DEFENSE NUCLEAR FACILITES SAFETY BOARD

April 22, 1994

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: Richard E. Tontodonato, Technical Staff

SUBJECT: Trip Report - Review of Implementation of DNFSB Recommendation 93-5 at the Hanford Site, March 28-31, 1994

1. Purpose: This trip report documents a visit by DNFSB staff members (David Lowe, Dominic Napolitano, Richard Tontodonato and Robert Warther) to the Hanford Site on March 28-3l,'1994, to review progress toward implementing DNFSB Recommendation 93-5 regarding characterization of high-level tank waste.

2. Summary: The Westinghouse Hanford Company (WHC) has made progress toward implementing Recommendation 93-5, but the technical basis for the characterization program remains ill-defined. Application of the process which WHC has identified for defining sampling and analysis needs remains inconsistent. There is evidence of a lack of a systems engineering approach to the characterization program. Also, WHC is planning to deviate from the agreed-upon Implementation Plan with respect to sampling and analytical laboratories.

   The Department of Energy (DOE) is not providing adequate technical management oversight of the program. As a result, critical decisions regarding characterization strategy, safety criteria, and required confidence levels for decisions are being made by WHC with little input from the Department of Energy Richland Operations Office (DOERL) or the responsible headquarters line organization (EM-36, EM-30, or EM- 1).

3. Background: Characterizing the tank wastes is key to resolving most of the 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 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 the watch list, tanks and three years for other tanks. The Board accepted DOE's Implementation Plan on March 25, 1994.

   DNFSB technical staff members visited the Hanford site in November 1993, to review progress in preparing an Implementation Plan for Recommendation 93-5. The principal issue from this visit was that WHC did not have an adequate technical basis for determining the sampling needed to meet Recommendation 93-5 objectives. Second, WMC was not developing adequate contingency plans for increasing sampling and analytical capacity if more sampling was needed. This review was conducted as a

follow-up to the November 1993 review.

4. Discussion: Deficiencies were identified both in the WMC waste tank characterization program and in the technical and administrative oversight provided by DOE-RL.

   a. DOE-RL is not providing the direction required to successfully carry out the program. DOE-RL has not reviewed and forwarded to the DNFSB any deliverables from the Recommendation 93-5 Implementation Plan, including the Data Quality Objectives DQO documents which define the number of samples required from each tank, the analyses to' be performed, and the desired confidence levels for meeting safety limits. Further, DOE-RL is not providing WMC with clear guidance regarding what actions are required to satisfy each commitment contained in the Recommendation 93-5 Implementation Plan, with the result that some actions will probably not be completed on time. Lastly, it is not evident that DOE-RL is actively involved in resolving two issues which could delay using off-site laboratories to support the tank characterization program (determining whether an environmental assessment is needed and obtaining a permit for Type B containers to be used for shipping samples off-site).

   b. WHC has made progress in implementing Recommendation 93-5, but the technical basis for the characterization program remains ill-defined. Many of the DQOs provide little basis for the number of samples specified, and WHC has been unable to justify the statistical model used to calculate sampling requirements for ferrocyanide tanks, despite queries from the DNFSB staff dating back to November 1993. Further, the DQOs are not being developed with the goal of meeting established tank farm safety limits with high statistical confidence. Instead, WHC is using less conservative decision criteria to define sampling needs. This will reduce sampling requirements and may also have the effect of reducing the number of tanks added to watch lists. It is also not clear that analytical error is adequately factored into the DQO decision criteria and sampling requirements. Lastly, WHC has not yet developed a basis for deciding when to reject samples based on inadequate or non-representative recovery. This must be done soon to support timely re-sampling of tanks with recovery problems and to ensure that decisions regarding tank safety are not made using invalid data.

   c. Several of the problems observed by the DNFSB staff indicate a lack of a systems engineering approach to the sampling program. The sampling schedule does not recognize plans by other tank farm programs for installing equipment such as thermocouple trees and liquid observation wells into risers needed for sampling. In fact, the number of risers available for sampling is not known for many of the tanks, and it is not clear how and when WHC will obtain this information and incorporate it into the sampling strategy. WHC is also not using most of the existing data from recently sampled tanks in developing spatial variability models and the overall sampling strategy. Data for only two analytes from two tanks are presently being used, whereas samples have been obtained and extensively

analyzed from 22 tanks since 1989.

d. WHC is also planning to deviate from two key elements of the approved Implementation Plan. WHC currently plans to obtain only two samples per tank, even though the Implementation Plan states that more will be taken if more risers are available. WHC does not yet have an adequate basis for concluding that two samples per tank are sufficient either to characterize individual tanks or to validate their models. DOE-RL personnel indicated disagreement with WHC's plans, but had not intervened to enforce compliance with the Implementation Plan.

