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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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



July 5, 1995

Mr. Mark Whitaker, EH-9
Department of Energy
1000 Independence Avenue, SW
Washington, D.C. 20585

Dear Mr. Whitaker:

Enclosed for your information and distribution are 20 Defense Nuclear Facilities Safety Board staff reports. The reports have been placed in our Public Reading Room.

Sincerely,

A handwritten signature in black ink, appearing to read "G. W. Cunningham", is written over the typed name and title.

George W. Cunningham
Technical Director

Enclosures (20)

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

April 20, 1995

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: Lester Clemons

SUBJECT: KE-Basin Radiological Engineering Assessment

- 1. Purpose:** This assessment was made to determine the extent to which radiological issues have been addressed and their solutions incorporated into the design and planning for the Hanford KEast-Basin (KE-Basin) Spent Fuel Dry Storage Program. This assessment was performed by L. Clemons and K. Fortenberry through a review of documents and a series of telephone discussions with site personnel.
- 2. Summary:** The program for packaging and transporting the spent fuel in the KE-Basin must be carefully planned to protect workers from potential radiation hazards. A review by the staff indicates that radiological engineering personnel are not currently involved in the design and development phases of the program.

The Westinghouse Hanford Company (WHC) line management for the KE-Basin Spent Fuel Dry Storage program appeared to be aware of radiological issues associated with the transfer of spent fuel from the KE-Basin to a shielded dry storage facility. However, the crosscut review teams formed to evaluate functional elements in the dry storage design and development processes did not include the radiological engineering discipline and the as-low-as-reasonably-achievable (ALARA) dose reduction and work practice elements in the evaluation process. There was little indication that the systems engineering approach being used in the program had been applied to ensure that radiological issues were adequately addressed. Therefore, the potential exists for decisions with radiological consequences to be made without conducting the appropriate radiological evaluations.

In addition, there was no indication that the Department of Energy-Richland Operations Office (DOE-RL) was involved in providing radiological oversight for the KE-Basin dry storage program. However, subsequent to the inquiries, the staff understands that DOE-RL is adding radiological oversight to the functions of the DOE-RL Spent Nuclear Fuel Project Office.

- 3. Background:** Staff reviews have indicated that approaches to the organization and management of major maintenance projects at the DOE nuclear sites often do not incorporate the radiological engineering discipline during the planning and development phases of the program. The DOE contractors line organizations typically develop the projects, some of which are known to have a high potential for radiation exposure to the workers, from initial concepts

to the assembly of job task documents, with minimal input from radiological engineering. Frequently, the review of procedures and work packages in preparation for implementing the project in the field is the initial involvement of radiological engineering. Unfortunately, at this late stage of project development, decisions for the design of tooling, equipment, process development and training of workers have already been made without adequate radiological engineering review. Furthermore, the line organizations often do not have the radiological expertise to fully assess the potential radiation hazards associated with implementation of the project. This approach to radiological planning and development of major maintenance projects is not in compliance with radiological guidance criteria, since it does not ensure that the ALARA principle is effectively implemented in the design phases to protect worker health and safety.

The radiological criteria for the review of existing facilities undergoing major modifications are described in PNL-6577, *Health Physics Manual of Good Practices for Reducing Radiation Exposure to Levels that are As Low As Reasonably Achievable (ALARA)*, Section 5.2, *Design Review Responsibilities in Modifications to Existing Facilities*. The guidance states that, "proposed modification to existing buildings (and facility configurations) should be reviewed and approved by the ALARA committee or ALARA coordinator prior to initiating any construction activity". In 10 CFR 835.1002, paragraph (b) states that, "Optimization (ALARA) methods *shall* be used to assure that occupational exposure is maintained ALARA in *developing* and *justifying* facility design and controls" (emphasis added). The Radiological Control Manual, DOE/EH-0256T, (Article 312, paragraph (1)) states that, "Maintenance and modification plans and procedures *shall* be reviewed to identify and incorporate radiological requirements, such as engineering controls, dose and contamination reduction considerations. Performance of this review is the responsibility of *line management*, with support and concurrence from the Radiological Controls Organization" (emphasis added). These radiological criteria must be incorporated in the development stages of the project in order to maximize their effectiveness in reducing worker exposures to radiological hazards.

4. **Discussion:** The transfer of spent fuel in the Hanford KE-Basin from an underwater shielded environment to dry storage raises the potential for workers, the public, and the environment to be exposed to a variety of radiation sources. The movement of spent fuel increases the potential for workers to be exposed to high dose radiation sources, exposed to airborne releases of radioactive gases and radioactive particles in airborne water vapors, spread contamination by removing wet tools from basin water, and release of radioactive materials to the environment. Therefore, the program for packaging and transporting the spent fuel in the KE-Basin must be carefully planned to protect workers from these potential radiation hazards. The program must incorporate the ALARA principle and good work practices in the design of tools and equipment, the development of procedures, training of workers in dose minimization methods on full-size mockups, and implementation of effective radiation exposure and contamination controls in the workplace.

