DEFENSE NUCLEAR FACILITIES SAFETY BOARD

August 8, 1995

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: Richard E. Tontodonato

SUBJECT: Trip Report - Review of Hanford Site High-Level Waste Tank Safety and Characterization, July 17-20, 1995

1. **Purpose:** This trip report documents a visit by Defense Nuclear Facilities Safety Board (Board) staff members (David Lowe, Ralph Arcaro, and Richard Tontodonato) to the Hanford Site on July 17-20, 1995, to review the implementation of Recommendation 93-5 (high-level waste tank characterization) and the accelerated safety analysis for the tank farms.

2. **Summary:**

   a. The Westinghouse Hanford Company (WHC) and the Department of Energy's Richland Operations Office (DOE-RL) are working to develop a sound characterization strategy. However, improvement is needed to meet the intent of Recommendation 93-5. Although DOE-RL has begun to approve the WHC data quality objectives, and the new sampling prioritization is well-founded, resource constraints continue to hinder the program, and core sampling continues to be plagued by poor recovery.

   b. It is not evident that the analytical results from the tank sampling program are being used effectively. For example, four tanks found to contain reactive waste were not promptly put under proper watch list controls. Conversely, actions were not being taken to remove two tanks with no detectable energetics from the organic watch list.

   c. The draft tank farm accelerated safety analysis (ASA) does not analyze the potential for organic-nitrate reactions in the tanks. It is impossible to determine whether the ASA is adequate until this topic is addressed. Also, an independent review by Idaho National Engineering Laboratory (INEL) made several significant comments on the ASA, including that the source term used for tank accident analysis may not be bounding.

3. **Background:** Characterizing the tank wastes is key to resolving high-level waste tank safety issues at the Hanford Site. On July 19, 1993, the Board issued Recommendation 93-5, which addresses the need for the DOE to undertake a comprehensive reexamination and restructuring of the characterization effort. The recommendation sets goals of two years for completing safety-related sampling and analysis for watch list tanks and three years for other tanks. The Board accepted DOE's implementation plan on March 25, 1994, and members of the Board's staff have visited the Hanford Site nine times since November 1993 to review implementation

of Recommendation 93-5. This review was conducted as a follow-up to the previous reviews and as an initial review of the draft tank farm ASA.

4. Discussion:

a. Characterization results: Based on the discussions of recent characterization data, it was evident to the Board's staff that WHC and DOE-RL are not effectively using the analytical results to identify unsafe conditions and improve the safety posture of the Tank Farms. Several examples are listed below. Because of these concerns, WHC and DOE-RL representatives briefed the Board on August 1, 1995, on actions to improve communication and use of characterization data. Future staff reviews will assess the effectiveness of these actions.

1. Sampling results from three non-watch list tanks (241-C-105, -201, and -202) show that the tanks meet WHC's criteria for "unsafe." Although WHC and DOE-RL personnel understood that the tanks contained high energetics and low moisture, they were not aware that the tanks met their own criteria for "unsafe." As such, the required action to mitigate or remediate the tanks was not taken. However, WHC reported that watch list controls required for "conditionally safe" tanks had been implemented for two of the tanks. Upon further investigation, WHC determined that the controls had actually been implemented for only one of these tanks. By July 24, 1995, WHC applied organic watch list controls to four additional tanks based on analytical results that had been available for two to three months.

   WHC stated that additional testing was being pursued to better characterize the samples obtained from two of these tanks. Although the original data were reported in May 1995, it is still not clear when the follow-up testing will be performed or how the "unsafe" status of these tanks will be resolved. WHC has developed new screening limits that would declare these tanks safe, but it is not clear when the new limits will be validated and implemented (see 4.b below).

2. WHC safety program personnel had accepted reported moisture values for tank 241-C-105 despite laboratory reports showing that most of the samples had been contaminated by water from the push mode sampler. The sampler's hydrostatic head fluid (water) tends to leak into the waste sample, so lithium is added as a tracer element. The WHC data quality objectives document (DQO) for safety screening specifies analysis for lithium to identify when contamination occurs, but WHC safety program personnel stated that this analysis does not indicate how much water has contaminated the sample. WHC has not taken additional action to determine whether this tank, which exceeded the energetics screening limit, is in fact dry and should be classified unsafe.

3. The safety screening DQO requires establishing "an upper (90%) confidence value" to compare to decision thresholds for each analyte. This action has not been taken.

Instead, WHC has used the extreme value reported by the laboratory. This value does not take into account analytical error or address the variability which has been exhibited from riser to riser within tanks and even between adjacent spots within a single sample. WHC's current approach does not appear conservative.

4. Samples from two tanks (241-U-203 and -204) currently on the organic watch list were found to contain no energetic material. WHC was not actively pursuing removal of these tanks from the watch list.

b. Proposed safety limits: WHC has proposed new energetics and moisture limits for safety screening of tank wastes. The new limits are intended to preclude a propagating reaction and are based on simulant testing and thermodynamic calculations. The proposed energetics limit is more than double the current limit. It is important to understand the non-conservatisms and errors in the derivation of these limits, particularly since WHC is applying them to raw laboratory data without any factor of safety.

