DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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July 8, 1999

Mr. James M. Owendoff
Acting Assistant Secretary for
Environmental Management
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-0113

Dear Mr. Owendoff:

The Hanford Spent Nuclear Fuel Project (SNFP) is critical to resolving the spent fuel vulnerabilities identified in the Defense Nuclear Facilities Safety Board's (Board) Recommendation 94-1, *Improved Schedule for Remediation*. There have been significant delays in the project since it was established to provide the removal, conditioning, and interim dry storage of the deteriorating spent N-Reactor fuel stored underwater in the aging basins at the K-Reactors.

The Board has previously pointed out deficiencies in the SNFP related to design, safety documentation, and resolution of technical issues. However, these deficiencies continue. The enclosed report by the Board's staff identifies several new examples. The Board is concerned that these continued difficulties are threatening even the significantly revised milestone for fuel removal. As such, the Board requests a response to the new issues summarized in the enclosed report, and an assessment of the current likelihood of meeting the November 2000, fuel movement milestone date.

If you have any questions on this matter, please do not hesitate to call me.

Sincerely,

John T. Conway
Chairman

c: The Honorable Ernest J. Moniz
Mr. Mark B. Whitaker, Jr.
Mr. Keith A. Klein

Enclosure

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Staff Issue Report

June 15, 1999

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

COPIES: Board Members

FROM: D. Grover, D. Wille

SUBJECT: Design and Safety Analysis Issues Associated with the Hanford Spent Nuclear Fuel Project

This report documents issues associated with the Spent Nuclear Fuel Project (SNFP) noted by the staff of the Defense Nuclear Facilities Safety Board (Board) during visits to the Hanford Site. These visits were made on February 16–18, 1999, by A. Gwal, D. Wille, and R. Zavadoski; on March 23–25, 1999, by D. Grover, D. Ogg, and J. West; on May 4–7, 1999, by D. Grover; and on June 10, 1999, by A. Hadjian and J. Stevenson (outside expert). Video teleconferences were also held with the site on April 20 and May 27, 1999, by D. Wille, A. Hadjian, and J. Stevenson.

South Load-Out Pit (SLOP) Cask Drop. The project informed the Department of Energy Richland Operations Office (DOE-RL) in March 1999 that an independent review of cask drop calculations had determined that an unrestrained drop of the multicanister overpack (MCO) cask into the SLOP would damage the pit floor-to-wall joint, resulting in unacceptably high basin water leakage rates. An expedited review of possible solutions to this problem led to two parallel paths: a probabilistic risk assessment of the drop and a design change to the Cask Loading System (CLS). DOE-RL directed the SNFP not to pursue the probabilistic risk assessment as it was unlikely to show that a cask drop would be an incredible occurrence, given the failure of a similar effort conducted for an MCO drop in the Canister Storage Building (CSB). The SNFP is currently redesigning the CLS immersion pail support structure (IPSS) to mitigate the consequences of a drop through a combination of hydraulic damping and impact absorption.

The redesigned IPSS will have impact absorber material in the upper and lower portions of the structure to absorb energy by deformation and a nesting sleeve around the immersion pail to absorb energy by hydraulic piston action. A conceptual design review by the project was held June 9, 1999, in Richland, Washington, to provide the basis for initiating final design activities by NAC International. M&D Professional Services of Richland, Washington, has been providing analytical support to the project for the conceptual redesign effort and will provide the same support to NAC International during the final design effort. The Board's staff conducted a structural and mechanical review of the conceptual design at the Hanford Site on June 10, 1999.

The energy absorption design concept appears to be practical given the limitation of existing SLOP geometry and structural capacity. The Board's staff believes that the critical design parameters used in the analyses should be demonstrated to be valid or bounded by test data or analysis. For example, to provide a high degree of confidence that the SLOP will maintain its structural integrity under the cask drop accident impact load, it is essential that the energy-absorbing material and the hydraulic piston effect behave as assumed in the analysis. Specifically, the use of energy-absorbing foam material in the telescoping sections of the IPSS and below the lower support plate may be outside the scope of the manufacturer's existing test data, particularly under moist or wet conditions. Additional loads, such as shock loads caused by the initial impact of the cask on the water surface and jet impingement loads through the relief ports in the nesting sleeve should be carefully analyzed.

