1.7)

- DOE completed a four-year corrective action plan to correct weaknesses in federal technical capability. (Recommendation 2004-1; Section 5.1.3)

- DOE transmitted draft guidance on performing verification reviews of the implementation of safety basis controls for defense nuclear facilities. This transmittal directed field offices to compare site practices to the draft guidance and make appropriate adjustments. (Board letter dated February 5, 2008)

- DOE reaffirmed the central role of integrated safety management in protecting the public, the environment, and workers in conducting its missions at defense nuclear facilities. (Board Public Meeting, November 24, 2009; 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. DOE has directed these field elements to provide an updated status on the implementation of Recommendation 2002-3, *Requirements for the Design, Implementation, and Maintenance of Administrative Controls*. (Recommendation 2002-3; Section 5.3.1)

Outstanding Safety Problems of Defense Nuclear Facilities

Safe Retrieval, Handling, and Stabilization of Nuclear Materials

DOE manages a large inventory of nuclear materials that have been declared surplus to national security needs or are otherwise no longer needed. More materials are being added to this inventory for a number of reasons: Cold War era programs are ending, old nuclear facilities are being decommissioned, and work funded by the Recovery Act uncovers or produces additional wastes.

DOE has defined the disposition paths for many of its excess nuclear materials, but some materials have no defined disposition path. Previously planned disposition paths may change. For many materials, DOE's preferred method of disposition is chemical processing through the H-Canyon facility at the Savannah River Site. This facility and its now-deactivated sister facility F-Canyon have successfully provided a safe disposition path for large quantities of spent nuclear fuel and other special nuclear materials. However, it is not clear to the Board that operating H-Canyon through the end of its planned lifespan in 2019 will be sufficient to process DOE's entire inventory of surplus nuclear materials that have no other disposition path. DOE will need to provide maintenance resources until H-Canyon is ultimately deactivated and carefully consider how long H-Canyon can operate safely.

DOE is also responsible for managing and disposing of tens of millions of gallons of high-level waste held in underground storage tanks. Both the Hanford and the Savannah River sites face challenges in retrieving the waste and transferring it to treatment plants to immobilize the waste 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 very dense wastes that make pumping difficult. DOE needs to continue research and development efforts to improve waste retrieval and treatment.

The Board finds commendable the efforts of the High-Level Waste Corporate Board to integrate and coordinate waste handling and treatment among the many DOE contractors. Because of uncertainties in the characteristics of the high-level waste, in retrieval technologies, and in the eventual treatment approaches, DOE must plan to prolong the life of aging tanks. 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. To promote the success of these programs, the Board continues to emphasize the need for improved understanding of corrosion mechanisms and in-tank conditions, definition of optimum chemistry for corrosion control, and enhanced inspection techniques for the tanks.

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 (55 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 relocating 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, both of these facilities have been delayed from original projections and will face continued 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 build replacement facilities quickly or, in the case of the Chemistry and Metallurgy Research building, find alternative means of accomplishing mission-related work.

Changes in Safety Design for the Hanford Waste Treatment Plant

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

DOE described the changes in the assumed feed material as based on a more realistic, but still conservative, estimate of the radiological properties of the waste to be treated. The Board has no objection to such a change. However, 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 believes the assumptions and technical justification for these changes are not adequate.

The original approach to controlling hydrogen in pipes and ancillary vessels would have prevented the occurrence of hydrogen explosions except in a very limited set of circumstances and required that the primary confinement boundary (piping) be designed to withstand the explosions, thereby preventing a release of radioactive material. DOE and its contractor presented revised 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 piping in hot cells; the piping may be permanently deformed but will not be allowed to rupture.

The Board believes this 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 approach instead relies on the facility structure and ventilation system to prevent the release of material to the environment. The Board considers such an approach inconsistent with DOE Order 420.1B, *Facility Safety*, and with the principle of defense-in-depth.

DOE is engaged in a determined effort to analyze the effects of explosions in small diameter pipe, relying on both experiments and quantitative risk assessment techniques. This effort is being undertaken to provide a technical basis for a design approach that is inconsistent with industry design code practices.

These changes are being contemplated at a very late stage in the Waste Treatment Plant project and are being pursued with great urgency. DOE's prevailing attitude that substantial reductions in safety-class controls are essential 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 evolving changes proposed by DOE, and expects this workload to continue for the foreseeable future.

Safety Initiatives Requiring Increased Management Focus and Staff Support

DOE accomplished a wide variety of safety improvements across the defense nuclear complex during 2009. 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 and staff support. The most prominent of these stalled initiatives are summarized below:

- **Recommendation 2004-1:** The Board conducted a public hearing on November 24, 2009, and plans to hold follow-up hearings in 2010. Three areas are languishing and need management attention:

  (a) Little progress was made in response to the sub-recommendation on nuclear safety research and development. DOE conducted a Nuclear Safety Research and Development Forum in February 2009, but the projects presented were severely underfunded in 2009.

  (b) DOE is more than two years behind schedule in issuing a guide to complement Order 226.1A, *Implementation of Department of Energy Oversight Policy.*

  (c) NNSA is lagging 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*, has been a particular concern.

- **Independent Validation Reviews:** In response to a letter issued by the Board on February 5, 2008, DOE transmitted in 2009 draft guidance on independent validation reviews for safety basis controls to its sites with defense nuclear facilities. However, by year's end, progress in adjusting site practices was uneven and progress to finalize and issue the guidance had stalled.

- **Safety-Related Fire Protection Systems:** The Board issued Recommendation 2008-1, *Safety Classification of Fire Protection Systems*, on January 29, 2008, because DOE lacked definitive guidance on the design requirements for fire protection systems used in safety applications. The first major deliverable, interim guidance on sprinkler systems, was delivered more than a year late in early 2010. DOE is expected to transmit this guidance for project use in early 2010.

- **Policy on Risk Assessment Methodologies:** The Board issued Recommendation 2009-1 on July 30, 2009, because DOE had failed to issue a policy governing the use of risk assessment methodologies at defense nuclear facilities. The recommendation was necessitated by four years of delay after the Board first highlighted the need for such a policy.

Each of these complex-wide safety initiatives requires consistent and visible leadership from a central authority to drive implementation. The Board feels that these actions have lost momentum because leadership is lacking at the headquarters level. DOE possesses sufficient resources to do the work; the problem is one of priorities.

During the coming year, the Board will reemphasize that implementation plans developed by DOE and approved by the Board are Secretarial commitments and must receive commensurate management attention and staff support.

1. Introduction

This Annual Report summarizes the Board's work during calendar year 2009. 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 2009-1 and 2009-2, Appendix B lists all recommendations cited in this report, Appendix C lists all reporting requirements sent to DOE in 2009, and Appendix D contains a complete list of the Board's 2009 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 twenty 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 52 formal recommendations, comprising 237 individual sub-recommendations. In that same period of time, the Board has issued 226 reporting requirement letters and held 97 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:

- 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 2009, 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. Specific issues include shortcomings in the procedure validation and review process, a lack of time spent by engineers in operating areas, and the inadequate flowdown of certain safety-related requirements into procedures. NNSA briefed the Board on the actions to be taken in response to the letter; the Board will continue to monitor NNSA's progress.

Safety Basis. In a letter dated July 30, 2007, the Board identified several faults in Pantex safety basis actions and documentation, including an inadequate level of detail in the wording of some technical safety requirements. In 2008, Pantex declared the safety basis fully implemented, but recognized the need to periodically re-examine the basis documentation, implementation, and level of detail in the wording of technical safety requirements. By December 2008, NNSA began these reviews and, in a related effort in 2009, began assessing all administrative controls for possible re-categorization to be consistent with DOE Standard 1186-2004. The Board is reviewing the progress of this initiative and its impact on the Pantex documented safety analysis.

W76 Activities. NNSA started W76-1 operations in 2007. However, operations were suspended in May 2008 due to safety-related findings by a hazard analysis team. NNSA pursued an intense effort from May to August 2008 to develop and justify controls to address the identified hazards. On August 8, 2008, the Board issued a letter detailing concerns with the process NNSA used to authorize restarting W76 nuclear explosive operations following the safety-related work suspension. The Board was concerned with the processes used to develop the technical basis for new controls and the use of administrative controls for new operations.

NNSA responded to the concerns raised in the Board's letter and issued a clear plan for controlling W76 operations as they were restarted. NNSA committed to review all similar operations for the hazards that caused the work suspension on the W76. As a result of these reviews, a similar control scheme was implemented for W78 operations.

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 for operations at Pantex. In a letter dated January 25, 2010, the Board expressed concern that NNSA had allowed W76-1 assembly operations to continue for several months using a nuclear safety component that did not meet military requirements. NNSA will conduct a causal factors analysis of this event.

Lightning Protection. The Board has worked with NNSA for the last several years to characterize and control potential lightning threats to nuclear explosive operations. NNSA applied resources to understand and mitigate the potential threat from direct effects of a lightning strike. The Board issued a letter on March 30, 2007, identifying work needed to mitigate the indirect effects of a lightning strike. NNSA responded by forming the Nuclear Weapons Complex Electromagnetic Committee to analyze both lightning and electrostatic discharge hazards.

The committee is addressing the Board's concerns systematically and, in turn, improving the understanding of lightning safety at Pantex. In 2008, the committee concluded lightning-induced concrete spalling is not a concern in Pantex nuclear or nuclear explosive facilities. In 2009, testing for intrinsic bonding in nuclear explosive facilities was initiated in an effort to verify the absence of voltages on engineered bonds that could compromise lightning standoff. In addition, Los Alamos National Laboratory and Lawrence Livermore National Laboratory made progress in characterizing the response of lightning-sensitive components to indirect lightning effects. The Board has engaged experts in the field of lightning effects to verify the committee's analyses.

Quality of Safety-Related Information. The final outstanding commitment in the implementation plan for Recommendation 98-2, *Safety Management at the Pantex Plant*, concerns the need for further guidance on weapon response to accident environments. In 2008, Los Alamos National Laboratory, Lawrence Livermore National Laboratory, and Sandia National Laboratories issued implementation plans for DOE Standard NA-3016-2006, *Hazard Analysis Reports for Nuclear Explosive Operations.*

Based on progress in improving the quality of safety-related information, the Board issued a letter on December 16, 2008, closing Recommendation 98-2 but encouraging NNSA to continue diligent oversight of the development of technical data for use in the Pantex safety basis. The Board will review the implementation of the DOE standard at each laboratory.

Nuclear Explosive Safety. In 2009, the Board evaluated nine nuclear explosive safety studies, operational safety reviews, or nuclear explosive safety change evaluations conducted at Pantex, including a master study of support activities. Completion of the master study closes a finding from 2005 that identified potential gaps between general operations and those covered in weapon-specific studies.

In its letter closing Recommendation 98-2, the Board stated its concern that recent nuclear explosive safety studies for operations at Pantex suggest NNSA is struggling with maintaining a sound nuclear explosive safety program. Of particular concern is the interface between the safety study groups and NNSA management. In response to the Board's letter, NNSA reviewed the outcomes of recent safety studies, operational safety reviews, and change evaluations, to gain insight into the effectiveness of the nuclear explosive safety function within NNSA. NNSA subsequently held workshops to develop criteria for categorizing shortcomings identified by the safety studies and to better ensure that pre-start and post-start findings were properly identified.

Revised Nuclear Explosive Safety Directives. In response to changes in operational and organizational realities, as well as observations communicated by the Board, NNSA published revised nuclear explosive safety directives, including DOE Order 452.1D, *Nuclear Explosive and Weapon Surety Program*, and DOE Order 452.2D, *Nuclear Explosive Safety*. The Board worked with NNSA to ensure the Board's concerns were addressed and improvements from the last four years of effort were adequately captured.

Training and Qualification. Following a review of training and qualification procedures, the Board issued a letter on July 8, 2008, noting concerns with the NNSA program for maintaining the fidelity (realism) of weapon trainer units and with the cessation of design agency training for Pantex employees on specific weapon critical skills. NNSA responded by incorporating weapon trainer units into the NNSA weapon provisioning process, which will ensure that parts needed to maintain weapon trainer units at the highest possible fidelity are identified and available when needed. The Pantex contractor also developed its own weapon education courses. In 2009, Pantex evaluated approximately half of its weapon system trainers and completed upgrades on two W88 trainer units.

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.

Enriched Uranium Operations. 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.

Over 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 2009, NNSA completed its second 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 include continuing to reduce the amount of nuclear material-at-risk, completing maintenance and equipment upgrades, and achieving Critical Decision-1 for a line-item project that will fund facility improvements while a proposed replacement facility, the Uranium Processing Facility, is being designed and constructed.

Criticality Safety. On January 23, 2009, the Board sent a letter to NNSA expressing concern over the nuclear criticality safety evaluations for the Highly Enriched Uranium Materials Facility at Y-12. The Board noted that some credible abnormal conditions for operations were not analyzed and that upset conditions deemed unlikely were not analyzed as required by the governing DOE standard for such evaluations. The Board requested a briefing on corrective actions taken or planned including results of any extent-of-condition reviews for these problems conducted for other facilities at Y-12.

In response, NNSA briefed the Board in April 2009. Progress had been made to correct the criticality safety evaluations and initiate other criticality safety program improvements. During the briefing, NNSA was questioned on its plan to include only a sample of the active criticality safety evaluations in the scope of its extent-of-condition reviews. Upon further reflection, NNSA committed to review all active criticality safety evaluations over the next year.

Work Planning and Control. The Board reviewed the processes used at the activity level to plan and control hazardous work. The review evaluated these processes against the Integrated Safety Management core functions and guiding principles defined in DOE Policy 450.4, *Safety Management System Policy.* Areas for improvement were identified in hazard analyses, work scope definition, and procedure development. The Board delineated these deficiencies in a letter to NNSA dated January 22, 2009. The Board determined that actions taken by NNSA to correct the noted deficiencies resulted in improved work planning processes and execution.

