DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004-2901
(202) 694-7000

August 30, 2000

General John A. Gordon
Administrator of the National
Nuclear Security Administration
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0701

Dear General Gordon:

During the past year, the Defense Nuclear Facilities Safety Board (Board) and its staff have been following attempts to restart the reduction process for Enriched Uranium Operations at the Y-12 Plant. The staff recently conducted a review and identified a number of safety issues associated with the operation of the reduction furnace, many of which had been identified during previous reviews. It is unclear to the Board why these issues have not been resolved in the 9 months since the last failed attempt to restart this critical national security capability.

The Board would like to be briefed on the Department of Energy's (DOE) resolution of the issues summarized in the enclosed staff issue report before the DOE Operational Readiness Review of the reduction process commences.

Sincerely,

John T. Conway
Chairman

c: Ms. Gertrude Leah Dever
Mr. Mark B. Whitaker, Jr.

Enclosure

00·2267

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

August 25, 2000

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: M. V. Helfrich

SUBJECT: Readiness to Resume Reduction Process for Enriched Uranium Operations

Lockheed Martin Energy Systems, Inc. (LMES) is currently planning to restart Enriched Uranium Operations (EUO) by the end of September 2000. This report describes observations made by members of the staff of the Defense Nuclear Facilities Safety Board (Board) W. Andrews, J. Blackman, P. Gubanc, M. Helfrich, M. Moury, and D. Moyle during a July 2000 review of technical issues associated with the safe resumption of reduction operations. During this review, the staff found that several issues related to the integrity of reactor vessels identified during the failed attempt to resume operations in the fall of 1999 remain open. In addition, about 2 months ago LMES changed key engineers and operations managers involved with the reduction process, significantly reducing the contractor's historical understanding of the technical issues at hand.

Background. The reduction process converts uranium tetrafluoride (UF_4) to uranium metal by reaction with calcium in a sealed "bomb" reactor vessel, which is heated in an induction furnace to initiate the reaction. The hazard analysis for the reduction process noted scenarios that could result in rupture of the pressure vessel during firing, causing death or serious injury to workers from flying debris and significant exposure to collocated workers. Furthermore, the reactor vessels will be subjected to significant pressure and temperature conditions during firings. Certification in accordance with the Boiler and Pressure Vessel Code would help ensure safe operation, but the pressure vessels used were not code stamped and had no code-required relief protection. LMES did not have needed information on pressure and temperature within the vessel during firing; therefore, they decided to instrument the pressure vessel for data collection and to monitor the reaction remotely until a code stamped vessel could be designed and procured.

The Board's staff raised the following issues with respect to the operation and integrity of the reduction vessel during a July 1999 review of readiness to restart operations:

- During the staff's review of the credited controls, the contractor could not produce data to validate that purging and inerting vessels prior to firing would prevent overpressurization for all possible levels of moisture in existing feed material. Accordingly, it appeared that full reliance was being placed on mitigation instead of prevention.

- A hazard analysis of the operation of the reduction furnace developed several scenarios that included the possibility of breaching the reactor vessel because of vessel flaws and moisture in the material. During the staff's review, analytical personnel stated their assumption that feed material would be fresh from the hydrogen fluoride process, and no analysis was conducted to determine whether long-term storage could result in material characteristics that could cause the vessel to rupture during firing. Although visual inspections had been performed on the reactor vessels, there were no standards governing the details of this inspection. Safety basis personnel were also unaware of the types of inspections required for certified vessels.

- The hazard analysis also postulated overheating of the reactor vessel due to improper setting of the furnace power factor. Historically, engineered safety systems were credited to prevent this scenario (e.g., 20 kW furnace output control, high-temperature alarm system, high-temperature cutoff system). Additionally, the Criticality Safety Evaluation stated that failure to insert an igniter or failure of the igniter could result in a higher vessel skin temperature at the onset of the exothermic reaction, which would almost certainly exceed the pressure vessel design temperature. These scenarios were not analyzed in the Basis for Interim Operation (BIO).

As discussed below, none of these issues have been fully addressed, and additional issues have been identified.

Integrity of Reduction Vessel. A March 2000 interpretation from DOE's Office of the Assistant Secretary for Environment, Safety and Health (EH) on the use of the current vessels recommended remote operation of the furnace in addition to actions designed to protect against chemical or radiological consequences of a vessel failure. EUO personnel intend to protect the operators by evacuating the room during reactor firing, but no actions are planned to protect collocated workers and the public, who are estimated to receive 7 and 0.4 rem, respectively, from this accident. In fact, EUO personnel have discontinued previous efforts to install either a blast barrier or high-efficiency particulate air (HEPA) ventilation, citing the DOE-approved safety basis for EUO operations in Building 9212, which requires no such equipment. While the BIO characterizes this event as "unlikely," the uncertainty in the reaction conditions and the use of uncertified pressure vessels may increase the likelihood to "anticipated." LMES has not yet documented a technical justification for its path forward on closing out the vessel integrity issues or for ignoring EH's recommendations.

LMES recently began work on developing a technical basis and quantifying the margin of safety expected while using the current reduction vessels. However, despite citations in earlier safety documents and technical reports of higher reaction temperatures and pressures, LMES engineers initially focused on recent test data that supported their safety assertions. An initial review by the Board's staff of these recent test data suggested that the conditions favored lower temperatures and pressures (e.g., higher surface-to-volume ratio, resulting in a lower heat flux and resultant vessel wall temperature, and better preparation of the charge to remove moisture). After this information was conveyed to EUO personnel, they agreed to incorporate