

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



April 1, 2013

The Honorable Ronald L. Wyden
United States Senate
221 Dirksen Senate Office Building
Washington, D.C. 20510

Dear Senator Wyden:

In response to your request dated March 22, 2013, the Defense Nuclear Facilities Safety Board (Board) would like to present our perspective on the state of nuclear safety at the Hanford Site. The Board has observed firsthand the challenges facing the Department of Energy (DOE) at Hanford as it strives to eliminate the hazards posed by its high-level radioactive waste. Resolution of these significant challenges will require continued focus by both DOE and the Board over the next several years.

During the past 3 years, the Board has issued three Recommendations to the Secretary of Energy, held three public hearings (October 2010, March 2012, and May 2012), and written numerous letters describing the Board's concerns related to nuclear safety at the Hanford Site. In response to your request dated March 22, 2013, the information provided below summarizes the Board's perspective on (1) safety concerns associated with the Hanford Tank Farms, (2) unresolved technical issues related to the design of the Waste Treatment and Immobilization Plant (WTP), and (3) the current state of Hanford's safety culture.

Safety Concerns Associated with the Hanford Tank Farms

DOE stores more than 50 million gallons of high-level radioactive waste in 177 underground tanks at the Hanford Site. Many of the old single-shell tanks have been known to leak. As a result, DOE transferred most of the liquid waste in those tanks to newer double-shell tanks. The Board has been following DOE's plans for dealing with leaking tanks, and the impact these tanks have on the DOE's overall waste retrieval, treatment, and disposition strategy. In August 2012, DOE discovered that double-shell tank AY-102 was leaking and more recently DOE announced that single-shell tanks are continuing to leak. This situation reinforces the need to retrieve and treat the tank waste and be vigilant in maintenance and safe operations in the Hanford Tank Farms for the foreseeable future. The Board believes that prolonged storage of waste in the Hanford Tank Farms represents a potential threat to public health and safety.

Eliminating the risk of high-level waste (HLW) release to the environment requires waste retrieval and treatment. The very nature of the waste makes establishment of viable retrieval and treatment systems extremely challenging because some of the waste has "sludge-like" consistency and some also contains relatively large plutonium particles. Accurate characterization of tank waste is necessary to meet the waste acceptance criteria of WTP and to operate the facility safely. However, the development of accurate waste characterization

methods faces formidable technical challenges. Formidable technical challenges also remain in the development of safe waste mobilization and transfer systems.

In addition to tank leakage, another issue with the current Tank Farms concerns a possible deflagration event caused by hydrogen gas generation within a tank. Such an event could spread radioactive waste in the Tanks Farms. On September 28, 2012, the Board transmitted Recommendation 2012-2, *Hanford Tank Farms Flammable Gas Safety Strategy*, to the Secretary of Energy. This Recommendation identified concerns with DOE's administrative controls for monitoring flammable gas conditions in its double-shell waste tanks and recommended that DOE restore the functional classification of the ventilation systems in these tanks from general service to safety-significant. DOE's safety analyses show many of the 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 waste that continuously generates some flammable gas. This gas will eventually reach flammable conditions if adequate ventilation is not provided. Consequently, ventilating the double-shell tanks is critical to the safety posture of the Hanford Tank Farms. DOE has accepted this Recommendation and is currently developing an implementation plan.

In an April 26, 2011, letter sent to DOE's Assistant Secretary for Environmental Management, the Board identified weaknesses in the underground waste transfer system used at the Hanford Tank Farms. For example, the Board's letter noted deficiencies in the methodology for extending the service life of temporary "hose-in-hose" waste transfer lines located in trenches and the process for certifying the waste transfer system can perform its safety function. DOE has taken actions to address these issues, including (1) implementation of a Fitness for Service Program that addresses some of the performance and maintenance issues of the waste transfer system and (2) developing a test plan for studying the aging of the hose-in-hose lines and other common polymer components. As the frequency of waste transfers increases, these issues could require additional management attention.

Technical Issues Concerning the Design of WTP

DOE is in the process of transitioning the WTP project from a design-construction phase to a construct-operate phase. However, DOE has not resolved key technical issues with the WTP design, many of which were identified several years ago. These technical issues must be resolved to support completing the design and construction of the Pretreatment Facility (PTF) and, to a lesser extent, the HLW facility. Key technical challenges associated with the PTF include operations associated with pulse-jet mixing, strategies for hydrogen in pipes and ancillary vessels, and erosion/corrosion of pipes and vessels. The resolution of these safety issues is complicated by the partial construction of the PTF and the use of a "black-cell" design concept that may not allow for maintenance over the 40-year life of the plant.

