

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

**DEFENSE NUCLEAR FACILITIES
SAFETY BOARD**

Washington, DC 20004-2901



March 27, 2013

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

Dear Secretary Chu:

The Defense Nuclear Facilities Safety Board (Board) is pleased to enclose a printed copy of its Twenty-Third 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 2012.

Sincerely,

Peter S. Winokur, Ph.D.
Chairman

Enclosure: as stated



Defense Nuclear Facilities Safety Board

23rd Annual Report to Congress February 2013

**Required by Section 2286e of the
Atomic Energy Act of 1954, as amended**

“Above all, the Board must have a primary mission to identify the nature and consequences of any significant potential threats to public health and safety, to elevate such issues to the highest levels of authority, and to inform the public.”

Senate Report 100-232, Nuclear Protections and Safety Act of 1987, S. 1085, Committee on Armed Services, November 19, 1987.

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SAFETY BOARD**

Washington, DC 20004-2901



February 28, 2013

To the Congress of the United States:

The Defense Nuclear Facilities Safety Board is pleased to submit to Congress its Twenty-Third Annual Report for Calendar Year 2012. The Board is an independent executive branch agency responsible for making recommendations to the Secretary of Energy, and in certain cases to the President, necessary to ensure adequate protection of public health and safety at the Department of Energy's defense nuclear facilities.

As required by 42 U.S.C. § 2286e(a), this report describes the Board's current safety initiatives and assesses improvements in the safety of defense nuclear facilities as well as safety problems yet to be resolved.

Respectfully submitted,

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

Peter S. Winokur, Ph.D.
Chairman

A handwritten signature in black ink, appearing to read "Jessie H. Roberson".

Jessie H. Roberson
Vice Chairman

A handwritten signature in black ink, appearing to read "John E. Mansfield".

John E. Mansfield, Ph.D.
Member

A handwritten signature in black ink, appearing to read "Joseph F. Bader".

Joseph F. Bader
Member

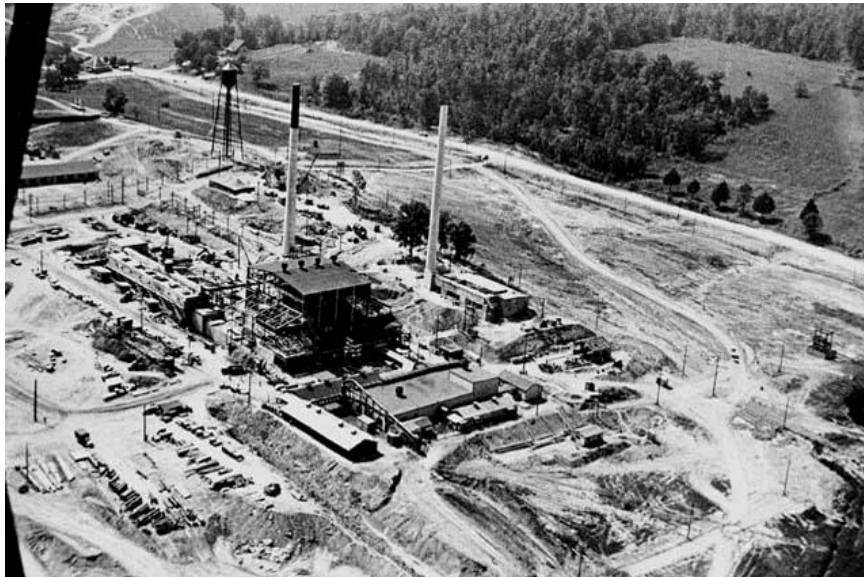
A handwritten signature in black ink, appearing to read "Sean Sullivan".

Sean Sullivan
Member

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Clinton Engineer Works, Oak Ridge, October 1943

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I. The Board's Statutory Mission

History and Legislation

The 1970s and 1980s were turbulent decades for the nuclear industry worldwide. In 1975, a serious fire at the Browns Ferry nuclear power station nearly led to a core melt accident. Such an accident did take place four years later at the Three Mile Island power reactor site in Pennsylvania. These two watershed events caused the Nuclear Regulatory Commission to spend much of the 1980s seeking to impose new safety requirements on both operating reactors and reactors under construction. By 1986, much progress had been made, and the nuclear industry was “settling down.” In April of that year, however, the Soviet-built Chernobyl nuclear reactor in Ukraine exploded, causing the largest accidental release of radioactive material in history. While safety experts agreed that U.S.-built power reactors did not share the flawed Chernobyl design, there was some concern with graphite-moderated reactors operated by the U.S. Department of Energy (DOE). Broader studies of DOE's defense reactors revealed that safety improvements lagged far behind those being made in the commercial nuclear industry. Congress was also concerned about the slow pace of cleaning up the waste generated by decades of nuclear weapons production.

Beginning in 1987, Congress began to consider legislation imposing some kind of external oversight or regulation of DOE's nuclear operations. Following two years of work by House and Senate committees, a compromise bill emerged based largely on Senator John Glenn's original bill, S. 1085, *Nuclear Protections and Safety Act of 1987*. On September 28, 1988, President Reagan signed a modified bill into law as part of the National Defense Authorization Act for Fiscal Year 1989. The provisions relating to the Defense Nuclear Facilities Safety Board (Board) were later codified in the Atomic Energy Act of 1954, as amended, at 42 U.S.C. § 2286 et seq.

Mission, Jurisdiction, and Powers

The Board is an independent federal agency within the executive branch of government, answerable to the President and subject to Congressional oversight and direction. The five Board members,¹ appointed by the President subject to confirmation by the Senate, are required by law to be “respected experts in the field of nuclear safety with a demonstrated competence and knowledge relevant to the independent investigative and oversight functions of the Board.” The Board is a collegial agency, meaning that its actions are determined by the Board as a whole. The Board's chairman is chief executive officer.

The Board's essential mission is to advise the Secretary of Energy on measures needed to ensure the safety of DOE's “defense nuclear facilities,” a term defined in the Atomic Energy

¹ For the majority of 2012, the Board consisted of four members – one less than called for in the Board's enabling legislation. Mr. Sean Sullivan of Ledyard, Connecticut, was confirmed by Congress as the Board's fifth member on August 2, 2012, for a term expiring October 18, 2015.

Act of 1954.² This advice generally relates to preventing accidents affecting the public, workers, or both. Advice may be offered in a variety of ways, from informal exchanges between technical professionals to formal recommendations made on the public record to the Secretary of Energy. Safety measures may pertain to specific DOE facilities and activities or may be directed at the safety requirements and guides employed to regulate nuclear activities. Perhaps the most cogent summary of the Board's mission is that made by the Senate Committee on Armed Services in 1987: "Above all, the Board must have a primary mission to identify the nature and consequences of any significant potential threats to public health and safety, to elevate such issues to the highest levels of authority, and to inform the public."

As noted above, the Board's jurisdiction covers DOE's "defense nuclear facilities." The statute's definition is somewhat complex, but it can be understood in plain language. The Board is only concerned with facilities operated by DOE that are (1) covered by the Atomic Energy Act and (2) have a function related to national defense. The phrase "defense nuclear facilities" thus excludes two major classes of government-regulated nuclear facilities: DOE's nuclear projects that are civilian in purpose, and commercial nuclear facilities regulated by the Nuclear Regulatory Commission. The Board's oversight jurisdiction does not extend to the U.S. Navy's nuclear propulsion program or to environmental hazards regulated by other federal and state agencies. The table below lists the major sites that the Board oversees.

The Board's oversight mission covers all phases in the life of a defense nuclear facility: design, construction, operation, and decommissioning. During the Board's more than two decades of work, some major sites have closed (such as Rocky Flats in Colorado), while other major facilities have been or are being built (such as the Waste Treatment and Immobilization Plant at Hanford in Washington State).

To carry out the mission outlined above, Congress granted the Board an effective suite of statutory tools. Principal among these is the formal Board recommendation issued to the Secretary. The statute requires the Secretary to either accept or reject the Board's recommendation, and in the case of an acceptance, to write and execute an implementation plan. This process all takes place on the public record. In cases involving an "imminent or severe threat" to the public health and safety, the statute requires the Board to also send its recommendation to the President, who makes the final decision on actions to be taken. In addition to recommendations, the Board is empowered to hold public hearings (and subpoena witnesses if necessary), conduct investigations, demand information and documents needed for the Board's work from DOE and its contractors, and review and comment on DOE requirements and standards affecting safety at defense nuclear facilities. DOE is required by law to grant the Board "ready access to such facilities, personnel, and information as the Board considers

² On January 2, 2013, the National Defense Authorization Act (NDAA) for Fiscal Year 2013 (Public Law No. 112-239) was signed into law. The NDAA made many significant changes to the Board's enabling legislation, most relevant of which was the addition of section 2286a(a), "Mission." This section emphasizes that "[t]he mission of the Board shall be to provide independent analysis, advice, and recommendations to the Secretary of Energy to inform the Secretary, in the role of the Secretary as operator and regulator of the defense nuclear facilities of the Department of Energy, in providing adequate protection of public health and safety at such defense nuclear facilities."

necessary to carry out its responsibilities.” Finally, the statute authorizes the Board to seek assistance from other federal agencies (such as the Nuclear Regulatory Commission) and from organizations outside the government (such as the National Academy of Sciences).

Major Sites Subject to Board Jurisdiction

Site	Location	Operations	DOE Website
Hanford Site	Richland, Washington	Cleanup and decommissioning	http://www.hanford.gov
Idaho National Laboratory	45 miles west of Idaho Falls, Idaho	Storage and processing of radioactive waste	http://www.inl.gov
Lawrence Livermore National Laboratory	Livermore, California	Research to support the nuclear weapons arsenal	https://www.llnl.gov
Los Alamos National Laboratory	Los Alamos, New Mexico	Research to support the nuclear weapons arsenal; manufacturing of nuclear weapon components	http://www.lanl.gov
Nevada National Security Site	Northwest of Las Vegas, Nevada	Disposition of damaged nuclear weapons; nuclear fission and subcritical experiments; waste management	http://www.nv.doe.gov
Oak Ridge National Laboratory	Oak Ridge, Tennessee	Energy research; treatment and disposal of radioactive wastes	http://www.ornl.gov
Pantex Plant	Near Amarillo, Texas	Maintenance of the U.S. nuclear stockpile	http://nnsa.energy.gov/npo
Sandia National Laboratories	Albuquerque, New Mexico	Nuclear research; support for weapons stockpile maintenance program	http://www.sandia.gov
Savannah River Site	Aiken, South Carolina	Tritium extraction, recycling and storage; management and treatment of radioactive wastes; nuclear materials storage and disposition; research and development	http://www.srs.gov
Waste Isolation Pilot Plant	26 miles east of Carlsbad, New Mexico	Safe disposal of transuranic waste in underground repository	http://www.wipp.energy.gov/
Y-12 National Security Complex	Oak Ridge, Tennessee	Manufacturing and surveillance of nuclear weapons components; processing of weapons-grade uranium	http://nnsa.energy.gov/npo

II. Highest-Priority Safety Problems

Earthquake Hazard at Los Alamos National Laboratory

The risk posed by the Plutonium Facility (PF-4) at Los Alamos National Laboratory remains among the Board's greatest concerns. An earthquake resulting in collapse of the facility would likely result in very high radiological doses to the public in nearby towns. The Board continues to urge senior leaders at DOE to take meaningful, near-term action to mitigate this risk.

On October 26, 2009, the Board issued Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*, to focus the attention of the leadership at DOE and the National Nuclear Security Administration (NNSA) on the need to address the danger posed by the potential for an earthquake to damage PF-4 and start a major fire in the facility. In response, NNSA took immediate actions to reduce the nuclear material at risk, combustible materials, and ignition sources. NNSA also completed analyses confirming that a large earthquake would likely damage the PF-4 structure and many of its safety systems. As a result, NNSA reinforced several structural elements, including the roof.

However, continuing review of NNSA's seismic analyses has led the Board to conclude that more needs to be done to reduce the risks at the facility. The Board issued a letter to NNSA on July 18, 2012, questioning the modeling approach the site contractor is using in seismic analyses. In response, NNSA has begun work on an independent seismic analysis of PF-4. NNSA expects to complete this analysis in 2013.

In September 2012, the site contractor completed its own detailed analysis and identified previously unknown structural weaknesses that could result in PF-4 collapsing during an earthquake. The newly revealed weaknesses result in postulated offsite dose consequences that could significantly exceed DOE's guideline for protecting the public, despite the structural upgrades made to PF-4 in response to the Board's Recommendation 2009-2. NNSA is evaluating this new information using guidance issued by the Deputy Secretary of Energy in response to the Board's Recommendation 2010-1, *Safety Analysis Requirements for Defining Adequate Protection for the Public and the Workers*. As part of this effort, NNSA is examining the need for additional actions to strengthen the facility.



Plutonium Facility (PF-4, in foreground)

In light of the developments during 2012, the Board issued a letter to the Secretary of Energy on January 3, 2013, strongly urging DOE to take additional near-term measures to reduce the consequences of a potential earthquake-induced collapse of PF-4.

Early Integration of Safety in Design

During 2012, DOE struggled to integrate safety early into its large, complex design projects and to improve timeliness in resolving safety-related issues. For example, in an April 2, 2012, letter to NNSA, the Board expressed concern that the project team developing the Uranium Processing Facility at the Y-12 National Security Complex had not integrated safety adequately into the preliminary design. The Board identified numerous deficiencies, including that the hazard analyses failed to analyze all hazards necessary to comply with the methodology in DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, and DOE Standard 1189 for performing unmitigated hazard analysis. NNSA is taking corrective actions to revise the safety documentation.

In the case of the Hanford Waste Treatment and Immobilization Plant, DOE struggled to integrate safety into the design, and has not resolved the most critical open technical issues. For example, DOE's response to the Board's Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*, is being delayed. On April 30, 2012, DOE informed the Board that the approach described in its implementation plan for verifying the design of vessel mixing systems was inadequate. DOE committed to revise its implementation plan to describe a workable approach by December 31, 2012. However, in the ensuing period, the Secretary of Energy undertook a more comprehensive review of the plant's design. In a letter dated November 8, 2012, the Secretary informed the Board that this review may result in further changes to DOE's approach to resolving the mixing issues. The Secretary committed to incorporate these changes into the planned revision of the Recommendation 2010-2

implementation plan in early 2013. Meanwhile, DOE is slowing the construction of two key facilities of the treatment plant to resolve longstanding safety-related issues and reevaluate the plant's design.