Conduct of Operations. In 2008, following operational errors and inconsistencies in procedure use during hazardous operations, the Board observed that NNSA's procedure use expectations (e.g., reader-worker, continuous use, reference as needed) were defined by first-line supervisors rather than being more formally defined. To address Board concerns, NNSA developed and implemented new protocols in 2009 that call for the procedure use expectation to be determined by appropriate management and clearly incorporated into each nuclear operating procedure.

Building 9204-2E Structure. 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 the concrete degradation. In September 2009, in accordance with an inspection plan, NNSA extracted concrete core samples from a region of high chemical exposure in the slab. NNSA completed testing the concrete core samples in November and is currently documenting the test data. The Board will review the results and encourage NNSA to conduct future inspections to monitor the condition of the concrete slabs.

Freeze Protection Program. In 2008 and 2009, fire suppression systems in nuclear facilities were compromised during periods of extended freezing weather. The Board found that action was needed to improve freeze protection. Specifically, the Board urged NNSA to clearly define freeze protection responsibilities for operations managers of nuclear facilities and to preplan facility-specific actions to be taken during the onset of freezing weather (e.g., verifying actuation of heaters). NNSA has revised applicable site procedures to incorporate these improvements, and facility-specific plans and checklists were developed.

Building 9212 Electrical Safety. The Board found that comprehensive short-circuit, voltage profile, and coordination studies for Building 9212 had not been developed by NNSA in accordance with Institute of Electrical and Electronics Engineers standards. These calculations are essential to safeguard personnel and maintain a safe and reliable power system. The Board urged NNSA to perform the electrical calculations associated with these studies and to correct any identified deficiencies. In response, NNSA has completed the majority of these calculations, and they are currently under review by the Board.

Highly Enriched Uranium Materials Facility. The Board observed NNSA's Operational Readiness Review for startup of this facility. Operations will involve receipt, re-containerization, and storage of enriched uranium. At year's end, NNSA was addressing the findings from the review. The Board will follow resolution of the findings to support safe startup.

2.1.3 Savannah River Site - Tritium Operations

In 2009, the Board conducted reviews of conduct of operations and work planning and control at the Savannah River Site's tritium facilities. As a part of the conduct of operations reviews, the Board noted that an increase in rupture disc failures in process systems indicated the need for improved conduct of operations. The Board has also been tracking improvements in the documented safety analysis for the tritium extraction facility. The contractor has accepted comments in each of these areas and made appropriate improvements.

2.1.4 Nuclear Material Packaging

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 2009, the Board provided oversight of DOE's efforts to qualify containers meeting the requirements of Manual 441.1-1, *Nuclear Material Packaging Manual*. Although some work has been done, DOE has yet to qualify any containers. The Board evaluated DOE's final complex-wide implementation schedule and found that it adequately prioritizes the risk-based packaging of items at those sites listed, but that implementation plans for low-risk items at Y-12 and some items at other sites have not yet been developed.

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 2009, the Board focused its oversight on formality of operations, the Plutonium Facility, fire and emergency response, the Chemistry and Metallurgy Research facility, nuclear criticality safety, safety systems, efforts to restart the Weapons Engineering Tritium Facility, and work planning.

Recommendation 2009-2. The decade-old safety basis for the Plutonium Facility credited a passive confinement strategy instead of active confinement ventilation as a safety-class control to protect the public from postulated accidents. As part of DOE's implementation plan for the Board's Recommendation 2004-2, an evaluation of the facility's confinement strategy was conducted, along with a parallel effort to develop a new safety basis for the facility.

The Board issued a reporting requirement on this subject on January 13, 2009. In its June 16, 2009 response, NNSA asserted that some modifications identified as needed in the confinement ventilation evaluation may not be necessary to meet the overall safety strategy and goals set out in the documented safety analysis.

This analysis showed that the mitigated offsite consequences of a seismically-induced large fire would greatly exceed DOE's evaluation guideline for a passive confinement strategy. As a result, the Board issued Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*, on October 26, 2009. The Board recommended that DOE implement near-term actions and compensatory measures to achieve a significant reduction in the potential consequences of seismically-induced events involving the Plutonium Facility. The Board further recommended that DOE develop and implement a safety strategy for seismically-induced events that includes the following elements:

- A technically justifiable decision logic and criteria for evaluating and selecting safety class structures, systems, and components that can effectively prevent or mitigate the consequences to acceptably low values.

- The seismic approach for structures, systems, and components required to implement the seismic safety strategy.

- A prioritized plan and schedule for seismic analyses, necessary upgrades, and other actions to implement the seismic safety strategy.

Chemistry and Metallurgy Research Facility. In response to the Board's safety concerns about prolonging operations in the 55-year-old Chemistry and Metallurgy Research facility, NNSA commenced a plan to reduce the material-at-risk by relocating some activities to a more robust facility. The laboratory continued decontamination efforts in Wings 2, 3, and 4, restricting programmatic work only to Wings 5, 7, and 9. In May 2009, the Board reviewed the laboratory's proposed safety basis for operations beyond 2010, identified inconsistent or inadequate assumptions in the safety analysis, and pointed out opportunities to improve safety by further reducing material-at-risk. The laboratory is revising the proposed safety basis.

Plutonium Facility - Vault Water Bath and Heat Source Plutonium. The Board followed up on its previously-identified concerns about the ability of the Plutonium Facility's Vault Water Baths to provide adequate protection for stored heat source plutonium during a loss of cooling water event. The Board noted that about 200 non-safety class containers, many without reliable design information, may over-pressurize during a loss of cooling water event, causing container failure and release of material. The Board issued a letter on April 7, 2009, establishing reporting requirements for immediate and long-term actions to improve the safety posture. The laboratory commenced a campaign to address containers of concern by either overpacking them in robust safety class containers or introducing them into gloveboxes and venting them to eliminate over-pressurization concerns. Approximately 40 containers were vented and 60 were overpacked in 2009, with the remaining scheduled for completion by June 2010.

Tritium Facility Restart. Programmatic activities at this facility were shut down in October 2009, following the Board's identification of deficiencies in maintaining vital safety systems and implementing technical safety requirements. The laboratory identified additional inadequacies in the facility's pressure safety program. The Board closely followed the plans and preparations for restart throughout the year to ensure the laboratory met its internal requirements as well as DOE Order 425.1C, *Startup and Restart of Nuclear Facilities*. The discovery of additional problems has delayed facility restart until 2010. NNSA has directed that a federal operational readiness review will be conducted.

Integrated Nuclear Planning. The Board found that NNSA had no formal mechanisms for ensuring that design requirements and interfaces for pit manufacturing at the laboratory were appropriately managed and controlled. In response to this finding, NNSA developed an Integrated Nuclear Planning process to improve coordination among its projects. In 2009, the Board observed three integrated nuclear planning meetings focused on Plutonium Facility programs, facilities and projects, and enduring waste management. These meetings contribute value and improve coordination between NNSA and the laboratory.

Fire and Emergency Response. NNSA responded to the Board's letter of December 8, 2008 on the status of implementing a baseline needs assessment. NNSA reported that significant progress was achieved by the laboratory in 2009 in training, fire pre-plans, and exercises conducted by the Los Alamos Fire Department. A performance based incentive was added to the site contract for fiscal year 2010 to encourage building on these initial efforts.

Formality of Operations. In an October 16, 2007 letter, the Board identified the need for NNSA to focus on rapidly improving deficiencies in safety systems. As part of its response, NNSA has bolstered management attention and added personnel to the formality of operations initiative, which aims to improve the conduct of engineering, operations, maintenance, and training. The laboratory continued to make progress in 2009, declaring core implementation of all elements of formality of operations, except for conduct of maintenance and engineering at the Weapons Engineering Tritium Facility and conduct of engineering at the Plutonium Facility, which are scheduled to be complete in 2010 and 2011, respectively.

Nuclear Criticality Safety. The Board reviewed the adequacy of corrective actions taken in response to deficiencies identified in fissile material handling that led to the cessation of operations in the Plutonium Facility in 2007. No significant issues were discovered during this review.

Work Planning. The Board reviewed the processes used at the activity level to plan and control hazardous work at both the Plutonium Facility and the Radioactive Liquid Waste Treatment Facility. Deficiencies were identified in the laboratory's work planning and control directives, defining roles and responsibilities for work planning, hazard analysis processes, and document control. These shortcomings have resulted in procedures and maintenance work packages that do not adequately stipulate the controls and instructions necessary to ensure worker safety. The Board issued a letter on December 2, 2009, requesting a report on actions planned to correct the identified deficiencies.

2.2.2 Lawrence Livermore National Laboratory

Lawrence Livermore National Laboratory, located 45 miles southeast of San Francisco, California, is a nuclear weapons 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 2009, the Board conducted reviews of software quality assurance, startup of the Tritium Process Station, improvements to radioactive and hazardous waste operations, and emergency management.

Software Quality Assurance. The Board reviewed the laboratory's quality assurance program for the Collaborative Authorization Safety-Basis Total Lifecycle Environment software that is currently undergoing validation at the Pantex Plant. This software is intended to streamline and standardize the safety basis process through automated configuration management processes, and to improve assembly, disassembly, and inspection throughput efficiencies through multi-site data exchange and collaboration. The Board's review found that, although opportunities for improvement exist, the laboratory's practices comply with DOE Order 414.1C and the implementation plan commitments for the Board's Recommendation 2002-1, *Quality Assurance for Safety-Related Software*.

Tritium Process Station. The Tritium Process Station will provide enhanced tritium handling capability to a variety of customers including the National Ignition Facility. The Board

observed readiness assessment activities associated with this new capability and concluded that there were opportunities for significant improvement in the safety basis control set and conduct of operations associated with the station. Specifically, the Board does not believe the hazard analysis adequately characterized some accident scenarios involving tritium, leading to inadequate controls to protect facility workers. Some of these issues stem from weaknesses in the existing safety basis for the Tritium Facility. NNSA is evaluating the Board's concerns.

Improvements to Waste Management Operations. The Board monitored improvements in operational controls resulting from a glovebox overpressurization incident in December 2008. In the facilities of concern, hazardous, transuranic, low-level, mixed, combined, and nonhazardous industrial wastes are handled and stored. Inquiries performed by the laboratory contractor following the 2008 incident identified significant weaknesses in the facility's safety basis and its implementation, as well as in many key safety management programs such as conduct of operations, radiation protection, and training. Corrective actions have targeted improvements to the work control process, personnel changes, and safety basis improvements. NNSA also self-identified weaknesses in its oversight of these facilities and has begun making improvements. The Board will continue to follow the implementation of these corrective actions and evaluate their effectiveness.

2.2.3 Nevada Test Site

The Nevada Test Site is located in southern Nevada, about 75 miles northwest of Las Vegas. Stockpile activities at the site include test readiness preparations, planning for the disposition of damaged nuclear weapons, and subcritical experiments. Underground testing of nuclear weapons is no longer being conducted; however, the site is maintained in a state of readiness should national security requirements demand the resumption of underground testing. The Board seeks to ensure that testing, if resumed, will be done safely. During 2009, the Board focused its attention on the Device Assembly Facility 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 for facility modifications and modification of the critical assembly machines. In 2009, the Board reviewed construction activities and the re-build and testing of the four machines. The Board will evaluate startup activities in 2010.

G-Tunnel. The Board continued to stress the need to identify and accomplish safety upgrades for the G-Tunnel facility, which is to be used in disposing of an improvised nuclear device. NNSA is developing a plan for implementation of safety controls and upgrades appropriate to the scope of operations at the facility. The Board expects the new plan to be available in 2010. As a result of the Board's interactions and discussions in 2009, NNSA continued to complete some facility improvements and implement the results of the cost/risk benefit analysis of the proposed controls and improvements. Improvements in 2009 focused on significant occupational safety issues, for example, tunnel ventilation. The Board expects NNSA to address operational safety issues in 2010.

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.

In 2007, the laboratory completed implementation of a safety basis improvement project to resolve the underlying deficiencies and implemented a safety basis operations schedule. The Board noted continued improvement during its reviews in 2008 and 2009. In 2010, the Board will review a revised documented safety analysis being prepared in support of planned materials disposition activities at the Auxiliary Hot Cell Facility. Other planned activities for 2010 that the Board will review include on-site transportation of Hazard Category-3 material and plutonium isentropic compression experiments on the Z-machine.

The Board has also been examining the support Sandia National Laboratories give to nuclear explosive operations at the Pantex Plant, particularly in regard to electrostatic discharge and lightning hazards. The focus for 2010 will be on safety-related aspects of significant finding investigations and weapon response information used in Pantex hazard analysis reports.

3. Nuclear Materials Processing and Stabilization

3.1 Stabilization and Storage of Remnant Materials

3.1.1 Complex-Wide Program

DOE and NNSA manage a large inventory of nuclear materials that have been declared surplus to national security needs and are no longer required in active programs. These materials include plutonium metal, plutonium oxides, spent nuclear fuel, enriched uranium, and other special nuclear materials. DOE's and NNSA's contractors continue to add to this surplus inventory by ending Cold War era programs, decommissioning old nuclear facilities, and uncovering or producing additional wastes during work funded by the Recovery Act.

One example of newly excess material comes from the Idaho National Laboratory, where DOE recently dismantled the Zero Power Physics Reactor. In its wake remain more than 250,000 unirradiated or slightly irradiated fuel plates totaling several hundred metric tons of material. Most of the plates are made of depleted uranium metals and oxides, and DOE may dispose of these plates as low-level waste. However, DOE must also find a disposition path for more than 20,000 fuel plates and pins made of plutonium metals, oxides, and alloys totaling more than one metric ton of plutonium.

