December 27, 2002

The Honorable Everet H. Beckner
Deputy Administrator for Defense Programs
National Nuclear Security Administration
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0104

Dear Dr. Beckner:

The Defense Nuclear Facilities Safety Board (Board) sent a letter to the Department of Energy (DOE) on March 25, 2002, regarding the Highly Enriched Uranium Materials Facility (HEUMF) at the Y-12 National Security Complex. The Board's letter and its enclosure identified several weaknesses in the design and safety basis requirements of the HEUMF. These included inadequate identification of codes and standards in the General Design Criteria document, incomplete hazard analysis and identification of safety controls, and unclear criteria for the type of material to be stored in the facility.

The Board's staff has continued its review of the design and safety basis documents for this facility and met with DOE and its contractor representatives on November 5–7, 2002, at the site. While the contractor has improved its design criteria document and the process for identification of safety controls, persistent weaknesses discussed in the enclosed report need to be addressed to ensure an adequate safety basis for the operation of this facility.

The draft Preliminary Documented Safety Analysis (PDSA) is currently scheduled to be submitted to DOE in March 2003. The hazard evaluation studies performed in support of the PDSA have identified several events that require a safety-class secondary confinement system provided by the building structure and its isolation system. The confinement system, required by DOE Order 420.1, *Facility Safety*, is based on the isolation (holdup) of the facility following a design basis fire event. This concept, however, depends on numerous analytical assumptions that may be impractical to implement. Furthermore, the proposed design does not provide for post accident recovery activities.

In that same letter dated March 25, 2002, the Board also identified potential inadequacies related to the form and packaging requirements of uranium for long-term storage at the HEUMF. Recent reviews by the Board's staff indicate that the gap between the Program Requirements Document and the safety basis documents may have widened due to a significant number of uranium forms that might be stored in the HEUMF. The hazard evaluation studies list a number of different forms of uranium, including solutions. The site does not appear to have specific standards for long-term storage of these forms. The concern is that long-term storage of some of this material may result in unidentified hazards and a less than adequate safety basis for their storage.

Therefore, the Board requests that you examine the issues outlined in the enclosed report and, pursuant to 42 U.S.C. § 2286b(d), provide a report within 90 days of receipt of this letter to address:

1. Identification and evaluation of the current secondary confinement system design, or an alternate design, to address the deficiencies raised in the enclosed report. This evaluation should address the related safety functions for protection of the public, workers, and national security interests, as well as the preventive, mitigative, and post accident recovery features of the proposed design.

2. Identification and evaluation of the primary confinement systems envisioned for storage of special nuclear materials at the HEUMF, including the types and physical characteristics of the materials, the technical standards and criteria for their storage, and the stabilization activities required for the materials to be stored in the HEUMF that do not currently meet these standards.

Sincerely,

John T. Conway
Chairman

c: Mr. William J. Brumley
Mr. Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

December 3, 2002

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: F. Bamdad

SUBJECT: Design and Safety Review of the Highly Enriched Uranium Materials Facility

This report documents observations of the staff of the Defense Nuclear Facilities Safety Board (Board) regarding the design and safety bases of the Highly Enriched Uranium Materials Facility (HEUMF) at the Department of Energy's (DOE) Y-12 National Security Complex. Members of the Board's staff W. Andrews, V. Anderson, F. Bamdad, J. Deplitch, W. Linzau, and R. Zavadoski reviewed the relevant available documents and held discussions at the site on November 5–7, 2002.

Background. On March 25, 2002, the Board sent DOE a letter identifying several weaknesses in the design and safety basis requirements of the HEUMF. The enclosure to the Board's letter also noted weaknesses related to the technical safety basis and to identification of the safety controls needed to address the potential hazards in the facility. The contractor, BWXT Y-12, has taken a number of actions to respond to the Board's letter and address some of the safety-related issues raised. These actions include:

- Revising the General Design Criteria document to include the appropriate codes and standards.
- Defining the criteria for identification of structures, systems, and components (SSCs) supporting safety-class and safety-significant controls.