Maintaining Adequate Safety Controls

Weaknesses in the development, review, approval, and implementation of safety controls at DOE defense nuclear facilities were highlighted in Recommendation 2010-1. In 2012, the Board noted several examples where DOE and NNSA placed insufficient emphasis on the use of bounding safety analyses and on following the well-established "hierarchy of controls" defined in DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*. This standard dictates that bounding, conservative safety analyses be employed and that engineered structures, systems, and components are to be preferred over reliance on administrative controls. Deficiencies noted by the Board in the selection and implementation of safety controls were communicated to DOE in the following letters:

- At Lawrence Livermore National Laboratory, the Board identified systemic deficiencies related to the development, review, and approval of safety control strategies for nuclear operations at both the Tritium Facility and the Plutonium Facility. In particular, the Board identified non-conservative accident analyses and inadequate federal oversight that resulted in mischaracterization of hazard scenarios and improper safety controls. The Board also found that the defined safety functions of certain systems could not be reliably implemented and that the boundaries of some safety systems were inappropriately defined. (Letter, Winokur to D'Agostino, August 30, 2012)
- At Los Alamos National Laboratory, the Board identified deficiencies in the safety bases and control strategies at the Plutonium Facility and the Area G waste storage and disposal facility. At the Plutonium Facility, the Board found that the accident analysis used non-conservative input parameters and methodologies that resulted in underestimating the offsite dose consequences of certain accident scenarios. As a result, it is likely that compensatory measures or more robust safety control strategies will be necessary. At Area G, the weaknesses included non-conservative and inadequately supported analyses that resulted in an inadequate set of safety controls. (Letter, Winokur to D'Agostino, June 18, 2012; Letter, Winokur to Smith, November 19, 2012)
- At the Hanford Tank Farms, the Board determined that a revised control strategy approved by DOE was inadequate. The revised strategy downgraded the safety importance of ventilation systems that limit the accumulation of flammable gas and thereby help to prevent explosions in the high-level waste tanks. Consequently, the Board issued Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, on September 28, 2012. (Section III provides a complete discussion of this recommendation.)

Revision of DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*

DOE issued Standard 3009 in 1994 to formalize preparation of safety analyses for its nuclear facilities. This standard established safety expectations that were applied by the contractors for the following 15 years, resulting in significant improvement to the safety posture of defense nuclear facilities. Subsequent to the issuance of subpart B, *Safety Basis Requirements*, to the Nuclear Safety Management Rule (10 CFR Part 830), DOE adopted the methodology prescribed in Standard 3009 as an acceptable approach for preparing safety bases that comply with the rule. The Board agreed that the methodology described in this standard, if implemented properly, would enhance the safety of defense nuclear facilities.

DOE approved a safety basis for one of its plutonium facilities in 2008 that was a significant departure from the approach provided in Standard 3009. In subsequent correspondence with the Board, DOE stated that the standard, though a safe harbor for 10 CFR Part 830, was nevertheless guidance rather than a prescriptive requirements document. Consequently, the Board issued Recommendation 2010-1, *Safety Analysis Requirements for Defining Adequate Protection for the Public and the Workers*, on October 29, 2010, in order to strengthen DOE's regulatory framework and identify clear and unambiguous requirements for protection of the public and the workers.

One of the major actions in DOE's implementation plan for the Board's recommendation is to revise Standard 3009 so that it clearly identifies the requirements that must be met to ensure adequate protection of the public and the workers. DOE is currently working on the revision. Completing and implementing a revised standard with a clear and comprehensive set of safety requirements should improve the safety posture of DOE's defense nuclear facilities significantly.

Integrated Safety Management at the Activity Level

From 2008 to 2012, the Board's staff conducted a series of reviews at all DOE sites with defense nuclear facilities to evaluate the implementation of Integrated Safety Management (ISM) at the activity/worker level.³ Effective planning of work at the activity level is based on the development of effective procedures to perform work safely and the ability of workers to follow those procedures as written. This planning is essential to accomplish DOE's mission safely and involves implementing the five core functions of ISM: defining the scope of work, analyzing the hazards, developing and implementing hazard controls, performing work within those controls, and providing feedback and continuous improvement. As the staff's reviews progressed, the Board transmitted several reports to NNSA and to DOE's Office of Environmental Management detailing deficiencies and weaknesses in the implementation of

³ Integrated safety management is the process by which DOE and its contractors integrate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment.

ISM at the activity level.

As the final product of these reviews, the Board transmitted Technical Report DNFSB/TECH-37, *Integrated Safety Management at the Activity Level: Work Planning and Control*, to DOE in August 2012. This report concluded that DOE had not achieved sustained improvement in implementing ISM at the activity level. In the Board letter accompanying the report, the Board stated that it believes “this is in large part due to a lack of formalized requirements and guidance within DOE's directives system and the resulting lack of DOE and contractor oversight in this area.” In December 2012, DOE transmitted its response, which the Board is currently evaluating.

Conclusion of DOE’s 2010 Safety and Security Reform Plan

During 2012, the Board completed its review of key safety directives that DOE had revised as part of the *DOE 2010 Safety and Security Reform Plan*. These directives included:

- DOE Order 420.1C, *Facility Safety*
- DOE Guide 420.1-1A, *Nonreactor Nuclear Safety Design Criteria for Use with DOE O 420.1C, Facility Safety*
- DOE Standard 1066-2012, *Fire Protection*
- DOE Standard 1020-2012, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*

The Board ensured that the final versions included an effective set of safety requirements. DOE’s approval of these directives on December 4, 2012 officially concluded the Reform Plan.

The Reform Plan significantly reduced the number of directives controlled by DOE’s Office of Health, Safety and Security (HSS). However, the requirements that help ensure the safety of the public and workers at defense nuclear facilities remained largely unchanged. DOE started with 107 HSS directives (73 of interest to the Board) and ended with 55 HSS directives (40 of interest to the Board). Directives that are “of interest to the Board” involve any activity or operation at DOE defense nuclear facilities that could impact nuclear safety; for example, directives may include fire protection, quality assurance, and chemical safety.

Contractor Assurance Systems

During its May 2010 public hearing on DOE’s implementation of Recommendation 2004-1, the Board expressed its concerns about DOE’s increasing reliance on contractor assurance systems and the corresponding reduction in the level of independent Federal oversight for safety. As part of the review of safety management programs, Board members and staff continue to find problems with the effectiveness of contractor assurance systems in identifying and correcting safety issues. Board members have addressed the use and effectiveness of contractor assurance systems during site visits and hearings. The Board is aware of lessons

learned from the security incident at the Y-12 National Security Complex and will closely monitor safety management programs at defense nuclear facilities for indications of applicability of the security lessons to safety management.

Longevity of High-Level Waste Storage Systems

DOE's plan for cleanup of the high-level waste Tank Farms at the Hanford Site rests on the integrity of 28 double-shell tanks at the site. These million-gallon tanks are to be used for decades as storage space for wastes retrieved from the 149 older single-shell tanks. They will serve as feed tanks for the Waste Treatment and Immobilization Plant and for other supplemental treatment facilities designed to immobilize the wastes for long term storage and disposal.

During 2012, DOE discovered that the inner shell of Tank 241-AY-102, the first double-shell tank built at Hanford, had leaked a small quantity of waste onto the floor of the outer shell. The source of the leak was not visible, but DOE believes the leak was most likely due to corrosion of the steel bottom of the inner shell. DOE researched records from the construction of Tank 241-AY-102 and found evidence of problems that may have resulted in the inner shell being more susceptible to degradation than the other double-shell tanks. Presently, it is uncertain if the leak was caused by a defective weld, stress corrosion cracking, pitting corrosion, or some other factor. The uncertainty makes it difficult to predict the susceptibility of other tanks to failure as well as the ability of the outer shell of Tank 241-AY-102 to contain the leaking waste, since that shell also experienced construction difficulties. DOE has begun an extent-of-condition evaluation of six similar tanks and is considering options for eventually transferring waste from Tank 241-AY-102 should DOE determine such a transfer is necessary. The Board is closely monitoring this effort because of the specific hazard posed by a leak from Tank 241-AY-102 and because of the broader implications for the high-level waste cleanup program at Hanford. It is worth noting that many double-shell tanks will be well beyond their design life before they are emptied.

III. Recommendations to the Secretary in 2012

Recommendation 2012-1, Savannah River Site Building 235-F Safety

On May 9, 2012, the Board transmitted Recommendation 2012-1, *Savannah River Site Building 235-F Safety*, to the Secretary of Energy. The full text of the recommendation is reprinted in Appendix A to this report. This recommendation identified the need for DOE to reduce the hazard of a potential release of plutonium-238 contamination from this inactive facility.

Building 235-F no longer has a programmatic mission. It is operated in a surveillance and maintenance mode, is normally unoccupied, and houses several partially deactivated processing lines. With the exception of substantial quantities of residual contamination, Building 235-F has been de-inventoried of special nuclear material. This residual contamination constitutes the principal hazard and includes a significant quantity of plutonium-238 (Pu-238). Pu-238 in this facility is in the form of highly dispersible, fine powder. This form increases the potential dose consequences associated with a release.



Building 235-F, Savannah River Site

The Board previously identified the need to address hazards posed by the residual contamination in Building 235-F. On a number of occasions, DOE evaluated options and developed plans to address the residual contamination. However, these efforts did not successfully transition from planning to execution, and the hazard remained.

The Board therefore issued Recommendation 2012-1, identifying the need for DOE to take action to immobilize and/or remove the Pu-238 in Building 235-F. On July 10, 2012, the Secretary of Energy accepted the recommendation. DOE submitted its implementation plan for the recommendation to the Board on December 5, 2011. It is presently under review.

Recommendation 2012-2, Hanford Tank Farms Flammable Gas Safety Strategy

On September 28, 2012, the Board transmitted Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, to the Secretary of Energy. The full text of the recommendation is reprinted in Appendix A to this report.

The ventilation systems for the double-shell tanks in the Hanford Tank Farms are important in preventing and mitigating potential accidents involving the flammable gases generated by the high-level wastes stored in these tanks. The safety analyses at the Hanford

Tank Farms show that 11 of the 28 double-shell tanks currently have enough flammable gas retained in the waste that, if released in the tank headspace, could create a flammable atmosphere. Furthermore, all the double-shell tanks contain wastes that continuously generate flammable gases and, therefore, will eventually contain a flammable atmosphere without adequate ventilation. Consequently, ventilating the double-shell tanks is a critical safety strategy at the Tank Farms.

In 2010, DOE approved downgrading the functional classification of the ventilation systems from safety-significant to general service. In lieu of this credited engineered feature, DOE implemented an administrative control to monitor flammable gas conditions in the tanks. However, the Board identified a number of weaknesses with the administrative control that collectively rendered the control inadequate to perform the specified safety function. The Board also noted that other systems providing indications used in determining whether operators need to take corrective action to respond to abnormal conditions were not classified in accordance with their safety function. The Board documented its concerns in a letter to DOE on August 5, 2010.

In response, DOE issued a letter to the Board on February 25, 2011, stating that it would take action to restore the double-shell tank ventilation systems to safety-significant status and upgrade other monitoring systems to safety-significant status. However, DOE did not make meaningful progress in accomplishing these important commitments. The Board therefore issued Recommendation 2012-2 to bring the issue to the attention of the Secretary.

In a letter dated November 27, 2012, the Secretary of Energy acknowledged receipt of the recommendation. The Secretary accepted the recommendation on January 7, 2013.

IV. Open Prior Recommendations

Recommendation 2000-1, *Prioritization for Stabilizing Nuclear Materials*

The Board issued Recommendation 2000-1 as a follow-up to Recommendation 94-1, *Improved Schedule for Remediation in the Defense Nuclear Facilities Complex*. Recommendation 94-1 identified the need to remediate large amounts of nuclear materials in liquid and solid form that remained in the manufacturing pipeline at the end of the Cold War. In Recommendation 2000-1, the Board sought to re-establish the priority for stabilizing the materials that remained after six years of effort to implement the original recommendation. The Board noted that Savannah River Site, Hanford, Rocky Flats, and Los Alamos National Laboratory possessed most of the legacy materials that were significantly behind schedule for remediation.

As of 2012, a tremendous amount of material has been stabilized, and the greatest hazards have been remedied. The only commitments remaining involve spent fuel sludge at Hanford and plutonium at Los Alamos National Laboratory. The project team working on the stabilization of fuel sludge at Hanford completed the preliminary design for equipment to retrieve and package the sludge. They also initiated construction on the facility to house processing equipment and successfully processed, packaged, and placed in interim storage the fuel rubble remaining in the K West Basin. Personnel at Los Alamos National Laboratory continue to make progress in stabilizing their remaining materials. The remaining commitments at Hanford and Los Alamos National Laboratory are years overdue with respect to the completion dates listed in DOE's implementation plan. The Board is working with DOE to amend the plan to reflect expected completion dates for the remaining stabilization activities.

Recommendation 2002-3, *Requirements for the Design, Implementation, and Maintenance of Administrative Controls*

Recommendation 2002-3 identified the need for additional requirements for administrative controls used to assure safety at defense nuclear facilities. In response to the recommendation, DOE developed new requirements, standards, and training to ensure that administrative controls throughout the defense nuclear complex are reliable and effective. All of the deliverables identified in DOE's implementation plan have been provided to the Board. During 2012, the Board's staff conducted a number of field reviews to assess contractor actions and DOE oversight in this area, and found the use of specific administrative controls (SACs) appropriately implemented. The Board expects DOE to propose closing this recommendation in 2013.

Recommendation 2004-1, *Oversight of Complex, High-Hazard Nuclear Operations*

The Board issued Recommendation 2004-1 to address changes in DOE's organizational structure and safety practices. The recommendation dealt with delegations of authority for fulfilling safety responsibilities, technical capability of federal officials with safety

responsibilities, Central Technical Authorities for decisions affecting safety, nuclear safety research, application of lessons learned from significant accidents in other segments of industry, and application of the principles of Integrated Safety Management. DOE responded with an implementation plan defining actions to: (1) strengthen federal safety assurance, (2) learn from operating experience within DOE and other industries, and (3) revitalize the implementation of Integrated Safety Management.

