DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

May 14, 2015

Mr. Mark Whitney
Acting Assistant Secretary for
Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Mr. Whitney:

Members of the Defense Nuclear Facilities Safety Board's staff reviewed the Safety Design Strategy and Conceptual Safety Design Report for the Low Activity Waste Pretreatment System (LAWPS) project at the Hanford Site. Our staff review team found no safety issues that would preclude the LAWPS project from advancing to the next design phase. The staff review team identified three concerns that the project plans to address during the preliminary design phase. The staff review team also identified three important design inputs for the LAWPS project to consider in the preliminary design phase. The enclosure to this letter describes these concerns and considerations for preliminary design, as well as our understanding of the current design and safety strategy for the project. We will continue to follow the Department of Energy's efforts to integrate safety into the design as the LAWPS project proceeds through the preliminary design phase.

Sincerely,

Jessie H. Roberson
Vice Chairman

Enclosure

c: Dr. Monica Regalbuto
Mr. Joe Olencz

ENCLOSURE

Summary of the Low Activity Waste Pretreatment System Project and Related Concerns

Project Summary. The Low Activity Waste Pretreatment System (LAWPS) is planned to pretreat the supernatant portion of the Hanford tank waste and directly feed it to the Low Activity Waste (LAW) Facility at the Waste Treatment and Immobilization Plant. LAWPS is an integral part of the direct-feed LAW mission described in the Department of Energy's (DOE) *Hanford Tank Waste Retrieval, Treatment, and Disposition Framework* document. Direct-feed of LAW through LAWPS provides an opportunity to begin vitrifying waste at the LAW Facility before completion of the Waste Treatment and Immobilization Plant's Pretreatment Facility.

LAWPS will be a hazard category 2 major modification to the Hanford Tank Farms. LAWPS will be located northeast of the 241-AP tank farm in a permanent facility. The main processing equipment will be located in below-grade vaults accessible through the vault cover blocks. The primary treatment capabilities of LAWPS will be removal of undissolved solids and soluble cesium from the tank waste. LAWPS will receive supernatant into the filter feed tank from the tank farms via double-shell tank 241-AP-107. The supernatant will then be fed from the filter feed tank through cross flow filters to remove undissolved solids. The filtrate will be then sent to the ion exchange columns (IXC) for cesium removal. The two IXCs will be in series (lead and lag) and will utilize an elutable spherical resorcinol-formaldehyde resin. The treated LAW will be stored temporarily in the treated waste transfer tank then sent to the lag storage tanks. The treated LAW will be sampled in the lag storage tanks to confirm that the waste meets the LAW Facility waste acceptance criteria before it is transferred to the LAW Facility. Solids and cesium that have been removed from the treated LAW will be returned to the tank farms.

The LAWPS contractor, Washington River Protection Solutions, developed a Safety Design Strategy (SDS) and Conceptual Safety Design Report (CSDR) as part of conceptual design. On December 31, 2014, the DOE Office of River Protection (DOE-ORP) approved the SDS and CSDR. These documents identified a set of facility-level design basis accidents for LAWPS. The major hazards include flammable gas explosions, spray releases, and waste spills and misroutes. The SDS and CSDR did not identify any design basis accidents that required safety-class controls. The following is a summary of the safety-significant controls identified for LAWPS as described in Table 4-2 of the CSDR.

- The assured elution system reduces the flammable gas generation rate and the heat generation rate in the IXC.
- The vessel ventilation system maintains the concentration of hydrogen below the lower flammability limit in process vessels.
- The primary process piping and equipment maintains confinement of waste.
- The misroute prevention system prevents backflow of waste into the cold chemical system, the raw water system, and the fresh resin addition skid.

- The spent ion exchange (IX) resin removal controls prevent introduction of un-eluted or incompletely eluted resin into the spent resin handling room and prevent facility worker exposure to waste during resin removal activities.

- The treated waste monitoring and diversion system prevents accumulation of high cesium-137 waste in the lag storage tank.

Safety Concerns and Project Responses. The Defense Nuclear Facilities Safety Board's (Board) staff team reviewed the LAWPS SDS, CSDR, and supporting documentation and identified the following concerns. The staff team discussed these concerns with LAWPS project personnel. LAWPS project personnel identified actions that will likely resolve these concerns in the preliminary design phase.

Seismic Design Bases—The LAWPS SDS and CSDR designate a seismic design category (SDC) assignment for major structures, systems, and components (SSCs), but neglect to assign a limit state. DOE Standard 1189-2008, *Integration of Safety into the Design Process*, requires projects to assign appropriately conservative seismic design bases, which include an SDC and limit state for major SSCs, in the conceptual design phase. According to ASCE/SEI 43-05, *Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities*, the SDC assigns the minimum design requirements for an SSC based on the level of the radiological or toxicological hazards. For instance, an SDC is used to determine the appropriate ground motion and analytical methodology for which an SSC is to be designed. However, a limit state defines the allowable deformation or required performance of the SSC in response to that ground motion. Therefore, it is essential that a limit state be conservatively defined for each major SSC in the conceptual design phase to ensure minimal risk associated with significant redesign as required by DOE-STD-1189. The LAWPS project plans to specify the limit state for each SSC early in the preliminary design phase.