While these actions address some of the safety issues identified in the Board's letter, several major issues remain unresolved. The contractor has nonetheless continued its preliminary design activities, after receiving approval to proceed with work in May 2002, and has prepared several hazard evaluation studies that will form the foundation of a draft Preliminary Documented Safety Analysis (PDSA). The draft PDSA is scheduled to be submitted to DOE in March 2003 in support of Title I design activities and a request for approval of the Critical Decision 2 project milestone.

Discussion. The Board's staff reviewed documents that have been prepared in support of the preliminary design activities and held discussions with project representatives from DOE and BWXT Y-12. While significant progress has been made in addressing some of the safety issues previously identified by the Board, the following weaknesses observed by the Board's staff need to be addressed prior to completion of the draft PDSA.

Design Requirements—The HEUMF project team is attempting to use the methodology described in the safe harbor provisions of the Nuclear Safety Management rule to prepare the PDSA (i.e., DOE-STD-3009-94, *Preparation Guide for U.S. Department of Energy Nonreactor Nuclear Facility Documented Safety Analysis*). However, several of the site standards developed for compliance with the safe harbor provisions do not meet DOE requirements. For example, Change Notice #2 to DOE-STD-3009-94, issued by DOE in April 2002, elaborates on protection of workers and identification of safety-significant SSCs. The current site standard does not adequately address worker safety and could result in less than adequate protection of the facility workers from radiological hazards, as well as inadequate classification of safety SSCs needed to protect both facility and collocated workers from chemical and toxicological hazards. Although similar requirements to Change Notice #2 have existed in DOE Order 420.1, *Facility Safety*, since 1998, the site standards have not been revised to be consistent with DOE expectations.

In another example, Appendix A to DOE-STD-3009-94 treats operational transients and events that are expected to happen within the life of the facility (i.e., anticipated events) as part of normal operations that should meet the requirements of the radiological protection programs stipulated in 10 Code of Federal Regulations (CFR) 835, *Occupational Radiation Protection*. The current design of the HEUMF does not appear to meet these expectations, nor are these expectations specifically captured in the prevailing site standards.

Design Considerations—The hazard evaluation studies performed in support of the PDSA have identified several events that require safety-class or safety-significant SSCs. The most hazardous event is identified as a fire scenario engulfing one or more nuclear weapon parts stored in the facility. The radiological consequences are estimated to exceed the DOE evaluation guideline for identification of safety-class controls. In addition, the toxicological consequences are estimated to exceed Emergency Response Planning Guideline-3 levels at the site boundary, and reach significantly higher levels within the facility. This would require having a safety-class confinement system.

DOE Order 420.1 requires that the design of new nuclear facilities be based on confining the identified hazards. The approach taken by the HEUMF project team to comply with this requirement is to use the material container as the primary confinement barrier, and to isolate (hold up) the building as a secondary confinement system to contain the radiologically and toxicologically hazardous material released during a design basis event (e.g., fire). This secondary confinement system consists of safety-class fire barriers provided by the building structure and isolation valves on the normal ventilation system. Large fires have been determined to be the most limiting events and thus dictate the

design considerations for the secondary confinement system. Detection systems have been identified to initiate isolation signals based on a seismic event (potentially followed by fire), water flow in the fire suppression system, or loss of negative pressure in the facility. However, even though the secondary confinement system is designated a safety-class SSC, the detection systems are designated only safety-significant. Similar classification issues were identified by the Board's staff during a January 2002 review.

The Board's staff identified several weaknesses in the project team's approach to safety, particularly as it regards the secondary confinement system:

- The proposed design incorporates certain assumptions with regard to maintaining the confinement boundary following a fire. These assumptions may be unrealistic, inconsistent with emergency response practices, or impractical to implement, and they introduce significant analytical uncertainties into the accident analysis and the safety basis of the facility. Examples of such assumptions include the following:

  - Fire department and security personnel are assumed to limit the amount of radiological and toxic material that leaves the building through the doors (to meet the analytical assumptions) by using the normal procedures for accessing the building through the air-locks.