DOE is considering alternate strategies to bypass the PTF, which includes directly feeding the WTP vitrification facilities from Tank Farms. These strategies are in the conceptual phase. The Board will evaluate these alternate strategies to identify any safety issues when engineering and safety strategy information is available. The Board believes that directly feeding waste into the WTP vitrification facilities will be a challenging undertaking that will

involve resolving some of the same technical and safety issues associated with the design of the PTF and the HLW facility. For example, DOE will be required to partially re-design the existing facilities to receive wastes directly from Tank Farms, develop new processes to “precondition” the waste, duplicate process operations that are currently housed in the PTF, and resolve technical issues associated with feed delivery and development of waste acceptance criteria.

The Board has identified a number of safety-related risks with the WTP, including many that were identified in the design of WTP. A summary of these safety-related issues are listed below. The first listed issue, *Mixing in Process Vessels*, was considered by the Board to be of such significance as to warrant a recommendation to the Secretary. The remaining concerns presented advice, analysis and concerns to the Secretary, but did not warrant a recommendation and are listed here in reverse chronological order. The summary is based on information from the Board’s Report to Congress on the Status of Significant Unresolved Issues with DOE’s Design and Construction Projects, the most recent of which is dated December 24, 2012.

Mixing in Process Vessels—On December 17, 2010, the Board transmitted Recommendation 2010-2, *Pulse Jet Mixing at the Waste Treatment and Immobilization Plant*, to the Secretary of Energy. This Recommendation identified concerns that inadequate performance of mixing systems at WTP could lead to nuclear criticality accidents, explosions of flammable gases, and mechanical failures of process vessel components. DOE has informed the Board that resolution of these issues is delayed because a key technical assumption underlying DOE’s implementation plan was not supported by test data. The Secretary is developing a revised implementation plan.

Formation of Sliding Beds in Process Pipes—In an August 8, 2012, letter sent to DOE’s Senior Advisor for Environmental Management, the Board expressed concerns that the current design of the WTP slurry pipeline system is susceptible to frequent formation of sliding beds of solids on the bottom of the pipe. The sliding bed of solids could increase wear from erosion/corrosion and could increase the likelihood of pipeline plugging. Prolonged operation of a centrifugal pump with a plugged process line can cause the pump to fail catastrophically potentially resulting in the loss of primary confinement, and damage to adjacent structures, systems, and components. The Board also observed that DOE has not yet incorporated new information on waste properties into the design of the slurry transport system.

Design and Construction of Electrical Distribution System—In an April 13, 2012, letter sent to DOE’s Senior Advisor for Environmental Management, the Board identified several issues with the operability and safety of the electrical distribution system for WTP. DOE has developed a plan to address these issues.

Erosion and Corrosion of Piping, Vessels, and Pulse Jet Mixer Nozzles—In a January 20, 2012, letter sent to DOE’s Senior Advisor for Environmental Management, the Board communicated its concern that design information for WTP does not provide confidence that wear allowances are adequate to ensure that piping, vessels, and components located in black cells are capable of performing their safety functions over the 40-year design life of the facility. DOE is developing a plan to address the erosion and corrosion issues.

Ammonia Control—In a September 13, 2011, letter to DOE’s Acting Assistant Secretary for Environmental Management, the Board expressed concern that the existing design and safety-related controls associated with the storage and potential release of large quantities of ammonia at the WTP site did not adequately protect workers or facilities at WTP. DOE stated that the project team would perform three new hazard analyses to address the Board’s concerns. The Board will evaluate the hazard analyses and supporting calculations as they are developed.

Heat Transfer Analysis for Process Vessels—In an August 3, 2011, letter sent to DOE’s Acting Assistant Secretary for Environmental Management, the Board identified technical issues with the heat transfer calculations used to establish post-accident hydrogen mixing requirements necessary to prevent explosions in PTF process vessels at WTP. DOE plans to revise these calculations.

