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DEFENSE NUCLEAR FACILITIES SAFETY BOARD

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April 11, 1997

Mr. Mark B. Whitaker, Jr.
Department of Energy
1000 Independence Avenue, SW
Washington, DC 20585-1000

Dear Mr. Whitaker:

Enclosed for your information and distribution are 25 Defense Nuclear Facilities Safety Board staff trip reports.

Sincerely,

Andrew L. Thibadeau
Information Officer

Enclosures (25)

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

September 23, 1996

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: Steven Stokes

SUBJECT: Review of F- and H-Area High-Level Waste (HLW) Tank Closure at the Savannah River Site

1. **Purpose:** This report documents a preliminary Defense Nuclear Facilities Safety Board (Board) staff assessment of the Department of Energy's (DOE's) proposed approach for the closure of selected High-Level Waste (HLW) tank systems in F- and H-Areas at the Savannah River Site (SRS). The assessment is limited to the review of the *Industrial Waste Water Closure Plan for F- and H-Area High-Level Waste Tank Systems* (Closure Plan), a follow-up video conference discussing the closure of Tank 20, the first tank to be closed, and review of a limited number of references to the Closure Plan believed to contain information important to the overall plan. This assessment was conducted by Steven Stokes, Dermot Winters, and Ray Daniels.

2. **Summary:** The Closure Plan outlines the technical and regulatory approach/process DOE intends to use when assessing the efficacy of HLW Tank closure designs. Overall, the closure process involves fate and transport modeling of the residual material left in the tank system after cleaning and stabilization. This modeling effort is conceptually the same approach DOE uses to verify performance of Low-Level Waste (LLW) disposal facilities; DOE has therefore identified the performance assessment (PA) objectives contained in DOE Order 5820.2A, *Radioactive Waste Management,* as applicable requirements for this effort. The Board staff feels that the approach described is generally acceptable. However, the Board staff has considerable concern that, in those areas where the plan departs significantly from practices currently employed within DOE to perform PAs, i.e., model selection, the analysis will be less rigorous and consequently contain greater and potentially unacceptable uncertainties about the efficacy of the closure design. Additionally, due to the lack of detail contained within the plan, the inavailability of critical engineering studies, and the limited sampling of Tank 20 residuals, the Board staff are unable to assess the closure of Tank 20, and other variables discussed below, important to the efficacy of the ultimate closure design.

3. **Background:** The purpose of the Closure Plan is to set forth DOE's general protocol for closure of the F- and H-Area HLW Tanks at SRS in accordance with existing South Carolina rules for closure of Wastewater Treatment Systems. In determining pertinent closure requirements, DOE rigorously applied the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process to determine applicable requirements and performance objectives. DOE has identified the LLW performance objectives contained in DOE Order 5820.2A, *Radioactive Waste Management,* as applicable to tank closure. This determination was based on DOE's assumption that residuals remaining in the tank after

removal of HLW and repeated cleaning are "incidental wastes" and can be disposed of as LLW as long as they are not greater than Class C wastes as defined in 10 CFR 61.

4. Discussion:

a. Approach to Closure: Overall, the closure process involves fate and transport modeling of the residual radioactive waste left in the tank system after cleaning and stabilization, and its impact upon a hypothetical population at risk. This modeling effort is conceptually identical to the one used by DOE to verify performance of LLW disposal facilities (PA process). However, the approach discussed in the Closure Plan departs significantly from the modeling approach(s) used for other LLW PAs at SRS. These departures primarily involve the type of model selected, the modeling approach used to integrate the impacts (in time and space) from other sources of contamination, the point of compliance, and several simplifying assumptions.

The most significant departure is in the selection of the model used to perform the analysis. DOE has selected the Multimedia Environmental Pollutant Assessment System (MEPAS) code to model the closed tank system. This model was designed by Pacific Northwest National Laboratory (PNNL) for screening and ranking of environmental problems. Previous DOE use of this code includes the Environmental Survey Risk Assessment and Complex-Wide Programmatic Waste Management Environmental Impact Statement Impact Analysis. DOE has not used this code for other PAs at SRS, preferring to use much more detailed codes. It is not clear why DOE has chosen this "relatively" simplistic approach to do virtually the same analysis which was performed, for example, as part of the E-Area Vault PA. Additionally, DOE's criteria for code selection are not readily apparent in the Closure Plan. Based on a review of the code selection criteria and considerations presented in Appendix B.1 of the *Performance Assessment for the E-Area Vaults* (WSRC-RP-94-218), it appears that MEPAS fails to meet two critical criteria for its selection as a code capable of meeting the objectives of DOE Order 5820.2A. These criteria are: (1) The degree of complexity of the computer code(s) should be consistent with the quantity and quality of data, and the objectives of the computation; and (2) The code(s) should allow site- and facility-specific applications, i.e., be capable of simulating the hydrogeologic, geologic, and/or geochemical setting of the site, as well as specific design features of the facility over time.

