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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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January 6, 2010

The Honorable Inés R. Triay
Assistant Secretary for Environmental
Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Dr. Triay:

The Defense Nuclear Facilities Safety Board (Board) recently reviewed the design and testing of the pulse jet mixing technology being deployed in the Pretreatment Facility at the Waste Treatment and Immobilization Plant (WTP) at the Hanford Site. The Board found deficiencies in the functional requirements for mixing and transport systems; specifically, the requirements do not adequately bound the properties of waste to be processed. As currently designed, the pulse jet mixers lack sufficient power to adequately mix and transport the most rapidly settling particles expected to be present in the Hanford waste inventory. This shortcoming results in three significant safety issues:

- Dense particles rich in plutonium and uranium are expected to settle preferentially on the bottom of tanks. These settled particles may form a sediment layer with sufficient fissile mass in a geometry such that a criticality accident is credible. Furthermore, if the vessels are not well mixed, samples drawn from the vessels to ensure that such an event does not occur will not be representative.

- The development of a sediment layer on the bottom of tanks may reduce the effectiveness of the pulse jet mixing systems below that assumed in the design. As a result, an initially thin sediment layer could grow sufficiently to retain significant quantities of flammable gas. The existence of a deep sediment layer would not be recognized by plant operators because there is no instrumentation that indicates the quantity of sediment. Gas release events from this sediment layer could exceed the lower flammability limit in the vessel headspace and result in an explosion.

- The presence of a deep sediment layer may also have a detrimental effect on the performance of bubbler systems used to measure the tank level and average density in the vessels. The tank level and average density are inputs to the calculation of the drive time of the pulse jet mixers, which is relied upon to prevent overblows. The cumulative effect of many overblows could result in the material failure of components internal to process vessels located in black cells.

The Department of Energy's Office of River Protection has suggested that these safety issues could be addressed by preventing rapidly settling particles from entering WTP using controls that would limit the particle size and density of the waste stream from the tank farm. This approach would necessitate deployment of new mixing, sampling, and separation systems. The result would be new design basis requirements for particle size and density for WTP that must be consistent with the actual performance of the newly deployed systems.

Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a report within 60 days of receipt of this letter that addresses the safety issues associated with inadequate pulse jet mixing detailed in the enclosed report. This response should describe an approach to (1) establish functional requirements and technical criteria for safe operation of the integrated WTP pulse jet mixing, transport, and sampling systems; (2) establish bounding design basis requirements for particle size and density based on actual feed qualification capabilities; (3) develop design correlations derived from testing of pulse jet mixers at realistic scales that demonstrate actual system performance can meet functional requirements with bounding design basis inputs; and (4) establish a criticality safety strategy that considers the practical performance of the mixing, transport, and sampling systems.

Sincerely,

John E. Mansfield, Ph.D.
Vice Chairman

Enclosure

c: Ms. Shirley J. Olinger
Mr. Mark B. Whitaker, Jr.