Spray Leak Analysis—In an April 5, 2011, letter sent to DOE’s Assistant Secretary for Environmental Management, the Board identified technical issues with DOE’s model for estimating radiological consequences to the public from spray leak accidents in the PTF and HLW facilities of WTP. DOE subsequently completed a spray leak-testing program at Pacific Northwest National Laboratory, which similarly concluded the spray leak model is non-conservative. DOE is planning additional testing to resolve this issue.

Hydrogen in Piping and Ancillary Vessels—Beginning with the April 15, 2010, *Quarterly Report to Congress on the Status of Significant Unresolved Issues with the Department of Energy’s Design and Construction Projects*, the Board expressed concern with DOE’s 2010 change in its safety strategy for hydrogen hazards in pipes and ancillary vessels¹. Flammable gases, such as hydrogen, generated by the wastes treated in WTP will accumulate whenever flow is interrupted in process piping, and in regions of the piping system that do not experience flow, such as piping dead legs. DOE has approved a strategy that allows hydrogen explosions in piping under certain conditions, and relies on a Quantitative Risk Analysis (QRA) and other complex models to predict the magnitude of the explosions and the response of the piping system. The Board remains concerned that DOE has not yet developed a QRA that demonstrates that explosions would not lead to a breach of the primary confinement in process piping and vessels.

Hanford’s Safety Culture

The Board’s evaluation of the technical issues at WTP discussed above was broadened in the summer of 2010 to include an investigation into the project’s safety culture after the Board received a letter from Dr. Walter Tamosaitis, a former engineering manager for the project’s contractor. In his letter, Dr. Tamosaitis alleged that he was removed from the project because he identified technical issues that could affect safety. He further alleged that there was a flawed safety culture at the project. The Board’s investigation concluded that a flawed safety culture at WTP was inhibiting the identification and resolution of technical and safety issues.

¹ *Conditional Approval of Safety Requirements Document (SRD) Change Adding Hydrogen in Piping and Ancillary Vessels (HPAV) Design Criteria for Pretreatment (PT) Facility*, 10-NSD-013, February 15, 2010

As a result, on June 9, 2011, the Board transmitted Recommendation 2011-1, *Safety Culture at the Waste Treatment and Immobilization Plant*, to the Secretary of Energy. This Recommendation highlighted the need for DOE to expeditiously make major improvements in the safety culture at WTP. Subsequently, DOE's Office of Health, Safety and Security independently reviewed the safety culture at WTP and issued a report in January 2012 that confirmed the Board's conclusions. In its public hearing on March 22, 2012, the Board concluded that the flawed safety culture within DOE's field and contractor organizations was inhibiting the ability to (1) identify and address long-standing technical issues and (2) resolve conflicts between the engineering and nuclear safety to ensure safety controls were integrated into the facility design as required by DOE's *Nuclear Safety Management Rule*, Title 10, Code of Federal Regulations, Part 830.

DOE has taken several significant actions to address the safety culture issues identified in the Board's Recommendation. These include clarifying roles and responsibilities in the federal field and Headquarter organizations; strengthening the Differing Professional Opinion and Employees Concerns processes; validating the basis for the project's nuclear safety strategy; and increasing DOE's Senior leadership involvement in technical challenges.

On December 5, 2011, Secretary Chu and Deputy Secretary Poneman issued a memorandum to the heads of all DOE elements describing expectations for nuclear safety in the Department. The memorandum addressed roles and responsibilities, safety culture, standards and directives, and Integrated Safety Management. The Secretary and Deputy Secretary clearly stated their commitment "to a strong and sustained safety culture, where all employees—from workers with shovels in the ground to their managers all the way up to the Secretary and everyone in between—are energetically pursuing the safe performance of work, encouraging a questioning work environment, and making sure that executing the mission safely is not just a policy statement but a value shared by all." The Board believes that Secretary Chu has vigorously tackled this issue, but progress in changing any organizational culture is historically slow. Fundamental differences between WTP engineering and nuclear safety must still be resolved. DOE has committed to conducting a review of the WTP safety culture within the next few months to evaluate the effectiveness of its corrective actions. The Board looks forward to the results of this review.

If you would like additional information regarding any of these issues, I would welcome the opportunity to discuss them further at your earliest convenience.

Sincerely,

A handwritten signature in black ink, appearing to read "Peter S. Winokur". The signature is stylized and cursive.

Peter S. Winokur, Ph.D.
Chairman