DOE has met most of the commitments in its implementation plan, but the remaining commitments are all overdue. In addition, in 2012 the Board found that DOE's effort to reinvigorate integrated safety management at the activity level was not fully successful (see the discussion on DNFSB/TECH-37 in Section II of this report). The remaining open commitments from DOE's implementation plan are associated with research and development for nuclear safety, guidance on safety oversight, and verification of the effectiveness of the actions that DOE has taken to improve its capability to assure safety.

In 2012, DOE established a committee on nuclear safety research and development, but it has yet to develop processes to identify department-wide needs for nuclear safety research and development or to assess the extent to which those needs are being addressed. In June 2012, DOE approved a guide for safety oversight; however its scope was too narrow to satisfy the commitment in DOE's implementation plan. In discussions with the Board's staff, DOE personnel agreed to develop a path forward to address this issue.

Recommendation 2004-2, *Active Confinement Systems*

The Board issued Recommendation 2004-2 advising DOE to disallow reliance on passive confinement systems and require an active confinement ventilation system for all new and existing Hazard Category 2 and 3 defense nuclear facilities with the potential for a radiological release. The Board believes that active confinement systems are critically important for new facilities and existing facilities like the Los Alamos Plutonium Facility, because such systems prevent the release of radioactive materials in accidents. The Secretary submitted an implementation plan for the recommendation on August 22, 2005, and a revised implementation plan on July 12, 2006.

In the summer of 2010, DOE completed its evaluation of all defense nuclear facilities in accordance with its implementation plan for this recommendation. NNSA concluded that only its Plutonium Facility at Los Alamos required upgrades. DOE's Office of Environmental Management assigned an independent team to study results of evaluations for its facilities and prioritize them according to safety enhancement value and cost effectiveness. The team recommended that DOE initiate projects to modify or upgrade the active confinement ventilation systems in selected facilities at Savannah River and Hanford in order to meet the performance criteria established in the DOE Guide prepared for this purpose. In a letter dated October 1, 2010, DOE committed to make these upgrades and to brief the Board within one year on the progress made in enhancing the reliability of those systems. In 2011, contractors at the Savannah River Site evaluated the proposed modifications in more detail and concluded

that different modifications to their ventilation systems would be more cost-effective. However, this effort has not been completed since the funding was not made available to perform the upgrades.

The Board continues reviewing the design of new facilities, such as the Uranium Processing Facility at the Y-12 National Security Site, to confirm that an active confinement system remains in the design of those facilities. Active confinement systems are also critically important for existing facilities like the Los Alamos Plutonium Facility, because such systems prevent the release of radioactive materials in accidents. As part of its implementation plan, DOE revised pertinent directives in 2012, such as DOE Order 420.1C, *Facility Safety*, to ensure that active confinement systems are considered the preferred option in designing new facilities.

Recommendation 2005-1, *Nuclear Material Packaging*

The Board issued Recommendation 2005-1 to improve protection for workers employed in the storage and handling of nuclear materials. DOE provided the final implementation plan deliverable, a DOE-wide plan and schedule for implementing DOE Manual 441.1-1, *Nuclear Material Packaging Manual*, in September 2009. In forwarding his plan and schedule, the Secretary committed to updating the Board annually on progress made and any changes to DOE's repackaging plans. That effort continued in 2012. Specifically, the Board provided oversight of DOE's efforts to qualify containers to the requirements of the Packaging Manual. In March 2012, safety analysts at Los Alamos National Laboratory submitted a revised safety analysis for a new plutonium storage container to NNSA's Office of Package and Transportation. The process of review and comment resolution was ongoing at the end of 2012.

Several other sites also plan to use this new container once it is approved. So far, only NNSA's Los Alamos Site Office has developed a formal process for approving its contractor's technical basis for nuclear material packaging and surveillance of packages as required by the Packaging Manual. NNSA's Office of Packaging and Transportation is developing a safety guide for sites other than Los Alamos National Laboratory that are planning on packaging nuclear material into the new containers. This Safety Guide will help other sites document compliance with the Packaging Manual by providing a check list of requirements addressing site-specific materials and hazards not covered by the safety analysis developed for use at Los Alamos National Laboratory.

Personnel at the Y-12 National Security Complex had previously developed conceptual designs for several improved containers for the storage of weapons grade uranium materials in the Uranium Processing Facility currently under design. However, the new Y-12 approach is to employ research to demonstrate that the hazards of weapons-grade uranium are too low to necessitate improved containers. This approach is allowed and described in an appendix to the Packaging Manual. If the Y-12 effort is successful, weapons-grade uranium oxide would no longer be within the scope of the Packaging Manual. The Board is monitoring this effort.

Recommendation 2007-1, *Safety-Related In Situ Nondestructive Assay of Radioactive Materials*

The need for improved in situ nondestructive assay techniques will grow as DOE designs new facilities and decommissions old ones. Recommendation 2007-1 requested that DOE develop standardized requirements for performing nondestructive assay measurements and place a higher priority on research and development activities for nondestructive assay instrumentation and measurement techniques. In response, DOE performed complex-wide reviews to identify best practices and weaknesses in its nondestructive assay programs. DOE is executing an action plan to address weaknesses it identified in the following areas: training and qualification, equipment capabilities, directives, research and development, quality assurance, and oversight. In October 2012, DOE communicated to the Board that it has completed the actions identified in its implementation plan. The Board is continuing to evaluate DOE's progress toward completing the institutional improvements that are needed for its nondestructive assay programs.

Recommendation 2008-1, *Safety Classification of Fire Protection Systems*

Recommendation 2008-1 identified the need for standards governing the design and operation of fire protection systems relied upon to protect the public and workers from radiological hazards at defense nuclear facilities. DOE issued the first major deliverable of the implementation plan—interim guidance for the design and operation of wet pipe sprinkler systems and supporting water supplies—in 2010. DOE completed the required deliverables for Recommendation 2008-1 and issued DOE Standard 1066-2012, *Fire Protection*, in late 2012. This directive incorporated and expanded on the interim guidance to present a comprehensive set of safety-related attributes for wet-pipe fire sprinklers, fire water supplies, and fire barriers. The Board expects DOE to propose closing this recommendation in 2013.

Recommendation 2009-1, *Risk Assessment Methodologies at Defense Nuclear Facilities*

In Recommendation 2009-1, the Board pointed out that policies, standards, and guidance were needed to govern use of quantitative risk assessment methodologies at defense nuclear facilities. In response, DOE issued a complex-wide information notice discussing allowable uses of risk assessment in 2010, and drafted a standard for probabilistic risk assessment for trial use and comment. In April 2011, DOE issued a new departmental policy on nuclear safety that covered the appropriate use of quantitative and probabilistic risk assessment. Despite the progress achieved, quantitative risk analysis continues to be used in an ad hoc manner in the safety analyses for some defense nuclear facilities. DOE has not yet identified any applications of the new policy or provided guidance on its practical application. The Board's staff reviewed and assessed the DOE training course given to new DOE/NNSA managers; the Board and its staff will continue to monitor DOE's efforts to identify suitable pilot applications of the new standard.

Recommendation 2009-2, *Los Alamos National Laboratory Plutonium Facility Seismic Safety*

The Board issued Recommendation 2009-2 on October 26, 2009, to focus DOE and NNSA management on the risk posed by an earthquake and subsequent fire at the Los Alamos National Laboratory Plutonium Facility (PF-4). The Secretary submitted an implementation plan for the recommendation on July 13, 2010. NNSA took several actions to reduce risk, including reduction of the quantity of nuclear materials in the facility, implementation of new controls on combustible material loading and operation of furnaces, installation of robust storage safes, and installation of other seismic upgrades. NNSA plans to continue work on seismic upgrades through fiscal year 2013. See Section II above for a detailed discussion.

Recommendation 2010-1, *Safety Analysis Requirements for Defining Adequate Protection for the Public and the Workers*

In Recommendation 2010-1, the Board concluded that DOE was weakening the safety structure by reinterpreting certain key provisions of Title 10 CFR Part 830, *Nuclear Safety Management*, intended to provide adequate protection of public health and safety. The Board issued Recommendation 2010-1 advising DOE to define a clear and unambiguous set of nuclear safety requirements. DOE partially accepted the recommendation on February 28, 2011. DOE rejected the portion of the recommendation relating to existing defense nuclear facilities where an accident could cause offsite doses exceeding well-established safety criteria.

In the implementation plan for the recommendation, DOE committed to revising several of its standards to clarify the requirements that must be met by its contractors in preparation of documented safety analyses and by DOE in approval of documented safety analyses. DOE also established a new process for the review and approval of any safety bases that do not meet certain safety criteria. DOE has not met, however, several of the scheduled milestones established in the implementation plan. The Board continues to encourage and assist DOE to make progress in this vital effort.

Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*

On December 17, 2010, the Board issued Recommendation 2010-2 to resolve potential nuclear safety hazards at the Hanford Waste Treatment and Immobilization Plant. The recommendation focused on the need for large-scale testing to demonstrate the performance of mixing and transfer systems using representative simulants. DOE submitted its implementation plan on November 10, 2011, and the Board accepted it on January 19, 2012. Subsequently, DOE's testing program obtained results that were inconsistent with an important assumption in the implementation plan. In a November 8, 2012, letter, the Secretary of Energy informed the Board that a full-scale testing program would become the new technical basis for implementing the recommendation. This change in strategy requires a major revision to DOE's implementation plan.

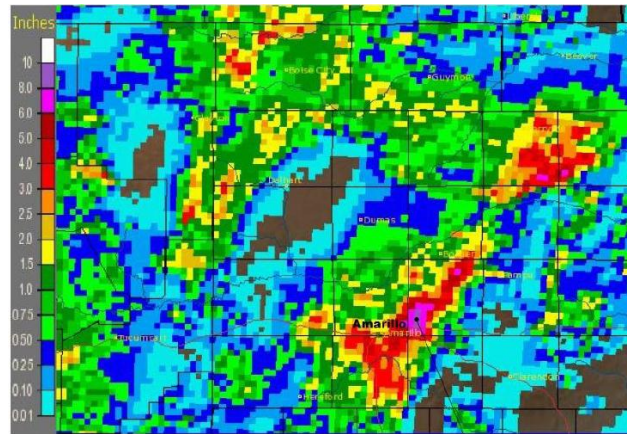
Recommendation 2011-1, *Safety Culture at the Waste Treatment and Immobilization Plant*

The Board issued Recommendation 2011-1 following an investigation into the safety culture of the Waste Treatment and Immobilization Plant project at the Hanford Site. DOE submitted its implementation plan for the recommendation to the Board in December 2011 and provided an addendum describing additional actions in September 2012. DOE completed a number of actions from the implementation plan during 2012, many of which focused on working to achieve and reinforce a safety conscious work environment at Hanford and across the DOE defense nuclear complex. Notably, the Secretary of Energy conducted a town hall meeting at Hanford to directly convey his expectations to the management personnel and staff of DOE and its contractors. DOE also developed training on achieving a safety conscious work environment for the senior leadership of DOE and its contractors. More than 300 managers completed this training in 2012, with 700 more across the complex still to be trained. Based on the success of this training, DOE is developing a training module to deliver to all employees.

As part of the implementation plan, DOE's Office of Health, Safety and Security undertook independent assessments of the safety culture at DOE's Office of Environmental Management, the operating contractor at the Pantex Plant, as well as several major design and construction projects across the complex. These assessments were led by recognized experts in safety culture and found numerous areas needing attention. A number of important actions remain, including performing self-assessments at sites and facilities not assessed by the Office of Health, Safety and Security; integrating the findings across the complex into a coherent whole; and developing tools to sustain a robust nuclear safety culture throughout DOE's defense nuclear complex.

V. Emergency Preparedness, Response, and Recovery

The Board continues to focus attention on improving DOE's ability to respond to emergencies, particularly those associated with low-probability, high-consequence accidents and natural phenomena events. These types of severe events include beyond-design-basis accidents that can affect multiple facilities at a site and can also lead to cascading scenarios, such as an earthquake that ruptures a dam or ignites a wildland fire. As demonstrated by recent weather events, a common impact is the loss of infrastructure such as roads, utilities, and communications—all of which DOE relies on for emergency response.



Precipitation Map from Flash Flooding Event at Pantex Plant, July 2010

Emergency management, which encompasses emergency preparedness, response, and recovery, is a common topic addressed during the Board's visits to the Pantex Plant in January 2012, to Los Alamos National Laboratory in August 2012, and to Hanford in December 2012. In addition, during its visit to Lawrence Livermore National Laboratory in June 2012, the Board was briefed on the facility drill program, an important element of emergency management.



Hanford Responders Practice Firefighting Techniques

During 2012, the Board's staff conducted baseline assessments of the ability of DOE and its contractors to prepare for, respond to, and recover from emergencies at the Pantex Plant, the Y-12 National Security Complex, and at individual emergency management facilities in Oak Ridge, Tennessee. The Board's staff conducted follow up reviews at Hanford and Los Alamos National Laboratory to address concerns with their emergency management programs identified during previous reviews. The Board's staff also observed emergency drills and exercises conducted at DOE sites.

In general, the Board has observed a wide variation in the implementation of emergency preparedness and response requirements across the defense nuclear complex. Recovery is one area of emergency management that is not addressed in detail by most DOE sites.

In addition to encouraging DOE to improve its overall emergency management capabilities, the Board has continued to focus on DOE's ability to respond to severe events (including beyond design basis events). The Board's staff has observed efforts by sites and facilities on an individual basis to improve this capability, including incorporation of severe event scenarios into tabletop exercises, drills, and site exercises. However, DOE has not yet issued guidance on addressing beyond design basis events in safety basis directives and severe events in emergency management directives. Such guidance was recommended as a result of the June 2011 Nuclear Safety Workshop, held by DOE as part of its response to lessons learned from Fukushima. The Board has used its public hearings, site visits, and other opportunities— such as the Chairman's presentations at the September 2012 Nuclear Safety Workshop and the October 2012 *Weapons Complex Monitor* Decision Maker's Forum— to encourage this effort.



**Chairman Winokur Speaking at the
2012 Nuclear Safety Workshop**

VI. Nuclear Weapon Operations

The Board is responsible for ensuring the safety of DOE's nuclear weapon operations. These operations include making nuclear weapons components, taking apart retired weapons, disassembling active weapons for surveillance and maintenance, and reassembling weapons for deployment by the armed forces. The Board also provides safety oversight of the handling and storage of special nuclear material and tritium, and of DOE's nuclear weapon research and development work.

