



Department of Energy  
Washington, DC 20585

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DNF SAFETY BOARD

The Honorable Jessie H. Roberson  
Vice Chairman  
Defense Nuclear Facilities Safety Board  
625 Indiana Avenue NW, Suite 700  
Washington, DC 20004

Dear Ms. Vice Chairman:

Enclosed is the Department of Energy's (DOE) Office of Environmental Management (EM) Office of River Protection (ORP) evaluation, in response to the Defense Nuclear Facilities Safety Board's (Board) January 21, letter pertaining to DOE's nuclear safety control strategy for hydrogen explosion hazards contained in the Safety Design Strategy (SDS) for the Hanford Waste Treatment and Immobilization Plant's High-Level Waste (HLW) facility. Your letter requested a written report documenting DOE's path forward, and technical basis for its path forward, in the development of a nuclear safety control strategy for hydrogen explosion hazards in the HLW facility.

EM will be revising the HLW SDS and preliminary documented safety analysis. During an onsite review on April 7 ORP briefed the Board staff on the status and path forward of its nuclear safety control strategy for hydrogen explosion hazards in HLW vessels.

In response to the Board's letter, ORP prepared the enclosed document, *U.S. Department of Energy, Office of River Protection Evaluation to Support Development of the U.S. Department of Energy Response to Defense Nuclear Facilities Safety Board Letter Issued January 21, 2015, Regarding Development of a Nuclear Safety Control Strategy for Hydrogen Explosion Hazards in the High-Level Waste Facility.*

If you have any further questions, please contact me or Mr. James Hutton, Deputy Assistant Secretary for Safety, Security, and Quality Programs, at (202) 586-5151.

Sincerely,

Mark Whitney  
Acting Assistant Secretary  
for Environmental Management

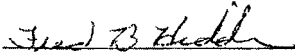
Enclosure



Attachment  
to  
15-NSD-0014

U.S. Department of Energy, Office of River Protection Evaluation to Support Development  
of the U.S. Department of Energy Response to Defense Nuclear Facilities Board Letter  
Issued January 21, 2015, Regarding Development of a Nuclear Safety Control Strategy for  
Hydrogen Explosion Hazards in the High-Level Waste Facility

(total number of pages, 3)

  
Fred B. Hidden  
Nuclear Safety Division

**U.S. Department of Energy, Office of River Protection Evaluation to Support Development of the U.S. Department of Energy Response to Defense Nuclear Facilities Safety Board Letter Issued January 21, 2015, Regarding Development of a Nuclear Safety Control Strategy for Hydrogen Explosion Hazards in the High-Level Waste Facility**

This evaluation provides the U.S. Department of Energy, Office of River Protection's path forward to establish a nuclear safety control strategy including technical basis for vessel hydrogen explosion hazards in the Waste Treatment and Immobilization Plant High-Level Waste (HLW) Facility as requested in formal correspondence from the Defense Nuclear Facilities Safety Board (DNFSB) on January 21, 2015.

The HLW Safety Design Strategy (SDS) (24590-HLW-PL-ENS-13-0001, *Safety Design Strategy for the High-Level Waste Facility*) acknowledged design risks and opportunities associated with vessel hydrogen explosion events. Report 24590-HLW-RPT-ENS-14-001, 2014, *HLW SDS-PDSA Gap Analysis Report* specifies that the HLW SDS:

...serves as the strategic approach document for [Design] Engineering and Nuclear Safety Engineering to use during the development of design changes necessary to align the SDS, design, and the [Preliminary Documented Safety Analysis (PDSA)].

The SDS states that the resolution of technical and design issues contributing to these risks will influence the selected control strategy for hydrogen in HLW vessels. As documented in 24590-HLW-PL-ENS-12-0001, *Safety Basis Development Project Execution Plan for the HLW Facility*, all HLW design basis accident scenarios will be addressed to support development of a compliant 10 CFR 830, "Nuclear Safety Management," Subpart B, "Safety Basis Requirements," safety basis for the HLW Facility to provide assurance of adequate protection of the public and workers.

Incorporation of the SDS into a revised preliminary documented safety analysis (PDSA) will change some PDSA credited controls, which will require U.S. Department of Energy approval. Spargers were eliminated for hydrogen control for the HLW melter feed vessels in the SDS because of anticipated high aerosol production rates from their use and the impact on the facility ventilation filters, the large quantity of filtered air required during post-design basis accident periods, and the complexity of controls needed to address redundancy and safety integrity level requirements. However, the HLW PDSA has not been revised to eliminate spargers from these vessels as a credited control system and spargers have not been removed from the HLW Facility design. The PDSA hydrogen mitigation system control strategy for vessels having a high public consequence (i.e., **Safety Class**) explosion event is air sparging and purging. Sparging, purging, and mixing will be included as potential PDSA control strategies during the future hazards analysis process.

