DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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February 11, 2005

Mr. Paul M. Golan
Acting Assistant Secretary for
Environmental Management
U.S. Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Mr. Golan:

As accelerated deactivation and decommissioning (D&D) work is performed at the Department of Energy's (DOE) defense nuclear facilities, continued vigilance must be maintained to ensure that an inadvertent criticality accident does not occur.

Enclosed is a report detailing observations made by members of the staff of the Defense Nuclear Facilities Safety Board (Board) concerning criticality safety issues at the Plutonium Finishing Plant at the Hanford Site. Two recent assay errors involving kilogram quantities of plutonium have occurred. The amount of plutonium involved is sufficient to result in a criticality accident under abnormal conditions. The root causes of these errors appear to be a lack of trained personnel and inadequate criticality safety procedures. These same deficiencies were identified by DOE during reviews and assessments conducted in 2003, prior to the start of D&D work in the Plutonium Finishing Plant. DOE also noted in its 2003 assessment that the Fluor Hanford Senior Nuclear Criticality Safety Committee had been disbanded, and that there was no evidence of a corporate strategy for criticality safety as facilities transition from production work to D&D. Effective corrective actions are needed to ensure that an inadvertent criticality accident is prevented.

On a broader scale, the fact that appropriate DOE criticality experts identified these issues in 2003, but were unable to ensure they were addressed, indicates that DOE's Nuclear Criticality Safety Program is not yet performing at an adequate level. DOE did not fully recognize the seriousness of the problems or appreciate the potential for criticality accidents. As a result DOE failed to ensure that the contractor had adequate trained personnel and adequate criticality safety procedures for the D&D work.

Therefore, pursuant to 42 U.S.C. § 2286b(d), the Board requests a briefing within 60 days of receipt of this letter that addresses the corrective actions being taken in response to the recent assay errors and the related issues discussed in the enclosed report.

Sincerely,

John T. Conway
Chairman

c: Mr. Keith A. Klein
Mr. David H. Crandall
Mr. Mark B. Whitaker, Jr.

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

December 28, 2004

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: W. Yeniscavich

SUBJECT: Nuclear Criticality Safety Issues at the Plutonium Finishing Plant

Purpose. This report documents criticality safety issues identified by members of the staff of the Defense Nuclear Facilities Safety Board (Board) during a visit to the Plutonium Finishing Plant (PFP) at the Hanford Site on October 5 and 6, 2004. The report also includes information obtained in subsequent discussions with personnel from the Department of Energy's Richland Operations Office (DOE-RL) and Fluor Hanford, and during a review of documents received after the site visit. Members of the Board's staff involved in this review were W. Yeniscavich, J. Roarty, L. Zull, H. Massie, and D. Grover.

Background. The removal of the bulk plutonium inventory from the processing equipment in PFP was completed in February 2004, and plant workers have initiated deactivation and decommissioning (D&D) activities. There are 232 gloveboxes and hoods and other areas that contain plutonium holdup.

DOE Review of Nondestructive Assay (NDA) Program—In August 2003, DOE-RL, assisted by Facility Operations Support (EH-24), performed a review of the NDA program at PFP. The main purpose of the review was to determine the adequacy of the program to support the upcoming D&D mission. The review revealed that the NDA program and its associated infrastructure, including such aspects as staffing, equipment availability, training programs, organization, and specific measurement methods and techniques, were not adequate to support planned D&D activities at PFP.

The report documenting the August 2003 review noted that improvements were needed in training NDA operators to understand the specific factors that affect measurements; that PFP did not have a stand-alone, documented NDA program such as that implemented at the Rocky Flats Environmental Technology Site during D&D activities; and that there was no nationally recognized senior scientist on the NDA staff at PFP. Specific areas requiring improvement were not called deficiencies, but were treated as suggestions and called "opportunities for improvement."

DOE Review of Nuclear Criticality Safety Program—In October 2003, personnel from DOE's Office of Safety and Engineering (EM-5) performed an assessment of the nuclear criticality safety program at Fluor Hanford facilities. The assessment focused on PFP because this facility had reported the majority of criticality nonconformances. The assessment report noted that the Nuclear Criticality Safety Program was well documented and comprehensive, but the report also contained several observations and recommendations for the contractor to review and identify appropriate corrective actions. The report reiterated the finding of the August 2003 NDA review that NDA operators needed training on NDA techniques. In addition, the report noted that the Fluor Hanford Senior Nuclear Criticality Safety Committee had been disbanded, and that a corporate strategy was not evident for maintaining criticality safety while transitioning from operations to D&D.

