Department of Energy
Washington, DC 20585

March 9, 2015

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) December 5, 2014, letter pertaining to the Summary of Melter Accidents Unanalyzed in the Safety Design Strategy for the High-Level Waste (HLW) Facility. The letter identified four unanalyzed melter accident scenarios associated with ORP's HLW Facility and requested a written response outlining DOE's intent and plan to address them as part of the development of a compliant safety basis.

EM is revising the HLW Safety Design Strategy and preliminary documented safety analysis (PDSA). The four HLW melter accident scenarios in the Board Staff Issue Report were previously recognized by ORP and are being actively analyzed. While none of the four accident scenarios were determined to be design basis accidents, EM is committed to developing a comprehensive hazards analysis according to the established processes for updating the PDSA, including ORP review and approval such that a compliant design can be released and procurements and construction can be initiated.

In response to the Board's letter, ORP prepared the enclosed response, *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 December 5, 2014, Regarding Melter Accidents not Analyzed in the High-Level Waste Safety Design Strategy*, documenting the intent and plan to address all credible design basis melter accident scenarios in the HLW Facility to support development of a compliant safety basis.

If you have any questions, please contact me or Mr. James A. Hutton, Deputy Assistant Secretary for Safety, Security, and Quality Programs, at (202) 586-0975.

Sincerely,

Mark Whitney
Acting Assistant Secretary
for Environmental Management

Enclosure

Attachment
to
15-NSD-0004

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 December 5, 2014, Regarding Melter Accidents not Analyzed in the High-Level Waste Safety Design Strategy

(total number of pages, 3)

Fred B. Hidden

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 December 5, 2014, Regarding Melter Accidents not Analyzed in the High-Level Waste Safety Design Strategy

The U.S. Department of Energy (DOE), Office of River Protection (ORP) is providing the intent and plan to address all design basis melter accident scenarios in the High-Level Waste (HLW) Facility to support development of a compliant safety basis, as requested in the Defense Nuclear Facilities Safety Board letter dated December 5, 2014. This evaluation specifically responds to four HLW melter accidents documented in the Staff Issue Report dated October 17, 2014.

ORP determined that all four accidents were previously recognized by the project and actively being worked. None of the four accidents were determined to be design basis accidents (i.e., "were bounded by other events").

As stated in Section 1 "Purpose," of 24590-HLW-PL-ENS-13-0001, *Safety Design Strategy for the High-Level Waste Facility*, Rev. 0A, dated October 23, 2014, and as quoted in the Staff Issue Report, the Safety Design Strategy (SDS) "provides the basis for updating, and ultimately revising, the preliminary documented safety analysis (PDSA) for the HLW Facility to ensure the final design is compliant with 10 CFR 830, Subpart B, *Nuclear Safety Management*."

Implementation of the HLW SDS into the HLW PDSA requires the conduct of a gap analysis to identify differences between the two documents, to determine all systems and controls impacted, and the course of actions necessary to resolve the gaps. That initial gap analysis has been completed as documented in 24590-HLW-RPT-ENS-14-001, *SDS-PDSA Gap Analysis Report*, Rev. 0, dated October 15, 2014.

Many of the gaps will require engineering studies and design changes for resolution and to support implementation. As design changes are completed, hazard analyses will be performed, followed by the development of accident analyses and control selection (inclusive of analysis for performance criteria). All credible design basis melter accidents will be documented in the SDS and the PDSA as supported by hazard and accident analyses. Therefore, the four HLW melter accidents documented in the Staff Issue Report will be included in the future analyses.

Revisions to the HLW SDS and PDSA will be developed in accordance with the document's implementation and development procedures and plans, to modify accident scenarios and to address specific accident initiators in any credible accidents that had not previously been bounded. The HLW SDS and PDSA will be revised to address specific actions documented below, as well as, additional issues developed during hazards and accident analyses activities may result in the need to further revise the documents.

Specific accidents identified in the Staff Issue Report are discussed below:

1. **Melter Steam Explosion:**

   The Defense Nuclear Facilities Safety Board (DNFSB) staff report notes that "The SDS does not identify a melter steam explosion initiated by a molten salt and water

interaction." Additionally, the report states that "molten salt and water initiator for a steam explosion will require different nuclear safety controls than those intended for a steam explosion initiated by water injection through the bubblers."

