DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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June 5, 2002

The Honorable Jessie Hill Roberson
Assistant Secretary for Environmental Management
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Ms. Roberson:

The Spent Nuclear Fuel Project (SNFP) at Hanford was initiated to address the deteriorating spent fuel stored underwater in the K-Basins in response to Defense Nuclear Facilities Safety Board (Board) Recommendation 94-1, *Improved Schedule for Remediation in the Defense Nuclear Facilities Complex*. In its Implementation Plan for Recommendation 94-1, the Department of Energy committed to completing fuel removal from K-West Basin by December 2002 and from the K-East Basin by July 2004. Operations of the K-West Basin fuel retrieval system during the past year have been hampered by frequent equipment failures that have delayed the removal of the deteriorating spent nuclear fuel.

The results of a review by the Board's staff indicate that equipment unavailability continues to plague the SNFP. Some of this unavailability is due to design flaws; however, weaknesses related to poor work control, inadequate outage planning, and insufficient efforts to improve equipment reliability and availability are also significantly impacting spent nuclear fuel removal. This situation has resulted in decreased efficiency and has contributed to delays that have caused the project to fall behind the schedule established by the Implementation Plan for Recommendation 94-1. From a safety perspective, these delays extend the amount of time that the spent nuclear fuel will remain in the K-Basins, thereby contributing to an overall increase in risk.

If these issues are not addressed in an effective and timely manner, continuing equipment problems can be expected which would unnecessarily delay this vital project. The Board would like to be informed of any efforts to improve the maintenance program and equipment reliability and availability at the SNFP.

Sincerely,

John T. Conway
Chairman

c: Mr. Mark B. Whitaker, Jr.
Mr. Keith Klein

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

May 8, 2002

MEMORANDUM FOR: J. K. Fortenberry, Technical Director

COPIES: Board Members

FROM: J. L. Shackelford

SUBJECT: Review of Maintenance, Hanford Spent Nuclear Fuel Project

This report documents the results of a review by the staff of the Defense Nuclear Facilities Safety Board (Board) of maintenance activities at the Hanford Spent Nuclear Fuel Project (SNFP). A review of the activities associated with a planned maintenance outage at the K-West Basin and Cold Vacuum Drying Facility was conducted by staff members D. Grover, M. Moury, R. Rosen, J. Shackelford, and outside expert D. Boyd. Additionally, the staff, including M. Sautman, briefly reviewed the reliability-centered maintenance (RCM) program under way at the Hanford tank farms.

Background. The SNFP at Hanford was initiated to address the deteriorating spent fuel stored underwater in the K-Basins, in response to the Board's Recommendation 94-1, *Improved Schedule for Remediation in the Defense Nuclear Facilities Complex*. That Recommendation emphasized the need to remove and stabilize the spent fuel and sludge contained in the Hanford K-East Basin. Although the risk associated with continued storage of degrading fuel and sludge in the K-East Basin is greater than that of the K-West Basin, the Board agreed that worker safety could be improved through experience gained from first performing construction and fuel removal in the less-contaminated work environment of the K-West Basin. In the current Implementation Plan for Recommendation 94-1, the Department of Energy (DOE) commits to completing fuel removal from K-West Basin by December 2002 and from K-East Basin by July 2004.

Removal of largely-intact fuel from the K-West Basin commenced in December 2000, but equipment availability problems with fuel processing and packaging have hampered fuel removal. The SNFP initially planned to construct similar fuel processing equipment in the K-East Basin. In April 2001, the SNFP decided instead to transfer the K-East fuel to the K-West Basin for processing, effectively doubling the required lifetime of the equipment in the K-West Basin.

Assessment of Effectiveness of the Spent Nuclear Fuel Project Maintenance Program. During the past year, operations of the processing and packaging equipment at the K-West Basin have been hampered by frequent equipment failures. This situation is due in part to a weak design and the implementation of first-of-a-kind equipment, which has been troubled by problems with conduct of operations. The design of the processing equipment suffers from a

number of single-point failure vulnerabilities that have the potential to halt production if a high degree of equipment reliability and availability is not maintained. The staff concluded that weaknesses in the SNFP maintenance program threaten to extend the time that the fuel remains in the basins. These weaknesses include issues related to poor work control, inadequate outage planning, and insufficient efforts to improve equipment reliability and availability. Consequently, maintenance activities have not always been completed in a timely manner, thereby sacrificing efficiency and contributing to schedule delays. As a result, the production rates are substantially below those needed to meet the commitments of the Implementation Plan for Recommendation 94-1.

To minimize the time that the fuel remains in the basins, the SNFP must improve equipment availability. This can be accomplished by improving equipment reliability, improving work planning to ensure that the SNFP can respond quickly to equipment failures, and strengthening the control of maintenance to reduce delays caused by procedural problems and conduct of operations issues.

The SNFP has developed a Maintenance Implementation Plan (MIP) as directed by DOE Order 4330.4B, *Maintenance Management Program.* The staff identified that the implementation of several key elements of this plan, such as "Maintenance Procedures," "Planning, Scheduling, and Coordination of Maintenance," "Control of Maintenance Activities," "Maintenance History," and "Analysis of Maintenance Problems," was deficient. The following sections summarize the staff's specific observations and conclusions associated with the maintenance program, including those elements of the MIP found to be deficient in their implementation at the SNFP.