Earthquake Hazard at the Plutonium Facility, Los Alamos National Laboratory

The Plutonium Facility (PF-4) at Los Alamos National Laboratory plays a unique role in supporting NNSA's mission. It is the location for long-term plutonium processing, purification, and component fabrication. The Board remains very concerned about the high risk posed by PF-4 and intends to work closely with NNSA to ensure the adequate protection of the workers and public in Los Alamos. (See Section II above for a detailed discussion.)

Nuclear Explosive Operations, Pantex Plant

The primary mission of the Pantex Plant is to assemble, disassemble, examine, and dismantle nuclear weapons. These activities must be given the highest level of safety oversight because an accident could result in a nuclear detonation or detonation of high explosives. Personnel in NNSA's nuclear explosive safety program are responsible for ensuring all operations meet the required standard of safety for these high-hazard operations.

In a letter dated November 7, 2011, the Board identified inadequacies in how NNSA tracks and closes findings of its nuclear explosive safety review teams and comments from senior technical advisers participating in reviews of nuclear explosive operations. (According to DOE M 452.2-2, *Nuclear Explosive Safety Evaluation Processes*, "Findings" are safety deficiencies that could lead to a nuclear detonation or a violent reaction of high explosives.) NNSA responded that it would address these concerns.

On March 2, 2012, the Board issued a letter to NNSA stating its concern that certain nuclear explosive operations were conducted outside of the defined safety controls, despite objections that had been expressed by B&W nuclear explosive safety experts at Pantex. These events led the Board to question whether the B&W Nuclear Explosive Safety organization had sufficient independence and authority and whether the process for managing changes to nuclear explosive operations was deficient. In response, NNSA conducted assessments of the safety culture at the Pantex Plant, and DOE's Office of Health, Safety and Security conducted an independent assessment led by nationally recognized experts in safety culture. These reviews found major weaknesses, and both NNSA and B&W Pantex are now working on corrective measures. NNSA is also conducting a review of its nuclear explosive safety directives. The Board is monitoring these efforts closely.

Weaknesses in Safety Basis Documents and Associated Controls

DOE's Nuclear Safety Management Rule requires contractors to prepare a documented safety analysis and establish controls to ensure adequate protection of workers, the public, and the environment. DOE Standard 3009, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, dictates that bounding, conservative safety analyses be employed and that engineered structures, systems, and components be employed wherever possible in preference to reliance on administrative controls. Examples where the rule and standard were not implemented adequately by NNSA are summarized below.

Lawrence Livermore National Laboratory. The Board's staff identified several instances where the laboratory contractor proposed revisions to the safety bases for its defense nuclear facilities founded, in part, on non-conservative assumptions. In a letter to NNSA dated August 30, 2012, the Board noted systemic deficiencies in the development, review, and approval of safety controls for nuclear operations. The Board identified the following specific concerns:

- The Tritium Facility gloveboxes are allowed to operate with a leak rate for tritium significantly greater than that specified in industry standards and DOE's own guidance. Additionally, laboratory engineers have not provided an engineered control for protecting the workers from a fire involving tritium, but instead rely on evacuation.
- In planning and conducting a classified experiment, laboratory scientists modeled potential accident scenarios involving plutonium with data that were inapplicable to the actual configuration of the experiment. As a result, laboratory analysts did not credit engineered features, relying instead on an administrative control and personal protective gear for worker protection.
- In response to the malfunction of the safety-class fire suppression system at the Plutonium Facility in May 2012, the laboratory contractor inadequately assessed the increased risk of fire suppression system failure to function on demand. The contractor then failed to implement appropriate compensatory measures.



Tritium Processing Station, Lawrence Livermore National Laboratory

National Criticality Experiment Research Center, Nevada National Security Site. The Board has provided close oversight of startup, initial operations and experiments, and revisions to the documented safety analysis at this facility. Operators at the facility conduct criticality experiments using assemblies named Comet, Flat-Top, Godiva, and Planet. The assemblies can accommodate different fissile materials and configurations to support a variety of experiments relevant to defense nuclear programs.

The Board's staff conducted a review of NNSA's proposed revision to the documented safety analysis and improvements to the control system. As a result of identified deficiencies, NNSA managers completed or proposed further corrective actions to the safety basis and controls:

- Technicians replaced components of the safety-significant SCRAM Shutdown System for Flat-Top with components qualified to perform their safety functions.
- Site analysts will expand the accident analysis and correct the characterization of reactivity insertions that were previously considered incredible.
- NNSA will reduce the quantity of plutonium allowed in Godiva and Flat-Top from 250 grams to 5 grams, significantly reducing the potential dose consequences from an accident.
- Facility operators will include instrument setpoints and system response times in experiment plans to ensure safe operations.



Planet Critical Assembly Machine

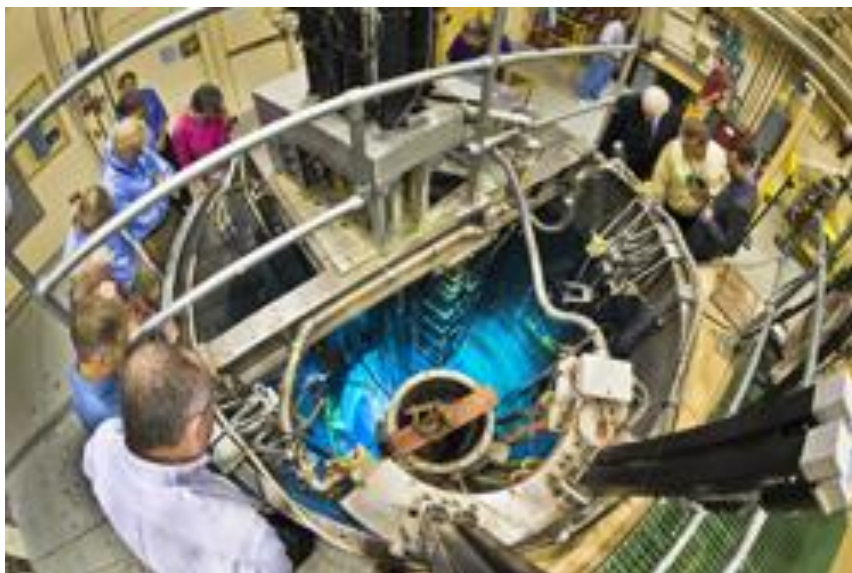
In an August 5, 2010, letter to NNSA, the Board expressed its concern about “a number of deficiencies in the accident analysis, control set, and safety system design at the Criticality Experiments Facility (CEF) at the Nevada Test Site.” The Board listed the following three categories as the primary areas of concern: identification and evaluation of hazards, identification of an adequate set of controls, and classification and design of the controls important to safe operation of CEF. Since 2010, the Board's staff has worked with NNSA to monitor the corrective actions taken. The Board plans continued close oversight to ensure that NNSA corrects weaknesses at this facility.

Plutonium Facility, Los Alamos National Laboratory. As part of efforts to strengthen safety at Los Alamos National Laboratory's Plutonium Facility, the Board's staff reviewed the annual update of the facility's documented safety analysis. In its letter to NNSA dated June 18, 2012, the Board found several assumptions made in preparing the safety analysis technically unsound. These assumptions deal with the integrity of walls inside the facility after an earthquake, the amount of combustible material available during facility fires, and the

properties of some nuclear materials when disturbed by fire or seismic activity. Some parameters were assumed to have non-conservative values without adequate justification, such as the number of fires the facility may experience after an earthquake. (See also Section II above.)

Annular Core Research Reactor, Sandia National Laboratories. The Annular Core Research Reactor is a pool-type reactor located at Sandia National Laboratories in Albuquerque, New Mexico. Its primary purposes are reactor safety research and testing electronics in high radiation fields. These are accomplished by exposing various components to pulsed and steady state neutron irradiation environments.

During 2011, the Board examined the documented safety analyses and control systems at the facility. On February 28, 2012, the Board sent a letter to NNSA describing its concerns with accident analysis assumptions and reliability of the reactor's control systems. Due to its unique design and operating profile, the reactor operates under a combination of requirements applicable to commercial and research reactors as well as DOE directives. The Board found



Pulse Operation of the Annular Core Research Reactor

weaknesses in this approach that allowed potentially unsafe conditions to exist during certain postulated accidents. The Board questioned the reliability of the reactor's control system based on several previous failures and the lack of a documented analysis of reliability that is normally required by industry standards. NNSA and the contractor applied several compensatory measures to ensure

operations are conducted in a safe manner. These measures included additional operator checks of the control system and limits on the quantity of nuclear materials allowed in the facility. NNSA is conducting additional analyses to verify several other assumptions in the safety basis and better define the reliability of the reactor control system.

Safe Operations and Training and Qualification Programs, Y-12 National Security Complex

The primary missions of the Y-12 National Security Complex include the safe, secure, and reliable management of the nuclear weapons stockpile. Operators at Y-12 primarily receive and store enriched uranium, and assemble, disassemble, and inspect nuclear weapon components. During 2011, the Board identified a number of issues with the quality and

execution of technical procedures and the implementation of work planning and control processes. Contractor personnel developed and implemented several performance improvement plans to address the Board's concerns; these efforts continued throughout 2012. During an annual site visit to Y-12, Board members questioned federal and contractor managers regarding these improvements. Operational issues persist, and the Board's interest has driven more frequent management assessments of operational performance and continued management attention to address emerging work planning and control issues.

Since many improvements in the areas of procedural compliance, conduct of operations, and activity-level work planning depend on training to emphasize management's expectation for safe operations, the Board's staff reviewed the contractor's training and qualification program. While this program meets DOE's requirements, the Board identified a number of areas for improvement and communicated them to NNSA in a letter dated June 5, 2012. As a result, the contractor has developed new continuing training programs, expanded and enhanced its lockout/tagout training program, and improved its systematic approach for identifying training requirements.

VII. Design and Construction

New Facilities

The Atomic Energy Act requires that the Board review the design and construction of new defense nuclear facilities to ensure that eventual operation of these facilities will be safe for workers and the public. The Board uses a variety of methods to carry out this function, including detailed reviews by the Board’s technical staff, public hearings, requests for information, and visits by Board members to construction sites. Currently, the Board is actively overseeing the design and construction of 10 new defense nuclear facilities with a projected total cost of approximately \$25 billion dollars. The Board is waiting to see what action DOE takes on several other projects that are either on hold or have been deferred. The table below lists DOE’s design and construction projects, the status of each project, and the status of the Board’s review.

Design and Construction Projects Under Review

Project Name	Location	Projected Cost	Status of Project	Status of Board Review
Waste Treatment and Immobilization Plant	Hanford Site, Richland, WA	\$12.3 billion	Concurrent design and construction	Ongoing (see text)
K-Basin Closure Sludge Treatment Project	Hanford Site, Richland, WA	\$280 million	Phase 1: Final design Phase 2: Conceptual design	Ongoing – two open safety issues
Integrated Waste Treatment Unit	Idaho National Laboratory, ID	\$571 million	Construction complete, conducting performance testing	Ongoing – no current safety issues
Chemistry and Metallurgy Research Replacement Project	Los Alamos National Laboratory, NM	\$3.7–5.8 billion (Under DOE review)	Final design	Project suspended by DOE during 2012
Radioactive Liquid Waste Treatment Facility Upgrade Project– Transuranic Waste Processing Facility	Los Alamos National Laboratory, NM	\$202–270 million	Preliminary design	Ongoing – no current safety issues

Design and Construction Projects Under Review (cont.)

Project Name	Location	Projected Cost	Status of Project	Status of Board Review
Transuranic Waste Facility Project	Los Alamos National Laboratory, NM	\$71–124 million	Final design	Ongoing (see text)
Transuranic Waste Processing Center Sludge Project	Oak Ridge National Laboratory, TN	\$50 million	Preliminary Design	Ongoing – no current safety issues
Salt Waste Processing Facility	Savannah River Site, Aiken, SC	\$1.34 billion	Construction	Ongoing – one open safety issue
Waste Solidification Building	Savannah River Site, Aiken, SC	\$345 million	Construction	Ongoing – no current safety issues
Uranium Processing Facility	Y-12 National Security Complex, Oak Ridge, TN	\$4.2–6.5 billion	Preliminary Design	Ongoing (see text)

Hanford Site, Waste Treatment and Immobilization Plant

The Waste Treatment and Immobilization Plant (sometimes referred to as the Waste Treatment Plant or WTP) is a \$12 billion radiochemical processing facility. DOE began work on this project in the late 1990s. Its purpose is to treat 56 million gallons of radioactive and toxic waste stored in 177 underground tanks on the Hanford Site near Richland, Washington. After these wastes are retrieved from the tanks, the plant will chemically separate the waste into two streams of differing radioactive hazard and solidify them into glass in stainless steel canisters. The low-radioactivity glass will be disposed of onsite, while the high-level waste glass will be shipped offsite for permanent disposal once a repository is available. The plant will use three primary nuclear facilities known as the Pretreatment, Low-Activity Waste, and High-Level Waste Facilities to meet these objectives. DOE’s principal design and construction contractor is Bechtel National, Inc., a business unit of the Bechtel Corporation.

For more than a decade, the Board has devoted time and resources to oversight of this critical facility with two main safety objectives. First, operation of the plant must not expose the public or workers to undue risk. Second, the plant must achieve its design objectives to eliminate the safety and environmental risks posed by continued storage of this waste in aging

underground tanks. Although this is a one-of-a-kind project with novel technology that requires significant research and development, it is being designed concurrent with construction. As a result, timely identification and resolution of technical issues is paramount to meeting the objectives of the Hanford cleanup effort.



Waste Treatment and Immobilization Plant, Hanford Site

The Board's reviews have focused on ensuring that important safety systems can meet the functional and performance requirements in the project's safety basis documents. During the past year, the Board identified weaknesses in the design of safety systems and is working closely with DOE to correct them. The Board also held public hearings in Kennewick, Washington, and Washington D.C., regarding this project. (See Section X below.)

- **Erosion and Corrosion of Piping, Vessels, and Pulse Jet Mixer Nozzles.** The design and strategy for operating the plant depend on piping, vessels, and the pulse jet mixers inside vessels remaining functional for the plant's 40-year design life with no maintenance. In a letter dated January 20, 2012, the Board communicated its concern that design information does not provide confidence that wear (erosion and corrosion) allowances are adequate to ensure that piping, vessels, and components located in inaccessible "black cells" will perform their safety functions for the entire design life of the facility. The Board's staff coordinated with DOE to review the contractor's action

plan for resolving the technical issues regarding erosion and corrosion issues. DOE is still evaluating the contractor's plan.