The consultant to WHC who developed the new limits stated that they have an overall error band of approximately five percent, owing mostly to measurement uncertainties during simulant testing. However, this estimate was not systematically derived and did not include non-conservatisms introduced in the calculational model. For example, the calculational model assumes that the starting temperature of the waste is negligible (i.e., 0°C), even though tank 241-C-106 underwent local boiling last year, and tank 241-SX-108 has a steady state temperature of about 90°C. WHC estimated that a conservative starting temperature would lower the energetics limit by five to ten percent. WHC plans to better quantify the non-conservatism introduced by this particular assumption. However, the staff believes that the total uncertainty and non-conservatism in these criteria need to be defined to support developing appropriate screening limits and factors of safety.

Furthermore, the proposed screening limits were developed using nominally dry simulant materials, with fixed percentages of water added to determine the effect of moisture. However, some of the nominally dry starting materials (e.g., sodium citrate and HEDTA) were actually hydrated forms of the chemicals, so there was more water present than is indicated in the test reports. This additional water reduces the ignitability of the simulant. The resulting limits thus overestimate the energetics required to sustain a propagating reaction and underestimate the amount of water needed to preclude such a reaction. WHC now recognizes this problem, and the report that summarizes the testing and derives the screening limits will be revised.

c. Tank sampling schedule and strategy: As shown in Figure 1, WHC is still far behind the sampling schedule identified in the Recommendation 93-5 Implementation Plan, which committed to characterize all watch list tanks by October 1995 and all other tanks by October 1996. WHC currently expects to sample the 26 highest priority tanks by November 1996 and to finish all core sampling by August 1998.

1. Sampling status: As of July 21, 1995, the following sampling has been done:

   - Rotary mode core sampling - partial sampling of two tanks, variable recovery
   - Push mode core sampling - 13 tanks, generally improving recovery
   - Auger sampling - 20 tanks, variable recovery, new bits under development
   - Liquid grab sampling - 27 tanks
   - Vapor sampling - 32 tanks

   Current activity is focused on improving rotary sampling performance. New drill bits and samplers are being tested in simulant materials using one of the rotary mode trucks. WHC is field testing other improvements to the rotary mode system on two ferrocyanide watch list tanks, 241-BY-108 and -110. A portable x-ray unit has proven valuable in evaluating recovery during sampling. When radiography reveals recovery problems, sampling parameters can be immediately adjusted.

2. Sampling Prioritization: WHC has developed a system for prioritizing tanks for core sampling. Tanks are rated based on their importance to the safety and disposal programs and characterization technical basis development. The highest priority tanks are those that are important to multiple programs (e.g., an organic watch list tank with a layer of ferrocyanide and REDOX waste). The prioritization scheme is basically sound, but the staff made the following observations:

   - WHC placed priority on several organic-containing tanks judged to be unsafe if drained. No additional priority was given to two tanks, 241-BY-108 and -109, even though these organic-containing tanks have already been drained. (Despite this problem, BY-108 was given high priority for other reasons and will be the third tank to be rotary mode core sampled.)

   - Although moisture retention is central to WHC's proposed resolution to the organic-nitrate safety issue, dryness was not an important factor in WHC's prioritization system. Therefore, it is not clear that data will be available promptly to develop a sound approach toward resolving this issue. Furthermore, since the driest tanks are the most vulnerable to organic-nitrate reactions, it is not clear that adequate priority is being placed on characterizing potentially unsafe tanks.

3. Resource constraints: Although WHC plans to increase the sampling rate to five core samples per month, only three core sampling crews will be used. WHC plans to use all three crews to support round-the-clock operation of one truck at a time. An additional crew (the move crew) will prepare another truck for the next sample. This process leaves one or two trucks idle at all times.

   Even with this modest sampling rate, capacity at the WHC 222-S laboratory is inadequate. WHC's June 1995 Characterization Strategy White Paper reads, "Field

sampling rate is estimated to be roughly twice that of existing analytical throughput based on current laboratory resources and analysis requirements." WHC plans to resolve this imbalance either by revising data quality objectives to reduce analytical needs or by increasing laboratory staffing using tank farm operators or PUREX technicians. The Pacific Northwest Laboratory's 325 lab will not be used.

4. Data quality objectives: DOE-RL has begun to formally comment upon and approve WHC's DQO documents. Several DQOs were approved in June 1995, including the safety screening and organic safety issue DQOs. This is an important step toward developing a DOE-approved basis for tank sampling and analysis.

d. Tank farm accelerated safety analysis: WHC has completed a draft of an accelerated safety analysis for the tank farms. An independent review by INEL, requested by DOE-RL, made several significant comments, including the observation that the source term used to evaluate the consequences of tank accidents may not be bounding. Initial review by the Board's staff further revealed that the ASA does not analyze potential organic-nitrate reactions in the tanks. WHC stated that this analysis will be done, but has not identified a completion date. It is impossible to determine whether the ASA is adequate until this important topic is addressed. The staff will thoroughly review the ASA and associated operational safety requirements before they are implemented.

e. Tank Waste Remediation System (TWRS) reorganization: The DOE-RL Assistant Manager for the TWRS (J. Kinzer) announced a reorganization of his department. The organization will be "projectized" into three main projects: Storage, Disposal, and Management. The directors of the Storage and Disposal Divisions will be hired with excepted appointment authority. The staff considers use of excepted appointment authority a positive change at TWRS. However, this reorganization is occurring independent of the Recommendation 92-4 Implementation Plan, which requires a DOE-RL staffing analysis and improvements in technical competence of DOE-RL personnel responsible for TWRS.

Figure 1: Core Sampling Schedule and Progress