The melter steam explosion with a molten salt and water initiator was discussed by the SDS working group early in the development of the HLW SDS and was evaluated as a bounded event. However, to address the DNFSB staff concern, the accident will be evaluated, along with calculations as required. The revision to the HLW PDSA incorporating the results of the hazard evaluation and control selection is forecast for submission to the Office of River Protection in March 2016.

2. Simultaneous Spill of Molten Glass and Water:

The DNFSB staff report states ".... the SDS does not analyze the scenario where a design basis seismic accident breaches the melter and molten glass spills simultaneously with water from the various water sources. ..." In addition, the staff report states that "Failure of the radial HEPA filters under elevated temperature and high humidity conditions is a longstanding issue with the WTP HEPA filter design efforts."

HLW accident analysis and comprehensive hazard analysis will be performed to include all credible design basis HLW melter hazardous events including molten glass-water interactions due to seismic initiation. The resulting design basis accidents will be documented in the HLW SDS and PDSA.

3. Simultaneous Spill of Molten Glass and Nitric Acid:

The DNFSB staff report states "The capability is being provided to fill the HEME with nitric acid and allow the HEME to soak, thus facilitating solids removal. In the event of a design basis seismic accident during a HEME nitric acid soak, the contents of the HEME could spill onto the melter cave floor, where they could mix with molten glass and water released from the melter. Heated nitric acid produces corrosive vapors that could be carried into the ventilation system. ... however, the hazard was not identified in the DOE-approved SDS."

The Hazard Identification and Evaluation section (3.2.1) of the SDS, under "Hazard Screening," states "the following chemicals were not identified within DBAs and therefore were not considered within this SDS: nitric acid, sodium hydroxide, and cerium nitrate (to be re-reviewed in future hazards analysis efforts)." As stated in the staff report, the flash off of nitric acid vapors from a high-efficiency mist eliminator failure during acid rinse simultaneously occurring with a melter failure (e.g., glass spill) could result in corrosive acid vapors carried into the ventilation system.
Section 3.3.5.10.2, "HSH Decon Vessel Overflows" of the HLW PDSA addresses the chronic representative nitric acid spill and confinement provided by the C5V ventilation system. Documentation, including calculations to support this section of the PDSA, addresses the carryover of corrosive vapors into the C5V system.

Based on the PDSA and supporting documentation identifying nitric acid sources, as well as a postulated failure resulting from nitric acid spills, a revision to the SDS does not

appear to be necessary to incorporate this event, pending hazard and accident analysis. Inclusion in the PDSA of the high-efficiency mist eliminator as an additional nitric acid source, however, will demonstrate the requirement for a comprehensive hazard analysis. As previously discussed, current plans include the mechanisms to address all credible design basis melter accidents through hazard and accident analyses in support of HLW PDSA updates.

4. **Loss of Melter Cooling:**

The DNFSB staff report states "The SDS does not identify nuclear safety controls for a melter cooling panel rupture or loss of cooling to the melter. The SDS specifies in section 4.1.3, titled '*Additional Data Needed*,' that additional analysis is needed for this event, but the analysis is not required to be performed based on the SDS implementation procedures. The manufacturer's system description for the HLW melter states that 'the refractory package has been designed to provide adequate containment of glass in the event of a temporary loss of cooling water flow. However, during a sustained loss of cooling water flow, the cooling panels will eventually boil dry. This condition will lead to rapid heating of the refractory and melter cooling panels, which may then lead to increased corrosion of refractories, glass leakage, and cooling panel warping."

The SDS identifies loss of melter cooling caused by a seismic event as a bounding condition (*Bounding Event (L-B2): Loss of Confinement due to Melter Degradation*), noting that the bounding event "... spills the entire contents of the melter." A chilled water system failure resulting in prolonged loss of cooling water results in melter failure, which is bounded by Event L-B2. The time for the refectory to corrode and cooling panes to warp and the amount of glass expected to leak has been evaluated as less severe an event than that caused by a seismic induced loss of melter cooling.

While DOE agrees that the loss of cooling water due to a seismic event bounds the melter cooling panel rupture or loss of cooling to the melter event, the HLW SDS and PDSA will be revised to clarify that melter cooling panel rupture or loss of cooling to the melter can be initiated by other events.

Conclusion:

In response to the DNFSB's letter, and in line with the evolution of the SDS, the project agrees to revise the SDS and PDSA to include additional detail for three of the melter accidents, and one will not require a revision. The four HLW melter accidents included in the Staff Issue Report were previously recognized by the project and actively being worked. None of the four accidents were determined to be design basis accidents.