Secondly, WHC has formally recommended and DOE-RL has verbally agreed to use only one off-site laboratory for tank waste analysis, even though the Implementation Plan states that both the Idaho National Engineering Laboratory and Los Alamos National Laboratory will be used. WHC believes that the reduced analytical requirements resulting from the DQO process will allow two Hanford labs and one offsite lab to perform the safety-related analyses for any reasonable scenario. DOE-RL plans to submit a change to the Implementation Plan to eliminate one off-site lab. The DNFSB staff expects the change to provide technical justification why the second offsite lab is not necessary and identify contingencies for activating the second lab if it becomes necessary.

Further detailed DNFSB staff comments are contained in the appendix to this report.

5. Future Staff Actions: The DNFSB technical staff plans to visit the Hanford Site in midMay 1994 to follow up on the issues noted from this trip, to review the results of the first core sampling efforts, to more thoroughly review laboratory issues, and to discuss the status and quality of deliverables for the Recommendation 93-5 Implementation Plan.

Appendix - Detailed DNFSB Staff Comments

1. DOE.-RL, Involvement: DOE-RL is not providing the technical direction required to successfully carry out the characterization program. Subsequent discussions with a representative from the responsible headquarters office (EM-36) confirmed that he was aware of this problem but had not intervened effectively to correct it.

   a. DOE-RL has not reviewed and forwarded any deliverables from the Recommendation 93-5 Implementation Plan, even though many have been provided to them by WHC. Several WHC documents have been received from DOE-RL after the DNFSB staff specifically requested them through the DOE-RL DNFSB liaison. Because of this, twenty-nine deliverables due between January and March 1994 are overdue.

   b. DOE-RL was not sure how or when it would review and approve DQOs related to waste tank safety issues. The DOE-RL manager for waste tank safety programs stated that the DQOs would be approved by his office, but none had been reviewed yet, including the ferrocyanide DQO, which WHC provided to DOE-RL in December 1993. Site manager (i.e., DOE-RL) approval is required by the Environmental Protection Agency's guidance for the DQO process, because the DQOs make fundamental decisions regarding the number of samples required from each tank, the analyses to be performed, and the desired confidence levels for meeting safety limits.

   c. DOE-RL is not providing WHC with clear guidance regarding what actions are required to satisfy each commitment contained in the Recommendation 93-5 Implementation Plan. For example, Commitment 3. 1 1 states that "operational availability" of two additional rotary mode sampling trucks is required by September 1994. The DNFSB staff and DOE-RL interpret "operational availability" to mean the trucks are ready to take core samples, but WHC interprets "operational availability" as "ready for operational testing." This represents approximately a one month delay in the use of these trucks to take core samples.

      Similarly, as further detailed in Section 2 below, DOE-RL has not required WHC to plan to obtain samples from each available riser for the first several tanks, as required by the Implementation Plan.

   d. There are no DOE-RL facility representatives dedicated to the tank sampling program. DOE-RL plans to hire three additional facility representatives and assign them to the tank farms. However, no specific dates or training and qualification requirements have been established. In the interim, DOE plans to assign contractors to monitor the sampling program. Similarly, no training or qualification program has been established for the contractors.

   e. It is not evident that DOE-RL is actively involved in determining whether an

environmental assessment is needed for shipping waste samples to off-site laboratories or in obtaining a permit for Type B shipping containers for off-site samples. Either of these issues could delay using off-site labs to support the waste tank characterization program.

2. Sampling Strqtegy: WHC's tank sampling strategy, as defined by the various safetyrelated DQOs, is not consistent with the Recommendation 93-5 Implementation Plan. WHC's current strategy is to obtain two core samples per tank, but the strategy defined in the Implementation Plan is to take a minimum of two cores per tank, and to take additional cores if risers are available. Development of spatial variability models is just beginning, and WHC does not yet have an adequate basis for concluding that two samples per tank are sufficient either to characterize individual tanks or to validate their models.

