DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Washington, DC 20004-2901

April 5, 2011

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) has completed a review of the Waste Treatment and Immobilization Plant (WTP) methodology for assessing dose consequences from pressurized spray leaks involving radioactive liquids. WTP project personnel used this methodology to estimate radioactive doses to the public receptor caused by spray leaks. This estimate was then used to determine the safety classification of the WTP primary confinement boundary (i.e., process piping). Based on the WTP analysis, the primary confinement boundary would not be classified as safety class. The Board believes that (1) WTP's methodology is not reasonably conservative and (2) safety-class structures, systems, or components may be required to mitigate accident scenarios involving spray leaks in the hot cell region of WTP.

In particular, the Board is concerned with the WTP project's treatment of uncertainty in the spray leak methodology. Major sources of uncertainty include:

- *Orifice configuration*—The WTP methodology uses a single rectangular slit to represent all potential leak site geometries. Leak site geometry is a major contributor to the total quantity of radioactive material released and the distribution of droplet sizes. Both of these parameters have a direct effect on the postulated unmitigated dose consequences to the public receptor. An analysis by the Board's staff shows that using different possible leak site geometries (i.e., several small orifices encompassing no more total crack area than assumed in the WTP analysis) results in higher unmitigated dose consequences to the public receptor. The small orifices may be more representative of an actual crack that causes a spray leak.

- *Droplet size distribution*—The WTP methodology assumes that the distribution of droplet sizes in a spray release is accurately described by a Rosin-Rammler probability distribution (with assumed values for the mean and variance of the distribution). The type of droplet size distribution and its variance have a significant impact on the postulated unmitigated dose consequences to the public receptor. The Rosin-Rammler distribution, a cumulative Weibull distribution, was originally proposed as a natural distribution of particle diameters from crushing and grinding coal, although it has been used in industry for spray droplet size distributions. An analysis by the Board's staff

shows that other equally viable distributions of droplet sizes, such as the lognormal distribution, will result in higher unmitigated dose consequences to the public receptor because they have more small droplets.

- *Agglomerate structure*—WTP process slurry contains a significant population of submicron-sized particles that could form loosely packed agglomerates; however the WTP methodology assumes that the dried agglomerates transform from multiple discrete particles into a solid monolith with no void space. Analyses considering a more probable sub-micron behavior of formation of agglomerates instead of a solid monolithic particle upon drying yield higher unmitigated dose consequences to the public receptor.

The Board also notes that the Department of Energy's (DOE) Office of Environmental Management (EM) concluded that the airborne release fraction and respirable fraction provided for spray leak accident scenarios in DOE Handbook 3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*, are not conservative. Since this handbook is used for complex-wide applications related to spray leak analysis, EM communicated this concern to DOE's Office of Health, Safety and Security. The Board understands that this office is currently addressing this complex-wide concern.

Based on the Board's review, the WTP project needs to provide a well-formulated analysis that accounts for the uncertainties and reduces the potential for non-conservative results associated with the analysis of spray leaks. The Board believes it may be possible to reduce uncertainties to more manageable levels by completing additional research and development.

Therefore, pursuant to 42 U.S.C. § 2286b (d), the Board requests a report within 60 days of receipt of this letter that describes (1) an approach for performing a reasonably conservative, well-formulated spray leak analysis that accounts for the uncertainties and non-conservatisms in the WTP accident analyses, especially those discussed above, and (2) an outline of any research and development activities DOE will perform to reduce uncertainties in the analysis approach.

Sincerely,

Peter S. Winokur, Ph.D.
Chairman

c: Mr. Glenn S. Podonsky
Mrs. Mari-Jo Campagnone