Analysis of Equipment Reliability Issues—A number of recent equipment failures at the K-West Basin have resulted in unplanned production slowdowns and stoppages. While some of these problems appear to be attributable to design deficiencies, the contractor had not aggressively pursued many avenues available for improving overall equipment reliability and availability. For example, it is not clear that systematic root-cause analyses of key equipment failures have been performed as described in DOE Order 4330.4B and as required by 10 Code of Federal Regulations 830, Subpart B, *Quality Assurance.* Without an effective assessment of the root and apparent causes of equipment failures, it will be difficult to ensure that adequate feedback and lessons learned from previous equipment failures and maintenance tasks are incorporated consistently into ongoing maintenance activities and planning efforts. Additionally, the SNFP performance indicators do not capture maintenance resulting from corrective maintenance or equipment rework activities. As a result, there was missed information regarding the effectiveness of maintenance that could be used to improve the overall reliability and availability of important equipment.

The contractor has expended considerable effort to identify all of the required and recommended maintenance activities for the equipment associated with the SNFP facilities. In conjunction with this effort, separate studies have been performed to identify those maintenance tasks that could be eliminated based on the limited-life assumptions associated with the SNFP operations. Additionally, these studies identified the critical spares necessary to address

potential failure vulnerabilities. The staff noted that these studies had been performed in a comprehensive manner and provided valuable insight that could potentially be used to reduce maintenance costs while sustaining acceptable reliability and availability for limited-life conditions. However, it was also noted that there were no plans to use future operating experience and feedback from equipment failures and maintenance activities to refine or improve initial decisions regarding required maintenance and spare-part inventories. As a result, the value of studies aimed at resolving issues related to the mean time to equipment failure and mean time to repair is somewhat diminished.

Planning, Scheduling, and Coordination of Maintenance—A number of weaknesses were identified in the SNFP outage planning process. Two major planned activities—manipulator arm replacement and tipping station modification—were not accomplished during the outage. The reasons for not completing these planned maintenance activities included incomplete work packages and unavailability of workers and parts. Further, it was observed that the planning and development process for work packages was deficient in that lessons learned from previous evolutions were not always captured in the work packages, and facility conditions were not always thoroughly addressed in the planning efforts. For example, the planning for the ion exchange module replacement had not addressed significant changes associated with equipment contamination that had occurred during facility operations prior to the replacement effort. The existing contamination was not reflected in the work package and required considerable additional planning for the decontamination effort, which caused significant delays during the removal of the ion exchange modules. During pre-job briefings for several major maintenance activities, the staff noted that the workforce generated an unusually large number of questions and required extensive clarification regarding many fundamental aspects of the proposed maintenance. The contractor maintained that this occurred because it had encouraged a questioning attitude and active participation by the workforce at the pre-job briefings. The staff noted that the site's effort to foster a work environment in which craft personnel were comfortable in questioning work activities was commendable. However, this is not an acceptable alternative to an Integrated Safety Management-based planning effort that properly addresses the major issues in advance of the work.

Control of Maintenance Activities—The staff observed a number of issues related to problems with work packages and poor or improper work control during the outage. The workforce was observed to have violated approved maintenance procedures on at least one occasion. The staff also noted deficiencies related to the command and control functions associated with maintenance activities. On a number of occasions, confusion existed with respect to which organization (e.g., operations or maintenance) was in charge of the activity in progress.

A calibration activity associated with safety-class equipment had to be terminated and rescheduled because of an inadequate work package. The procedural deficiency, although minor, made it impossible for the craft personnel to perform the task as outlined in the guidance. Further, it appeared that this deficiency should have been identified and corrected during a previous revision of the procedure. The majority of the maintenance procedures and work packages reviewed by the staff were issued as general guidance in which the steps can be

performed in any order rather than as a step-by-step procedure. However, it appeared in many cases that some of the steps, if performed out of sequence, could cause equipment damage or personal injury. This approach is not consistent with the guidance in DOE Order 4330.4B or the Fluor Hanford requirements for procedural compliance. The lack of formality introduced into maintenance activities by these practices increases the likelihood of incorrect maintenance being performed and increased equipment failures.

Department of Energy's Oversight of Maintenance. DOE Order 433.1, *Maintenance Management Program for DOE Nuclear Facilities*, requires DOE elements to ensure that "DOE operational awareness review and analysis capability exist for evaluation of maintenance program performance and effectiveness." Currently, the Office of River Protection (ORP) does not have a subject matter lead for maintenance. Instead, ORP relies on a facility representative to perform this function on a part-time basis. The maintenance oversight responsibility of the DOE Richland Operations Office (DOE-RL) is shared by the program office, the engineering group, and facility representatives. The engineering group is focused primarily on the site-wide maintenance program initiatives of the contractors and management of the maintenance backlog. The program office has been focusing on the maintenance outage planning by the SNFP, while the majority of day-to-day maintenance oversight has been accomplished by the facility representatives. However, the facility representatives are also responsible for overseeing substantial modifications to the facility and reviewing readiness preparations for new systems. Additionally, a substantial portion of their time is devoted to addressing persistent problems in other programmatic areas, such as conduct of operations, corrective action management, and engineering performance. Without more assistance from DOE-RL program and engineering offices, it is unreasonable to also expect the facility representatives to identify and evaluate systemic maintenance issues such as those identified in this report.

Overview of Reliability-Centered Maintenance Program for Tank Farms. The staff briefly reviewed the RCM program under way at the Hanford tank farms. The contractor described the program, which includes a 12-week rolling maintenance schedule similar to that used in the commercial nuclear power industry. The program incorporates an analysis of the maintenance requirements associated with the tank farm systems and is intended to identify optimal maintenance schedules and strategies for the associated equipment. To date, the contractor has completed the analysis for the double-shell tank annulus ventilation systems. The RCM initiative is being conducted with a 20- to 30-year lifetime planning assumption for the tank farm systems. Based on the limited information provided, the staff concluded that the effort, if implemented as planned, should provide benefits in terms of reduced maintenance costs, effective use of resources, and improved reliability and availability of critical equipment.