   Further, several of the problems observed by the DNFSB staff indicate a lack of a systems engineering approach to the sampling program. Specifically:

   a. Valid data from most of the recent core samples are not being used in the development of spatial variability models or the overall sampling plan, even though WHC is using this data for safety-related tank characterization. Twenty-two tanks have been core sampled and extensively analyzed since 1989, and WHC has only used the results for two analytes from two tanks with a total of five cores to define their strategy. Using available data to the extent possible, rather than waiting for new cores to be obtained and analyzed, could allow WHC to develop its technical basis much sooner.

   b. The number of risers available for sampling is not known for many of the tanks, and it is not clear how and when WHC will determine which risers are available, incorporate this information into the sampling strategy, and capture it for future use.

      Undocumented obstructions are present inside some risers, and other risers cannot be accessed by the sampling trucks. Further, WHC has raised the concern that clearing risers by removing equipment such as thermocouple trees using current sluicing methods will disturb and dilute the waste below the riser to the point that it may no longer be representative when sampled. It appears that WHC is addressing these problems by minimizing the amount of sampling to be done, rather than by defining what sampling is needed and ensuring that adequate tank access is made available.

   c. A safety-driven systems engineering approach is not being used in prioritizing tanks for core sampling. For example, the sampling schedule does not account for plans by other tank farm programs for installing equipment such as thermocouple trees and liquid observation wells into the limited supply of available risers. Although this issue as raised by the DOE-RL characterization program manager during the DNFSB staff visit, DOE-RL had not acted to correct the problem.

Follow-up discussions were held with EM-36 personnel, with the result that WHC has decided to delay the next scheduled thermocouple tree installation until a riser availability study is done.

As another example, tank 241-C-106 is the first tank scheduled for rotary mode sampling, even though the analytical results from the samples will not be used to resolve any safety issues. This tank has an excessive heat load, and WHC plans to sluice out as much waste as possible to remedy the problem, using already defined equipment, regardless of the sample data. The sample data will be used to support equipment design for retrieving the remaining waste from the tank, to satisfy a Tri Party Agreement milestone for demonstrating retrieval technology.

3. Data Quality Objectives (DQO): WHC has prepared several safety-related DQOs, which define why a group of tanks needs to be characterized, what data are needed, and what sampling and analysis are required to obtain the data. However, the DQOs are inconsistent, and the most recent examples have generally declined in quality compared to early documents. The principal deficiencies identified by the DNFSB staff are how the number of samples required was determined, how the safety limits used in the DQOs were selected, and the degree of uncertainty WHC considers acceptable for deciding whether or not a tank meets a safety limit:

   a. The required number of samples is determined with a high level of statistical rigor in the ferrocyanide DQO, but is essentially arbitrary in the more recent safety screening and crust sampling DQOS, and is not even discussed in the waste compatibility DQO. As discussed in Section 2 above, existing data should be used to the extent possible so that the DQOs can be formulated with appropriate statistical rigor.

   b. The safety limits and risk acceptance criteria (uncertainty that the decision makers are willing to accept) used in determining the number of samples needed to characterize a tank are neither consistent nor conservative. Several DQOs do not require obtaining sufficient data to verify that WHC's established tank safety limits are met with high confidence. Instead, less conservative decision criteria are used, which will reduce the number of samples needed to provide confidence that the criteria are met and may lessen the number of tanks added to watch lists. While excessive conservatism can become counterproductive, WHC has not adequately demonstrated that the revisions to the limits are either acceptable or necessary. The principal examples of failing to meet established, conservative safety limits with high confidence are listed below:

      (1) The ferrocyanide DQO allows a 20% chance of incorrectly concluding a tank is safe when it actually exceeds the maximum safe ferrocyanide concentration limit established by the @C waste tank safety program. A limit approximately twice as high will be met with 95 % confidence.

(2) The waste compatibility DQO, which defines characterization requirements for transfers to and among the waste tanks, allows a 50% chance of incorrectly concluding that a waste transfer is acceptable when it actually violates YMC's criticality limit for waste transfers. A limit three times as high will be met with 95 % confidence.

