May 12, 1999

The Honorable Victor H. Reis
Assistant Secretary for Defense Programs
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0104

Dear Dr. Reis:

Replacing aging defense nuclear facilities and maintaining a cadre of technically competent staff to build and manage those facilities are two of the most important safety challenges currently faced by the Department of Energy (DOE). The Defense Nuclear Facilities Safety Board (Board) recently reviewed the status of the first facility design to be initiated as part of the Y-12 Site Integrated Modernization (Y-SIM) Plan—the Highly-Enriched Uranium (HEU) Storage Facility. Because of the current and future mission of the Y-12 Plant, it is important that the Y-SIM be brought to a successful and timely conclusion that ensures its freedom from future safety problems.

Following reviews of recent facility upgrades at the Y-12 Plant and a staff assessment of the conceptual design report for the HEU storage facility, the Board concludes that increased effort is required to integrate safety into the planning process to ensure overall success. A disciplined process for controlling the design of facilities based on the principles of systems engineering, Integrated Safety Management, and the guidance contained in DOE Order 430.1A, *Life Cycle Asset Management*, should achieve this goal. Failure to do so would jeopardize the successful completion of these vitally important efforts. An issue report summarizing the results of the review of the conceptual design report for the HEU storage facility by the Board's staff is enclosed for your reference.

The Board will continue to closely monitor DOE's progress in this matter, and has directed its staff to work closely with its DOE counterparts in addressing the issues identified in the enclosed report.

Sincerely,

John T. Conway
Chairman

c: Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

March 28, 1999

MEMORANDUM FOR: G. W. Cunningham, Technical Director
J. K. Fortenberry, Deputy Technical Director

COPIES: Board Members

FROM: J. Blackman

SUBJECT: Review of Conceptual Design of Highly Enriched Uranium Storage Facility at Y-12 Plant

This report documents an initial review of the Conceptual Design of the Highly Enriched Uranium (HEU) Storage Facility at the Y-12 Plant. J. Blackman and P. Gubanc of the staff of the Defense Nuclear Facilities Safety Board (Board) participated in the review on March 18, 1999.

Background. The existing Y-12 manufacturing plant is housed and supported primarily by facilities that are 45–55 years old. The Department of Energy (DOE) has initiated the Y-12 Site Integrated Modernization program to replace these aging facilities with a new fully consolidated operational factory for the manufacture of nuclear weapon secondaries and radiation cases. The goal of this program is to ensure stockpile management capability into the twenty-first century by attaining operating efficiencies, reducing safety risks, and improving flexibility to meet future needs by the year 2012. The first of several facilities envisioned is a new HEU Storage Facility. Approval of Mission Need–Critical Decision 1 and preparation of the conceptual design report was given on November 27, 1998.

Discussion. The proposed HEU Storage Facility is an above-ground facility, nominally 230 x 500 ft, configured to store 14,000 secondaries and 14,000 cans (metal and oxides) of HEU. In addition, a portion of the facility will accommodate International Atomic Energy Agency surveillance of HEU, as well as provide for receipt and disassembly of secondaries. The facility is to be covered by a 10 ft berm of soil to mitigate safeguards concerns. DOE Order 430.1A, *Life Cycle Asset Management*, has been incorporated into the site contract; therefore, the staff's review was based on the assumption that the site would be implementing the requirements of that Order, as well as following Integrated Safety Management (ISM) principles. Since the conceptual design report for this facility was scheduled to be issued by May 1999 to support FY 2000 budget submittal requirements, the staff conducted its review to determine whether controlling safety requirements had been sufficiently defined early in the design process to ensure adequate treatment in the preliminary and final designs.

Identification of Conceptual Design Engineered Controls—A significant feature of the current arrangement is the 10 ft berm of soil covering the roof and sides of the facility. Soil depth

and placement are dictated by the need to mitigate safeguards concerns. The load resulting from soil on the roof is transferred to the foundation by the internal and external structural framing. Given the large mass of soil involved, it is a major factor to be considered in the design of the structure to resist dead weight, as well as seismic loads. Additional natural phenomena hazard (NPH) requirements identified were wind, tornado, flooding, and lightning hazards.