As DOE declares or identifies excess materials, it must also safely characterize, package (or repackage), and store the materials pending disposition. The Board continues to advise that DOE complete implementation of safe packaging practices, per the Board's Recommendation 2005-1, *Nuclear Material Packaging.*

DOE has defined the disposition paths for many of its excess nuclear materials, but some materials have no defined disposition path. Other previously planned disposition paths may change. For many materials, DOE's preferred method of disposition is chemical processing. DOE must carefully align its declared and future inventory of surplus nuclear materials with options for decommissioning the few aging facilities capable of chemical processing to ensure the availability of an adequate nuclear materials disposition path.

Nuclear Material Stabilization. DOE continues to pursue stabilization activities prompted by the Board's Recommendation 2000-1, *Prioritization for Stabilizing Nuclear Materials*. Five commitments remain open under the implementation plan: one at Hanford and four at Los Alamos National Laboratory. DOE originally intended to complete stabilization of all materials identified under the recommendation by December 2009, but this schedule has been delayed. DOE has requested an extension for the Hanford commitment from November 2009 to December 2015. Los Alamos has not officially notified the Board regarding its progress towards completing its commitments; however, realistic plans for facility use suggest that these stabilization activities will not be completed until 2013.

Nuclear Materials Consolidation, Storage, and Disposition. DOE is responsible for consolidating and disposing of many metric tons of excess nuclear materials that have been declared surplus to national security needs. These materials, which include plutonium, uranium,

neptunium, and spent nuclear fuel, can pose significant hazards if not stored, shipped, and disposed of properly. In 2009, DOE issued Order 410.2, *Management of Nuclear Materials*, and the NNSA established a new Office of Nuclear Material Integration. The Board provided comments on the order and continues to review DOE's implementation of associated requirements.

H-Canyon Operations. DOE continues to rely heavily on the H-Canyon (including HB-Line) facility at the Savannah River Site for the disposition of nuclear materials. The Board notes that this aging facility is the only option for the processing of some materials, including certain plutonium and highly-enriched uranium materials, other actinides, and aluminum-clad spent nuclear fuel. DOE is planning to operate and maintain the H-Canyon facility through 2019. Processing and disposition of all the nuclear materials in DOE's inventory having no other viable disposition path may not be possible by that date. Given the uncertain situation regarding the disposition of a large inventory of nuclear materials, DOE needs to carefully consider the lifespan over which H-Canyon can operate safely. H-Canyon remains DOE's only operational large chemical processing capability. Before prematurely reducing infrastructure support or terminating operations at H-Canyon, DOE must assure that all DOE's nuclear materials have a disposition path. A comprehensive listing of all DOE's hazardous nuclear materials and a plan linked to the facility necessary for each item's disposition do not exist today. Without such a resource loaded disposition plan, the Board believes it would be premature for DOE to decommission H-Canyon.

3.1.2 Plutonium

Plutonium Stabilization, Los Alamos National Laboratory. Three material types remain to be stabilized under Recommendation 2000-1: weapons grade plutonium, plutonium materials in large vessels, and plutonium-bearing scrap materials. DOE continues to make progress in risk reduction by repackaging some of these materials into sturdier containers, awaiting stabilization at a later date when aqueous processing capability is fully restored. Many of these items are stored in containers not suitable for long-term storage and therefore warrant stabilization or repackaging on a priority basis. The expected completion date for these efforts is 2013, well past the 2009 date in the implementation plan for Recommendation 2000-1. The Board continues to provide close oversight of storage conditions and stabilization efforts.

Plutonium Consolidation and Disposition, Savannah River Site. Savannah River Site's K-Area continues to receive and store plutonium from across the defense nuclear complex, particularly from Hanford, and the Los Alamos and Lawrence Livermore National Laboratories.

DOE's plan for this plutonium includes several disposition paths. The first is processing plutonium through Savannah River Site's H-Canyon for transfer to the site's high-level waste tanks, followed by vitrification in high-level waste glass 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. Material not suited for either of these pathways may be disposed of as transuranic waste. In addition, 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.

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. DOE has started implementing an Integrated Facility Aging Management Program that unites programs such as system health reports, maintenance, equipment performance monitoring, and structural integrity. DOE completed reviews of several major H-Canyon systems in 2009, identifying needed repairs and replacement parts. The Board reviewed both the evaluation process and DOE's actions taken to address deficiencies. The Board informed DOE of electrical deficiencies at H-Canyon and HB-Line; DOE is working to remedy these deficiencies.

The Board continued its focus on conduct of operations and emergency preparedness at H-Canyon. Several significant operational events occurred this year, leading DOE to drive improvements in operational discipline. The Board is reviewing these efforts and has provided feedback to DOE regarding new operator training sessions.

3.2 Stabilization of Spent Nuclear Fuel

3.2.1 Idaho National Laboratory

The Board has been monitoring the safe transfer of spent nuclear fuel between facilities at the Idaho National Laboratory for many years. Fuel transfers from wet basin storage to dry storage were approximately 82 percent complete by December 2009. DOE plans to complete the remainder by 2012.

Transfers of spent nuclear fuel between the Idaho National Laboratory and the Savannah River Site are proposed by DOE to avoid building more than one packaging and handling facility at each site. DOE plans to ship its aluminum-clad fuel to Savannah River Site and ship stainless steel-clad and zircaloy-clad spent nuclear fuel to the Idaho National Laboratory. Transfers are scheduled to begin in 2011; however, no funding has been provided. DOE plans to hold a National Spent Fuel Program Strategy meeting in spring 2010 to discuss options; members of the Board's staff will attend.

3.2.2 Savannah River Site

DOE plans to start processing spent fuel stored at the Savannah River Site in 2010. The Board is reviewing DOE's preparations at H-Canyon and L-Area needed to support this activity. The Board reviewed the new documented safety analysis for H-Canyon and provided feedback to DOE. This documented safety analysis will authorize the processing of spent fuel in the canyon. The Board also began reviews of plans for shipments of spent fuel out of L-Area and improvements to site infrastructure needed to support these transfers.

3.2.3 Hanford Site

DOE continues to store approximately 30 cubic meters of radioactive sludge, including corrosion products of spent nuclear fuel, in the K-West Basin at Hanford. This sludge and small

pieces of fuel scrap are the only material at Hanford within the scope of Recommendation 2000-1 remaining unstabilized. DOE continued to develop the Sludge Treatment Project to remove the sludge and treat it for disposal. The project warrants a high priority because the K-West Basin is aging and not suitable for long-term storage of the sludge.

The Board has scrutinized design activities, including analysis of alternatives, a technical readiness assessment, and value engineering sessions. DOE conducted an external technical review in March 2009, resulting in approval of the recommended design approach. Project personnel also submitted a new project execution plan and safety design strategy.

3.3 Waste Management

3.3.1 High-Level Waste

Hanford. The high-level waste storage tanks at Hanford contain millions of gallons of radioactive waste that DOE plans to vitrify for eventual disposal. DOE plans to use some of these tanks until at least 2045. Radioactive waste is currently being transferred from 149 older, single-shell tanks to 28 newer, double-shell tanks to reduce the environmental risk.

Tank Integrity. DOE conducts tank integrity programs for both types of tanks. The Board evaluated DOE's structural and leak assessment of the single-shell tanks and found the proposed actions to extend the tank lives 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 tank walls to measure general corrosion, pitting, and cracks. The Board reviewed these programs and encouraged DOE to continue laboratory and in situ testing of corrosion mechanisms related to the high-level waste tanks.

Safety Basis. The Board reviewed an inadequacy in pressure-relieving devices for a new pump used to transfer waste from double-shell tank AN-101. Without adequate pressure relieving devices, a pump overspeed accident could cause a pipe rupture and radiological exposure to workers. To compensate for the impaired pressure relief function, DOE planned to rely on the pump's variable frequency drive. This plan was inconsistent with DOE requirements, because the variable frequency drive lacked the requisite safety pedigree to ensure it would reliably perform this safety function. In response to Board input, DOE developed effective compensatory measures that provide an adequate and independent layer of protection for the pumping operation.

Effectiveness of Corrective Actions. The Board conducted several reviews of the effectiveness of corrective actions for emergency management, the electrical distribution system, and the maintenance management program. DOE updated its emergency planning hazard assessment, completed the necessary modifications for design deficiencies in the electrical distribution system, and improved the effectiveness of the maintenance program. The Board reviewed these actions and found them to be satisfactory.

Work Planning and Conduct of Operations. The Board reviewed work planning processes at the activity level and conduct of operations at the Hanford Tank Farms. The Board

found that the work planning processes included numerous inconsistencies with the guidance of DOE Policy 450.4, *Safety Management System Policy*. DOE 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. The Board continued to observe instances of procedure noncompliance and poor oral communications. The Board is working with DOE to improve this unsatisfactory situation.

Savannah River Site. DOE stores millions of gallons of radioactive waste in large underground storage tanks at the Savannah River Site and operates several facilities to prepare the waste for permanent disposal. The Board performed several oversight activities of DOE efforts to manage this waste.

Implementation of Board Recommendation 2001-1. Recommendation 2001-1 addressed safety risks associated with the management of high-level waste at the Savannah River Site. The Board expressed continuing concern for delays in waste processing activities as noted in its letter to DOE dated March 31, 2009. In September 2009, DOE submitted a revised implementation plan for the recommendation that reflected long delays in two key efforts: treating wastes in Tank 48 and startup of the Salt Waste Processing Facility. The Board continued to work with DOE to mitigate the risks associated with these delays.

Tank 48 Organic Waste Processing. The Board followed closely DOE's efforts to design a process for treating wastes containing organic materials in Tank 48. In response to a March 5, 2009 Board letter that noted several project weaknesses, DOE took action to ensure compliance with DOE Order 413.3A and to perform an evaluation of the confinement ventilation system for the proposed treatment facility. In June 2009, DOE confirmed the fluidized bed steam reforming process as the preferred treatment process for Tank 48. In 2009, DOE demonstrated the selected process in a test facility. However, the project has been subject to delays of more than five years. The Board has expressed concern over the risks caused by delay.

Integrity of High-Level Waste Tanks. The Board reviewed the integrity program for the high-level waste tanks with a continued focus on ultrasonic testing. In response to a Board letter dated September 4, 2008, DOE issued a revised Tank Inspection Plan and completed a more thorough inspection of Tank 29. The inspection did not reveal any significant corrosion or other tank integrity problems. The chemistry control program for tank waste implemented at the site appears to control tank corrosion. The Board found that there are uncertainties in understanding the corrosion mechanisms and limitations with the current tank inspection techniques and suggested in a January 2010 letter to DOE that further research and development of inspection techniques would be valuable. The Board continues to engage DOE regarding research and development of new tank inspection techniques to improve DOE's tank integrity programs.

Maintenance Program. The Board found that DOE had not reviewed the contractor's maintenance implementation plan since February 2000, contrary to DOE requirements that mandate review and approval of the plan every two years. In response, DOE reviewed and approved the revised maintenance implementation plan.

Tank Closure. The Board observed mechanical waste removal from Tanks 18 and 19, and chemical waste removal from Tanks 5 and 6. The Board also monitored DOE's efforts to recover from the failure of mechanical cleaning equipment in some of the tanks.

Idaho National Laboratory. DOE previously stored high-level wastes in eleven large (300,000 gallon) and four small (30,000 gallon) underground tanks. The Board monitored DOE's continuing efforts to clean and close its high-level waste tanks at Idaho. By the end of 2007, DOE had emptied and grouted seven of the large tanks and all four small tanks. Three of the four remaining large tanks contain 900,000 gallons of sodium-bearing waste that is to be treated by a steam reforming process at the Integrated Waste Treatment Unit, now under construction. The fourth large tank is a spare and not currently in use. DOE estimates that treatment of remaining waste may be completed by 2012.

Work Planning and Control. The Board reviewed the processes used at the activity level to plan and control hazardous work at Idaho. The review evaluated these processes against the guidance of DOE Policy 450.4. Deficiencies were identified in hazard analyses and implementation of controls to ensure worker safety. The Board observed that DOE oversight had not been effective at identifying and correcting these deficiencies. The Board issued a letter dated March 23, 2009, requesting a report on actions planned to correct the identified deficiencies. In response to the Board's letter, DOE has made improvements in both work planning processes and the oversight of these activities.

3.3.2 Low-Level and Transuranic Waste

National Transuranic Waste Program. DOE manages large quantities of transuranic wastes at many sites and has been retrieving these wastes for shipment to the Waste Isolation Pilot Plant for disposal since 1999. The Board evaluated DOE's efforts to package and ship transuranic wastes at various sites across the complex. The Board also monitored the activities of the DOE Transuranic Waste Corporate Board as DOE developed and began to implement plans to utilize funds from the Recovery Act. DOE used these funds to accelerate the recovery, characterization, and shipment of transuranic wastes to the Waste Isolation Pilot Plant for disposal.

Savannah River Site. The Board provided oversight of transuranic waste operations at the Savannah River Site's Solid Waste Management Facility and F-Canyon. The Board reviewed preparations for the restart of transuranic operations at F-Canyon and provided DOE with feedback to improve emergency preparedness and work practices.

Oak Ridge National Laboratory. The Board verified that characterization and packaging of remote-handled transuranic waste at the Transuranic Waste Processing Center was performed safely. In early 2009, DOE began shipments of remote-handled transuranic waste to the Waste Isolation Pilot Plant. The Board also reviewed the planning and initial implementation of cleanup and waste management activities funded by the Recovery Act at both the Transuranic Waste Processing Center and the laboratory's main campus.

Idaho Cleanup Project.

Advanced Mixed Waste Treatment Project. DOE's largest effort to retrieve and repackage transuranic waste at the Idaho Cleanup Project takes place at the Advanced Mixed Waste Treatment Project. The Board continues to provide close oversight of the activities there. As of December 2009, DOE had shipped more than 30,000 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.

Accelerated Retrieval Project. DOE operates a smaller facility to retrieve transuranic wastes buried at the Idaho Cleanup Project: the Accelerated Retrieval Project. The Board has toured the project several times to monitor operations. DOE completed retrieval of "targeted" transuranic wastes from burial grounds covered by the first three temporary structures of the project. A fourth facility has been constructed and will begin operation in January 2010. A fifth facility is under construction.