The Board's letter explains that evaluations to resolve similar hazards in the Pretreatment Facility may not be applicable to the HLW Facility because of significant differences in the design of the mixing systems and waste properties at the two facilities.

In February 2015, Bechtel National, Inc. initiated an engineering study to evaluate implementable controls for non-Newtonian solution HLW vessel hydrogen explosion event mitigation. The study, which is forecast to be complete in July 2016, will consider sparging, mixing, and purging as control options and will parallel the Pretreatment Facility Technical Team 1 (Resolution of Hydrogen Gas Release from [Pretreatment Facility] vessels) process. The study will consider Technical Team 1 results only as applicable to HLW, recognizing the differences between the two facilities with respect to mixing design and waste solution characteristics (e.g., rheology). Where there are system designs in common between both facilities (e.g., purges), the controls to be considered for the two facilities are anticipated to be similar, if not the same.

The path forward to define a compliant nuclear safety control strategy for hydrogen explosion hazards in HLW vessels will be based on a compliant hazard analysis of facility processes. That path consists of the following activities:

- Complete determination of the safety significance level of the controls required to mitigate or prevent a hydrogen explosion event for a HLW vessel:
  - 24590-WTP-ES-NS-14-001, *Determination of a Methodology to Calculate the Amount of Solids Aerosolized from Vessel Interior Surfaces Following a Postulated Hydrogen Explosion*, completed February 22, 2015.
  - 24590-HLW-Z0C-H01T-00001, *HLW Hydrogen Explosions*, initiated in January 2015.
- Complete the non-Newtonian solution HLW vessel hydrogen explosion event mitigation engineering study to evaluate implementable controls as discussed in the previous paragraph, initiated February 18, 2015, with completion forecast for July 2016:
  - Sparging, mixing and purging are control options.
  - HLW effort will parallel Pretreatment Technical Team 1 (Resolution of Hydrogen Gas Release from [Pretreatment Facility] vessels). Results will be utilized as applicable, recognizing the differences between the two facilities with respect to mixing design and solution characteristics (e.g., rheology).
- Complete the DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, compliant process hazards analysis for receipt, storage, and transfer of HLW process solutions, inclusive of a hydrogen explosion event and associated impacts, for selection of controls, to be initiated July 2015 with completion forecast for January 2017.
- Implement the hydrogen explosion control strategy into the appropriate HLW system design based on U.S. Department of Energy approval of the revised PDSA after control selection, with completion forecast for August 2017.

**Conclusion:**

In response to the Defense Nuclear Facilities Safety Board's letter, and consistent with the evolution of the HLW PDSA, although spargers have been eliminated from the current SDS as a hydrogen control strategy, spargers have not been removed from either the HLW design or the

HLW PDSA. The use of spargers will be considered as a potential control strategy during the hazards analysis process, prior to developing a revision to the PDSA.

**References:**

- 10 CFR 830, "Nuclear Safety Management," Subpart B, "Safety Basis Requirements," *Code of Federal Regulations*, as amended.
- 24590-HLW-PL-ENS-12-0001, *Safety Basis Development Project Execution Plan for the HLW Facility*, Bechtel National, Inc., Richland, Washington.
- 24590-HLW-PL-ENS-13-0001, 2014, *Safety Design Strategy for the High-Level Waste Facility*, Rev. 0A, Bechtel National, Inc., Richland, Washington, October 23.
- 24590-HLW-RPT-ENS-14-001, 2014, *HLW SDS-PDSA Gap Analysis Report*, Rev. 0, Bechtel National, Inc., Richland, Washington, October 15.
- 24590-HLW-Z0C-H01T-00001, 2015, *HLW Hydrogen Explosions*, Bechtel National, Inc., Richland, Washington.
- 24590-WTP-ES-NS-14-001, 2015, *Determination of a Methodology to Calculate the Amount of Solids Aerosolized from Vessel Interior Surfaces Following a Postulated Hydrogen Explosion*, Bechtel National, Inc., Richland, Washington.
- DNFSB, 2015, (external letter to M. Whitney, U.S. Department of Energy Headquarters, Washington, D.C.), from J.H. Roberson, Defense Nuclear Facilities Safety Board, Washington, D.C., January 21.
- DOE-STD-3009-94, 2006, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses*, Change Notice Number 3, DOE Standard, U.S. Department of Energy, Washington, D.C., March.