For all cask drop scenarios, it is essential that the energy dissipation timeline from drop initiation to resting of the MCO cask be clearly defined. Additionally, as part of the design basis documentation, a model and analysis should be developed that demonstrate how the time-history loading of the cask impact is defined and is converted to an equivalent static load used to determine the structural and leakage integrity of the SLOP. The modeling of the wall-slab joint is quite unconventional and therefore requires supporting documentation (e.g., reinforcing bar pullout test data) in a timely manner. A major uncertainty in the current analysis is the soil response (stiffness) supporting the basin and pit as an elastic spring. In-situ soil investigations of these foundation soils could be performed to reduce this uncertainty, or the structural analyses could be performed for several values of subgrade soil stiffness (e.g., increments of 50 lb/cu in. for the range from 100 to 250 lb/cu in.).

The fabrication and installation of the new IPSS are now on the project critical path and will result in a delay of associated interim project milestones of more than 6 months, although the project still expects to start fuel removal by November 2000 (high-risk schedule). The Board's staff concurs that changes to the IPSS are necessary to minimize the consequences of an MCO cask drop. However, the staff is concerned that no effort is being made to identify cask drop initiating events and potential corrective actions to reduce the probability of the postulated MCO cask drop into the SLOP. For example, a fault tree analysis that was to be part of the probabilistic risk assessment of the drop and was halted by DOE-RL could identify additional beneficial measures.

Safety Analysis Report (SAR) Preparation. The ongoing SAR preparation and review effort has recently been experiencing delays due to numerous reviewer comments regarding the adequacy of design and safety analysis documentation. The SNFP recently had a contractor team on site for a review of SAR preparation, task management, communications, and coordination. The team included personnel from Westinghouse Safety Management Solutions. The project is currently evaluating the results of that review. The Board's staff believes that incomplete engineering and design efforts have been a significant contributor to this problem. DOE-RL agrees and has been trying to focus the project engineering on closure of the design issues for each subproject.

Similar problems with the Cold Vacuum Drying (CVD) design and safety documentation have recently been identified by a CVD design review team. Most notable are inconsistencies between the SAR and design documentation for the CVD, similar to those found during the MCO and CSB SAR reviews that resulted in ongoing delays in Final SAR (FSAR) approval. The review team also noted that the CVD FSAR references the SNFP FSAR for supporting information; however, this information is not given in the SNFP FSAR (which has already been submitted for approval). This will likely become a review problem given the short amount of time remaining prior to submittal of the CVD FSAR. The Board's staff is also concerned that the delays in safety analysis documentation are likely to have an impact on procedure development, training, and Operational Readiness Review preparations.

Quality Assurance Requirements for the MCO. The DOE Office of Civilian Radioactive Waste Management (OCRWM) developed a *Quality Assurance Requirements Document* (QARD) (RW-0333P) for all activities related to disposal of DOE spent fuel and high-level waste in the proposed repository at Yucca Mountain. The QARD establishes the OCRWM quality program for all DOE disposal activities related to the repository and prescribes methodologies for their execution. The development of the QARD by OCRWM and its application to DOE sites were considered necessary to ensure that site quality assurance programs would be acceptable to the Nuclear Regulatory Commission (NRC). In the commercial nuclear industry, standard NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities*, is used; however, detailed implementation of the standard is approved by the NRC for each facility. The QARD invokes and implements the fundamental requirements prescribed by NQA-1, as well as additional requirements derived from various programmatic needs. These additional requirements typically have resulted from lessons learned by the NRC during approval of NQA-1 applications, and reflect those requirements imposed by the NRC during implementation.

In July 1995, DOE-RL applied the QARD to all SNFP activities as they related to disposal in the proposed repository. In November 1998, DOE-RL authorized the contractor to eliminate the procurement and fabrication of the MCOs and baskets from the requirements of the QARD, and directed the contractor to procure the MCOs to the requirements of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, Section III. Reapplication of the QARD to the MCO and baskets has been suggested by the DOE National Spent Nuclear Fuel Program. It is likely that fabrication of the MCOs might be acceptable because of their ASME Section III compliance. However, the baskets may still need to meet the QARD requirements, and impacts on the project schedule and fabrication costs could result. The Board's staff is concerned that the schedule and cost impacts of imposing additional QARD requirements will not be justified by the limited increase in quality of the MCO and baskets.