. The MEPAS code does not sufficiently address either of these criteria which are critical in developing a detailed description of the system being modeled and subsequently understanding the behavior of the closed tank system over such long periods of time (the period of analysis is 10,000 years).

b. Integration of the Impacts (in time and space) from Other Sources of Contamination: The Closure Plan outlines a process for identification of regions within the groundwater system where radioactive source term interactions are allowed to occur. This region of space is called a Groundwater Transport Segment (GTS). This concept attempts to

integrate interactions from multiple sources and to apportion dose objectives over a system of disposal facilities (an improvement over existing DOE PA practices). The concept, though valid in principle, does not appear to fully address dispersive/diffusive phenomena on a system-wide basis. For example, the GTS approach described in the plan represents a conservative modeling approach only if there are no significant source terms contributed from other disposal sites. Since the time of compliance and travel distances being modeled are rather long, it is not readily apparent that an *a priori* rejection of dispersive and diffusive effects is warranted. It is entirely possible that the movement of contaminants into the segment could more than offset the movement out, particularly with regard to the proximity and degree of contamination associated with some nearby sites (e.g., the Old Burial Grounds). Overall, this approach does have merit, particularly with regard to apportionment of dose across tanks and/or contamination sources. However, the Board staff believes that a more detailed treatment of the system interactions would better characterize the actual performance of each disposal system, and meet the intent of Board Recommendation 94-2 regarding composite dose impacts due to multiple sources of contamination.

c. Simplifying Assumptions: The assumptions listed below are also believed to impact the final closure.

1. Time of Contaminant Release: The Closure Plan models releases from the tanks assuming full integrity of the tank system for 1000 years. The basis for using this value is calculations contained in the E-Area Vault PA regarding the concrete behavior for that system. Review of the E-Area Vault PA revealed that a deliberate effort was undertaken to model concrete degradation mechanisms for a known concrete formulation and operating history. This assessment reviewed sulfate and magnesium attack, concrete- and geology-controlled leaching of calcium hydroxide, and reinforcement corrosion/chloride attack. It is not clear to the Board staff that the comparison between these two systems is entirely valid. For example, concrete degradation is highly dependent on formulation, and there is no analysis to validate the representiveness of E-Area Vault concrete formulations with regard to tank formulations. Additionally, in the case of tanks exposed to high heat sludges, the effects of thermal cycling on long-term concrete integrity may invalidate the comparison.

2. Receptor Scenario: The Closure Plan clearly identifies the manner in which radionuclides are introduced to the receptor. However, although the receptor is assumed to be a resident who is exposed to and consumes surface water in a variety of ways, direct consumption via drinking water is not considered. Assuming receptors receive their drinking water from some distant unaffected source mark this approach as nonconservative in its attempts to discriminate between behaviors that occur 10,000 years in the future. It is a more common practice to use a consistently conservative set of assumptions (i.e., assume the receptor drinks water provided by

a down gradient well, as was employed in the E-Area Vault PA). This approach eliminates arguments with little or no empirical basis.

d. Tank Sampling: Data used to formulate source term inputs for the modeling effort are not yet based on a detailed sampling of existing heels or sludges. The documentation provided to the modelers, which communicated the tank waste characterization data used to formulate modeling inputs for source term in Tank 20 (WSRC [Westinghouse Savannah River Company] Memorandum, *Waste Characterization Input Information for NUS Performance Assessment*, March 25, 1996), revealed that no sampling of the F-Area Low-Heat Waste Sludge had been completed. Therefore, initial modeling efforts to determine the closure requirements for Tank 20 were based on only the anticipated source term developed through process knowledge. Since an accurate source term is the most important modeling parameter in long-term performance determinations, process knowledge should only be used if it is highly reliable. Additional Board staff review of the validity of current estimates revealed that an initial sampling effort revealed results that were not predicted by process knowledge alone. The significance of the sampling results is not yet well understood by SRS and more investigations are likely. However, these preliminary sampling results suggest to the Board staff that it is difficult to understand how accurate characterization data can be obtained without some form of representative sampling, particularly after new or modified processes are initiated which are not well understood with respect to the effect they will have on the chemistry of the residuals (e.g., a tank cleaning/washing processes).

e. Grout Formulation: Reducing grout formulations have been selected to immobilize any remaining tank waste (heels). These formulations offer advantages over other grouts in that they have the ability to promote reduced leaching of contaminants. Typically, the chemistry of each formulation is based upon the type of waste being treated and, therefore, their performance characteristics vary to some degree. The existing Closure Plan does not specifically address (1) the process or criteria used for the selection of reducing grout formulations, and (2) performance over time, especially with regard to variability in contents from tank to tank. Initial Board staff review revealed that DOE has selected an outside agent to conduct grout formulation studies. These studies will not be completed until some time in the future (late September 1996). It will be necessary for DOE to determine if the grout formulations selected are sufficiently robust to account for a lack of accurate characterization data and what impacts, if any, could result from improper selection of grout formulation(s).

5. **Future Staff Actions:** The Board staff activities will focus on the assessment of additional information concerning the technical and modeling issues identified above. In addition, the staff will review the impact this approach might have on the closure of tank systems across the DOE complex.