DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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January 12, 2009

The Honorable Thomas P. D'Agostino
Administrator
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0701

Dear Mr. D'Agostino:

The Defense Nuclear Facilities Safety Board (Board) has completed its review of the final design documents for the Waste Solidification Building (WSB), to be constructed at the Savannah River Site (SRS). The Board understands that the National Nuclear Security Administration has approved Critical Decision (CD)-2/3, which formally establishes the project baseline and allows the start of facility construction. The enclosure to this letter summarizes the Board's understanding of the WSB project status and safety posture. The Board has no safety issues with the project that would preclude commencing construction. As the final design nears completion, three safety issues must be addressed early in the construction phase:

- The Mixed-Oxide Fuel Fabrication Facility (MFFF) and WSB projects previously estimated that low levels of organics would be received by WSB from MFFF. These low levels can no longer be assured and, as a result, the WSB project now considers red oil explosion to be a credible design basis accident. The Board understands that the project team has identified both a safety-class temperature control and a Technical Safety Requirement-level administrative control on organic contents to prevent a red oil explosion. The Board considers this approach consistent with the recommendations of DNFSB/TECH-33, *Control of Red Oil Explosions in Defense Nuclear Facilities.* However, the details of these controls and their implementation have yet to be developed. This needs to be done carefully, considering recent research on red oil formation. The Board will continue to monitor the implementation of the proposed controls with great interest.

- The safety basis identifies the need for a design feature to maintain hydrogen levels below 25 percent of the lower flammability limit in the headspace volume in process tanks. The current design does not perform this safety function. The project team needs to identify and document an alternative control strategy or modify the evaporator tank design to achieve this safety function and preclude a hydrogen deflagration/detonation.

- The Board's review of calculation T-CLC-F-00411 (referenced in the Department of Energy's (DOE) September 22, 2008, letter to the Board) revealed that design checks were performed inadequately and that the facility was not in compliance with national consensus codes and standards for the project's design basis settlement. The project team recognized this mistake, revised this calculation and associated drawings, and will add reinforcement to the building's structure. Since the calculation and drawings were only recently revised and released, the project team should confirm that all issues have been properly identified and closed prior to start of construction.

According to current SRS practice, the Consolidated Hazard Analysis is a reference cited in the safety basis of a facility and is not included in the Safety Basis List of documents covered by the requirements of the *Nuclear Safety Management* rule (Title 10 Code of Federal Regulations, Part 830, Subpart B). The Consolidated Hazard Analysis documents defense-in-depth and worker protection features identified to protect the public and workers that are in addition to the safety-related controls specified in the Documented Safety Analysis (DSA). The Board believes that a summary of the Consolidated Hazard Analysis controls that are identified as defense-in-depth or provide significant worker protection features should be identified in chapter 3 of the DSA. Alternatively, the Consolidated Hazard Analysis could be listed as part of the Safety Basis List. Either approach assures compliance with the *Nuclear Safety Management* rule and its safe harbor, DOE Standard 3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analyses.*

The Board looks forward to working with the WSB project team as the final design approaches completion and hopes that the productive interactions between its staff and project personnel continue.

Sincerely,

A. J. Eggenberger
Chairman

Enclosure

c: Mr. Jeffrey M. Allison
Mr. Mark B. Whitaker, Jr.

Enclosure

Waste Solidification Building Project Summary

The Waste Solidification Building (WSB), to be constructed at the Savannah River Site (SRS), will support the Mixed-Oxide Fuel Fabrication Facility (MFFF) and the Pit Disassembly and Conversion Facility (PDCF) by processing their liquid waste streams. WSB received an approval of Critical Decision (CD)-1 in October 1997 while it was a line item under the PDCF project; it has since become a separate project from PDCF. The National Nuclear Security Administration has recently approved CD-2/3 for the WSB project, which formally establishes the project baseline and allows the start of facility construction.

The main processes at WSB include evaporation, neutralization, and solidification (cementation) of the incoming liquid waste. The building structure and safety-related equipment for WSB, classified as a Hazard Category 2 facility, will be designed to a seismic demand based on Nuclear Regulatory Commission Regulatory Guide 1.60 (for consistency with MFFF and PDCF). This seismic motion is scaled to 0.2 g peak ground acceleration and envelopes the SRS Performance Category 3 response spectrum. The current facility design is divided into two main processing areas for high-activity and low-activity liquid waste. Most of the material-at-risk (MAR) will be generated by MFFF and processed in the high-activity waste (HAW) process area.

Safety-related controls are identified in the WSB Preliminary Documented Safety Analysis (PDSA) to prevent or mitigate a release of material from the low-activity waste (LAW) and HAW process areas. These controls are present in both the process system and facility design features. In addition, the Waste Acceptance Criteria document will control the amount of material (MAR, organics, etc.) entering the WSB and protect the levels assumed in the PDSA. To prevent hydrogen explosion, red oil explosion, and material release, the following safety-significant (SS) and safety-class (SC) controls have been identified by the project team for the HAW area:

- The building structure, HAW process vessels, and HAW process piping are credited as SS to provide material confinement.

- The HAW process vessel ventilation system is designated as SS to both exhaust hydrogen gas from the head space of the process tanks and provide filtration.

- The HAW room ventilation system is designated as SS to prevent an airborne release of material from exiting the HAW rooms.

- The cementation, sampling, and laboratory enclosures have SS ventilation systems to prevent an airborne release of material.

- The backup diesel generator and electrical power distribution system that support SS active components are designated SS.

- The HAW fire suppression system is designated as SS to extinguish HAW room fires.

- The temperature interlocks on the HAW evaporator are credited as SC to prevent the vessel from reaching temperatures favorable to red oil formation.

- A safety-related administrative control on the organic contents will be developed to prevent red oil formation.

The following issues still remain open from the Board's staff review of the WSB final design:

- The project team has identified both a SC temperature control and a Technical Safety Requirement-level administrative control on tri-*n*-butyl phosphate contents to prevent a red oil explosion, which is consistent with DNFSB/TECH-33, *Control of Red Oil Explosions in Defense Nuclear Facilities*. However, the details of these controls have yet to be developed.

- The current design of the WSB HAW evaporator tank does not have the required design feature to protect headspace assumptions to maintain hydrogen levels below 25 percent of the lower flammability limit; this design feature is a requirement of the safety basis.

- A Board review of the calculation T-CLC-F-00411, Rev. 1 found that design checks were inadequately performed for the project's design basis settlement. While bending moment contours were used for selecting the location of design cuts through the walls and slabs of the WSB, axial stress contours were not. Since portions of the building were controlled by axial stress, and not bending moment, certain critical design checks were never made. The Board's staff will review the revised calculation and drawings, which were recently issued.

- Current SRS practice does not list the Consolidated Hazard Analysis in the Safety Basis List as a document to be covered by the requirements of the *Nuclear Safety Management* rule (Title 10 Code of Federal Regulations, Part 830, Subpart B). Although safety-related controls identified in the Consolidated Hazard Analysis are carried forward to the facility safety basis, other defense-in-depth controls and significant worker protection features are not.