Remote-Handled Waste. DOE applied Recovery Act funds to a new project at Idaho to repackage remote-handled transuranic wastes. The project involves the repackaging of 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 project and plans to examine carefully the radiological controls to be used. Significant worker hazards exist due to dose rates as high as 1,000 rad/hr on contact with some containers. The contractor completed its readiness assessment in December 2009 and identified several pre-start findings. The DOE readiness assessment began in late January of 2010.

Waste Isolation Pilot Plant. During 2009, DOE disposed of more than 900 shipments of contact-handled transuranic waste at the Waste Isolation Pilot Plant. This represented a total volume in excess of 6,500 cubic meters. Remote-handled transuranic waste operations consisted of 108 shipments totaling 61 cubic meters. The Board verified that both contact-handled and remote-handled transuranic waste operations were conducted safely. The Board's emphasis was on reversing negative trends in conduct of operations and resolving problems identified in the radiological control program. The Board also performed a review of the site's electrical systems and electrical safety program, noting some minor deficiencies that facility managers committed to correct.

3.4 Facility Deactivation and Decommissioning

The Board increased its oversight of facility decommissioning work at DOE sites during 2009 as DOE accelerated such projects using Recovery Act funds.

3.4.1 Hanford Site

Plutonium Finishing Plant. The Board continued to follow deactivation and decommissioning work at the Plutonium Finishing Plant. Some work was accelerated by use of Recovery Act funds. The Board reviewed hazard evaluations and controls for chemicals used to

decontaminate gloveboxes at the facility. After the Board questioned the maximum temperature used in thermal studies, contractor engineers conducted more detailed thermal analyses of drums containing waste from the decontamination process. The contractor put in place additional controls to limit waste drum temperatures and initiated further evaluations.

The Board identified weaknesses in the safe performance of work at the Plutonium Finishing Plant. DOE initiated actions to resolve these issues, but the actions are not fully implemented. The Board plans continued oversight at this facility as one of its priorities at Hanford.

Burial Grounds. The Board reviewed the final hazard categorization of activities to recover uranium fuel found during remediation of burial grounds at Hanford. The Board questioned the assumptions used in the analysis and the final hazard categorization. DOE implemented more stringent controls on the quantity of exposed fuel, which resulted in a better safety posture for the activities.

3.4.2 Idaho Cleanup Project

The Board made several visits to the Idaho Cleanup Project to review deactivation and decommissioning activities. Workers at the Idaho Cleanup Project decontaminated, decommissioned, and demolished 37 legacy buildings or structures using Recovery Act funds. The Board plans close oversight as DOE moves ahead to demolish more hazardous facilities and treat more hazardous wastes.

3.4.3 Oak Ridge

The Board observed deactivation and decommissioning work being conducted at the Oak Ridge National Laboratory and at Y-12. Recovery Act funds are being applied to the demolition of some facilities at Y-12 and acceleration of the processing of transuranic wastes at the Oak Ridge National Laboratory. The Board noted that excessive amounts of wastes and contaminated protective clothing presented fire hazards in Building 9201-5/5E at Y-12.

3.4.4 Savannah River Site

As DOE accelerated the pace of cleanup work at the Savannah River Site using Recovery Act funds, the Board observed some of the more hazardous work. The Board reviewed the corrective actions following a spill of nitric acid during tap and drain operations in F-Area and suggested several improvements to DOE. The Board also followed DOE's efforts to grout spent nuclear fuel basins at the decommissioned P- and R-Reactors.

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

In its issuance of Standard 1189, *Integration of Safety into the Design Process*, DOE committed to revise other directives that had been affected by the standard. Consistent with this memorandum, the Board was provided with a list of directives and a schedule for the revisions. Since issuing the standard, DOE has issued a change to Order 413.3A, guides accompanying Order 413.3A, and Standard 1104-2009, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*. Order 413.3A, its accompanying guides, and Standard 1104 primarily address the programmatic and management aspects of safety in design. 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 issued.

In early 2009, DOE developed a change to Order 420.1B, *Facility Safety*. This change only provided consistency with Standard 1189 and did not address many of the safety-related technical requirements needed to implement safety-in-design objectives. However, the draft change did not reflect all requirements from Standard 1189 or changes to other DOE orders, such as Order 413.3A, Change 1. The draft change also failed to incorporate commitments from existing Board Recommendations that impact facility safety, such as Recommendation 2004-2. DOE declined to expand the scope of the proposed change to address these concerns, but indicated that additional changes to incorporate these concerns would be made in an unspecified future revision. To date, DOE has not implemented the proposed change to Order 420.1B or taken action to initiate the additional changes that are needed.

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. The Board and DOE informally agreed to use two projects—the Uranium Processing Facility (an NNSA project) and the Integrated Waste Treatment Unit (a DOE-Environmental Management project)—as pilot projects for application of Standard 1189.

In developing the conceptual design for the Uranium Processing Facility, NNSA identified facility-level safety systems: facility structure, fire barriers, fire suppression,

ventilation, and the electrical system, among others. At first, the conceptual design of these systems did not demonstrate reliable performance of safety functions. One example of this shortcoming was a structural design that did not consider load paths and lacked realistic shear walls to transmit these loads. Project engineers initially designed shear walls to accommodate equipment layout, resulting in a complex and faulty structural design. The Board's reviews early in preliminary design resulted in changes to the process layout. A second example of a design deficiency was reliance on non-safety emergency power supplies to power safety functions. Based on early feedback from the Board, the project revised the design to eliminate unneeded safety-class aspects and consolidate safety-related loads. This simplified the system and made it consistent with the design requirement. A third example: ventilation systems had an excessive degree of redundancy employing separate systems for each process area. The Board's comments clarifying expectations for safety-related ventilation systems allowed the project to combine systems, thus reducing cost and complexity.

The Integrated Waste Treatment Unit design was relatively mature when Standard 1189 was issued. The Board used this project as a retrospective to gain insight on whether the Standard 1189 process would have benefitted project designers. The consensus was that use of Standard 1189, with the associated earlier involvement by the Board, would have been more efficient than the design process actually followed. In addition to this review, the Board offered comments on instrumentation and control systems, the safety strategy for post-accident operator actions, and the need to enhance reliability of safety instrumentation by separating it from non-safety instrumentation.

Although the Board stressed the importance of using Standard 1189, DOE's implementation of the standard remains uneven. 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 Standard 1189 indicate that DOE needs to reinvigorate its efforts in this area.

4.3 Hanford Site

Waste Treatment Plant. The Waste Treatment 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 receives high-level waste from Hanford's tank farms and separates it into high- and low-activity streams. The low-activity portion is transferred to the Low-Activity Waste facility, where it is mixed with glass-forming materials and converted to a stable borosilicate glass, or "vitrified." Glass canisters from the Low-Activity Waste facility are placed in an onsite, near-surface disposal facility. The high-activity waste stream is transferred from the Pretreatment facility to the High-Level Waste facility, where it is also vitrified. After vitrification, high-level waste glass canisters are stored onsite in the Canister Storage Building 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 2009,

the Board's activities focused on the resolution of previously-identified issues and a major initiative by DOE to change the safety design strategy for the project.

Compliance with DOE Standard 1066. In January 2008, the Waste Treatment Plant contractor submitted a request to modify design requirements for protection of confinement ventilation systems from the effects of a fire. The intent of the request was to provide an alternative means of protecting the final high-efficiency particulate air filters of the confinement ventilation systems in a manner equivalent to the features prescribed in DOE Standard 1066. In a June 24, 2008 letter to DOE, the Board noted that Standard 1066 permits the use of equivalent or superior methods of fire protection for final filter plenums in nuclear facilities, but identified significant issues pertaining to the proposed tailoring of the standard, adherence to higher-tier policies, and the underlying technical justification for the request. DOE found similar issues and rejected the contractor's request. The contractor prepared a revised proposal to resolve outstanding technical issues and initiated work to address DOE and Board concerns.

On January 23, 2009, the DOE Office of River Protection altered course by taking the position that protection of the confinement ventilation system from the effects of fire was not needed if the calculated offsite consequences of a fire fell below the evaluation guideline used to classify safety systems. The Board questioned this approach because it failed to apply defense-in-depth principles and called into question commitments made by DOE in its implementation plan for the Board's Recommendation 2004-2. In March 2009, DOE revised the confinement ventilation system design and fire protection features to protect the air filters from the effects of fire. After reviewing the proposed design, the Board found the design to be acceptable but did not find DOE's proposed approach to tailoring Standard 1066 acceptable. In July 2009, DOE provided a supplement to the ventilation system evaluation, based on a revised design of the ventilation system for the Pretreatment and High-Level Waste facilities. The new design features and alternative means to comply with the intent of Standard 1066 address the Board's concerns; the current confinement ventilation design is adequate.

Structural Design. The Board has reviewed the adequacy of the structural design of the Waste Treatment Plant facilities since April 2002. During 2009, the Board's staff reviewed the design of the structural steel for these facilities, which had recently been completed. The Board found that the analytical models used in design 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 will cause the loads to be distributed differently and may affect the adequacy of the structural steel supporting the floor slabs. 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. The Board expects that DOE will satisfactorily address all Board technical concerns and revise the structural steel design as necessary.

Reclassification of Safety Components. The Board is studying proposed changes by DOE to the safety basis of the Pretreatment facility resulting from assuming a reduced radiological inventory (material-at-risk) in the facility. The concentrations of radionuclides in waste material transferred to the facility will be controlled administratively using waste acceptance criteria to protect the revised assumptions. DOE's contractor recalculated the consequences of postulated

accidents using the new assumptions to demonstrate that the consequences to the public are below the evaluation guideline, which determines the need for safety-related controls. While the Board does not question reducing the material-at-risk, the Board's review found that the contractor made unrelated changes to its analyses that may have inappropriately reduced the calculated consequences of accidents.

DOE briefed the Board on August 17, 2009, to explain which structures, systems, and components would remain categorized as safety class after taking into account the reduced material-at-risk. Subsequent discussions revealed that many important details are still being developed and the ultimate safety control strategy is still evolving. Notwithstanding the unresolved issues, DOE approved an addendum to the preliminary documented safety analysis for the facility that changes the safety classification of structures, systems, and components, subject to conditions of approval.

The Board is continuing to press DOE to develop technically sound solutions for each unresolved issue; examples include the deposition rate of radionuclides following a postulated accidental release, analysis of accidental releases associated with leaks and spills, and the need to credit the safety function of the primary confinement boundary of process systems. DOE has shown reluctance to accept that changes to the proposed safety strategy will be necessary to meet established safety design practices. This reluctance is most apparent regarding the issue of crediting the safety function of the primary confinement boundary to prevent release of radioactive material. DOE Order 420.1A requires that nuclear facilities have the means to confine uncontained radioactive materials to minimize their release in facility effluents during normal operations as well as during and following accidents. The Board believes it is essential that the safety strategy preserve the integrity of the primary confinement boundary rather than rely on the facility structure and ventilation system to prevent the release of material to the environment. Components forming the primary boundary need to be credited in the safety analysis and designed to confine radioactive wastes under all postulated operational and accident conditions, including natural phenomena. This approach provides defense-in-depth and protects the worker as well as the public.

Hydrogen Control. The presently approved approach to controlling hydrogen in pipes and ancillary vessels is based on preventing the occurrence of hydrogen explosions except in a very limited set of circumstances. Where explosions are possible, the primary confinement boundary is designed to contain the explosion (without permanent deformation), thereby preventing any release of radioactive material within the facility. However, along with the proposed changes to the material-at-risk, a revised strategy for control of hydrogen has been proposed. This strategy has evolved during the past year but remains of concern to the Board.

On February 26, 2009, DOE accepted its contractor's report, *WTP-Control of Hazards Associated with Hydrogen Accumulation in Piping and Ancillary Vessels, Alternative Evaluation and Design Approaches*. The Board reviewed this report and determined that it makes several inadequately supported recommendations that would be detrimental to the safety of the facility and depart significantly from accepted safety and design practices. Objectionable changes include allowing explosions that could permanently deform or breach the primary confinement barrier. As initially proposed, the new strategy relied on the facility structure (i.e., hot cells) and

ventilation system to mitigate potential radiological exposures to collocated workers and the public from such explosions.

The Board does not agree that this approach is consistent with DOE's existing design requirements, which specify that the design of new facilities should rely on prevention rather than mitigation of accidental releases of radiological materials. The proposed approach accepts the potential consequences associated with explosions (e.g., cost of facility repairs, exposure to workers) with little understanding or analysis of the risks. Ultimately, DOE agreed with the Board's concerns and concluded that it would not change the design criteria for piping and vessels in the inaccessible black cells in the Pretreatment facility and piping larger than 4 inches in diameter in hot cells.

Although DOE's current path forward would not allow hot cell piping less than or equal to 4 inches in diameter to rupture, such piping would be allowed to undergo permanent deformation by a hydrogen explosion. Based on a number of reviews conducted since receiving new proposed criteria on October 6, 2009, the Board made the following observations:

- The revised strategy is extremely complex, less conservative than the current safety strategy, will not adhere strictly to a single design code, and is overly reliant on the engineering judgment of DOE's contractor. Consensus design codes for process piping currently applied to the Waste Treatment Plant, such as those of the American Society of Mechanical Engineers, are not adequate to address the proposed strategy. Using consensus codes is the preferred approach for design, as these codes are developed using a much broader spectrum of engineering judgment and experience.

- Piping would be allowed to permanently deform to varying degrees throughout the plant. The current Pretreatment facility design does not include the capability to detect a hydrogen detonation in process piping nor to measure permanent deformation from individual or successive events.

- If a hydrogen detonation were to occur and result in significant permanent deformation, the Board believes that assessment of the significance of the deformation will be complex and costly. If repair or replacement of the piping is needed, these repairs will be time consuming, result in significant disruption of plant operation, and potentially result in considerable risk to the workers performing repairs. These concerns are particularly important if the damage impacts the black cell area of the Pretreatment facility, which has no ready access.

