DEFENSE NUCLEAR FACILITIES SAFETY BOARD

625 Indiana Avenue, NW, Suite 700, Washington, D.C. 20004-2901
(202) 208-6400

July 13, 1998

The Honorable Ernest J. Moniz
Under Secretary of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585-1000

Dear Dr. Moniz:

In its Recommendation 94-1, the Defense Nuclear Facilities Safety Board (Board) made it clear that the continued storage of potentially unstable and dispersible plutonium-bearing compounds in sub-standard containers is a safety issue that requires strong and urgent attention. Despite agreement on this point by the Department of Energy (DOE) in its 94-1 Implementation Plan, the slow pace of progress made in stabilizing plutonium-bearing compounds at the Hanford Site's Plutonium Finishing Plant (PFP) leads the Board to believe that the Richland Office and the Hanford contractor have not given this activity the attention deserved by a commitment made by the Secretary of Energy. Since the self-imposed hold on fissile material handling at PFP in December 1996, there has been no progress toward meeting the milestones of DOE's Implementation Plan for Recommendation 94-1. Current schedules, presented to the Board during a public hearing on May 7, 1998, indicate that stabilization and packaging activities will not be completed until July 2005, three years after the date to which DOE originally committed.

The Board's staff visited the PFP May 27 and 28, 1998, and performed a detailed review of the technological challenges facing DOE in its efforts to stabilize these materials. Perhaps the most distressing finding from the staff's review is the apparent lack of aggressiveness by DOE and its contractors in finding solutions to the problems that are causing these significant delays. As described in the enclosed report by the Board's staff, there appear to be several opportunities to accelerate the current schedule and accomplish the stabilization necessary to remediate some of the more urgent risks. Members of your staff and DOE representatives at Hanford committed to pursuing some of these opportunities during a second public hearing on Recommendation 94-1 held on June 2, 1998. In addition to these activities and pursuant to 42 U.S.C. § 2286B(d), the Board requests that DOE provide a report including the following:

- The recovery schedule of stabilization activities at PFP that will be requested as part of a formal proposed change request to DOE's 94-1 Implementation Plan.

- Reasons, if any, that the prototype vertical calciner cannot be used to accelerate stabilization of plutonium-bearing solutions.

- Reasons, if any, that the installation of three additional muffle furnaces cannot be completed to accelerate stabilization of plutonium metal and oxides.

- How the use of precipitation and cementation processes can be used selectively to accelerate the stabilization of plutonium-bearing solutions.

- Impact of the above actions on the schedule for other stabilization activities, such as polycube pyrolysis.

The Board requests that this report be submitted within 60 days of receipt of this letter. Should you have questions in this regard, please feel free to call me, or have your staff contact Ralph Arcaro of the Board's technical staff.

Sincerely,

John T. Conway
Chairman

c: The Honorable Elizabeth A. Moler
Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

June 18, 1998

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: D. Moyle

SUBJECT: Plutonium Stabilization at the Hanford Plutonium Finishing Plant

This report documents an issue reviewed by members of the staff of the Defense Nuclear Facilities Safety Board (Board) R. Arcaro, S. Krahn, D. Moyle, and W. Von Holle during a visit to the Plutonium Finishing Plant (PFP) on May 27 and 28, 1998.

Background. The PFP contains a relatively large inventory of plutonium-bearing materials in the form of metals, oxides, polycubes, solutions, and residues such as sand, slag, and crucibles. As addressed in the Board Recommendation 94-1, stabilization of these materials in a timely manner is essential to reducing the risk of plutonium dispersal. Babcock & Wilcox Hanford Company (BWHC), the contractor in charge of PFP operations, has made virtually no progress toward meeting Recommendation 94-1 Implementation Plan commitments in the last 18 months since the PFP imposed a hold on fissile material handling. As a result of this hold on material movement and recent budget constraints, the proposed stabilization schedule extends into the year 2005, three years past the end date in the Recommendation 94-1 Implementation Plan.

Summary. BWHC appears unwilling or unable to pursue parallel paths toward stabilization of all types of plutonium-bearing materials. As a result, different material classes will be prioritized for treatment according to their perceived risk. Recent information has led BWHC to conclude that metals are the highest-risk materials, and they are scheduled to be stabilized ahead of solutions, which were originally deemed to be the highest priority. While there may be valid justification for the increased perceived risk associated with the current metal storage, an inspection program is necessary to verify that solution containers are maintaining their integrity.