- **Selection of Validation Set for Computational Fluid Dynamics Model.** The Board issued a letter to DOE identifying technical issues with a plan to experimentally validate a computer model of pulse jet mixing of wastes in the plant's process vessels. DOE's contractor had planned to use the FLUENT computational fluid dynamics model to confirm that performance of the WTP mixing systems meets several nuclear safety requirements. In a November 8, 2012, letter, the Secretary of Energy informed the Board that DOE would execute a full-scale test program to demonstrate mixing instead of using computational fluid dynamics calculations.
- **Design and Construction of Electrical Distribution System.** On April 13, 2012, the Board issued a letter to DOE identifying several issues with the operability and safety of the electrical distribution system. The Board's staff later commented on a draft response by DOE. DOE's final response, sent on September 27, effectively addressed many of the Board's safety concerns.
- **Formation of Beds of Solids in Process Pipes.** In a letter dated August 8, 2012, the Board expressed concerns that the design of the WTP slurry pipeline system is susceptible to forming beds of solids that slide along the bottom of pipes. The beds of sliding solids will increase wear from erosion/corrosion and increase the likelihood of pipeline plugging. DOE is in the process of developing its response to this issue.

Further technical information on the Board's involvement in the Waste Treatment and Immobilization Plant may be reviewed in the following documents that can be found on the Board's website.

- **Erosion and Corrosion of Piping, Vessels, and Pulse Jet Mixer Nozzles.** Board letter dated January 20, 2012; DOE response dated March 5, 2012.
- **Selection of Validation Set for Computational Fluid Dynamics Model.** Board letter dated April 3, 2012; DOE response dated July 27, 2012.
- **Design and Construction of Electrical Distribution System.** Board letter dated April 13, 2012; DOE response dated September 27, 2012.
- **Formation of Beds of Solids in Process Pipes.** Board letter dated August 8, 2012.
- **Hydrogen in Piping and Ancillary Vessels.** Periodic reports to Congress on the status of significant unresolved technical differences between the Board and DOE on issues concerning the design and construction of DOE's defense nuclear facilities, dated March 7, 2012 and June 25, 2012.

Los Alamos National Laboratory, Transuranic Waste Facility

Aging facilities at Area G are used to store, process, characterize, and ship transuranic waste to the Waste Isolation Pilot Plant for disposal. In a consent order agreement with the State of New Mexico, DOE committed to close Area G before December 2015. Although DOE is closing Area G, the ability to prepare transuranic waste for shipment and disposal remains essential in order for Los Alamos National Laboratory to perform its role in NNSA's nuclear weapon Stockpile Stewardship Program. Consequently, NNSA is designing a new Transuranic Waste Facility to replace the storage and characterization functions currently carried out in Area G. The project is part of NNSA's long-term strategy to consolidate hazardous and radioactive waste operations at the laboratory into a smaller, more compact area that can operate safely, securely, and effectively for the foreseeable future.

The facility will have the capability to receive, characterize, stage, and store up to 1240 drums of newly-generated transuranic waste. The characterization function will ensure that the waste containers meet the requirements for shipment and disposal at the Waste Isolation Pilot Plant. The facility layout is shown below.



Proposed Layout for the Transuranic Waste Facility

The new facility has been designated as a Hazard Category 2 nuclear facility because of the quantity of radioactive waste that will be stored. Much of the waste will also contain other hazardous wastes that are controlled by the Resource Conservation and Recovery Act. Because of the hazards associated with the facility, the Board is following the development of the safety controls to ensure that the public, workers, and the environment are adequately protected. The

preliminary design is nearly complete, and in June 2012 the Board completed a review of design documentation. The review uncovered a number of concerns. In particular, the Board noted that NNSA did not always use conservative values for the input parameters used to analyze accident scenarios. As a result, the dose consequences for some accident scenarios were understated. In another case, the Board noted that the analysis of aircraft accidents did not comply with DOE standards. As a result of the error, the calculation underestimated the probability of an aircraft striking the facility. Underestimating probabilities or consequences in accident analyses can result in a design that does not include adequate controls to prevent or mitigate an accident.

During the review, the Board also noted that the safety-class barriers intended to protect the buildings from a runaway vehicle could not stop a heavy vehicle such as a large truck. The Board also determined that system designs did not provide adequate assurance that the water in the safety-significant fire protection system would not freeze during cold weather. The Board notified DOE of the above concerns in a letter dated June 11, 2012, and NNSA is acting to resolve the concerns.

Y-12 National Security Complex, Uranium Processing Facility⁴

Enriched uranium processing and fabrication are vital to maintaining the nation's nuclear weapons stockpile and supplying fuel for the United States Navy's nuclear-powered submarines and aircraft carriers. The Uranium Processing Facility is the centerpiece of NNSA's plan to consolidate enriched uranium operations at the Y-12 National Security Complex into a safe, modern, and secure facility that replaces Y-12's aging infrastructure.

The Board's oversight in the past year has focused on ensuring integration of safety into the facility's design and assessing the safety implications of several major project decisions that affect the design and the project execution strategy. Major decisions made by NNSA in 2012 include indefinitely deferring the installation of certain manufacturing and machining capabilities and significantly changing the structural design and internal layout to ensure all the required process equipment and support systems will fit in the facility.

In late 2011 and early 2012, the Board reviewed the project's preliminary design and safety basis. This review identified significant deficiencies. In an April 2, 2012, letter to NNSA, the Board concluded that safety is not adequately integrated into the project's design. In response, NNSA's contractor made major revisions to the project's safety design strategy and safety basis. The Board is assessing the adequacy of these revisions. To further evaluate the factors affecting timely execution and safety of the Uranium Processing Facility, the Board conducted a public hearing in Knoxville, Tennessee, on October 2, 2012. (See Section X below.)

⁴ The National Defense Authorization Act for Fiscal Year 2013 recently directed changes to this facility's name and scope. This section describes the Board's activities occurring before the legislative change.

VIII. Hazardous Materials

The Board is responsible for ensuring that DOE safely processes, stabilizes, and disposes of hazardous nuclear materials. The Board's safety oversight focuses on DOE's management of defense-related high-level waste, processing of nuclear materials into stable forms for safe long-term storage or disposal, and deactivation and decommissioning of defense nuclear facilities that are no longer needed.

High-Level Waste Management

DOE manages high-level defense waste at the Hanford, Savannah River, and Idaho National Laboratory sites. The Board has focused operational oversight on the large tank farms at the Hanford and Savannah River sites along with the radioactive materials that were extracted from high-level waste and stored at Hanford's Waste Encapsulation and Storage Facility. In addition, the Board's staff has conducted reviews of the startup of the Integrated Waste Treatment Unit at Idaho. The primary safety issues evaluated by the Board during 2012 are summarized below.

Hanford Site

- **Ventilation Systems for High-Level Waste Tanks.** As discussed in Section III of this report, the Board issued Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, to reduce the risk posed by flammable gas in the high-level waste tanks.
- **Integrity of High-Level Waste Tanks.** DOE stores more than 50 million gallons of radioactive waste in high-level waste tanks at Hanford. Many of the old single-shell tanks have been known to leak. For this reason, liquids in those tanks had been mostly removed and transferred to newer double-shell tanks. These tanks were expected to remain sound until the wastes were eventually retrieved and immobilized for disposal. However, DOE identified a slow but continuing leak from a double-shell tank, AY-102, in August 2012. The Board has been closely following DOE's plans for dealing with the leak and DOE's evaluations of other tanks containing similar waste, as well as the potential impact on the overall waste retrieval and treatment strategy. (See Section II above.)
- **High-Level Waste Transfer System.** In a letter dated April 26, 2011, the Board identified weaknesses in the underground waste transfer system used at the Tank Farms. The letter also noted deficiencies in the methodology for extending the service life of temporary "hose-in-hose" waste transfer lines that are located in trenches. In 2012, DOE began implementing a Fitness for Service Program that addresses some of the performance and maintenance issues for the underground waste transfer system. DOE also began to develop a test plan for studying the aging of the hose-in-hose lines and other common polymer components under environmental conditions and irradiation they will experience at the Tank Farms.

- **Conduct of Operations.** The Board's staff reviewed DOE's corrective actions in conduct of operations at the Tank Farms. The staff found that DOE had made progress in correcting deficiencies in some areas, but that further actions are needed in other areas. The Board is working with DOE to correct the remaining deficiencies.

- **Flammable Gas in Tanks with Deep Solids Layers.** The Board's staff identified concerns with the potential for a few double-shell tanks that contain large amounts of high-level waste sludge to accumulate and release flammable gas. In response, DOE began developing a plan to establish the technical basis for ensuring flammable gas safety is maintained in these tanks.

- **Waste Encapsulation and Storage Facility.** The facility stores 1,936 cesium and strontium capsules in water-filled pool cells. The capsules are highly radioactive and contain approximately 32 percent of the total cesium-137 and strontium-90 on the Hanford Site. In response to issues identified in a Board letter to DOE dated October 6, 2011 regarding maintenance practices, the facility contractor completed a formal causal analysis to identify why its assessment process had failed to identify the issues found by the Board's staff dealing with work planning and control, conduct of operations, training and weaknesses in contractor oversight. During 2012, the contractor worked to resolve associated deficiencies and assessed nuclear operations at its other nuclear facilities and projects.



Hanford Tank Farms Aerial View

Savannah River Site

- **High-Level Waste Tank Farms.** The Board focused on ensuring that complex and hazardous work activities involving high radiation dose rates and contamination levels were thoroughly planned, analyzed for hazards, and executed with a high degree of rigor. These hazardous activities include the replacement or repair of equipment in

tanks and an evaporator. In the summer of 2012, a number of incidents in the Tank Farms led to concerns regarding safety and the conduct of operations, including an incident where some waste was transferred to the wrong tank. The Board is monitoring the steps the contractor is taking to improve the conduct of operations and foster a safety-conscious work environment. In addition, the Board reviewed the repair of cracks in carbon steel ventilation ducts, safety alarm activations, and the maintenance program. The Board is reviewing how DOE is managing such aging safety-related infrastructure problems in the Tank Farms.

- **Waste Solidification.** The Saltstone facility receives decontaminated liquid waste from the Tank Farms and converts it to a grout waste form that is disposed of on-site in large underground vaults. In the coming years, the Saltstone facility will need to reliably operate at a high capacity in order to support operations at the Salt Waste Processing Facility, which will decontaminate millions of gallons of liquids from the Tank Farms. The Saltstone facility was in an outage much of the year to allow equipment modifications intended to improve the reliability of the process. The Board's staff evaluated the resumption of operations at Saltstone and the startup of a new grout vault. After some initial difficulties, the Saltstone process operated reliably for two months.

The Board's staff also evaluated the vitrification of sludge from the high-level waste tanks at the Defense Waste Processing Facility. The staff questioned the rigor of the implementation of administrative controls because the facility's response to two process upsets did not fully comply with the Technical Safety Requirements. This led DOE to make changes in how process parameters are monitored and take additional corrective actions in the implementation of administrative controls. The staff also performed oversight of the preparation of operations personnel for qualification exams and reviewed deferred maintenance, safety alarm activations, and control of impaired or nonconforming equipment. These staff actions resulted in resolution, and required no further Board action.

Idaho National Laboratory

- **Integrated Waste Treatment Unit.** During 2012, the Board's staff evaluated preparations to commence operations of the Integrated Waste Treatment Unit project at Idaho National Laboratory. This facility is designed to convert approximately 900,000 gallons of radioactive liquid waste stored in tanks at the Idaho Nuclear Technology and Engineering Center to a solid form in preparation for permanent disposal. On June 16, 2012, the process system over-pressurized during pre-operational testing using non-radioactive materials. The system's off-gas filters were breached, creating an unimpeded path from the process vessels to the environment. The staff reviewed the operating contractor's corrective action plan and found several weaknesses. Among the staff's concerns was the potential for improper operation of bypass valves in the pressure relief system to impact the function of safety-significant rupture disks that protect other portions of the process system from over-pressurizing. The staff's

communication of this concern prompted the contractor to declare a Potential Inadequacy of the Safety Analysis to ensure the issue was formally tracked and resolved. The Board continues to monitor the project's progress as DOE prepares to resume startup activities.

Nuclear Materials Stabilization and Storage

Hanford Site

At Hanford, the Board's staff evaluated preparations to process fuel rubble known as "knock-out pot material" from the K West spent fuel basin for safe interim storage on-site at the Canister Storage Building. The contractor initially planned to restart the Cold Vacuum Drying Facility previously used to process fuel rods and scrap from the basin without a formal assessment to ensure the equipment and personnel were ready to resume operations safely. Subsequent to discussions with the Board, the contractor completed a formal readiness assessment. Because the Columbia River affords the public unrestricted access to within a few hundred yards of nuclear facilities in K West, the Board's staff suggested that DOE consider additional controls to protect and if necessary evacuate the public on the river in the event of an accident. DOE chose to control access to the river using the local sheriff's office as a formal safety control. As a result of the thorough preparations by DOE and its contractor, the knock-out pot material was successfully removed from the K West Basin, processed at the Cold Vacuum Drying Facility, and is now stored away from the Columbia River in the Canister Storage Building.



Transporting of Fuel Sludge in Multi-Canister Overpack

The Board also reviewed DOE's preliminary design for systems to remove the remainder of radioactive fuel sludge from the K West basin. The Board identified several problems in a letter to DOE dated July 31, 2012. In response, DOE is developing requirements to ensure the ability of safety systems to fulfill their functions and improving the accident analysis that supports the safety basis for sludge removal. During this review, the Board also identified some deficiencies in the design of the structure that will house the sludge transfer equipment. This led DOE to delay construction and conduct its own review, which identified additional errors that had been missed in DOE's and its contractor's review processes. The design is currently being reevaluated and errors are being corrected prior to construction.