Defective Welds in Integrated Water Treatment System (IWTS) Piping. On May 27, 1999, the SNFP identified a welding problem with the IWTS piping. When a welded section of the IWTS pipe was cut during installation, the weld surface on the inside diameter was exposed and revealed heavy oxidation, porosity, and lack of penetration. These defects are consistent with the use of insufficient interior purge gas. The IWTS piping is 2 inches in diameter, stainless steel, schedule 10, and schedule 40. Some of the piping is installed, some is

not installed but on site, and some is still at the vendor's shop. Additional inspections of piping showed that 30 percent of the welds were defective. The piping was purchased to ASME B31, Code for Pressure Piping (B31.1, Power Piping); however, the specific vendor inspection requirements have not yet been identified. The receipt inspection at Hanford consisted of an exterior visual inspection. A hydrostatic test will be conducted upon completion of installation. The SNFP has not yet completed the root-cause analysis for these defective welds, but a breakdown of the welding quality assurance seems likely. This problem is cause for concern regarding the potential for defective welds within other components and structures in the SNFP.

Resolution of this issue and rework of installed components are likely to cause a slippage in completion of IWTS construction, scheduled for June 30, 1999. If defective welds are found within other components and structures, the overall SNFP schedule may be impacted.

Fuel Retrieval System (FRS) Primary Cleaning Machine (PCM). The FRS PCM cleans the spent fuel by mechanical agitation before the spent fuel is sorted and packaged into new fuel and scrap baskets. The central part of the PCM is a stainless steel screen drum that is split axially into two halves. The drum is oriented horizontally and rotates about its axis, causing a tumbling action for the spent nuclear fuel canister loaded inside.

The original design requirements dictated that operators be able to lift either half of the drum from the PCM base in order to empty and remove the canister in either the upright or the inverted position. To accommodate this requirement, design personnel created a bearing that is split axially in half like the drum and a bearing cup, open at the top, that allowed the top half of the drum to be lifted out of the way. However, in three iterations of factory acceptance testing, this bearing design has failed as a result of excessive wear and galling.

According to project personnel, a bearing expert hired after the testing reviewed the PCM design and commented that many of the fundamental concepts of bearing design had been violated. The project is pursuing two different design modifications to address the bearing failure, and this effort will delay the FRS subproject by several weeks. The Board's staff questions the quality of the original design effort and the level of independent review, and believes that DOE-RL should look closely at these issues with respect to other SNFP design activities.

Other Design Issues. During a review by the Board's staff of the FRS design, the project was unable to provide justification for the deletion of load cells previously identified as necessary to verify scrap and fuel weights in the loaded baskets. This information may be needed to provide material accountability and to ensure that the reactive surface area is bounded by the safety analysis.

While the CVD subproject indicated in February 1999 that it will upgrade the ventilation system fan and power supply to meet safety-significant requirements, the project had not yet identified the installation location for the standby diesel generator as of May 1999. The CVD review team also identified inconsistencies in the ventilation design and design documentation needed to support the issuance of air quality permits. In addition, the review team identified the

need to conduct a reliability, availability, and maintainability analysis for the CVD to verify that the operational requirements for throughput during the processing campaign can be met. The Board's staff is also concerned that there is a lack of reliability, availability, and maintainability analyses for the other subprojects.

As noted, the SNFP is currently redesigning the CLS IPSS to incorporate hydraulic damping and impact absorption. While the project has approved a deviation notice, DOE has not yet approved the baseline change request for this major redesign effort. In addition, CVD design and procurement activities not needed to support construction acceptance testing may be delayed into the next fiscal year so that funding can be transferred to the resolution of technical issues. Project managers are also increasingly rescheduling other project activities out to future dates using deviation notices, sometimes into the next fiscal year, making resource management more difficult. The growing number of rescheduled activities may not be fully funded in the out years, and additional delays in the project may result.