- a. Dry Storage Radiological Work Planning: A review of documents describing the various tasks that must be performed to complete the KE-Basin spent fuel dry storage program indicated that radiological planning for the resolution of issues was not well defined. The quality of worker exposure estimates in the document, "Personnel and Dose Estimates for Process Facilities," was poor. The estimated exposures for Health Physics (HP) technicians exceeded the combined exposures estimated for operations and maintenance personnel by 48%. Yet, HP technicians typically spend only 5-10% of the scheduled work production time in the workstation radiation fields compared to operations personnel.

A discussion with program managers and engineers indicated that: (1) the radiological engineering discipline and ALARA work planning and practice methods had not been incorporated in program planning, (2) exposure estimates had been generated by the various functional element team leaders with limited radiological expertise, (3) radiological conditions in the Plutonium/Uranium Extraction Facility (PUREX) plant during production operations was used as the model for making exposures estimates, which may not be appropriate for this project, (4) the estimates did not include worker exposures associated with fuel retrieval from the KE-Basin, where the majority of the radiation exposures are expected to be recorded, (5) the exposure estimates were not reviewed by radiological engineering before being released, (6) a line organization project team leader indicated that he did not know where to solicit radiological engineering support even if he needed it, and (7) it was not clear when radiological engineering would be tasked to review and evaluate the utilization of radiological work planning and work practices, and implementation of the ALARA principle of dose reduction for the program. Therefore, the staff concluded that radiological issues were not being adequately addressed for the KE-Basin Spent Fuel Dry Storage Program.

- b. Systems Engineering Applications: Application of a systems engineering (SE) approach to review the presence of radiological hazards in the workplace can be used to ensure the health and safety of workers is protected. The staff has developed a SE approach model for assessing the extent to which radiological engineering, work planning and practices, and the ALARA principle are applied systematically in performing maintenance and repair projects at DOE sites. Application of the SE model in situations having radiological consequences requires: (1) identification of needs for addressing radiological issues, (2) definition of requirements and general criteria, (3) collection of data and making radiological measurements as necessary, (4) comparison of collected and measured data with requirements, (5) design and fabrication of tooling and development of procedures, (6) training personnel to procedures, (7) conducting field operations, and (8) job completion, post-job review and "lessons learned" documentation. The SE approach for evaluating radiological engineering work planning and practices is shown in Figure-1.

The staff believes that application of the SE approach to evaluating adequacy of radiological work planning and practices for the KE-Basin dry storage program could resolve radiological issues associated with worker health and safety. The SE requirements of detailed planning in the initial phases, and the iterative review of functional elements in various development stages of the project, provide a consistent and disciplined method for addressing radiological issues. The selection of cost-effective tool and equipment designs, job task procedures, worker training techniques on full-sized mockups, and development of "good" radiological and dose reduction work practices, to ensure implementation of the ALARA principle during field operations, could be achieved. The attention-to-detail of the SE approach is a feature that would most likely prevent worker health and safety issues from "falling through the cracks".

- c. *KE-Basin Dose Reduction Program:* A dose reduction program at the KE-Basin is being evaluated to reduce the general area background by removing or shielding the source terms in the basin. Radiation surveys indicated that 10% of the background dose rates results from basin process piping, 80% results from the "bathtub ring" in the basin, and the remaining 10% from pool water. The process piping and bathtub ring are being evaluated for cost-effective alternatives for reducing the radiation fields. The alternatives include decontaminating the concrete and piping, installing additional shielding, and/or replacing the piping. The statements of work and radiological specifications are being developed for submittal to vendors for comments on feasibility of meeting the specifications.
 - d. *DOE Program Oversight:* A request for information was forwarded to the DOE-RL Radiological Controls (RC) group to determine DOE's involvement in the KE-Basin Spent Fuel Dry Storage Program. The staff's intent was to determine if DOE was providing adequate radiological oversight for the KE-Basin fuel dry storage program. The staff found that the RC group had not been involved with the KE-Basin project and there was no one at DOE-RL who was monitoring radiological issues associated with the program. A discussion with the DOE program manager for the KE-Basin dry storage project confirmed that radiological engineering involvement by DOE-RL had not been established. However, subsequent to the inquiries, the staff understands that DOE-RL is adding a radiological oversight to the functions of the DOE-RL Spent Nuclear Fuel Project Office.
5. **Future DNFSB Staff Actions:** Continue to closely monitor development of the KE-Basin Spent Fuel Dry Storage Program. A milestone of considerable interest will be when WHC and DOE-RL integrate radiological engineering, work planning and radiological work practices for dose reduction (ALARA) into the dry storage program.

Figure 1

Systems Engineering Approach to Radiological/ALARA Work Practice