- The proposed strategy relies on limited experimental data to assess the effects of explosions within piping systems. The data from recent testing are based on simplified piping configurations and component types, while the facility will have a complex set of piping configurations and component types. For example, the facility will have multiple pipe bends, elbows of varying radii, changes in pipe diameter, changes in hydraulic head, and numerous component types (valves, pumps, heat exchangers, etc.) and jumper designs. The testing that has been performed uses simplified geometries that generally test a single variable, e.g., a single bend.

- The proposed strategy would use quantitative risk analysis to determine the peak pressure and frequency of explosions. This analytical approach is not yet complete, has received little external review, and is unprecedented for use in the design of a DOE nuclear facility. DOE has no standard governing application of quantitative risk assessment that could be used to judge the adequacy of the contractor's analysis.

- The contractor document describing the proposed approach does not provide a complete set of design criteria. It summarizes the testing conducted at various DOE subcontractor locations and provides a general overview of the analysis but lacks the detail necessary to implement the design. The contractor is revising the document, but cannot complete it until additional testing confirms validity of analytical models and other technical assumptions in support of the piping design.

The Board is continuing to work with DOE to resolve these issues and arrive at a defensible path forward.

4.4 Savannah River Site

Plutonium Storage and Plutonium Pit Disposition. On November 22, 2009, DOE approved combining the Pit Disassembly and Conversion Facility functions and the Plutonium Preparation Project and building them into the K-Reactor Building (Building 105-K) and other associated facilities within K-Area Reactor Complex. DOE believes that the combination project will save money and eliminate the need for decommissioning another facility in the future. The combined project is called the Pit Disassembly and Conversion Project. The project will be executed in two phases. The first phase entails installation of two new gloveboxes to provide early plutonium feed to the Mixed-Oxide Fuel Fabrication Facility. Phase 2 will entail completion of the pit disassembly and conversion functions within the K-Reactor Building. The Board has initiated review of this project.

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 2009, the Board continued its review of this facility's design and construction, as well as the resolution of previously identified issues.

Flammable Gas Control. In a letter to DOE dated February 10, 2009, the Board pointed out that (1) the structural analysis of process piping to withstand potential explosions due to flammable gas accumulation did not include several key considerations, including deflagration to detonation transitions and reflections due to piping configuration or obstructions, (2) the analysis did not provide sufficient technical basis for allowing plastic deformation of the piping in the event of an explosion, and (3) the heat generated in process vessels due to the action of the air pulse agitators during mixing could cause a temperature increase in the process vessels following a loss of cooling. Such a temperature increase could result in substantially greater rates of flammable gas generation. This effect was not considered in the calculations for flammable gas generation that are used to establish purge air flow rate requirements and the need for high-temperature interlocks. The Board reviewed calculations of the heat produced by the air pulse

agitators and concluded that high-temperature interlocks are not required for these devices. DOE is taking action to resolve these problems.

Hydrogen Generation. The Board previously identified the need to establish through experimentation the technical basis for estimating hydrogen generation due to thermolysis in process vessels. Testing accomplished by Idaho National Laboratory demonstrated that the hydrogen generation rate assumed in the design bounds the cumulative hydrogen generation rate, including the effect of thermolysis.

Structural Design. In a letter to DOE dated January 10, 2007, the Board pointed out deficiencies in the analysis of the facility's ability to resist natural phenomena hazards. DOE made changes to the methodology for structural design, and to the structural design itself, and then issued summary structural reports containing details on modeling, load transfer capability, and the finite element analysis. These reports show that the Central Process Area building meets structural design requirements.

Concrete Quality. The Board reviewed the procedures and quality control for mixing, delivering, testing, placing, and inspecting concrete and rebar used in the facility. The Board noted problems with quality control practices and procedures at the concrete batch plant. DOE and its contractor took action to correct these problems.

Operator Actions Following a Seismic Event. In its February 10, 2009 letter, the Board found that the design of the facility does not ensure that all operator actions deemed necessary in the preliminary documented safety analysis following a seismic event can be readily accomplished. Such actions include turning off equipment providing heat input to process vessels, ventilating and sparging process vessels, and monitoring the performance of the air dilution system. Evaluation of the need for operator actions to cool process vessels following a seismic event was also lacking. The Board reviewed calculations of process vessel heatup following a loss of cooling and concluded that there were several non-conservative assumptions in the model used for the calculations. DOE is taking action to solve these problems.

Quality Assurance. The Board reviewed quality assurance procedures and practices and found problems with commercial-grade dedication practices, traceability of requirements, software quality assurance, and assessment of suppliers. DOE is working to improve quality assurance for the project.

Fire Protection for Air Filters. In its February 10, 2009 letter, the Board stated that the design of the confinement ventilation system does not implement or demonstrate equivalency with criteria in DOE Standard 1066 for protection of final high-efficiency particulate air filters. Subsequently, the Board reviewed DOE's justification for its position and concluded that the technical basis for the justification was inadequate. The Board continues to press for resolution of this issue.

Instrumentation and Control. The Board reviewed and found weaknesses in the design and procurement of the instrumentation and control system. DOE is taking action to correct this aspect of the design.

Process Vessel Mixing Controls. The Board reviewed the design, testing, and controls 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, and that any refinement or elimination of safety controls must be based on conservative engineering assumptions. DOE is taking actions in response to the Board's concerns.

Waste Solidification Building. The Waste Solidification Building will solidify liquid waste streams from the Mixed-Oxide Fuel Fabrication Facility and the Pit Disassembly and Conversion Project. On December 10, 2008, NNSA approved Critical Decision-2 (approval of the Performance Baseline) and Critical Decision-3 (approval to start construction). The Board reviewed the safety basis documentation and concluded it was adequate for design of the facility.

The Board also reviewed the updated safety strategy for a potential red oil accident and found the strategy consistent with the guidance of the Board's Technical Report 33, *Control of Red Oil Explosions in Defense Nuclear Facilities.* The project has appropriately identified a safety-class control for prevention of red oil formation in the updated preliminary documented safety analysis.

Finally, the Board reviewed the Active Confinement Evaluation, a deliverable of the implementation plan for Board Recommendation 2004-2. After reviewing this report, along with other pertinent drawings and calculations, the Board concluded that the ventilation system design satisfied the expectations of the recommendation. The Board plans to review the implementation of credited safety controls in the final design for instrumentation and control systems.

4.5 Y-12 National Security Complex

Highly Enriched Uranium Materials Facility. The Highly Enriched Uranium Materials Facility will replace several aging storage facilities at Y-12. The new facility will reduce the site footprint of uranium storage, enhancing safety and simplifying safeguards and security measures. During 2009, the Board reviewed the completion of the design and construction of this facility and performance testing of the safety-related equipment.

Structural Concrete. During construction, significant honeycombing and large voids were noted in the concrete. This problem necessitated demolition of portions of the facility. The Board completed its review of the results from the nondestructive evaluation of the remaining concrete problems. The Board's review concluded that the identified areas of concrete honeycombing do not contain significant voids that could compromise the structural strength.

Construction Quality Assurance. In 2008, the Board found substantial quality assurance problems in the procurement and installation of safety-class storage racks. In response to those findings, NNSA took two major actions in 2009. The first was to evaluate the level of quality assurance applied to the procurement and installation of other safety-related equipment in the facility. NNSA reconstituted objective quality evidence to determine whether the critical

characteristics of equipment had been evaluated prior to installation. The Board reviewed NNSA's efforts and determined that its procurement process met relevant quality assurance criteria.

The second action was to evaluate the causes of the quality assurance problems. The evaluation revealed that NNSA did not understand the requirements, resources, and organizational structure necessary to ensure quality assurance is appropriately applied to complex nuclear construction projects. It also determined that construction contractors and suppliers did not have sufficient experience in implementing rigorous quality assurance programs for a nuclear facility construction project. The Board will continue to urge that NNSA properly capture the lessons learned from these construction quality problems to help eliminate such problems in the future.

Startup Testing. The Board reviewed the startup testing of safety-significant systems for secondary confinement and electrical distribution. The Board concluded that the test plans captured the functional requirements for the systems reviewed and that the facility has a formal, robust process to review and approve test acceptance criteria, procedures, and results.

Fire Water Supply. In response to correspondence from the Board dated February 6, 2008, NNSA proposed configuration control of the existing fire water supply to the safety-significant fire suppression system as a near-term control, until a safety-significant water supply is built. The Board reviewed the implementation of the control and monitoring of the fire water supply and found that actions taken by DOE were adequate.

Derating Ampacity of Cables. The Board pointed out the need to consider the ampacity derating effect (reduction in the rated current of cable enclosed in penetrations) for electrical cables routed through penetration seals. NNSA is evaluating all the penetration seals and the contained cables to confirm the installation will preclude a fire or overheating of the cables.

Uranium Processing Facility. The Uranium Processing Facility is a new project intended to replace the aging facilities that process enriched uranium at Y-12. NNSA is planning to revise the project approach to combine Critical Decision milestones for preliminary and final design. The first of these combined critical decisions would be for site preparation and procurement of long-lead items. To support this approach, the Board focused its reviews on geotechnical characterization and seismic response evaluation, structural and seismic analysis, and structural design. The Board has provided NNSA with comments on the design approach and technical details of the geotechnical and structural engineering effort. At year's end, the Board was working with NNSA to resolve the comments. The Board has continued to follow the incorporation of safety in the preliminary design effort for processes and safety systems in anticipation of Critical Decision milestones in the next calendar year.

The Board has also reviewed the incorporation of lessons learned from the quality assurance failures from the Highly Enriched Uranium Materials Facility. NNSA is in the process of a major reworking of the quality assurance organization at Y-12 in recognition of the quality assurance needs of major nuclear construction projects as well as current facilities. Federal project staffing at Y-12 is being substantially increased as part of this organizational shift. The

Board will evaluate the detailed implementation of quality requirements during procurement and construction of the facility.

4.6 Los Alamos National Laboratory

Chemistry and Metallurgy Research Replacement Project. The Board's review of the preliminary design and draft preliminary documented safety analysis for this facility identified several weaknesses in the safety strategy and selection of safety controls. Section 3112 of the Duncan Hunter National Defense Authorization Act for Fiscal Year 2009 directed the Board to submit a certification that concerns raised by the Board regarding the design of the facility had been resolved by NNSA. The Board submitted to Congress its certification report on September 4, 2009.

The Board developed a systematic approach to completing the certification review. The Board identified seven topics: five open concerns previously identified by the Board in its periodic report to Congress, plus two additional areas the Board considered important to the design process. Each topic was assigned a number as follows:

1. Site Characterization and Seismic Design
2. Preliminary documented safety analysis and Safety Strategy
3. Safety-Class Fire Suppression System
4. Safety-Significant Active Ventilation System
5. Safety-Class Container Design
6. Safety-Significant Electrical Distribution System
7. Design Control Process

As these topics were reviewed, the Board identified concerns with NNSA's resolution of the topics as either "findings" or "comments." Findings, transmitted formally to NNSA during the review process, represented issues that needed to be resolved prior to certification, while comments represented issues that could be addressed during final design. The Board's certification review resulted in the following findings with regard to safety-related processes, structures, systems, and components:

- Seismic design (ensuring an adequate structural design).

- Seismic design of active confinement ventilation system and support systems (ensuring that safety systems are properly seismically qualified).

- Inadequate identification of safety-related controls, functional requirements, and performance criteria (ensuring that a complete set of safety-related controls and functional requirements are identified).

- Documenting and maintaining preliminary documented safety analysis safety-related functions and requirements (ensuring that the design control process formally integrates the safety envelope into the design).

- System design descriptions do not incorporate preliminary documented safety analysis requirements adequately (ensuring consistency between the safety analysis and system design).

NNSA provided a response to each finding. The Board reviewed each response and worked with NNSA to reach agreement on how each finding would be resolved. Based on NNSA's responses and commitments, each finding was closed. NNSA has revised or agreed to revise the preliminary design, design requirements, and design processes to address these concerns as more fully described in the Board's certification report. NNSA has also committed to implement detailed designs during final design consistent with the design requirements agreed to as part of this certification process.

The Board's certification relies upon the future full implementation of these final design commitments by NNSA. The Board will continue to review the facility design as it develops to ensure that it remains consistent with the commitments made by NNSA. The Board will reopen issues if commitments, as described in the certification report, are not properly met during final design.

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 enhanced preliminary design of the facility and concluded that previously identified issues of poor integration of the safety and design processes and weak federal oversight remain unresolved. These issues were pointed out to NNSA in a letter dated March 5, 2008. NNSA continues work to resolve these concerns.

Transuranic Waste Facility Project. The Board reviewed the conceptual design for the proposed Transuranic Waste Facility. This project will replace aging facilities that store, characterize, repackage, size-reduce, and load solid transuranic waste for shipment. The Board's review identified problems with the facility safety strategy (e.g., the use of personal protective equipment in lieu of engineered safeguards to provide worker protection) and poor integration of safety into the design. Following the Board's review in November 2008, NNSA decided to place construction plans on hold pending completion of an engineering needs assessment. The project remains on hold.

4.7 Oak Ridge National Laboratory

Uranium-233 Project, Building 3019. DOE has not made significant progress in addressing safety basis issues identified by the Board for downblending and disposition of uranium-233. A project rebaselining that includes a major redesign of the processing system has delayed all aspects of the project. The Board will continue its review of the revised design and verify resolution of all open items. The Board notes that DOE completed an inspection program of a sampling of the uranium-233 containers in 2003 in response to Recommendation 97-1, *Safe Storage of Uranium-233*. The inspection results indicated that the containers are generally in good condition and do not present a near-term safety concern while in storage and awaiting processing.

4.8 Idaho Cleanup Project

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 for disposal at the Waste Isolation Pilot Plant.