(3) The in-tank vapor sampling DQO allows a 10% chance of concluding that the tank atmosphere is not flammable when it actually exceeds YMC's limit for flammable vapor concentration. A limit more than double the VMC limit (and twice the National Fire Protection Association standard of 25 % of the lower flammability limit) will be met with 99 % confidence.

c. Similarly, the limit in the safety screening DQO for energetic waste materials was not conservatively established. YMC established a decision criterion of 125 calories per gram (cal/g) of dry waste for safety screening, even though the limit developed by the ferrocyanide safety program was I 10 cal/g. The justification for using a higher limit was that the 110 cal/g limit contains unquantified conservatism. Based on discussions with the DNFSB staff, YMC is reconsidering the safety screening limit.

d. Assumptions regarding analytical error vary arbitrarily among the DQOS, and it is not clear that the assumed analytical errors were factored into sampling requirements and the criteria used to decide whether tanks are safe or unsafe.

e. It is not clear how WHC calculated the relative standard deviation (RSD) for the feffocyanideconcentrationinsamplesfromtanks241-C-109and-112. Acore-to-core RSD of 22% is used in the feffocyanide DQO to conclude that only two samples are needed to adequately address spatial variability within a tank, but YMC has been unable to provide the supporting calculations, despite queries from the DNFSB staff dating back to November 1993. A higher RSD could require a larger number of samples to correctly characterize a tank.

The DNFSB staff held a separate session to discuss RSD calculations. VMC was not prepared to explain the details of the RSD calculation, but did state that the RSD was calculated and verified using commercially available statistical software. However, the model for assigning variability to various sources (such as tank-to-tank variability, analytical variability, segment-to-segment variability, etc.) was an input to the statistical software and was never validated. Based on these discussions 9 YM statisticians and Pacific Northwest Laboratory (PNL) personnel concluded that the calculation was sufficiently important to warrant an independent check.

It is worthy of note that even though the feffocyanide DQO was submitted to DOE-RL in December 1993, DOE-RL has not reviewed the derivation of the RSD in detail, and has not even identified personnel to review the statistical calculations

that are fundamental to the characterization program.

f. WHC has not yet developed a basis for deciding when to reject samples based on inadequate or non-representative recovery. This must be done soon to support timely re-sampling of tanks with recovery problems and to ensure that decisions regarding tank safety are not made using invalid data.

Additional , sample recovery currently cannot be assessed until the sampler is opened in the analytical laboratory. By the time poor recovery is discovered, the sampling truck may have moved to another tank or tank farm, delaying re-sampling.

4. Off-Site Laboratories:

a. RL formally has proposed and DOE has verbally agreed to use only one off-site laboratory for sample analysis, instead of the two labs specified in the Recommendation 93-5 Implementation Plan. RL believes that the reduced analytical requirements resulting from the DQO process will allow the two Hanford labs and one off-site lab to perform all of the safety-related analyses for any reasonable scenario. Analyses supporting pretreatment and other longer-term needs may not be fully supported if only one off-site lab is used.

DOE-RL plans to submit a change to the Implementation Plan to eliminate one off-site lab. The DNFSB staff expects the change to provide technical justification why the second off-site lab is not necessary and identify contingencies for activating the second lab if it becomes necessary.

b. Two issues may delay using the off-site labs to conduct analyses. The first concern is that DOE has not determined if an environmental assessment (EA) will be required to ship waste samples to the labs. If an EA is required, significant delays are possible. Secondly, @C needs Nuclear Regulatory Commission (NRC) approval of a permit modification for the Type B container to be used to ship samples off-site. The current schedule requires obtaining the Certificate of Compliance by January 1995. However, NMC stated that this is an optimistic date that could easily slip. It was not evident that DOE-RL was actively involved in resolving these issues.

5. Potential of Maintaining the current tank sampling schedule is subject to several limiting constraints. Personnel training and qualification is one constraint, but @C appears to be ready to staff equipment as it becomes available. The largest operafionallyoriented limitation to sampling may be the weather. VMC personnel indicated that cold, hot, and windy conditions can preclude sampling, at least during some parts of the day. The current sampling schedule is based on the assumption that the samplers can operate only about 80% of the time due to these factors. If it becomes apparent that these limitations are going to delay the sampling program, means to overcome them should be investigated.

Another potential source of delays is the need to sample the vapor space of each tank prior to rotary mode core sampling, to satisfy the permit for operating the sampler's exhauster. Once additional rotary mode sampling trucks become available (September 1994 commitment), vapor sampling and analysis may become a limiting factor. @C is confident that state regulators will agree to relax the permit once data is available from the first tanks, but stated that additional sampling equipment will be obtained if needed. Continued attention is needed to ensure that this issue does not become a problem.