Savannah River Site

The Board's staff reviewed the condition of the fire water supply systems at Savannah River National Laboratory and K-Area (plutonium storage and sampling). On March 27, 2012, the Board sent a letter to DOE questioning the ability of these systems to perform their credited safety functions. In response, DOE removed sediment from the K-Area fire water tank and inspected its interior, and is replacing both the electric and diesel fire water pumps in K-Area. DOE also completely reevaluated the fire water supply and sprinkler systems at Savannah River National Laboratory, in the process identifying dozens of non-compliances with National Fire Protection Association codes. Subsequent reviews at other nuclear facilities at the Savannah River Site identified additional code non-compliances. DOE is in the process of addressing these problems. Because of the resulting heightened awareness, the number of fire system impairments across the Savannah River Site was significantly reduced. Related inspections also identified hundreds of equipment condition issues that were then fixed. Modifications to the Savannah River National Laboratory fire protection system are ongoing and DOE is evaluating the possibility of upgrading the overall system. These issues are being resolved on a staff-to-staff basis, and no further Board action has been taken.

Transuranic Waste Remediation and Disposal

In recent years, DOE has transported most of the legacy transuranic waste stored at the Idaho and Savannah River Sites to the Waste Isolation Pilot Plant. The remaining work involves some of the more challenging waste. Cleanup is becoming increasingly hazardous and difficult as the effort progresses. Many of the containers remaining are in poor condition and contain much higher quantities of radioactive and hazardous materials than containers previously processed. Incidents that resulted in plutonium uptakes by workers at Idaho and Savannah River serve as important warnings that greater worker protection is now required during cleanup.

The Board's staff evaluated preparations for the retrieval of degraded waste boxes and drums at the Advanced Mixed Waste Treatment Project at Idaho. Previously, the staff identified problems with the contractor's implementation of safety controls, which were corrected during prestart activities for the retrieval work. Retrieval of degraded waste boxes awaits initial operation in early 2013 of new, remotely-operated equipment. Attainment of adequate work planning and controls and implementation of Integrated Safety Management systems are to be demonstrated in the spring of 2013. In addition, a staff review of the health physics program for the project identified areas for improvement; DOE is acting on the staff's findings.



**Transuranic Waste Transported in
TRUPACT-II Shipping Containers**

At the Savannah River Site, the Board's staff reviewed the planning and startup of waste campaigns to remediate the remaining and more difficult transuranic waste. The remediation has often involved handling waste having high radiation levels, extremely high contamination levels, potentially pressurized containers, degraded packaging, and other hazards. The staff observed many of these containers being repacked and provided real-time input to operations staff and management so that workers could immediately modify techniques and actions to reduce the hazards.

The Waste Isolation Pilot Plant is the nation's sole facility for permanent disposal of defense-related transuranic waste. As a result of the Board's efforts, DOE took actions in 2012 to improve the safety of these activities, as summarized below.



Mining Operations at the Waste Isolation Pilot Plant

- **Fire Protection.** The Board reviewed the fire protection program at the site and, in a letter dated June 24, 2011, noted a number of deficiencies. DOE acknowledged these problems and agreed to take corrective action. Most corrective actions were complete at the end of 2012, with the remainder anticipated to be completed in early 2013.
- **Maintenance.** The Board reviewed the maintenance program and noted numerous deficiencies in a letter dated June 27, 2012. DOE acknowledged these problems and has instituted corrective actions.

Deactivation and Decommissioning

Part of the Board's statutory task is to ensure that defense nuclear facilities are safely deactivated and decommissioned. Key Board efforts in this area include evaluating activity-level hazard analyses and work planning and control programs that are central to the safe performance of this type of work. In 2012, the Board reviewed corrective actions for past findings of weakness in these programs at the Hanford Plutonium Finishing Plant. The Board noted general improvement across several facets of work planning and control.

The Board continued its efforts to review remediation of waste in burial grounds at Hanford. This effort included ensuring the safety of recovery efforts to stabilize and inspect the contents of a drum after operators noted a rapid rise in temperature following its retrieval from the 618-10 burial ground. In addition, the Board began reviewing the draft safety basis for a system designed to remediate radioactive waste stored in vertical shafts (i.e., vertical units consisting of five 55-gallon drums welded end-to-end) at the 618-10 and -11 burial grounds. These oversight activities will continue in 2013.

At Oak Ridge National Laboratory, the Board had previously identified a number of safety issues in plans to excavate and remove a highly contaminated underground vessel, Tank W-1A. Subsequently, during 2011, DOE strengthened the safety basis for the work and improved the procedures for the operation. The work was completed safely in April 2012.



Highly Contaminated Equipment at the Hanford Plutonium Finishing Plant

IX. Safety Standards and Programs

Department of Energy Directives

The Atomic Energy Act requires the Board to evaluate the content and implementation of the standards relating to the design, construction, operation, and decommissioning of DOE's defense nuclear facilities. "Standards" in this context includes DOE orders, regulations, and guidance documents. In 2012, the Board completed its review and comment on DOE Order 420.1C, *Facility Safety*; DOE Guide 420.1-1A, *Nonreactor Nuclear Safety Design Criteria for Use with DOE O 420.1C, Facility Safety*; DOE Standard 1066-2012, *Fire Protection*; and DOE Standard 1020-2012, *Natural Phenomena Hazards Analysis and Design Criteria for DOE Facilities*. As discussed in detail in Section II of this report, DOE's approval of these directives officially concludes the *DOE 2010 Safety Security Reform Plan*. The Board completed formal review of 19 directives in 2012. Several of these were the most complicated and contentious directives and had been reserved for the latter portion of the reform plan for that reason. The Board expects to review a number of DOE technical standards during 2013, as many standards of interest to the Board are overdue for revision or recertification.

Review of Nuclear Safety Programs

In conducting oversight of DOE's nuclear safety programs, the Board applies a complex-wide perspective that builds on data collected at the field level, integrating the results to identify opportunities for broad safety program improvements. The Board dedicates significant resources to reviewing safety analyses and controls at defense nuclear facilities; key supporting programs such as quality assurance, nuclear criticality safety, and training and qualification of personnel; the technical competence of DOE's federal workforce; DOE's safety oversight of its contractors; and other attributes important to nuclear safety. These efforts led to significant safety improvements. Highlights are summarized below:

Integrated Safety Management. As discussed in Section II of this report, the Board completed a multi-year series of reviews of the implementation of integrated safety management in work planning at defense nuclear facilities across the DOE complex. In all cases, the Board found weaknesses in the analysis of hazards and development of controls to ensure worker safety. As previously noted in this report, the Board's reviews led to issuance of DNFSB/TECH-37, *Integrated Safety Management at the Activity Level: Work Planning and Control*, in August 2012. In response, DOE sent a letter to the Board on November 30, 2012, detailing its commitment to undertake concerted efforts to apply lessons learned to address Work Planning and Control (WP&C) challenges. Specifically, DOE committed to: (1) enhance complex-wide awareness of, and reinforce the need for rigorous activity-level WP&C; (2) strengthen guidance and formality associated with contractor implementation and federal monitoring of activity-level WP&C through the development of an implementation handbook for contractors and a DOE Guide on oversight and evaluation of the effectiveness of activity-level WP&C; and (3) enhance federal and contractor oversight of activity-level WP&C.

Similarly, the Board reviewed implementation of integrated safety management in conduct of operations and maintenance at Pantex, two Hanford facilities, and the Waste Isolation Pilot Plant during 2012. The Board noted weaknesses in the quality and use of technical procedures, supervisory control of work activities, and execution of work. The Board formally communicated its concerns regarding WIPP and will continue to evaluate DOE's efforts to improve conduct of operations and maintenance throughout the complex.

Governance and Oversight. The Board continued to evaluate reviews conducted by NNSA to affirm line oversight and contractor assurance systems at its sites. NNSA only conducted one affirmation review (at the Nevada National Security Site) in 2012. The Board is monitoring DOE's efforts to demonstrate that the affirmation review process provides sufficient detail to assess the effectiveness of line oversight and contractor assessment systems. The major security breach at Y-12 in 2012 prompted extensive effort by NNSA to reinforce the role of federal oversight of safety as well as security of its defense nuclear facilities. The Board will continue to monitor the NNSA governance transformation initiative and safety-related corrective actions resulting from the Y-12 event.

Safety System Design, Functionality, and Maintenance. The Board continued to conduct reviews of safety system design, functionality, and maintenance at defense nuclear facilities. In 2012, the Board's staff performed extensive follow-up of reviews at the Tritium Facility and Plutonium Facility at Lawrence Livermore National Laboratory and at the Hanford Tank Farms. As discussed in detail in Section III of this report, the Board issued Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, to bring the persistent issues at Hanford to the attention of DOE's senior leadership. The Board is also continuing to work with NNSA to resolve safety issues at the Livermore facilities.

X. Informing the Public

Public Hearings

The Board's enabling legislation vests it with a comprehensive suite of statutory tools to execute its oversight mission. Chief among these is the Board's power to hold public hearings. Public hearings play an essential role in the Board's mission of ensuring adequate protection because they assist the Board in obtaining vital safety information from DOE, NNSA, expert sources, and the public at large. In 2012, the Board made full and extensive use of this statutory tool, holding three public hearings. The Federal Register notice and agenda for each hearing were posted on the Board's website, and the Board advertised hearings held away from Washington, D.C., in local newspapers. The Board receives testimony from the public during its hearings, and such testimony is included in the public record of the hearing. For each of the hearings described below, a transcript may be reviewed in the Board's Public Reading Room, and a DVD copy may be obtained free of charge upon request.



Public Hearing in Knoxville, TN, October 2012

Hanford Session I. The Board's first public hearing of 2012 convened on March 22nd in Kennewick, Washington. The focus of this hearing was the status of actions related to unresolved technical safety issues in the design of Waste Treatment and Immobilization Plant and infrastructure needs at the Hanford Tank Farms. To better understand the relationship between the resolution of these safety issues and the development of sound nuclear safety strategy, the Board explored two areas of technical concern: erosion/corrosion and pulse jet mixing. The hearing also included panel discussions of actions to achieve a robust nuclear safety culture being undertaken by the DOE Office of River Protection and the contractor responsible for the Waste Treatment and Immobilization Plant. Prior to the conclusion of the hearing,

19 public citizens testified on the record. The Board offered a live webcast stream of this hearing on its website. The video streaming was well-watched, with 1,054 “hits” and an average viewing time of 23 minutes per viewer.

Hanford Session II. This hearing, held on May 22, 2012 at the Board’s Washington, D.C. headquarters, was devoted to exploring DOE senior management’s actions to achieve improvements in the safety culture and management of safety issues at the Waste Treatment and Immobilization Plant. One public citizen testified during this hearing. Video streaming statistics for this hearing indicate that there were 146 “hits” during the live broadcast and 244 “hits” on the archived copy. During the live broadcast, the peak number of viewers at any one time was 75.

Uranium Processing Facility. The Board’s final hearing of 2012 was held in Knoxville, Tennessee, on October 2nd. At this hearing, the Board received testimony from DOE and its contractors regarding factors that could affect the safety and completion schedule of the Uranium Processing Facility project. The specific factors analyzed during the hearing included DOE’s project team strategy for identifying and resolving safety issues in a timely manner; the potential safety impacts of DOE’s decision to accelerate the acquisition of select processing capabilities, and defer others to a later date; and the potential for weaknesses in technology development to impact safety. Seventeen public citizens testified at the end of this hearing. During the live broadcast there were 704 “hits” on the video link; to date 334 “hits” have been recorded for the archived video.

Response to FOIA Requests

The Board received 10 formal requests for Board records filed under the Freedom of Information Act (FOIA) in 2012. The average response time was 14 working days, as compared with the statutory requirement of 20 working days. The table below outlines how the Board responded to each request.

Board Response to 2012 FOIA Requests

Board Response	Denial Based on Exemption	Partial Grant	Full Grant	No Records Located
No. of Requests	1	1	3	5

When locating records responsive to a FOIA request, the Board must undertake a search that is “reasonably calculated to uncover all relevant documents.” To ensure its full compliance with this legal requirement, the Board updated its “Adequate Search Documentation” form to include the following subjects: the name of the person conducting the search, and his/her

qualifications and experience in conducting FOIA searches; the files searched and their location; the reasons for the search; the search terms used; the search methodology; the scope of the search; whether additional searches would be impractical; the requester's fee status; and the duration of the search. The Board anticipates that this change will further increase its precision in retrieving information pertinent to FOIA requests.

Information Technology Activities

In 2012, the Board made a series of changes to its public website to increase accessibility and improve transparency in its operations. Of significance was the Board's addition of a page providing Board employees with a confidential means to report waste, fraud, abuse, and employee or management misconduct, as well as the contact information for the Board's Office of the General Counsel and the U.S. Office of Special Counsel. The Board also began posting internal operating practices and procedures in the "About Us" section of the Board's public website. The "Contact Us" portion of the website was enhanced to provide another method for the public to provide feedback on Board activities, such as providing comments on recommendations. The Board's "Contact Us" page received 1,024 pageviews in 2012.

In addition to the public website modifications, the Board made more general information technology enhancements in 2012. For example, the Board migrated its e-mail, mobile device management, and internal phone systems from legacy on-premises deployments to hosted solutions. This move conforms with the Federal Chief Information Officer's "Cloud First" mandate and has resulted in improved staff efficiency and the reallocation of information technology resources to new projects.

Finally, as part of its routine technology refresh process, the Board began replacing all of its desktop computers with laptops and docking stations. The Board hopes this computer upgrade will create a more mobile workforce and allow Board's staff to work as effectively outside the office as they can from their official duty station. Moreover, the Board expects this change to enhance the Board's telework program and add additional flexibility in responding to incidents that disrupt normal operations at the Board's Headquarters.

Public Reading Room

The Board maintains a Public Reading Room for the purpose of providing a citizen-centered space that offers accessibility to a substantial portion of the Board's records. The reading room is located at the Board's Headquarters and is open to the public Monday through Friday from 8:00 a.m. to 4:30 p.m., with the exception of federal holidays. Knowledgeable staff members are on hand to assist visitors in finding documents, conducting computer searches of the Board's public electronic files, and studying the Board's library reference materials, which are restricted to the premises. The records available in the reading room for inspection and copying include Board regulations, technical reports, recommendations, transcripts of hearings, and reference copies of documents provided by DOE.

Pursuant to the Board's enabling legislation, all Board recommendations are transmitted to DOE's regional public reading room located at the DOE Federal Building, 1000 Independence Avenue, S.W., Room 1G-033, Washington, D.C. 20585.