The Board reviewed the design of the safety instrumented system, which was modified significantly to address Board concerns regarding its reliability. The Board identified concerns with the safety strategy for a fire in the granular activated carbon bed, including assumptions of risk reduction attributed to a heat detection system installed on the vessel containing the carbon bed. DOE is working to resolve these concerns.

4.9 Nevada Test Site

Device Assembly Facility. NNSA continues to expand the potential missions of this facility. New missions include receipt and storage of special nuclear material, operations involving special nuclear material, criticality experiments, assemblies of explosives and special nuclear material, and nuclear explosive operations. In letters to NNSA on November 3, 2004 and November 28, 2005, the Board challenged the reliability of the facility's fire suppression system. Continued evaluation by the Board resulted in another letter to NNSA on January 18, 2008. This letter disputed NNSA's claims concerning availability and reliability of fire protection features credited as safety-class or safety-significant.

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 adversely impact the fire protection system by clogging 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 solution. The Board also emphasized the importance of continued commitment from NNSA, as well as long-term funding for the most significant repairs.

4.10 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 the corrective action management process is initiated to allow feedback and improvement mechanisms to address manufacturing problems. This 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 monitor the testing data from the Filter Test Facility, as well as corrective actions by DOE and filter manufacturers.

4.11 Seismic Hazard Analysis

The Board provided feedback to DOE as new seismic ground motion criteria were developed and probabilistic hazard assessments updated. The Board has stressed 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 has continued to participate in a project to update the Central and Eastern United States Seismic Source Characterization for Nuclear Facilities. The Board is part of the participatory peer review panel for this project. Two workshops were held; the first focused on alternative interpretations and views of the informed scientific community on key seismic source issues, while the second focused on the preliminary identification of seismic sources, earthquake occurrence rates, and maximum earthquake magnitudes for these sources. The project plans on publishing updated seismic source information by the end of 2010. At that time it is expected that DOE will initiate an update of probabilistic seismic hazard analyses for Savannah River, Y-12, and Pantex.

DOE updated the probabilistic seismic hazard assessment for the Chemistry and Metallurgy Research Replacement facility at Los Alamos National Laboratory. The update considered new sets of empirical ground motion attenuation models and a revised approach used to derive vertical ground motions. The Board reviewed this work and found it acceptable.

Seismic Design of New Facilities. Los Alamos National Laboratory updated the seismic design ground motions for the Chemistry and Metallurgy Research Replacement facility based on the updated probabilistic seismic hazard assessment. Seismic design ground motions were reduced by about 25 to 40 percent. The Board reviewed this work and found it acceptable. Additional data were also collected at the site for the Uranium Processing Facility at Y-12 as a result of small changes to the facility layout and location. These studies are being used to assess ground motion site response. The Board continues to review this work as part of assessing the adequacy of the design basis earthquake ground motion for the facility.

Savannah River Site Soft Zone Investigation Program. DOE, 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 this site, soft zone soils have been identified about 80 to 140 feet below the ground surface. The engineering evaluation of potential soft zone collapse and resulting surface settlement has been a design challenge for the past 20 years. The research efforts at the Georgia Institute of Technology will improve the understanding of soft zone constitutive properties, the behavior of soft zones given various stress and strain conditions, and the engineering approach to evaluating surface settlement given soft zone collapse.

Work in the first year has focused on geochemical studies, laboratory testing of samples, and assessment of laboratory and field data that can be used to identify soft zones and their physical strength conditions. DOE is leading the field investigation efforts with attention to improving the collection of soft zone samples that have minimal sample disturbance. Given the soil settlement design challenges that have persisted at the Savannah River Site, the final results of this research could have significant benefits to both design and costs.

4.12 Recommendation 2008-1

Recommendation 2008-1 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 has taken longer than DOE expected. By the end of 2009, the guidance document, *Interim Guidance for the Design and Operation of Wet Pipe Sprinkler Systems and Supporting Water Supplies*, had been developed and was expected to be issued to the DOE complex in early 2010. The guidance should be beneficial in the design of safety-related, water-based fire protection systems.

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

On November 24, 2009, the Board held a public hearing to explore DOE's progress in implementing Recommendation 2004-1, *Oversight of Complex, High-Hazard Nuclear Operations*. The hearing was intended to confirm the commitment of DOE and NNSA senior leadership toward using integrated safety management at defense nuclear facilities and to heighten awareness of lagging departmental obligations. In this hearing, Deputy Secretary Poneman testified: "The Department continually strives to improve safety at our facilities through the use of our Integrated Safety Management System approach. This approach treats safety as an integral part of our work, not as an afterthought, so that missions are accomplished in a manner that protects workers and communities."

DOE's broad acceptance of integrated safety management principles is vital, but more work is needed in several important areas to fully execute the implementation plan for Recommendation 2004-1. Specifically, greater effort is needed in the following areas:

- Developing a process to identify research and development needs for nuclear safety across the defense nuclear complex. This includes identifying the extent to which these needs are being met by existing programs and developing a method to ensure nuclear safety research and development needs are identified and integrated into the programming, planning, budgeting, and execution. No real progress has been made in advancing this commitment, and the effort currently is two years behind the latest committed schedule.

- Issuing a DOE guide to complement Order 226.1A, *Implementation of Department of Energy Oversight Policy*. This deliverable is more than two years behind the projected schedule.

- Developing and implementing quality assurance plans as required by Order 414.4C, *Quality Assurance*. The Office of Environmental Management has proceeded with a well-

thought-out implementation plan. However, the Board is concerned with the fidelity and implementation of quality assurance at NNSA, where implementation has been relegated to the site offices without headquarters guidance.

During the transition between Presidential administrations in 2009, the Central Technical Authority function and the supporting function of Chief of Nuclear Safety within the Office of the Under Secretary of Energy were not appropriately staffed. The Board brought this issue to the attention of the Secretary of Energy and later to the Under Secretary of Energy, upon her confirmation, via letters dated March 23, 2009, and June 10, 2009, respectively. Shortly after the Board's second letter, the Central Technical Authority, along with the Chief of Nuclear Safety and his staff, were appropriately restored.

Recommendation 2004-1 included a sub-recommendation that DOE ensure the federal workforce encompassed the technical capability and appropriate experience for effective safety oversight. The Board evaluated DOE's implementation of this sub-recommendation through the Federal Technical Capability Program. In 2009, DOE replaced Manual 426.1-1A, *Federal Technical Capability Manual*, with Order 426.1, *Federal Technical Capability*. This modification strengthens program requirements for developing and maintaining the federal oversight corps. This action also completes the corrective action plan chartered by the Federal Technical Capability Panel, which reports to the Deputy Secretary and is responsible for overseeing and resolving issues affecting the program and providing recommendations to senior DOE officials regarding federal technical capability. The Board continues to monitor the ongoing activities of the Federal Technical Capability Panel and independently assess the effectiveness of the federal oversight corps.

5.1.3 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. Each site office now has at least one engineer engaged in oversight of activities involving fissionable materials. All of these engineers have met the requirements in DOE Standard 1173, *Criticality Safety Functional Area Qualification Standard*. DOE still does not have a defined methodology for determining the number of criticality safety personnel needed at each site to provide effective oversight. Most site offices still appear understaffed compared to the extent of fissionable material operations and/or contractor personnel involved in nuclear criticality safety. The Board will review site office staffing for criticality safety oversight during the coming year. The Board continues to require annual reporting by DOE on staffing and other nuclear criticality safety related topics.

5.1.4 Facility Representatives

The Board consistently stresses the importance of DOE Facility Representatives in providing line management oversight of safety at the activity level throughout the defense nuclear complex. DOE recognizes the key role of the Facility Representatives: in addition to conducting the 16th Annual DOE Facility Representative Workshop, DOE also sponsored the first annual Safety System Oversight meeting. The Facility Representative Workshop highlighted best practices evidenced through success stories and provided an example of institutional

learning across DOE's varied mission areas. The Safety System Oversight meeting provided examples of oversight methodologies employed across the nuclear power industry by commercial and government entities as well as oversight program overviews for DOE and NNSA sites. While the Board is encouraged by such information exchanges, increasing and retaining the cadre of Facility Representatives continues to require the attention of DOE's senior management.

5.1.5 Safety Basis Academy

The Safety Basis Academy is a series of courses intended to provide a training program to meet the needs of personnel with safety basis responsibilities at hazardous DOE facilities. During fiscal years 2007 through 2009, 23 courses were developed and piloted throughout the defense nuclear complex.

Contractor and DOE personnel are attending the courses. The Board's staff evaluated several of these courses and believes they will make a valuable contribution toward establishing a standard training program for safety analysts. The approved courses were finalized and transferred to the DOE National Training Center. The goal is to implement a comprehensive Safety Analyst Training Program, which could be used to certify safety analysts. The Board believes that the Safety Basis Academy is a positive step forward in establishing a formal certification process for safety analysts.

5.1.6 Activity-Level Work Planning

The Board continues to emphasize the implementation of the core functions and guiding principles of Integrated Safety Management at the activity level as essential to planning and executing work safely. During 2009, the Board conducted four reviews of work planning and control and issued four letters to DOE detailing the observed deficiencies. The Board consistently found inadequacies in hazard analysis, in clearly defining and controlling the scope of work, and in developing effective feedback and improvement mechanisms. Individual sites have made some enhancements in response to these letters, but additional progress is required. The Board will continue to pursue much needed improvement at the DOE headquarters level in this critical area, particularly the need for a directive governing the planning and control of work at defense nuclear facilities.

5.1.7 Safety Basis Controls

The process of independently validating the proper implementation of safety basis controls is vitally important to nuclear safety. A number of 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 DOE quality assurance program requirements call for such reviews but that additional guidance in this area was needed and would be developed.

In March 2009, DOE transmitted draft guidance on these reviews to DOE sites with defense nuclear facilities. DOE directed field offices to compare site practices to the draft guidance and make appropriate adjustments. The Board views this action as a positive initial step in instituting independent validation reviews. By year's end, however, progress in having each site adjust its practices was uneven, and progress to finalize and issue the guidance had stalled. The Board will continue to urge DOE to issue the needed guidance and fully institute independent validation reviews for implementation of safety basis controls.

5.2 Health and Safety Directives

5.2.1 Board Oversight of Directives

In 2009, as part of its ongoing review of new and revised DOE directives, the Board and its staff evaluated and provided constructive critiques of 34 directives affecting safety at defense nuclear facilities. At year's end, the Board was working to resolve issues on four pending directives to improve the content, clarity, and consistency in safety requirements and guidance, and was in the process of reviewing seven directives. Work was completed on 19 DOE directives; examples are listed below.

- Order 410.2, *Management of Nuclear Materials*
- Order 461.2, *Onsite Packaging and Transfer of Materials of National Security Interest*
- Handbook 1122-2009, *Radiological Control Technician Training*
- Standard 1123-2009, *Safeguards and Security General Technical Base Qualification Standard*
- Standard 1104-2009, *Review and Approval of Nuclear Facility Safety Basis and Safety Design Basis Documents*
- Standard 1083-2009, *Processing Exemptions to Nuclear Safety Rules and Approval of Alternative Methods for Documented Safety Analyses*

5.2.2 Secretarial Memorandum

The Board continues to expend a significant level of effort on changes to existing DOE directives and proposed new directives. On September 10, 2007, the Secretary of Energy issued a memorandum entitled, "Principles Governing Departmental Directives." The memorandum directs DOE personnel to "review existing and proposed directives to ensure that they are written and managed in accordance with the principles outlined in this memorandum." The stated intent of this review is to ensure that directives' objectives are "accomplished without being unclear, overly prescriptive, duplicative, or contradictory." In late December 2007, DOE released to the Board a plan for the review of 26 safety-related directives in accordance with the Secretary's memorandum.

During 2009, the Board reviewed the following draft directives resulting from DOE's effort to implement the Secretary's memorandum:

- Order 425.1D, *Verification of Readiness to Startup or Restart Nuclear Facilities*
- Order 426.1, *Federal Technical Capability*
- Order 433.1B, *Maintenance Management Program for DOE Nuclear Facilities*
- Order 422.X, *Conduct of Operations* (formerly Order 5480.19A)
- Order 426.Y, *Personnel Selection, Training, Qualification, and Certification Requirements for DOE Nuclear Facilities* (formerly Order 5480.20)
- Order 458.1, *Radiation Protection of the Public and the Environment* (formerly Order 5400.5)

5.2.3 Departmental Directives Program

On January 15, 2009, DOE approved Order 251.1C, *Departmental Directives Program*, which describes the DOE directives program and defines how directives are written, revised, and approved. Because this order establishes the framework for the entire directives program, it is a key safety directive. The revision to Order 251.1C required significant Board involvement to ensure DOE maintained the following key attributes of the directives system:

- The use of guides as a means of documenting best practices and the DOE's preferred methods of implementing requirements.

- The preparation and use of a management tool to track requirements, usually referred to as a crosswalk, to ensure that requirements are not inadvertently dropped when revising directives.

- Preventing cancellation of directives affecting health and safety at defense nuclear facilities without concurrence from the office of primary interest.

At the end of 2009, DOE informed the Board that a directives review aimed at reducing the number of directives would start in early 2010. This effort will include review and potential elimination of many directives that impact safety at defense nuclear facilities. The Board will monitor this latest initiative closely to ensure that safety directives are not reduced or eliminated.

5.2.4 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 non-conservative 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 perform a thorough evaluation of 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 in 2010 to incorporate this guidance. In

2009, the Board evaluated DOE's progress. The Board found that only a few sites actually implemented the supplemental guidance, and that little, if any, progress had been made toward issuing a revision to Standard 1027. The Board will work to ensure such a revision is started in the near future.

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. On this basis, DOE proposed that the recommendation be closed. The Board conducted a number of independent reviews to assess the effectiveness of DOE's implementation; these reviews identified a number of weaknesses and deficiencies. In response, DOE committed to additional field verification reviews to fully identify and correct the implementation deficiencies.