As part of the project team, the Lockheed Martin Energy Systems (LMES) Nuclear Criticality Safety (NCS) organization performed an assessment of the functional requirements for the facility. The conclusion of that assessment was that passive design features (versus administrative controls) should be employed to prevent criticality by using a combination of shielding and spacing requirements to configure drum and can storage. NCS also recommended a number of other requirements, including that the design build in flexibility for anticipated facility lifetime needs, that the equipment design be rugged, and that flooding be prevented in the HEU storage area.

The structure of the facility is classified as safety class; therefore, the structural framing arrangement of the facility, including the foundation, internal and external walls, supporting frame, and roof, is a major feature of the facility design and its safety. Given the number of secondaries and cans of HEU to be stored and potential criticality concerns, the support racks are also key components influencing the safety of the facility. In addition both are significant factors affecting the cost of the facility. Since the design is being performed to support FY 2000 budget submittals, the design for the structure and HEU storage racks must be reasonably well defined to support a valid facility safety basis and cost estimate.

Implementation of Conceptual Design Engineered Controls—Staff review of the NCS requirements reflected in the conceptual design disclosed that the project team had not factored a specific shielding and spacing requirement into the current proposed layout. Y-12 personnel acknowledged that if shielding were not used, the areal dimensions of the facility would be prohibitively large. Given the near-term completion date for the conceptual design, it was not apparent that the project team would consider the impact of shielding and spacing requirements on the areal dimensions of the building and the integrity of the storage racks. Thus, criticality controls would not be systematically developed to the appropriate level of detail in the conceptual design.

Staff review of other major design considerations and their impact on the safety basis of the facility indicated another potentially serious oversight. Recent safeguards concerns had resulted in a doubling of the depth of soil (from 5 to 10 ft) to be supported by the structure. However no structural analysis of the building and of the internal framing necessary to support the roof and transfer dead weight and seismic loads to the foundation had been performed. The proposed layout shown to the staff was only a concept and not a validated arrangement. The project team indicated that the design of the internal framing and evaluation of the building for NPH would require at least 1 month effort. Thus additional significant controlling design parameters would not be systematically developed to the appropriate level of detail in the conceptual design.

Based on additional discussions among the project team, DOE, and the Board's staff about how design projects are managed at the Y-12 Plant, it was not apparent that DOE has clearly established its expectations regarding the content and level of detail necessary to support a conceptual design. Nor has LMES developed any implementing process and procedure requirements consistent with the guidance in DOE Order 430.1A.

DOE Order 430.1A defines life cycle as: "The life of an asset from planning through acquisition, maintenance, operation, and disposition."[1] The Order requires that "(A)sset management performance measures shall ensure formal, comprehensive, integrated, documented planning and control methods . . ."[2] It assigns to Program Offices lead responsibility for " . . . establishing and clearly stating expected program performance objectives and program performance criteria . . ."[3] The Board's staff believes that, in order to meet these requirements, DOE should establish specific performance measures for nuclear facilities, specifying the format, content, and rigor of a conceptual design report. In addition, performance measures should address the manner by which the conceptual design report is to be prepared (e.g., by the use of accepted systems engineering practices) and the deliverables to be provided by the contractor(s), in order to comply with the corresponding elements of the Contractor Requirements Document that appears as Attachment 2 to DOE Order 430.1A.

The lack of effective implementation of hazard analysis and development of controls into design and construction projects has previously been identified by the Board,[4] specifically with respect to the new Hydrofluoric Acid System used for Enriched Uranium Operations, as well as the lack of effective implementation of ISM in engineering, design, and construction activities. Given the importance of Y-12 Site Integrated Modernization in general and the HEU Storage Facility as the pilot project for this effort, the Board's staff believes a formal process for controlling the design of facilities based on the principals of ISM and the guidance contained in DOE Order 430.1A should be implemented at the Y-12 Plant.

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[1] Par 29, Attachment 1, DOE Order 430.1A.

[2] Par 6.d., DOE Order 430.1A.

[3] Par 7.c.(10), DOE Order 430.1A.

[4] See letters from the Board to the Honorable Victor H. Reis, Assistant Secretary for Defense Programs, dated August 24, 1998, and January 28, 1999.