The Board's Public Reading Room

XI. Funding and Human Resources

Budget Levels and Staffing

The Consolidated Appropriations Act of 2012 granted the Board's request for \$29.130 million in new budget authority for FY 2012, which was also the amount requested in the President's Budget. For the first quarter of FY 2013, the Board operated under a Continuing Resolution at an annualized level of \$29.308 Million.

For the majority of 2012, the Board consisted of four members – one less than called for in the Board's enabling legislation. Mr. Sean Sullivan of Ledyard, Connecticut, was confirmed by Congress as the Board's fifth member on August 2, 2012, for a term expiring October 18, 2015. The Board also continued to increase its workforce with the goal of reaching the 120 full-time-equivalent (FTE) level specified in its FY 2012 and FY 2013 budget requests. This number includes the goal of having 84 staff engineers. By the end of calendar year 2012, the Board had 82 engineers on board, a net increase of five despite the retirement of three engineers. Total federal employee strength at the end of 2012 was 116 FTEs.

In 2012, the Board achieved its seventh consecutive unqualified audit opinion on its financial statements from an independent auditor, as required by Accountability of Tax Dollars Act of 2002. The auditor found that the Board complied with all applicable federal laws and regulations and had no material weaknesses in its internal controls. In its continuous pursuit of excellence, however, the Board plans to formalize additional internal controls governing the Board's technical operations. These controls will be evaluated by the Board's Executive Committee on Internal Controls in FY 2013.

To fulfill the National Defense Authorization Act for Fiscal Year 2004 requirement that federal agencies conduct annual employee surveys, the Board participated in the Office of Personnel Management's 2012 Federal Employee Viewpoint Survey. Based on the survey results, the Board ranked sixth among 29 small agencies for the Best Places to Work in the Federal Government for 2012. In response to this survey, the Board directed a thorough analysis of the results by December 31, 2012, with plans to begin implementing recommendations for improvement as early as the second quarter of FY 2013. The Board remains committed to working with all stakeholders to maintain and strengthen areas that make it one of the best places to work in the Federal Government.

The 2012 Consolidated Appropriations Act [Public Law No. 112-74] directed the Board to enter into an agreement to procure inspector general services from the Nuclear Regulatory Commission Inspector General (NRC-IG). Despite good faith efforts by both agencies to comply with the statutory directive, negotiations were unsuccessful. The Board explained the difficulties encountered in a March 20, 2012, letter to the House Appropriations Committee, a July 3, 2012, letter to the Senate Appropriations Committee, and an August 10, 2012, letter to the House and Senate Appropriations Committees and the House and Senate Appropriations Energy and Water Development Subcommittees. The Board expects a resolution to those

difficulties in the next appropriations act, and continued to work toward an agreement with the NRC-IG.

Prioritization of Work

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. The Board considers the following main factors:

- Quantity, chemical composition, physical form, and radiological characteristics of the nuclear material stored or handled in the facility;
- Potential for accidents involving energetic release of materials (e.g., earthquakes, tornados, runaway chemical reactions, fires, or explosions), criticality accidents, or nuclear detonations;
- Complexity of safety controls and the degree of reliance on active safety systems or administrative controls instead of passive design features;
- Novelty of materials, facilities, or operations;
- The significance of changes in facility configuration, facility conditions (e.g., degradation of aging systems and structures), operations, or personnel (e.g., transition to a new operating contractor); and
- Proximity to collocated workers and the offsite public.

The Board obtains the information needed for this risk-based prioritization through multiple avenues. Continuous in-field observations by the Board's Site Representatives provide real-time information regarding safety issues and potential risks to the workers and the public at six major DOE defense nuclear facilities. The Site Representatives provide weekly activity reports to the Board and are in constant communication with the Board's headquarters staff. This information is invaluable in allowing the Board to assess the priority of work and assign resources appropriately. Similarly, the Board's headquarters staff interacts frequently with DOE's Headquarters and field offices to inform the Board of the status and future plans for facilities and activities at defense nuclear sites. The Board's staff also monitors DOE's various reporting mechanisms for off-normal events (e.g., the Occurrence Reporting and Processing System) to identify individual occurrences or trends that indicate a need for safety oversight.

The Board members directly obtain information needed to prioritize oversight through a variety of other means. For example, Board members as a group visit principal DOE defense nuclear facilities each year to review activities and safety issues. Board members also visit sites individually to obtain a deeper understanding of specific issues. Board members are briefed

regularly by senior DOE officials on the status of activities and safety initiatives. Finally, the Board members interact informally with personnel at DOE's headquarters and field offices to gather information pertinent to safety oversight.

Based on this prioritization of work, four types of safety oversight are underway at all times:

- Evaluation of DOE's organizational policies and processes. These reviews evaluate topics such as technical competence of DOE and contractor personnel, adequacy of safety requirements and guidance, and the presence of a strong safety culture.
- Evaluation of actual hazardous activities and facilities in the field. These reviews focus on identifying the hazards and evaluating controls put in place to mitigate those hazards.
- Expert-level reviews of the safety implications of DOE's actions, decisions, and analyses.
- Identification of new safety issues otherwise unknown in the DOE complex. Since, by definition, these safety issues would not have been addressed but for the Board's efforts, this may be the area in which the Board has the largest impact on the safety of DOE's highly hazardous operations.

To ensure safety is integrated in the design of new defense nuclear facilities, the Board tracks every project and schedules its reviews to match each project's design maturity. The Board prioritizes these reviews based on the following considerations:

- Nuclear and chemical hazards in the facility and potential for energetic release of such materials;
- Maturity of safety documentation at key points in the project's life, e.g., prior to DOE's approval of the conceptual safety design report, preliminary safety design report, preliminary documented safety analysis, and the final documented safety analysis;
- Importance of safety controls at the facility level and process level—controls for higher hazard and more likely accidents are reviewed in greater detail; and
- Oversight capability of the DOE project management organization.

The Board uses its Strategic Plan and its Annual Performance Plan to ensure that its resources remain focused on the most significant safety challenges. This approach gives the Board confidence that its staff and budget are dedicated to the highest risk activities under the Board's jurisdiction.

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Appendix A: Recommendations 2012-1 and 2012-2

RECOMMENDATION 2012-1 TO THE SECRETARY OF ENERGY

Savannah River Site Building 235-F Safety

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

Dated: May 9, 2012

Background

The Defense Nuclear Facilities Safety Board (Board) believes that the Department of Energy (DOE) needs to take action to remove and/or immobilize the residual contamination within Building 235-F because of the potential dose consequences to collocated workers and the public. Furthermore, the Board believes that DOE must also take near-term action to more effectively prevent a major fire in Building 235-F.

Building 235-F at the Savannah River Site (SRS) houses several partially deactivated processing lines including the Plutonium Fuel Form (PuFF) facility, Actinide Billet Line, Plutonium Experimental Facility, and the old metallography lab glovebox. Building 235-F no longer has a DOE mission. It is currently operated in a surveillance and maintenance mode and is normally unoccupied.

With the exception of residual contamination, Building 235-F has been de-inventoried of special nuclear material. The remaining residual contamination is the principal hazard posed by Building 235-F and includes a significant quantity of plutonium-238 (Pu-238). More than 95 percent of the Pu-238 is located in the PuFF facility; approximately 82 percent is concentrated in 2 of the 9 PuFF facility cells. It should be noted that the residual Pu-238 contamination is a fine ball-milled powder that is in a highly dispersible form, which increases the potential dose consequences associated with a radiological release.

The responsible SRS contractor, Savannah River Nuclear Solutions (SRNS), has determined that the unmitigated consequences of a seismically-induced full-facility fire are greater than 10 rem offsite and 27,000 rem to the collocated worker at 100 meters. F-Area routinely has more than a thousand site workers who are normally in the facilities, construction sites, and trailers located adjacent to Building 235-F. Some of the trailers that house workers are located within the Building 235-F fence line.

While DOE does not conduct any operations within Building 235-F, fires could start inside the building if energized electrical equipment or wiring failed or was damaged during a seismic or other natural hazard event. Electrical sparks or heat from electrical equipment could ignite adjacent combustible material. Two of the key preventive controls for fire scenarios are eliminating potential ignition sources and controlling the amount of combustibles. In

September 2011, during a walkdown of Building 235-F, the Board's staff identified a significant quantity of transient and fixed combustibles and unnecessary electrical equipment that had not been air gapped. DOE has taken action to remove the transient combustible material and to limit access to Building 235-F. However, no actions are currently planned to remove the fixed combustibles or unneeded electrical equipment.

In the event of a fire, Building 235-F has several vulnerabilities. First, the Building 235-F fire detection system is not credited, does not provide complete coverage, nor is the building normally occupied; consequently, a fire could smolder and burn undetected. Second, Building 235-F does not have a fire suppression system to prevent an incipient stage fire from growing into a room fire. Third, Building 235-F does not have fire barriers with a qualified fire rating to prevent the spread of a fire to adjacent rooms. The Building 235-F Fire Hazards Analysis notes that the subdividing walls and floors are in many places incomplete or penetrated and are not adequately sealed to achieve a qualified fire rating. In addition, some of the existing walls contain cellulose, which is combustible and could allow a room fire to spread to other portions of the building. Fourth, the absence of standpipes or hose connections inhibits the ability of the fire department to fight a fire inside Building 235-F. To combat a fire, firefighters would need to prop open the exterior doors to allow the passage of fire hoses; this would allow smoke and firewater, potentially contaminated with radioactive material, into the environment.

The July 2011 draft of the Basis for Interim Operations (BIO), prepared by SRNS notes that the Building 235-F structure can only provide limited confinement during or following a seismic event because seismically-induced building cracks may develop. Consequently, the building structure cannot be credited as a control to prevent a post-seismic unfiltered release. In 2010, DOE took action to improve the safety posture of Building 235-F by reducing the height of the abandoned stack located adjacent to the building. The contractor's structural analysis indicated that the concrete stack, prior to the height reduction, could have collapsed onto Building 235-F during a seismic event causing significant structural damage.

In addition to fires, loss of confinement accidents could also release radioactive material. For instance, a release could be caused by a breach of the confinement or the ventilation system during a seismic event. However, the Building 235-F confinement ventilation system cannot be relied upon to continue to perform its safety function during or following a seismic event. The draft BIO states that non-load-bearing building elements may fail during a Performance Category-3 seismic event, resulting in impact damage to safety-related structures, systems, and components such as ventilation ducts. The draft BIO states that the metal ventilation ducts may leak after an earthquake because they are not completely welded and that the concrete roof exhaust tunnel may develop cracks.

Loss of confinement can be caused by degraded equipment. The deteriorated condition

of the PuFF facility was noted in an October 1991 report by DOE's Office of Nuclear Safety,⁵ which identified as an issue the integrity of elastomer seals that form part of the confinement boundaries inside Building 235-F. In addition to degradation with age, these elastomer seals also degrade with exposure to Pu-238. Although identified two decades ago, this issue remains. The cells have numerous penetrations (e.g., glove ports, viewing windows, ventilation supply and exhaust, utility services). In the draft BIO, SRNS stated that "the [elastomer] seals around the cell and glovebox penetrations are expected to be in a degraded condition due to the years of operation in a radiation environment." The continued deterioration of the elastomer seals increases the potential for the spread of the contamination outside of the cells. Even under normal operations, a loss of confinement from these cells would greatly increase the complexity and hazard associated with decontamination and decommissioning of Building 235-F.

DOE conducted a small fire drill at Building 235-F in December 2011, which simulated a minor radiological release. While DOE conducts periodic drills, DOE has not conducted a Building 235-F radiological drill involving the adjacent Mixed Oxide Fuel Fabrication Facility or Waste Solidification Building construction sites to examine how these facilities would respond to a significant radiological release from Building 235-F. In the event of a significant radiological release, the amount of mitigation provided by sheltering in place may not be sufficient to protect nearby workers. This is especially true for seismically-induced fires, since the same seismic event may also damage nearby trailers and administrative buildings.

The Board has previously identified the need to address the residual contamination in Building 235-F. In a June 12, 2003, letter to the Secretary of Energy, the Board noted that the risk associated with several hazards in Building 235-F, including the Pu-238 residual contamination, had been accepted rather than eliminated. The report enclosed with the June letter further noted that DOE should consider decontaminating areas with residual contamination to reduce the risk associated with a potential release. Since that time, DOE has on a number of occasions evaluated options and developed plans to address the residual contamination. However, these efforts have not successfully transitioned from planning to execution, and the residual contamination and the hazard it poses still remain in Building 235-F.

Conclusion

The Board believes that due to the potential dose consequences to collocated workers and the public, it is unacceptable for the residual contamination within Building 235-F to continue to remain unaddressed.

⁵ U.S. Department of Energy, 1991, *Report of an Investigation into the Deterioration of the Plutonium Fuel Form Fabrication Facility (PuFF) at the DOE Savannah River Site*, DOE/-NS-0002P, <http://www.osti.gov/bridge/servlets/purl/6246281-tBgi3H/6246281.pdf>.

Recommendation

Given the continuing hazard posed by Building 235-F as detailed above, the Board recommends that DOE:

1. Take action to immobilize and/or remove the Pu-238 that remains as residual contamination within Building 235-F.
2. Concurrent with sub-Recommendation 1, take near-term actions and implement compensatory measures to improve the safety posture of Building 235-F and reduce the potential for and severity of a radiological release, including but not limited to the following.
 - a. To the extent feasible, remove from Building 235-F all transient and fixed combustibles that are not directly necessary for surveillance and maintenance activities and ensure that the transient combustible loading in the facility remains as low as reasonably achievable.
 - b. Ensure that all electrical equipment not necessary to support facility safety systems, life safety, or surveillance and maintenance activities is de-energized and air gapped. Remove all electrical and support equipment remaining within former process areas that is not necessary for surveillance and maintenance.
 - c. Evaluate the condition and operability of early detection and alarm systems in the PuFF facility, such as the heat and smoke detectors (with the exception of those located within the PuFF facility cells, if evaluating them would require intrusion into the cells). Take action, as necessary, to ensure that these systems are credited in the safety basis, are remotely monitored, provide reliable detection of hazards, and are maintained in accordance with National Fire Protection Association 72, *National Fire Protection Alarm and Signaling Code*.
3. Concurrent with sub-Recommendation 1, take action to ensure that the SRS emergency response to a radiological release from Building 235-F is adequate and effective, including but not limited to the following.
 - a. Ensure that an integrated emergency response plan is in place that considers the collocated workers in facilities, construction sites, and trailers located adjacent to Building 235-F. Development of this plan should include an evaluation of the specific locations where collocated workers are directed to shelter in place to ensure their adequate protection during and following a potential radiological release from Building 235-F.