  - The confinement leakage allowances are based on normal operation (in-leakage). In a postfire condition, however, building overpressurization could lead to out-leakage that may exceed the in-leakage allowance. In addition, the total confinement leakage for the collection of penetrations in the facility has not been analyzed to determine allowable and expected leakage, and no practical measurement or survey plan is being devised to ensure that the allowable and expected leakage can be accommodated.

  - The confinement design includes a tactical staging area (to meet security requirements), but does not include provisions for the potential breach of the confinement boundary by security personnel following a fire.

- The proposed design does not provide any means of detecting or measuring conditions inside the building to coordinate proper access during and following a fire. Postfire recovery activities would be hindered by the isolation of the facility and the lack of instruments necessary to provide pertinent information.

- The contractor did not consider any alternatives to the proposed design or perform any cost/benefit evaluations. The building isolation concept was

adopted by the project team because of the potential for significant toxicological consequences of a fire scenario. The project team, however, has not evaluated other alternatives that may be capable of providing higher levels of safety, as well as reducing the analytical uncertainties discussed above. For example, an active confinement system equipped with high-efficiency particulate air filters (to protect against radiological hazards) and a scrubber system (to absorb the toxicological hazards) has not been evaluated by the project team. Nor did the team consider a limited-scope active ventilation system, equipped with a scrubber system for a compartmentalized area that could contain the toxicologically hazardous material.

The project does not appear to have implemented a tracking system to capture open analytical and design issues for resolution. In particular, assumptions regarding the initial conditions, design parameters, and functional requirements are not being captured systematically, documented, and tracked to closure during the preliminary and final design stages of the project. Such issues are currently listed in the pertinent documents; however, they are not entered into a tracking system to be maintained and cross-referenced as design activities mature.

Primary Confinement and Material Form—The established program mission for this facility is "assurance of a viable, long-term highly enriched uranium [HEU] storage capability to support the enduring nuclear weapons stockpile and strategic reserve for the foreseeable future." During meetings in January 2002, the Board's staff was informed that the project plan allowed for only two forms of uranium—metal and oxide—as well as canned subassemblies, into long-term storage in the HEUMF. During this more recent review, the staff noted that the hazard evaluation studies consider 13 different forms of uranium to be stored in the HEUMF. This material includes hundreds of containers of solutions, unirradiated and slightly irradiated reactor fuel elements. Consequently, a large portion of the material placed in the HEUMF will not be adequately containerized (e.g., in a 304L stainless steel container) and not in a chemical form (e.g., metal, oxide, or canned subassemblies) that is consistent with site standards for long-term storage. (It should be noted that the site does not appear to have any established criteria or standards for long-term safe storage of reactor fuels.)

The *Technical Safety Basis for the Highly Enriched Uranium Materials Facility* (April 2001) identified the highly enriched uranium long-term storage containers as safety-significant SSCs that serve a primary confinement function. This designation appears to have been eliminated from more recent documents. In addition, the only specific criteria established in HEUMF programmatic documents are for the containers to have a melting point greater than 2000° F and to have a positive seal. These criteria differ from the site standard for long-term storage of uranium oxide, which requires a 304-L stainless steel (melting point 2550–2650° F) container sealed with a commercial crimping apparatus, while also specifying a moisture content requirement. There are similar requirements for the long-term storage of uranium metal. The contractor appears to lack thorough knowledge of which existing highly enriched uranium items meet the site standards for long-term storage. The contractor

does not currently have any plans to process the material that does not meet the established standards for long-term storage prior to placing it in the HEUMF. This change is problematic in that it introduces material to the facility that is outside the scope of the existing site storage standards.