Fire in the IXC—For a fire involving the IX resin due to loss of liquid, the CSDR states that "[t]he consequences of this event are assessed to be bounded by the IXC pressurized release due to the availability of a greater source term (waste and IX resin). If credible, accident initiators will be evaluated in the preliminary design phase to aid in the selection of further controls." Different controls may be needed for a fire involving the IX resin due to different initiators. The project plans to evaluate the heat-up characteristics of the dry resin and process upsets that lead to loss of liquid in the IXC during the preliminary design phase.

Fire in the Process Vaults—The CSDR does not analyze for a fire in the LAWPS vaults where the process vessels and piping containing most of the material-at-risk are located. Rather, the CSDR references a similar event that was analyzed in the 242-A Evaporator Documented Safety Analysis, which results in consequences that do not challenge the evaluation guideline. While the project asserts this scenario is bounding, the project should evaluate vault fires specific to LAWPS instead of relying on a different facility's accident analysis. The project plans to analyze this event specifically for LAWPS in the preliminary design phase.

Considerations for Preliminary Design. The Board's staff team identified the following important design inputs for the LAWPS project to consider in the preliminary design phase.

Waste Acceptance Criteria (WAC)—The LAWPS project plans to develop a draft of the WAC for feed from the tank farms to LAWPS and incorporate it into the design basis early in the preliminary design phase. Similarly, the project has a draft of Interface Control Document 30, which contains the WAC for feed from LAWPS to the LAW Facility. These WACs are critical inputs to the LAWPS design basis, and it is important to develop them as early in the design process as practicable. The project's current plan to develop the WAC for feed from the tank farms to LAWPS early in the preliminary design phase and incorporate it into the design basis is appropriate.

Spray Releases—For the conceptual design phase, the LAWPS project estimated that the consequences from a spray release would be equivalent to the bounding consequences from a spray release from the tank farms. This estimate uses the existing tank farms spray release model to determine the consequences. In an April 5, 2011, letter to DOE the Board raised an issue regarding spray release estimates at the Waste Treatment and Immobilization Plant. DOE stated in its June 5, 2011, response that spray release testing and analysis would be performed by Pacific Northwest National Laboratory (PNNL) to address the Board's concerns. PNNL recently completed the spray release testing and developed a new reasonably conservative correlation for aerosol loadings. This correlation was developed using Hanford waste simulants and is applicable to Hanford waste streams. The CSDR documents the project's intent to re-evaluate the spray release consequences as the design matures and consider the impact of using the PNNL model. However, LAWPS project personnel informed the staff review team that they do not plan to implement the PNNL spray release model until DOE-ORP directs the implementation. It is important for the project to consider the best available spray release models for Hanford waste (e.g., the PNNL spray release model) in developing conservative consequence estimates.

Confinement of Radioactive Materials—The LAWPS project is currently required to meet DOE Order 420.1 B, *Facility Safety*; however, DOE Order 420.1 C will be implemented early in the preliminary design phase. DOE Order 420.1 C requires that Hazard Category 2 nuclear facilities "have the means to confine the uncontained radioactive materials to minimize their potential release in facility effluents during normal operations and during and following accidents, up to and including design basis accidents." DOE Order 420.1 C further states that "[c]onfinement design must include ... an active confinement ventilation system as the preferred design approach for nuclear facilities with potential for radiological release" and that "alternate confinement approaches [such as passive confinement systems] may be acceptable if a technical evaluation demonstrates that the alternate confinement approach results in very high assurance of the confinement of radioactive materials."

During the review, project personnel identified that LAWPS will apply an alternate approach that relies on safety-significant process piping and equipment as the primary confinement boundary to provide "very high assurance of confinement of radioactive materials." The natural phenomena hazard design categorization for the process piping and equipment has been adequately identified as SDC-3/Performance Category (PC)-3. The vessel ventilation

system, which maintains the concentration of hydrogen below the lower flammability limit in vessel headspaces, will provide confinement for the process vessel headspaces. The portion of the system responsible for maintaining the hydrogen concentration below the lower flammability limit will be designed to SDC-3/PC-3 requirements. The portion of the vessel ventilation system responsible for filtration of the vessel headspace exhaust will only be required to meet SDC-1/ PC-1 requirements. Project personnel provided adequate justification for this selection for the filtration component. An unmitigated release from the vessel headspaces through the vessel ventilation system results in accident doses much less than 5 rem to the public and collocated worker, which allows the filtration component to be designed to SDC-1 according to Table A-1 of DOE-STD-1189, Appendix A. This confinement strategy is adequate for the conceptual design; however, in future design phases, a technical evaluation that demonstrates that the alternate confinement approach results in a very high assurance of the confinement of radioactive materials will be necessary to meet DOE Order 420.1 C.