DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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January 17, 2008

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:

In a letter to the National Nuclear Security Administration (NNSA) dated February 28, 2006, the Defense Nuclear Facilities Safety Board (Board) identified inadequacies in safety basis documents for the 9212 Complex at the Y-12 National Security Complex (Y-12). These inadequacies included nonconservative approaches for estimating off-site dose consequences resulting from design-basis accidents that led to a less than adequate set of safety-class controls. The Board expected these nonconservative methodology issues to be fully resolved during subsequent updates to the Documented Safety Analysis (DSA) at Y-12. However, recent activities related to the preparation of preliminary DSAs for new facilities at the site, as well as the annual update of the DSA for the 9212 Complex, indicate that the methodology issues identified by the Board in 2006 have not been resolved and may lead to improper classification of safety systems and less than adequate protection of the public and workers.

The Board believes the methodology used at Y-12 to estimate airborne release fractions (ARF) remains nonconservative. YSO prepared a Safety Evaluation Report (SER) for Consequence Assessment Methodology in May 2006 that approved the use of a median value for the ARF applied to bulk uranium metal involved in a postulated facility fire, instead of the conservative bounding value provided in the Department of Energy (DOE) Handbook DOE-HDBK-3010-94, *Airborne Release Fractions/Rates and Respirable Fractions for Nonreactor Nuclear Facilities*. To support the median value for ARF, YSO recently solicited assistance from the principal author of the handbook to reevaluate the ARF and the respirable fraction (RF) for the uranium metals in question at Y-12. YSO inappropriately limited the scope of this reevaluation to the conditions where the fires involving uranium metal at Y-12 would not exceed 600 °C and would not result in direct flame impingement on uranium metal in the fire. As a result, the new ARF/RF values derived by the author in support of the SER are only valid for specific fire environments and limited scenarios that implicitly credit combustible controls, unqualified storage containers, and the distribution of the material at risk within a facility. It is not appropriate to take credit for these controls in an ARF that is universally applied at the site.

The Board's staff reviewed the letter report summarizing the reevaluation of ARF/RF values commissioned by YSO (*Applicable Uranium ARF and RF for Y-12 Fire Scenarios*, RP-FS-801768-A004, dated June 2007) to assess how broadly the new values could be applied. The main source of data used in developing the new ARF/RF values is the same set of experiments

referenced in DOE-HDBK-3010-94 (i.e., LA-8610-MS, *Oxidation of Depleted Uranium Penetrators and Aerosol Dispersal at High Temperatures*). The experiments that involved bulk uranium metal were performed in two distinct environments: (1) laboratory equipment passing either hot air or hot air mixed with carbon dioxide at a constant temperature over uranium metal, and (2) outdoor burn tests using wood-paper fuel. The bounding ARF value recommended in DOE-HDBK-3010-94 encompasses the data from both sets of these experiments, and is to be used for bulk uranium metal in a generic fire. The June 2007 letter report prepared for YSO uses only results from the constant temperature laboratory testing, consistent with its scope of review, and thereby arrives at reduced values for ARF and RF.

The outdoor burn tests embodied characteristics of real fires, including a temperature cycling characteristic that apparently increased the material aerosolization at temperatures higher than 600 °C. Given the uncertainties generally associated with a real fire, which involves direct flame impingement on uranium metal in the fire and the potential for increased aerosolization at higher temperatures as demonstrated by the outdoor burns, it is not appropriate to exclude data from these tests in determining the ARF value to be used in evaluating the unmitigated consequences of a generic bounding facility fire scenario for identification of safety-related systems.

The Board concludes that the recommended bounding values for ARF and RF from DOE-HDBK-3010-94 (i.e., 1E-3 and 1.0, respectively, for bulk uranium metal) remain the appropriate parameters for calculation of bounding unmitigated dose consequences for fire scenarios for determination of safety-related controls. Applications of median values for such conditions remains inappropriate for safety analysis. Less conservative ARF and RF values derived for specific conditions may be appropriate in some circumstances, for example, when it can be demonstrated that positive controls ensure fire temperatures are constrained and direct flame impingement is prevented.

The Board understands that YSO is reevaluating application of ARFs for Y-12 nuclear facilities following recent discussion with the Board's staff. Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a briefing within 90 days of receipt of this letter on NNSA's plans to clarify the appropriate use of bounding release fractions for accident analyses at Y-12 and the plans for applying this methodology to existing and planned facilities at Y-12.

Sincerely,

A. J. Eggenberger
Chairman

c: Mr. Theodore D. Sherry
Mr. Mark B. Whitaker, Jr.