In 2009, DOE promulgated additional guidance and expectations for implementation and added the review of specific administrative controls as a focus area for headquarters review efforts. DOE has directed the field elements to provide an updated status on the implementation of the recommendation. DOE plans to revisit whether sufficient progress has been made to request closure of the recommendation in 2010.

5.3.2 Active Confinement Systems

During 2009, DOE evaluated four of NNSA's nuclear facilities against the criteria developed under the implementation plan for Recommendation 2004-2, *Active Confinement Systems*. These reviews identified facility upgrades that were needed. The Board's review of the evaluation reports submitted in 2008 indicated that some facilities had not followed the DOE guidelines established in the implementation plan. The Board identified several examples of such deficiencies in a letter to DOE on April 21, 2009, and requested a report describing the actions to be taken to remediate the situation.

In a July 29, 2009 response to the Board's letter, DOE committed to performing a thorough review of those reports and to correct the deviations. DOE completed its review of the Environmental Management facilities and identified several ventilation system evaluations that were not performed consistently with the implementation plan. In a letter to the Board on December 31, 2009, DOE stated that it would request the Environmental Management Technical Authority Board to perform a cross-cutting review of the identified gaps and potentially needed upgrades, and to prepare an integrated priority list for implementing potential upgrades. The priority list is due to be completed by June 25, 2010.

The Board also reviewed DOE's new design and construction projects to ensure that the proposed designs will meet the intent of the recommendation and DOE's expectations as documented in the implementation plan. Several design modifications have been identified by

the Board that, if implemented by the projects, will significantly enhance the safety posture of these new facilities.

5.3.3 Software Quality Assurance

The safety of many defense nuclear facilities is assured, in part, by analysis and operational support provided by computer software. In January 2002, the Board issued Recommendation 2002-1 to improve DOE's policies and practices regarding the design, implementation, testing, and configuration management of safety-related software, as well as the training of associated personnel. In a series of presentations in 2009, DOE provided the Board information on how the commitments of the implementation plan were completed.

DOE has requested that this recommendation be closed, and has offered to provide annual briefings to the Board on quality assurance for safety software.

5.3.4 Recommendation 2009-1

The Board in previous years has conducted a comprehensive assessment of DOE's use of quantitative risk assessment and related methodologies. This assessment found that DOE widely employed quantitative risk assessment without adequate controls over quality and applicability. DOE responded to the Board's findings by chartering the development of a policy governing the use of risk assessment methodologies at defense nuclear facilities.

In a letter to DOE dated November 23, 2005, the Board described deficiencies in DOE's initial draft policy and objected to the slow pace of its development. In another letter dated May 16, 2007, the Board reiterated the need for progress in addressing the Board's concerns. Two years later, the situation remained unsatisfactory, leading to the Board's issuance on July 30, 2009 of Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities*. The Board recommended that DOE develop 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.

In a letter dated November 3, 2009, the Secretary of Energy stated that DOE accepted the Board's recommendation and would implement it as described in an attached implementation plan. This plan, however, was determined by the Board to be a partial rejection of the recommendation. In a letter to DOE dated December 18, 2009, the Board reaffirmed its recommendation. DOE is required by law to provide a written response, including a report to the Committees on Armed Services and on Appropriations in the Senate and the Speaker of the House, stating DOE's final decision on whether to implement all or part of the recommendation and the reasoning for its decision.

5.3.5 Criticality Safety

The Board continued to assess DOE's progress in improving nuclear criticality safety programs. In a January 23, 2009, letter, the Board expressed concern over the nuclear criticality

safety evaluations for the Highly Enriched Uranium Materials Facility at Y-12. Because the evaluations failed to meet the requirements of American National Standards Institute/American Nuclear Society and DOE standards, the Board requested a briefing. NNSA provided this briefing in two sessions, the first in April 2009 and the second in October 2009.

In March 2009, the Board reviewed criticality safety at Los Alamos National Laboratory. This review examined actions taken by DOE in response to the Board's September 2007 letter on software applications. NNSA committed to modifying procedures and retraining facility staff at the laboratory to ensure that the software application was only used for materials control and accountability and not to determine compliance with criticality safety limits. The actions taken by NNSA have resolved the primary concerns expressed by the Board.

The Board reviewed DOE's annual report on criticality safety for 2008 (issued on February 23, 2009) and was subsequently briefed on the report by DOE. Overall, the report was adequate as measured by Recommendation 97-2, *Continuation of Criticality Safety at Defense Nuclear Facilities in the Department of Energy*. However, the Board requested that DOE provide additional information in certain areas. The Board expects that these areas will be addressed in the report for 2009.

DOE's nuclear criticality safety program continues to provide a source of stable funding for many essential activities related to criticality safety. Machines needed to conduct criticality experiments have been relocated to the Critical Experiments Facility at the Nevada Test Site. Criticality experiments are scheduled to begin following facility startup, projected to occur in 2010.

5.3.6 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 2007, DOE formed a readiness review working group to ensure a more rigorous and conservative implementation of Order 425.1C, *Startup and Restart of Nuclear Facilities*, and to resolve other complex-wide startup and restart issues. In 2008, the Board worked with the authors and evaluated revisions to Order 425.1C to ensure the specific tenets of Recommendation 92-6, *Operational Readiness Reviews*, were incorporated in the updated directives. Revisions to Order 425.1C and Standard 3006, *Planning and Conduct of Operational Readiness Reviews*, have entered the DOE review and comment process.

The Board expects revisions of these directives to be approved in early 2010, and the Board is encouraged by the content of the drafts it reviewed. However, the Board remains concerned that DOE has yet to develop a plan to implement the revised directives.

5.3.7 Justifications for Continuing Operations

In 2009, the Board continued its review of DOE's use of justifications for continuing operations at defense nuclear facilities. The Board had previously documented weaknesses in this important area in a letter to DOE dated April 19, 2007. In response to this letter, DOE

established a working group that concluded additional emphasis and oversight area were needed.

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. The final revision and comment process for this guide began on November 30, 2009.

5.3.8 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 on April 25, 2007. DOE accepted the recommendation in June 2007 and submitted an implementation plan for the recommendation in October 2007; the Board accepted the implementation plan in April 2008.

DOE continues to accomplish the implementation plan milestones on schedule. The Technical Support Group, comprising senior DOE and contractor personnel with significant experience in nondestructive assay, conducted state-of-the-art reviews this year at the three sites within the scope of the implementation plan: Savannah River, Y-12, and Hanford. Each site was addressed in a separate report; all three reports were sent to the Board by DOE on November 18, 2009. The reports discussed the state-of-the-practice for nondestructive assay programs for measuring in situ holdup and covered several different topical areas as outlined in the implementation plan, including holdup measurement, quality assurance, training and qualification of personnel, and implementation of standards. DOE will use the results of these reviews to identify best practices for in situ nondestructive assay holdup measurement programs.

5.3.9 Conduct of Operations

In 2009, the Board reviewed conduct of operations at Y-12, the Hanford Waste and Fuels Management Program, and the Hanford Tank Farms. The workers generally conducted operations well, but the Board observed weaknesses and areas where conduct of operations could be improved. During the conduct of operations reviews, the Board observed instances where procedures were not followed step-by-step. In one instance, the Board observed operators deviating from a procedure without making a pen-and-ink change or formal change to the procedure.

The Board also reviewed operating logs, lockout/tagout logs, and operator round sheets, and determined that the formality and discipline operators employ when performing administrative record keeping varies greatly from facility to facility and site to site. The Board intends to perform further reviews of conduct of operations in 2010.

6. Public Outreach and Agency Administration

6.1 Responding to Public Requests

The Board answered numerous informal public requests for documents and information and responded to 13 formal requests filed under the Freedom of Information Act. The average response time for Freedom of Information Act requests was 9 working days, as compared with the statutory requirement of 20 working days. The Board's website (www.dnfsb.gov) contains a complete list of Freedom of Information Act requests processed since 2004.

6.2 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 400 addressees.

6.3 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 2009, the Board conducted an inquiry into health and safety issues at Los Alamos National Laboratory. This inquiry led to safety improvements in the conduct of work.

6.4 Suspect and Counterfeit Parts

The Board directed its staff to reopen its review of DOE's suspect and counterfeit parts program. This initiative was deemed appropriate in light of a 2009 indictment brought by the United States Attorney for the District of Columbia against individuals selling counterfeit parts to a number federal agencies including DOE and potentially to DOE's suppliers. Initial review indicates that further inquiry will be necessary to ensure that DOE's program has the appropriate headquarters support and rigor to meet the kind of threat presented by the unique aspects of the fraudulent operation.

6.5 Investigation of Negative Feedback

From time to time, the Board receives criticism from outside parties such as members of the public, other federal agencies, or Congress. The Board takes such criticism seriously and

endeavors to determine in each case whether improvements are needed in the Board's oversight policies and objectives.

6.6 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, 2009, 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.

6.7 Human Resources

During fiscal year 2009, the Board succeeded in increasing its staff from 95 to 102 government personnel. Nine engineers were hired. However, the Board lost three personnel to retirement or attrition, including the Chairman. Thus, only four of the five Board Member positions are filled. The Board is making hiring a priority in order to reach full strength of 115 personnel in 2010.

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 field, 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-eight percent of the Board's technical staff hold advanced science and engineering degrees, with 22 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 three more expected to enter the program in June 2010. The Board will continue its vigorous recruitment program to attract the brightest engineering students from colleges and universities across the country.

6.8 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's security posture was improved during 2009 by ensuring that all laptops issued to Board staff include full disk encryption software and by issuing encrypted USB drives to allow sensitive information to be securely transported.

The Board continued its deployment of Homeland Security Presidential Directive 12 credentials, and as of December 31, 2009, the Board had issued over 120 credentials.

The Board began deploying SharePoint in 2009. SharePoint will be used to create an enterprise-wide central repository of Board information and documents. Having all Board information in a centrally located, searchable application will improve the efficiency of the Board's staff.

6.9 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 contracts disputes economically.

6.10 Financial Management

The Board received a fourth 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 2009-1 TO THE SECRETARY OF ENERGY
Risk Assessment Methodologies at Defense Nuclear Facilities
Pursuant to 42 U.S.C. § 2286(a)(5)
Atomic Energy Act of 1954, As Amended

Dated: July 30, 2009

Overview

Quantitative risk assessment techniques are widely used to improve the safety of complex engineering systems. Such techniques have been relied upon in the nuclear industry for decades. One of the seminal documents, known as WASH-1400, used an event-tree, fault-tree methodology to assess the risk of accidents at nuclear power reactors operating in the United States. Today, the U.S. Nuclear Regulatory Commission (NRC) employs a more sophisticated set of risk assessment tools and methodologies. Likewise, the National Aeronautics and Space Administration (NASA) has developed and implemented a detailed policy on the use of quantitative risk assessment for its missions.

The Department of Energy (DOE) has historically endorsed a "bounding" or deterministic approach to hazard and accident analysis, which continues to have important applications at defense nuclear facilities. Beginning in the early 1990s, the Defense Nuclear Facilities Safety Board (Board) observed increasing use of quantitative risk assessment techniques by DOE. This increased use was not viewed by the Board as objectionable in itself; the Board's concern was that DOE was using quantitative risk assessment methods without having in place a clear policy and set of procedures to govern the application of these methods at facilities that perform work ranging from assembly and disassembly of nuclear weapons to nuclear waste processing and storage operations. For this reason, the Board wrote to the Secretary of Energy on April 5, 2004, and made the following observation:

> [T]he Board has reviewed the DOE's use of risk management tools at defense nuclear facilities. This review revealed that DOE and its contractors have employed risk assessment in a variety of activities, including the development of documented safety analyses and facility-level decision making. The level of formality of these assessments varies over a wide range. The Board's review also revealed that DOE does not have mechanisms (such as standards or guides) to control the use of risk management tools nor does it have an internal organization assigned to maintain cognizance and ensure the adequacy and consistency of risk assessments. Finally, the Board's review showed that other federal agencies involved in similar high-risk activities (e.g., National Aeronautics and Space Administration, U.S. Nuclear Regulatory Commission) have, to varying degrees, formalized the use of quantitative risk assessment in their operations and decision-making activities. These agencies have relevant standards and defined organizational elements, procedures, and processes for the development and use of risk management tools.

On this basis, the Board requested that the Secretary "brief the Board within 60 days of receipt of this letter as to DOE's ongoing and planned programs and policies for assessing, prioritizing, and managing risk."

The Board's initial concerns on this issue have been reiterated in letters dated November 23, 2005, and May 16, 2007. In the Board's 2006 Annual Report to Congress, the section on Risk Assessment Methodologies noted "the slow pace of its development," and the 2008 report noted that "all progress [has come] to a halt." The Board's most recent annual report stated that at "a time when governments, financial institutions and industries worldwide are expediting the implementation of enterprise-wide risk governance programs, DOE's slow pace for developing a policy is of serious concern."

DOE's most recent correspondence on this issue, dated January 9, 2007, outlined plans and progress toward developing a policy and accompanying guidance document on the use of risk assessment at defense nuclear facilities. This DOE letter indicated that the draft policy and guidance document would be ready for submittal to the DOE directives system in March 2007. Despite periodic meetings with the Board's staff and briefings to the Board, as of July 2009, the draft policy and guidance document has not been entered into the DOE Directives system, and near-term resolution of the issue is not evident. Without such a policy, DOE has little basis to accept the validity of existing risk management tools that use quantitative risk assessment. This is particularly important since the managers of DOE's field elements are allowed to accept the safety risks that high-hazard operations pose toward workers and the public based on widely varying levels of assessments.

Though Title 10, Part 830 of the Code of Federal Regulations (10 CFR 830, Nuclear Safety Management) and its associated quality assurance considerations govern nuclear safety evaluations at a fundamental level, these existing requirements are not of sufficient specificity to guide the use of complex quantitative risk assessments. The continued pursuit of ad hoc applications of risk assessment in the absence of adequate DOE policy and guidance is contrary to the standards-based approach to nuclear safety espoused by DOE and endorsed by the Board.