Plutonium Mass Errors in Glovebox HA-9A. Plutonium holdup on the interior walls and floors of a glovebox is determined by NDA. Plutonium holdup inside equipment within a glovebox is also usually determined by NDA. PFP analysts stated that in some cases, shielding by equipment prevents accurate NDA measurements of holdup in the equipment. The alternative is to develop an engineering estimate of holdup.

In May 2004, NDA measurements were made and the fissile mass holdup in glovebox HA-9A was calculated. The glovebox was reassayed in September 2004, and it was discovered that the May calculations for fissile mass were too low by a factor of approximately three. When these assays were performed, the detector was shielded with a 1/4-inch lead disc to improve the detector's performance. In the May calculations, however, the correction factor for the lead disc was not included in the assay calculation, resulting in the low assay results. The May data and calculations were reviewed by a second and then by a third NDA scientist without the error being detected.

A second error in the same glovebox was discovered by PFP personnel on October 6, 2004. The engineering estimate of plutonium mass within equipment in the glovebox was not provided to the group responsible for tracking glovebox inventories. As a result, the plutonium mass for glovebox HA-9A was under-recorded. The plutonium holdup in the equipment was not included in the NDA measurements because attenuation caused by the density of the equipment would have led to inaccurate results. Instead, an engineering estimate of plutonium holdup in the equipment was developed. The estimate of plutonium holdup in equipment is normally provided along with the letter providing the NDA results. In this case, the estimated plutonium holdup in the equipment was not attached to the NDA results letter, and as a result, the plutonium holdup in the equipment was not included in the glovebox inventory.

Contractor's Identification of Apparent Causes. Contractor personnel reviewed the deficiencies related to glovebox HA-9A and developed the following list of apparent causes:

- For the NDA calculation error:
  - The option for including lead shielding in the calculation was not selected.

- The two reviewers did not catch the error.

- There was time pressure to complete a large workload.

- For the glovebox fissile inventory error:

  - The NDA results letter provided for inventory management did not include the holdup in equipment, and no one recognized that the data were missing.

  - The glovebox inventory tracking process did not have a formal method for including data not acquired by the NDA.

Contractor's Corrective Actions. Contractor personnel developed a list of 18 suggested corrective actions. Many are short-term immediate actions, such as suspending work and correcting immediate errors. The longer-term corrective actions include hiring additional NDA personnel and implementing a formal checklist for processing and reviewing NDA data. To address the glovebox inventory error, contractor analysts proposed creating a process to prevent a recurrence, the details of which remain to be developed.

DOE-RL personnel noted that the NDA review process needs to be more rigorous, and that PFP has undergone a significant loss of experienced personnel. DOE-RL managers believe it would have been apparent to experienced operations personnel, based on process knowledge, that the NDA calculation for glovebox HA-9A was in error. No individual with process experience was involved in the review of the new NDA data; thus, the data were accepted without question.

Issues To Be Addressed. Based on the information obtained during this review, the Board's staff has identified the following issues associated with the criticality safety program at PFP:

- It appears that the recent NDA and inventory errors were the result of informal procedures and a lack of knowledge on the part of personnel doing the work. The contractor indicated that a more formal procedure will be developed. However, the contractor gave no indication that additional training of operators is planned. The final corrective actions and implementation plan for addressing these recent errors have not yet been completed.

- It is not clear that the findings and observations from DOE's August 2003 review and assessment resulted in the adequate formulation and implementation of corrective actions for the deficiencies. The Board's staff noted that the results of DOE's review and assessment were identified as suggestions, not findings, to be implemented at the contractor's discretion.

- There needs to be a process for determining the effectiveness of implementation of corrective actions. For example, at the Rocky Flats Environmental Technology Site,

independent assessments of the NDA program were conducted by senior individuals (some outside experts) experienced in this area.

- Reliance on only NDA to determine the plutonium holdup contributed to the incorrect mass assessment. NDA should be checked against historical records. In the absence of historical records, engineering estimates should be made to confirm the NDA results. This cross-checking of holdup estimates would increase the reliability of plutonium mass assessments.

- The use of engineering estimates as the only determination of plutonium holdup should be avoided. Additional effort should be made to measure plutonium holdup. Improved training in NDA techniques may allow measurements to be made that were previously thought impossible. Modified techniques other than standard NDA ought to be considered for measuring plutonium holdup in equipment.

- DOE's October 2003 assessment of the criticality safety program revealed that a corporate strategy was not evident for maintaining criticality safety while transitioning from operations to D&D. A clear strategy needs to exist for maintaining criticality safety when shifting from production operations to D&D. An effective Senior Nuclear Criticality Safety Committee is also vital to maintaining criticality safety.