Department of Energy
Washington, DC 20585

May 21, 2004

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, DC 20004-2901

Dear Mr. Chairman:

This letter provides the U.S. Department of Energy (DOE) report (Enclosures 1 and 2) in response to the Defense Nuclear Facilities Safety Board (DNFSB) concerns raised in the DNFSB letter dated March 24, 2004. The DNFSB notes that Bechtel National, Inc. (BNI) is attempting to build a technical basis for addressing hydrogen hazards related to non-Newtonian high-level wastes with an experimental Research and Technology (R&T) program using surrogate materials. The DNFSB's concern is that the use of preliminary data so heavily based on experimental testing with surrogate materials, which has not undergone a thorough quality review, increases the chances of introducing errors into the design that may be irreversible. The DNFSB believes that decisions to proceed with the final mixing tank system design(s) and development of operating strategies to prevent hydrogen deflagrations/explosions are premature, given the degree of uncertainty that presently exists.

The DNFSB also reviewed the report of the DOE's Office of River Protection (ORP) on the adequacy of the "black cell" design concept. The DNFSB is concerned that open items in the ORP report, like the one on BNI's material selection basis, appear to be sufficiently significant to require resolution before proceeding with certain design activities.

With respect to the Board's concern that use of preliminary data based on surrogate materials experimental testing without a thorough quality review may introduce irreversible errors into the design.

Thorough quality reviews of the experimental testing have been completed and the surrogate materials used in testing have been endorsed by independent mixing experts. The design of the hydrogen mixing and control (HMC) system is based on conservative assumptions of waste behavior used in the testing program (described further in Enclosure 1).

On April 2, 2004, BNI completed its initial technical and quality verification of the R&T program test results for mixing system designs for vessels in the Pre-treatment facility containing non-Newtonian high-level wastes. The material in this report (Enclosure 3) has undergone quality reviews by the Battelle Pacific

Northwest Laboratory (PNL) and Savannah River Technology Center (SRTC) which carried out the testing. The results of the reviews are documented in Enclosure 3 of this letter. The enclosure provides the scaled prototypic test platform data, the mixing scale-up approach and basis, sparging zone-of-influence (ZOI) development, and demonstration that the mixing systems will both keep retained gas at low levels during normal operations and following a design basis event (DBE) for the March 2004 base design, thereby preventing hydrogen deflagrations or explosions. The quality review of the Enclosure 3 test report for the Pretreatment (PT) facility confirmed that the design and operating strategies specified in Enclosure 4 remain consistent with the test data.

A Peer Review meeting with an external panel comprised of experienced safety personnel from Savannah River, Oak Ridge, and other areas was held March 31, 2004, and April 1, 2004. The panel evaluated the safety strategy of the base design and provided recommendations for potential modifications. The panel observed (in their exit briefing) that the WTP hydrogen correlations are adequately conservative.

The acceptability of using surrogate materials to bound in-situ waste behavior was established through the analysis of actual wastes, tests of simulant materials, consultant input, and comparison with data of other high-level wastes. The simulant had higher weight percent solids than the expected waste, a high yield stress value, and very conservative consistency for physical modeling. An external panel of international mixing experts met on October 30, 2003, to November 1, 2003, and concurred with the WTP simulant selection. Additional details of the acceptability of the simulant are discussed in Enclosure 1, item 4.

Design Conservatism, Margins, and Flexibility

As a result of the experimental testing with surrogate materials, several mixing systems have been identified, which will accomplish the needed mixing and hydrogen control. These include combinations of pulse jet mixers (PJMs), recirculation systems, and spargers. PJMs will be used in all pretreatment inaccessible (black cell) tanks for mixing and suspension of solids off the tank floor. Spargers and/or recirculation pumps provide the mixing for the upper elevations of the tanks. The current pretreatment operational design for the Lag Storage and Blend vessels allows for mixing via *all* methods: PJMs, recirculation pumps, and spargers.

Conservatisms have been included in both the design and safety strategy. Conservative approaches taken at each stage of the HMC testing program are outlined below. The safety margin in the mixing systems results from: 1) the conservative simulant selected for rheologic properties; 2) the scaled testing approach; 3) the methodology used to develop the sparging correlation; and 4) the techniques employed to evaluate gas retention and release behavior models. In order to put the conservatism of the design into perspective, scaling of test results

to date indicates that normal operation gas hold-up in the full scale vessels will be less than 1percent by volume. Instantaneous gas releases were not observed during testing until more than 20 percent gas by volume accumulates in the tank. Even then, in the test of 7 Pascal simulant, where this was observed, the release occurred over a 20-second period. Because these hold-ups are so low, an instantaneous uncontrolled release does not appear to be credible.