Recommendation

Therefore, the Board recommends that DOE:

1. Establish a policy on the use of quantitative risk assessment for nuclear safety applications.

2. Consistent with this policy, establish requirements and guidance in a DOE directive or directives that prescribe controls over the quality, use, implementation, and applicability of quantitative risk assessment in the design and operation of defense nuclear facilities.

3. Evaluate current ongoing uses of quantitative risk assessment methodologies at defense nuclear facilities to determine if interim guidance or special oversight is warranted pending the development of formal policy and guidance.

4. Establish a requirement to identify deficiencies and gaps in ongoing applications of quantitative risk assessment along with the additional research necessary to fill those gaps in support of the development and implementation of the final policy and guidance.

A. J. Eggenberger, Chairman

RECOMMENDATION 2009-2 TO THE SECRETARY OF ENERGY
Los Alamos National Laboratory Plutonium Facility Seismic Safety
Pursuant to 42 U.S.C. § 2286a(a)(5)
Atomic Energy Act of 1954, As Amended

Dated: October 26, 2009

Background

The Defense Nuclear Facilities Safety Board (Board) is concerned about the potential consequences of seismic events at Los Alamos National Laboratory's (LANL) Plutonium Facility and the adequacy of the safety strategy currently being pursued to address these events. In particular, the mitigated offsite consequences predicated on a seismically induced large fire at this operating nuclear facility exceed the Department of Energy's (DOE) Evaluation Guideline by more than two orders of magnitude. The Board believes this situation warrants immediate attention and action.

The Plutonium Facility has operated for more than a decade with a 1996 Final Safety Analysis Report as its safety basis. DOE issued Title 10, Code of Federal Regulations, Part 830, Nuclear Safety Management, in January 2001, requiring contractors for all its existing facilities to submit a Documented Safety Analysis (DSA). Ultimately, a DSA for the Plutonium Facility was submitted by LANL and approved by the National Nuclear Security Administration's (NNSA) Los Alamos Site Office (LASO) through a Safety Evaluation Report (SER) in December 2008. The DSA identifies an array of planned future upgrades to improve the safety posture of the facility. However, both the DSA and SER rely inappropriately on planned seismic upgrades to safety systems that (1) will not be implemented for many years and (2) are not sufficient to address adequately the bounding seismic accident scenarios. The only safety feature that can be credited for these accident scenarios is the passive confinement provided by the facility structure. Additionally, appropriate compensatory measures to protect public and worker health and safety have not been identified. As a result, a major deficiency in the facility's safety basis exists.

The safety strategy approved by LASO is based on the assumption that future upgrades to reinforce the support stands for a limited set of "high-risk" gloveboxes (including those containing ignition sources, such as furnaces) will prevent a large fire from occurring after a seismic event. While planned seismic upgrades to high-risk gloveboxes will provide some safety benefit in the future, the Board believes the critical NNSA assumption that these upgrades are

adequate is flawed and, as a result, the current safety strategy is not defensible for the following reasons. Not all ignition sources inside high-risk gloveboxes are seismically secured to the glovebox shell; therefore, fires could still result from ignition sources toppling inside gloveboxes during a seismic event, even if the gloveboxes themselves do not topple. Additionally, ignition sources that could initiate post-seismic fires exist outside of gloveboxes targeted for seismic upgrades. DOE must take steps to develop a defensible seismic safety strategy for the Plutonium Facility.

Near-term actions and compensatory measures to reduce significantly the consequences of seismically induced events will likely involve operating the facility with restrictions on material-at-risk, removing inventory from susceptible locations or storing material in robust containers, and reducing the likelihood of a fire following a seismic event by identifying and implementing appropriate safety measures. Consistent with the Board's Recommendation 2004-2, Active Confinement Systems, one long-term strategy that could provide effective mitigation for seismic events involves upgrading the facility's confinement ventilation system to meet seismic performance category 3 criteria. This strategy would allow the confinement ventilation system to reduce reliably the consequences of a seismically induced event by many orders of magnitude to acceptably low values.

In a letter to the Board dated June 16, 2009, the NNSA Administrator rejected the implementation of some upgrades identified to address performance gaps uncovered during execution of the Implementation Plan for Recommendation 2004-2 for the Plutonium Facility's confinement ventilation system on the grounds that these upgrades were not required under the current DSA/SER strategy. LASO's present position is that upgrades to ensure post-seismic operability for active confinement ventilation may be desirable, but LASO does not expect to develop the information necessary to make a decision (e.g., cost, scope, and mitigation benefits) until mid-fiscal year 2011. The Board believes that NNSA's current safety strategy is flawed and does not obviate the need for a seismically qualified safety class active confinement ventilation system at its Plutonium Facility.

Given the magnitude of the potential consequences to the public, the Board believes DOE must develop expeditiously a defensible safety strategy for seismically induced events at the Plutonium Facility and a credible plan for implementing this strategy. DOE's response must include definite, measurable, and immediate means to substantially reduce the potential consequences at the site boundary. Implementation of a sound safety strategy must be pursued on an urgent basis.

Recommendation

In this context, and in recognition of the fact that LANL's Plutonium Facility has been designated as the center for plutonium operations in the complex, which includes the manufacture of pits for weapon assemblies, the Board recommends that DOE:

1. Implement near-term actions and compensatory measures to reduce significantly the consequences of seismically induced events, including clear identification of consequence reduction targets/goals, schedule, and implementation methods. In planning for and completing

these actions and compensatory measures, DOE should be guided by the need for immediate actions and mindful of the provisions of 42 U.S.C. § 2286d(f)(1) regarding implementation timelines.

2. Develop and implement an acceptable safety strategy for seismically induced events that includes the following elements:

a. A technically justifiable decision logic and criteria for evaluating and selecting safety-class structures, systems, and components that can effectively prevent or mitigate the consequences of seismic events to acceptably low values.

b. The seismic analysis approach for structures, systems, and components required to implement the seismic safety strategy.

c. A prioritized plan and schedule, including quarterly briefs to the Board for the next 12 months, for seismic analyses, necessary upgrades, and other actions to implement the seismic safety strategy.

The severity of the problems that are the subject of this Recommendation and the urgency to remediate them argue forcefully for 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."

John E. Mansfield, Ph.D., Vice Chairman

Appendix B: Recommendations Cited

Number	Date	Title
92-6	August 26, 1992	Operational Readiness Reviews
97-1	March 3, 1997	Safe Storage of Uranium-233
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
2002-1	September 23, 2002	Quality Assurance for Safety-Related Software
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

Appendix C: Reporting Requirements

Date	Addressee	Site or Topic
January 13	Administrator, NNSA	Ventilation System Evaluation Report for the Plutonium Facility at Los Alamos National Laboratory
January 13	Acting Deputy Secretary of Energy	Supplement to the 2008 Nuclear Criticality Safety Annual Report
January 23	Administrator, NNSA	Nuclear Criticality Safety Evaluation Concerns at Y-12
February 6	Acting Assistant Secretary for Environmental Management	Electrical Distribution System at H-Canyon
March 23	Acting Assistant Secretary for Environmental Management	Work Planning and Controls Deficiencies at the Idaho Cleanup Project
April 7	Secretary of Energy	Storage of Plutonium-238 Enriched Heat Source Plutonium, Los Alamos National Laboratory
April 21	Secretary of Energy	Delinquent Deliverables and Remediation of Deviations from *Ventilation System Evaluation Guidance*
July 28	Administrator, NNSA	Modifications or Upgrades to the Device Assembly Facility Fire Protection Systems
October 15	Administrator, NNSA	Actions to Strengthen Process for Developing and Implementing Technical Procedures
December 2	Assistant Secretary for Environmental Management	Waste Treatment Plant Structural Design, Hanford
December 2	Administrator, NNSA	Work Planning and Control Deficiencies, Los Alamos

Appendix D: Correspondence

Hanford

January 8 letter to the Acting Assistant Secretary for Environmental Management regarding fire protection coating on structural steel at the Waste Treatment Plant.

December 2 letter to the Assistant Secretary for Environmental Management establishing 90-day reporting requirement for a report assessing structural steel design of the Waste Treatment Plant.

Idaho National Engineering Laboratory

March 23 letter to the Acting Assistant Secretary for Environmental Management establishing a 90-day reporting requirement regarding work planning and controls deficiencies.

Lawrence Livermore National Laboratory

January 27, 2010, letter to the Administrator, NNSA, regarding the readiness assessment for startup of the Tritium Process Station.

Los Alamos National Laboratory

January 13 letter to the Administrator, NNSA, establishing a 90-day reporting requirement for submitting several deliverables associated with the Ventilation System Evaluation Report for the Plutonium Facility.

January 16 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations providing findings on seismic design at the Chemistry and Metallurgy Research Replacement project.

January 16 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations providing findings on confinement ventilation at the Chemistry and Metallurgy Research Replacement project.

February 6 letter to the Administrator, NNSA, forwarding a staff report on design issues at the Radioactive Liquid Waste Treatment Facility.

March 4 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations providing findings on the preliminary documented safety analysis at the Chemistry and Metallurgy Research Replacement project.

March 16 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations, providing findings related to inadequate identification of safety-related controls, functional requirements, and performance criteria at the Chemistry and Metallurgy Research Replacement project.

March 18 letter to the Acting Assistant Secretary for Environmental Management transmitting Board staff concerns regarding the integration of safety into the design of the Transuranic Waste Facility.

March 30 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations providing findings related to system design descriptions at the Chemistry and Metallurgy Research Replacement project.

April 7 letter to the Secretary of Energy establishing a 45-day reporting requirement regarding heat source plutonium containers stored in the Vault Water Baths; 60-day reporting requirement on improving safety posture.

July 10 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations stating that Finding 5 for the Chemistry and Metallurgy Research Replacement project certification can be considered closed.

July 28 letter to the Administrator, NNSA, regarding enriched heat source plutonium storage and vital safety systems assessments.

August 26 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations stating that Finding 1 for the Chemistry and Metallurgy Research Replacement project certification can be considered closed.

August 26 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations stating that Finding 2 for the Chemistry and Metallurgy Research Replacement project certification can be considered closed.

August 26 letter to the Assistant Deputy Administrator for Nuclear Safety and Operations stating that Finding 4 for the Chemistry and Metallurgy Research Replacement project certification can be considered closed.

October 26 letter to the Secretary of Energy forwarding Recommendation 2009-2.

December 2 letter to the Administrator, NNSA, establishing a 90-day reporting requirement on work planning and control deficiencies.

Pantex Plant

October 15 letter to the Administrator, NNSA, on developing and implementing technical procedures.

December 7 letter to the President of B&W Pantex regarding seminar on emerging concepts and technologies.

Nevada Test Site

July 28 letter to the Administrator, NNSA, establishing a reporting requirement regarding plans to modify and upgrade the Device Assembly Facility fire protection systems.

Sandia National Laboratories

July 29 letter to Director of Citizen Action New Mexico regarding continuing safety operations.

January 25, 2010, letter to the Administrator, NNSA, regarding W76-1 communications issues.

Savannah River Site

January 12 letter to the Administrator, NNSA, regarding review of final design documents for the Waste Solidification Building.

February 6 letter to the Acting Assistant Secretary for Environmental Management establishing a 90-day reporting requirement regarding H-Canyon electrical distribution system.

February 10 letter to the Acting Assistant Secretary for Environmental Management identifying design concerns at the Salt Waste Processing Facility.

March 5 letter to the Acting Assistant Secretary for Environmental Management identifying several concerns regarding the processing of Tank 48 contents.

March 18 letter to the Acting Assistant Secretary for Environmental Management forwarding comments on review of maintenance of High Level Waste Tank Farms.

March 31 letter to the Secretary of Energy requesting a 90-day revised implementation plan for Recommendation 2001-1.

August 14 letter to the Coordinator for Friends regarding Savannah River Remediation's performance goals.

October 15 letter to the Assistant Secretary for Environmental Management forwarding a staff review on design, testing, and controls for air pulse agitators for the Salt Waste Processing Facility.

Y-12 National Security Complex

January 22 letter to the Administrator, NNSA, providing the results of the staff review of the integrated safety management work planning and control processes.

January 23 letter to the Administrator, NNSA, establishing a 90-day reporting requirement regarding nuclear criticality safety evaluation concern.

June 3 letter to the Secretary of Energy congratulating Stanley Watkins of the Y-12 Site office for being honored as the 2008 DOE Facility Representative of the Year.

Other Correspondence

January 13 letter to the Acting Deputy Secretary of Energy establishing a reporting requirement regarding items to be addressed in a supplement to the 2008 Nuclear Criticality Safety Annual Report.

February 9 letter to the Secretary of Energy transmitting Quarterly Report to Congress.

March 23 letter to the Secretary of Energy summarizing the Board's views on the state of nuclear safety at defense nuclear facilities.

March 24 letter to Secretary of Energy forwarding the 19th Annual Report to Congress.

April 21 letter to the Secretary of Energy establishing a 60-day reporting requirement on actions regarding completing deliverables and remediation of deviations from *Ventilation System Evaluation Guidance*.

June 10 letter to the Under Secretary of Energy summarizing the Board's views on the state of nuclear safety at defense nuclear facilities.

June 22 letter to the Secretary of Energy transmitting the Quarterly Report to Congress.

July 30 letter to the Secretary of Energy forwarding Recommendation 2009-1.

August 25 letter to the Secretary of Energy providing outline of topics to be discussed at public meeting on Recommendation 2004-1.

December 7 letter to the Secretary of Energy transmitting the Quarterly Report to Congress.

December 10 letter to the Departmental Representative to the Defense Nuclear Facility Safety Board forwarding Think Outside the Bomb's comments on Recommendation 2009-2.

December 18 letter to the Secretary of Energy partially rejecting Recommendation 2009-1 Implementation Plan.