The Board's staff has identified the following options which should be considered to accelerate stabilization of plutonium-bearing materials at the PFP:

- Use of the prototype vertical calciner in the near term to stabilize solutions that do not require pretreatment, and those solutions identified in an inspection program to be high risk.

- Accelerated installation of three additional muffle furnaces to expedite stabilization of metals and oxides.

- Consideration of proven precipitation or cementation processes to stabilize solutions that cannot be fed to the vertical calciner as opposed to the development of an ion exchange pretreatment process.

Discussion.

Prioritization of Metal Stabilization. Two recent events have prompted BWHC to reevaluate the risk of metals currently stored in cans in the vaults. In December 1996, a sucked-in or "paneled" can was opened and an energetic sparking reaction ensued. In a separate incident, a can spontaneously paneled itself when handled. These two events imply that plutonium metal is reacting to form pyrophoric hydride and nitride compounds. The formation of nitride depletes the nitrogen from the can air and causes a vacuum that sucks in the can, giving it a paneled appearance.

The storage condition of 69 out of approximately 350 total containers of metal was inspected by radiography in 1995 and 1996. Examination of these data has revealed that the current condition of metal containers is worse than expected. Approximately 50% of the sampled cans have questionable integrity and pose an elevated risk of failure. Nearly 40% of the cans radiographed showed only one contamination barrier, 7% contained paneled cans (implying hydride and nitride formation), and 5% exceeded the weight gain limit (implying air inleakage and metal oxidation). Continued radiography of the metal inventory is needed to identify the highest risk items for priority stabilization.

Risk of Solutions. Solutions are not currently perceived to pose the high risk of dispersal that metals do. The original stabilization plan set solution stabilization as the highest priority because of the pressurization of storage bottles from hydrogen gas generation, potential criticality hazards, and stainless steel container degradation due to incompatibilities with some solutions containing chlorides and fluorides. Most of these issues have already been addressed. All solution containers are vented, and criticality analyses show that the current storage configuration does not pose a criticality hazard even when container failures are considered. Additionally, the known chloride and fluoride solutions were stabilized prior to the fissile material hold. However, solution containers have not been rigorously inspected to verify their integrity. Document review is ongoing to better characterize the stored solutions, and additional chloride solutions have been identified. It would also be prudent to embark on an enhanced inspection program to include solutions as well as metals.

Accelerated Stabilization Options. The Board's staff recognizes that decreased funding has been a major factor in the extension of plutonium stabilization milestones. However, there are several options worth considering that could accelerate the stabilization campaign, allow flexibility to address high-risk items as they are identified, and improve confidence that proposed schedules can be met.

The PFP has a prototype vertical calciner that has been tested and proven on product Pu-nitrate solutions. This prototype system has the same throughput capacity as the production system, but with the limitation of batch versus continuous feed operation. Since the production calciner is not slated to be fully operational until November 2000 (at the earliest), it would be prudent to consider using the prototype model for the stabilization of liquids that do not require pretreatment (as much as 50% of the solution inventory).

To deal with the 50% of solutions that require pretreatment, the site plans to pursue an ion exchange pretreatment system, which must still be developed at a cost of approximately six million dollars. Alternatively, the PFP could consider stabilizing these liquids using cementation or precipitation. These processes are proven and could possibly be implemented sooner and for lower cost. The plant Environmental Impact Statement and Record of Decision already allow precipitation as an alternative to ion exchange and vertical calcination.

Currently, there are two fully installed and operational muffle furnaces at PFP to be used for metal and oxide stabilization. However, an additional three muffle furnaces are approximately 90% installed, awaiting fiscal year 2001 funding for completion. The use of three additional muffle furnaces could trim as much as seven months off the schedule for metals stabilization. Furthermore, accelerated installation of these furnaces would greatly enhance PFP's ability to complete the overall stabilization campaign within proposed schedules.

Polycube Pyrolysis. Polycubes are recognized as a high risk item because of the dispersible powder produced by degrading cubes. Development of a pyrolysis unit to stabilize the polycubes is funded for the next fiscal year. Los Alamos National Laboratory (LANL) is doing the development work, but there is currently a technical debate over which off-gas treatment should be used. Hanford engineers support the use of a silent plasma discharge unit, while LANL has recommended a catalytic oxidation process. An alternative option that it may be prudent to consider is for Hanford to simply ship the polycubes to LANL where a process to stabilize the polycubes already exists. On June 3, 1998, LANL and Hanford engineers met to discuss the path forward for polycube stabilization. During this meeting Hanford accepted LANL's proposal to pursue catalytic oxidation for off-gas treatment.