As a further step to ensure the operational safety, hydrogen monitors will be provided in the vessel vent system (tank head space or vent pipe). While these systems will most likely not be safety class systems, the ability to monitor H_2 in actual plant operations is viewed as beneficial to confirm design assumptions.

In addition, safety class hardware to control the fill level of the tanks has been added to the proposed design, and the radionuclide inventory will be controlled by technical safety requirements (TSRs). By controlling dome volume and radionuclide inventory, the estimated time to LFL can be extended beyond the current 6- to 8-hour minimum. As an operational conservatism, the Pretreatment operation limits, including rheology, for each waste tank will be defined using the samples delivered by the tank farm contractor prior to WTP processing. This additional TSR will assure that the waste slurries remain well within the rheologic limits supported by the testing program.

A current review of mixing systems redundancy in the pretreatment lag storage and blend vessels indicates that mixing may be accomplished with solely PJM operation and sparger operation in *both* normal operations and post DBE. An initiative to eliminate the recirculation pumps in these tanks depends on current testing, which is evaluating the effectiveness of the spargers to rapidly establish a ZOI and to maintain a low gas hold-up with intermittent sparging. If this is not demonstrated, then the recirculation pumps will be retained.

The current non-Newtonian fluid mixing design requirements and operating strategies are provided in Attachment 2 for the Pretreatment facility. More complete design requirements and how they are achieved will be contained in a system description document under preparation.

Current designs and planning schedules allow for system refinement without compromises to safety. The ability to modify the design before the construction is "irreversible" ties to the placement of the ceiling over the black cells, which is projected to be February 2005 for Pretreatment.

With respect to the Board's concern that the Black Cell report open items appear sufficiently significant to require resolution before proceeding with certain final design activities.

BNI has developed the closure plan for each recommendation open item identified in the Black Cell Review report and has entered them into the BNI

Recommendation and Issue Tracking System for formal tracking and closure. ORP has reviewed and concurred with the closure plan activities, deliverables, and schedule. DOE expects that completion of the closure plan activities on the identified schedule will ensure that the recommendations and open items are resolved before proceeding with associated final design activities. The closure plan is statused and updated on a weekly basis and these updates are provided to the DNFSB staff. Enclosure 2 provides the April 19, 2004, update of the closure plan.

Regarding the Board's specific example of an inadequate basis for materials selection and wear rates, DOE has conducted a preliminary review of the technical basis for corrosion allowances, and determined that the likelihood of change to the material selection is minimal, once the basis for material selection is more rigorously defined.

This preliminary review found that the primary waste constituents of concern were the chlorides, fluorides, and sulfates. These constituents, along with the possible pH values expected in the tanks during operations were considered in the review. In this preliminary assessment, BNI concluded (and ORP concurred) that there was a wide margin before the maximum concentrations for the constituents would impact the current materials selected. This margin was greater than the expected variation in waste concentration of these constituents. Therefore, the risk of change is minimal.

ORP will verify: (1) that waste feed hardness properties used by BNI in erosion evaluations are representative of tank farm waste information; (2) that BNI has evaluated the erosivity of the process waste streams; (3) that the corrosion evaluations have been adequately updated to account for erosion; and (4) ORP will review the need for modifications to the design required to accommodate changes in erosion allowances, if any. These actions are scheduled to be completed by July 30, 2004. Therefore, based on these reviews, both the erosion and corrosion attributes of the materials selected will be confirmed.

Based on the information provided in this letter and enclosures, ORP judges that the programmatic risk associated with continuation of the black cell vessel and piping design is acceptable.

Thank you for meeting with us on May 18. I realize that the Board has continuing concerns regarding the WTP and we have scheduled a follow-on meeting on June 2. As a result, we may need to provide refinements to this response.

If you have further questions, please call me at (202) 586-7709 or Patrice Bubar, Deputy Assistant Secretary for Integrated Safety Management and Operations Oversight, at (202) 586-5151.

Sincerely,

Jessie Hill Roberson
Assistant Secretary for
Environmental Management

4 Enclosures

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Enclosure 1

Enclosure 2

Enclosure 3

Enclosure 4