- b. Ensure that periodic coordinated drills in response to a simulated event at Building 235-F are conducted. Such drills should include appropriate response actions by personnel in the adjacent facilities and construction sites, such as sheltering in place or evacuating depending on proximity to the simulated plume of radioactive material.

The Board urges the Secretary to avail himself of the authority under the Atomic Energy Act [42 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.”

/s/ Peter S. Winokur, Ph.D., Chairman

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RECOMMENDATION 2012-2 TO THE SECRETARY OF ENERGY
Hanford Tank Farms Flammable Gas Safety Strategy
Pursuant to 42 U.S.C. § 2286a(a)(5)
Atomic Energy Act of 1954, As Amended

Dated: September 28, 2012

Background

The Defense Nuclear Facilities Safety Board (Board) believes that current operations at the Hanford Tank Farms require safety-significant active ventilation of double-shell tanks (DSTs) to ensure the removal of flammable gas from the tanks' headspace. A significant flammable gas accident would have considerable radiological consequences, endanger personnel, contaminate portions of the Tank Farms, and seriously disrupt the waste cleanup mission. Further, the Board believes that actions are necessary to install real time monitoring to measure tank ventilation flowrates as well as upgrade other indication systems used to perform safety-related functions.

On August 5, 2010, the Board sent a letter to the Department of Energy (DOE) outlining issues related to the safety strategy for flammable gas scenarios at the Hanford Tank Farms. In its letter, the Board identified that the safety analyses for accident scenarios used non-bounding values for (1) the radiological inventory of the tanks and (2) the amount of waste that could be released in a major accident. Notwithstanding these non-conservatisms, DOE's safety analyses show that all of the DSTs generate flammable gas in sufficient quantities to reach the lower flammability limit (LFL) for hydrogen. Further, many of the tanks contain sufficient quantities of gas trapped in the waste such that the LFL could be exceeded if the gas were spontaneously released, which is possible under both normal operating and accident conditions. The current control strategy does not include any measures to periodically release the trapped gases in a controlled manner to preclude the accumulation of flammable concentrations.

DOE's safety analyses show that the potential flammable gas scenarios warrant a credited safety control due to the dose consequences to workers and the public. Accordingly, the ventilation systems for the DSTs were previously classified as safety-significant and credited in the documented safety analysis for the Tank Farms to address flammable gas scenarios. The revision of the safety analysis approved by DOE on January 21, 2010, and implemented on March 30, 2010, reduced the DST ventilation systems from safety-significant to defense-in-depth and replaced them with a specific administrative control (SAC) for flammable gas monitoring.

In its August letter, the Board noted that DOE's SAC for flammable gas monitoring exhibited a number of weaknesses that collectively rendered it inadequate as a safety control. The reliance on an administrative control in lieu of an engineered feature is also contrary to DOE's established hierarchy of controls as well as sound engineering practice. Further, the

Board noted that a number of other installed systems that are (1) necessary to provide accurate and reliable indications of abnormal conditions associated with flammable gas events, and (2) serve as a direct input to determining whether an operator action is required were not appropriately classified in accordance with their safety function.

In response to these issues, DOE, in a letter dated February 25, 2011, informed the Board that it had revised its decision to downgrade the DST ventilation systems and would take action to restore the systems to their former safety-significant status. Additionally, DOE indicated that the level indication systems for the DST annuli and the double contained receiver tank would be upgraded to safety-significant.

During the last year, the Board reviewed DOE's progress in meeting these commitments and addressing the Board's safety concerns. The Board noted that while some improvements had been made to the SAC used for flammable gas monitoring, it remained inadequate as a credited safety control. The SAC is less reliable than an engineered feature, remains susceptible to undetectable false low readings, and lacks independent verification.

Although DOE maintains a commitment to upgrading the DST ventilation systems and other installed non-safety-related instrumentation used to perform safety functions, the Board has concluded that no progress has been made in these areas, and the schedule for upgrades continues to slip. The latest schedule, outlined in a letter to the Board dated April 2, 2012, reflects a commitment to completing the upgrades to three of the five DST ventilation systems by fiscal year 2014. During the Board's June 2012 review, DOE indicated that even this was no longer a realistic schedule. DOE's current path forward is to upgrade only one of the DST ventilation systems (AY/AZ Tank Farm) by fiscal year 2015 to support mixer pump testing that is currently anticipated in 2016. No near-term procurement or installation plans are in place for the four other DST ventilation systems. Similarly, no plans or activities are proposed to upgrade the installed non-safety instrumentation systems being used in safety-related applications (e.g., the level indication systems for the DST annuli and the double container receiver tank).

Conclusions

The Board believes that DOE needs to upgrade the DST ventilation systems and other instrumentation systems used for safety-related functions at the Hanford Tank Farms. Further, the continued reliance on an inadequate SAC for flammable gas control presents an unnecessary risk to safety. At this time, DOE does not have a means to provide alternate ventilation if the existing ventilation system becomes inoperable. The hazards posed by flammable gas releases in DSTs and the challenges they pose to any ventilation system are directly proportional to the volume of flammable gas retained within the DST wastes. Reducing the current inventories of flammable gases retained in the DST waste and keeping them small would reduce the future hazards posed by gas release events.

Recommendation

Accordingly, the Board recommends that DOE:

1. Take near-term action to restore the classification of the DST ventilation systems to safety-significant. In the process, determine the necessary attributes of an adequate active ventilation system that can deliver the required flow rates within the time frame necessary to prevent and mitigate the site-specific flammable gas hazards at the Hanford Tank Farms.
2. Take near-term action to install safety-significant instrumentation for real-time monitoring of the ventilation exhaust flow from each DST.
3. Take near-term action to upgrade the existing installed non-safety-related equipment that is being used to fulfill safety functions at the Hanford Tank Farms to an appropriate safety classification. This includes instrumentation and control equipment whose indications are necessary for operators to take action to accomplish necessary safety functions.
4. Identify compensatory measures in case any existing DST ventilation systems become unavailable at the Hanford Tank Farms.
5. Evaluate means to reduce the existing inventory of retained flammable gases in a controlled manner. Since these gases will continue to be generated until the tank contents are processed, evaluate methods to reduce the future retention of flammable gases in these tanks or to periodically mix them to prevent the future accumulation of flammable gas inventories that could cause the tank headspace to exceed the LFL if rapidly released.

The Board urges the Secretary to avail himself of the authority under the Atomic Energy Act [42 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.”

/s/ Peter S. Winokur, Ph.D., Chairman

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Appendix B: 2012 Reporting Requirements

Date	Addressee	Topic
Jan 20	Acting Assistant Secretary for Environmental Management	Erosion/corrosion wear allowances for Waste Treatment and Immobilization Plant piping and vessels
Feb 28	Deputy Administrator for Defense Programs, NNSA	Reliability of controls for the Annular Core Research Reactor at Sandia National Laboratories
Mar 2	Administrator, NNSA	Effectiveness of the nuclear explosive safety program at the Pantex Plant
Mar 27	Senior Advisor for Environmental Management	Safety-significant classification of fire protection water supplies at the Savannah River Site A- and K-Areas
Apr 2	Administrator, NNSA	Adequate integration of safety in the preliminary design of the Uranium Processing Facility at the Y-12 National Security Complex
Apr 3	Senior Advisor for Environmental Management	Validation of the FLUENT model prior to use for mixing system design confirmation
Apr 13	Senior Advisor for Environmental Management	Electrical distribution system for the Waste Treatment and Immobilization Plant at Hanford
Apr 18	Deputy Administrator for Defense Programs, NNSA	Quality assurance issues at the Annular Core Research Reactor at Sandia National Laboratories
Jun 11	Administrator, NNSA	Safety issues relating to the Transuranic Waste Facility project at Los Alamos National Laboratory
Jun 18	Administrator, NNSA	Approved safety basis for the Plutonium Facility at Los Alamos National Laboratory
Jun 27	Senior Advisor for Environmental Management	Safety issues with the maintenance program at the Waste Isolation Pilot Plant
July 18	Deputy Secretary of Energy	Seismic structural analysis for the Plutonium Facility at Los Alamos National Laboratory
Aug 8	Senior Advisor for Environmental Management	Safety analysis and design of the Waste Treatment Plant slurry transport system
Aug 28	Deputy Secretary of Energy	Technical Report on activity-level work planning and control (DNFSB/TECH-37)
Aug 30	Administrator, NNSA	Safety control strategies for nuclear operations at Lawrence Livermore National Laboratory
Sept 6	Administrator, NNSA	Analysis and design of the Uranium Processing Facility main building at Y-12 National Security Complex
Nov 19	Manager, Los Alamos Site Office	Issues regarding approved safety basis for Area G at Los Alamos National Laboratory

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Appendix C: Significant Board Correspondence in 2012
(letters available on both the Board's and DOE's websites)

Hanford

January 19, 2012, Board letter accepting the implementation plan for Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*.

January 20, 2012, Board letter establishing a 45-day reporting requirement for identifying the approach to be used to resolve issues relating to erosion/corrosion wear allowances for Waste Treatment and Immobilization Plant piping and vessels.

March 2, 2012, Board letter accepting the implementation plan for Recommendation 2011-1, *Safety Culture at the Waste Treatment and Immobilization Plant*, with a request for a revised implementation plan by April 30 that takes into account information gained from the January 2012 report by the DOE Office of Health, Safety and Security.

April 3, 2012, Board letter establishing a 45-day reporting requirement for identifying the approach to be used to resolve the issues relating to how the FLUENT model will be appropriately validated prior to use for mixing system design confirmation.

April 13, 2012, Board letter establishing a 120-day reporting requirement for actions DOE has taken or plans to take to address the issues related to the design and construction of the electrical distribution system for the Waste Treatment and Immobilization Plant.

June 14, 2012, Board letter recognizing Ms. Elaine N. Diaz of the Hanford Site Office of River Protection as the winner of the 2011 Department of Energy Safety System Oversight Annual Award.

July 31, 2012, Board letter regarding the preliminary design activities and safety basis development for Phase I of the Sludge Treatment Project.

August 8, 2012, Board letter establishing a 90-day reporting requirement to address issues related to deficiencies in the safety analysis and the design of the Waste Treatment Plant slurry transport system.

September 28, 2012, Board letter forwarding Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*.

Idaho National Laboratories

June 11, 2012, Board letter recognizing Mr. Bradley J. Davis of the Idaho Operations Office as the 2011 Department of Energy Facility Representative of the Year.

Lawrence Livermore National Laboratory

August 30, 2012, Board letter establishing a 60-day reporting requirement concerning the adequacy of the development, review, and approval of safety control strategies for nuclear operations.

Los Alamos National Laboratory

June 11, 2012, Board letter establishing 60-day reporting requirement for identification of actions taken or planned by NNSA to resolve safety issues relating to the Transuranic Waste Facility project.

June 18, 2012, Board letter establishing a 30-day reporting requirement regarding the approved safety basis for the Plutonium Facility.

July 18, 2012, Board letter establishing a 30-day reporting requirement regarding the seismic structural analysis for the Plutonium Facility.

November 19, 2012, Board letter establishing a 60-day reporting requirement for DOE's plans to address issues regarding the approved safety basis for Area G.

Pantex Plant

March 2, 2012, Board letter establishing a 30-day reporting requirement describing NNSA's actions to address the effectiveness of the nuclear explosive safety program.

March 2, 2012, Board letter regarding the supporting calculations for some of the Technical Safety Requirements in select Safety Analysis Reports.

Sandia National Laboratories

February 28, 2012, Board letter establishing a three-month reporting requirement describing NNSA's plans to review the accident analyses, modify the documented safety analysis, and evaluate the reliability of controls for the Annular Core Research Reactor.

March 2, 2012, Board letter to Citizen Action New Mexico regarding the safety basis for the Annular Core Research Reactor.

April 18, 2012, Board letter establishing a 90-day reporting requirement describing the plans and schedule for actions to be taken to address quality assurance and software quality assurance issues at the Annular Core Research Reactor.

June 27, 2012, Board letter to Citizen Action New Mexico regarding nuclear safety at the Annular Core Research Reactor and other facilities.

Savannah River Site

March 27, 2012, Board letter establishing a 60-day reporting requirement regarding the safety significant classification of fire protection water supplies at the Savannah River Site A- and K-Areas.

April 13, 2012, Board letter enclosing the Staff Issue Report regarding the activity-level work planning processes and procedures used by Savannah River Nuclear Solutions.

May 9, 2012, Board letter forwarding Recommendation 2012-1, *Savannah River Site Building 235-F Safety*.

Waste Isolation Pilot Plant

June 27, 2012, Board letter establishing a 90-day reporting requirement identifying actions taken or planned by DOE to resolve safety issues associated with the maintenance program.

Y-12 National Security Complex

April 2, 2012, Board letter establishing a 30-day reporting requirement describing NNSA's approach for demonstration of the adequate integration of safety in the preliminary design of the Uranium Processing Facility.

June 5, 2012, Board letter regarding the training and qualification program.

September 6, 2012, Board letter establishing a 60-day reporting requirement regarding NNSA's approach to validate the modeling assumptions in the analysis and design of the Uranium Processing Facility main building.

Other Correspondence

March 8, 2012, Report to Congress on the Status of Significant Unresolved Issues with the Department of Energy's Design and Construction Projects.

June 1, 2012, Board letter to Dr. Charles V. Shank regarding the *Managing for High-Quality Science and Engineering at the NNSA National Security Laboratories* report.

June 25, 2012, Report to Congress on the Status of Significant Unresolved Issues with the Department of Energy's Design and Construction Projects.

July 3, 2012, Board letter to Senators Dianne Feinstein and Lamar Alexander regarding implementation of Title IV of the Consolidated Appropriations Act, 2012, Public Law 112-74.

August 28, 2012, Board letter forwarding technical report regarding activity-level work planning and control (DNFSB/TECH-37).

October 31, 2012, Board's third periodic Report to Congress: *Summary of Significant Safety-Related Infrastructure Issues at Operating Defense Nuclear Facilities.*

November 16, 2012, Board's FY 2012 Performance and Accountability Report to Congress.

December 24, 2012, Board's Report to Congress: *Status of Significant Unresolved Issues with the Department of Energy's Design and Construction Projects.*

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