96-0003042

Department of Energy

Washington, DC 20585

July 31, 1996

The Honorable John T. Conway
Chairman
Defense Nuclear Facilities Safety Board
625 Indiana Avenue, NW, Suite 700
Washington, D.C. 20004

Dear Mr. Chairman:

The Defense Nuclear Facilities Safety Board's (Board) letter dated June 17, 1996, transmitted to the Department of Energy (Department) Headquarters (HQ) the Board staff's trip report entitled "Trip Report - Review of Hanford Tank Safety Issues February 21-22, 1996," dated March 28, 1996.

Enclosed are the responses to the concerns raised by the Board's staff. The responses were prepared by Westinghouse Hanford Company with reviews, modifications, and concurrences by HQ and Richland Operations Office (RL) staff. The Department is satisfied that the response to the Board's concerns are timely and accurate.

The Department continues to strive for excellence in Nuclear Safety and we are committed to continuing the dialogue on Hanford tank safety with the Board.

If you have any questions, or require additional information, please call me at (202) 586-7710.

Sincerely,

Alvin L. Alm
Assistant Secretary for
Environmental Management

Enclosure

cc:
T. O'Toole, EH-1
D. Pearman, FM-1

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

Response to: Defense Nuclear Facilities Safety Board (Board) letter dated June 17, 1996, and Trip Report by Board Staff - Review of Hanford Tank Safety Issues, dated February 21-22, 1996

Date: July 1996

The following report addresses issues identified by the Board staff during a routine site visit on February 21-22, 1996. For some of the issues there have been subsequent discussions between the Board staff, the Department of Energy (DOE) Richland Operations Office (DOE-RL), and Westinghouse Hanford Company (WHC). For issues that are not yet resolved, additional or updated information is provided. The intent is to keep the Board staff fully informed.

The Chairman's letter of June 17, 1996, highlighted two particular issues: (1) lightning protection and (2) inactive facilities. For lightning protection, action is underway to expeditiously install additional mitigation safety features. Regarding the inactive facilities, availability of funding is certainly an issue, but DOE-RL and WHC are continuing to pursue cleanup of the facilities identified by the Board staff. They are included in the overall Hanford site cleanup strategy and are being prioritized along with all other needed actions. Additionally, the possible change of the primary Hanford contractor is not a consideration affecting the prioritization of work.

Note that the Accelerated Safety Analysis (ASA) referenced in the Trip Report was not finalized and it will be subsumed by the Final Safety Analysis Report (FSAR), due to be completed by November 1996. The detailed responses to the Trip Report, Section 4, Discussion and Observations, are provided below.

Item a.

Comment: "Lightning: Weather data from a five-year period ending January 1, 1996, showed ten strikes within the 200-East and 200-West tank farms collectively. In order to develop a formal position on the lightning control issue, WHC has committed to issuing a comprehensive report in August 1996 on lightning and its associated safety issues. Preliminary discussions with WHC personnel indicate that the report will be probabilistic in nature and show that although lightning may strike the 200 areas at a frequency of twice per year, the probability of striking a tank is in the incredible range ($<10^{-6}$ per year). Given the unpredictable nature of lightning, the simplistic nature of a probabilistic analysis, and the availability of mitigation measures, a deterministic analysis of tank lightning strikes would be prudent."

Response: Additional progress has been made with respect to understanding the probability, consequences, and mitigation of lightning strikes at the Hanford Site. This information is included in the report committed to in Revision 1 of the Implementation Plan for Recommendation 93-5 (Milestone 5.4.3.1.b). This report has been completed and will be forwarded to the Board by August 1996. The main points in the report include:

1) While probabilities are discussed, the report uses deterministic concepts to present what happens when lightning strikes within the tank farms and how tanks and waste could be affected.

2) Lightning frequency, as measured over the past ten years by Global Atmospherics, Inc., and the Bureau of Land Management, is 0.06 flash/km^2/yr.

3) Flammable gas requires low amounts of energy for ignition and a strike anywhere on a farm is capable of inputting small amounts of energy throughout the farm because of interconnections among tanks and because of the fact that the tanks act as grounding electrodes. Therefore, for purposes of flammable gas concerns, the area of the tank farm is assumed as the lightning strike target area.

4) Because of the lack of definitive data for the frequency that tanks have flammable gas concentrations in excess of the Lower Flammability Limit (LFL), ignition of flammable gas by a lightning strike cannot be ruled out.

5) Organic waste (both solvent and extractant) requires a more robust energy source for ignition than flammable gas. Therefore, a more direct strike is required for ignition of organic waste than for flammable gas. Although it is conservative by a factor of 10, the cross-sectional area of the tank is assumed as the target area for a lightning strike for purposes of organic waste.

6) Although further research may demonstrate that fuel-rich, dry waste that is susceptible to ignition may be limited to only a few tanks, definitive data does not now exist to rule out the possibility of ignition of organic waste by a lightning strike.

7) It is incredible that a lightning strike can affect the structural integrity of the reinforced concrete tanks.

8) Field measurements of how well risers are grounded found that the risers that were added after original construction are not well-tied electrically into the tank structure. Those risers that were part of the original construction are well-grounded. The specific 300-plus risers that either failed the acceptance criteria or were added after original

construction and are, therefore, suspect are reported in WHC-SD-WM-TR-034, Rev. 0, "Single-Shell Tank Resistance to Ground Test Report," in greater detail.

9) Because ignition of waste by lightning cannot be ruled out at this time, mitigation in the form of air terminals on existing light poles is recommended as well as grounding of those risers, which present a threat to the waste.

Selection and prioritization criteria are now being established to address those tanks with the most serious concerns first. Funding has been secured for the engineering work and DOE-RL is committed to completion of grounding of tank risers, which are identified as the most serious concerns, and installation of air terminals on existing light poles in FY 1997.

Item b:

Comment: "Flammable gases: The staff discussed inconsistencies between the ASA and other technical reports on the Hanford waste tanks--some of which were used as references for the ASA. Inconsistencies included ignition source probabilities used to calculate accident frequencies and flammable gas compositions used to determine deflagration consequences. WHC stated that they will issue a topical report in September 1996 on flammable gases in order to eliminate these inconsistencies. However, because the release date of the report coincides with the release date of the tank farms FSAR, the staff is concerned that it will not be able to provide timely input for the hazards analysis, which is the core of the FSAR. Discussions with WHC also revealed the following issues:"

Response: A topical report on flammable gases is being prepared for the FSAR. The first draft of this report has been completed and sent to selected WHC staff for review. The release date for the FSAR is now November 1996; this date will allow for use of the results of the flammable gas topical report and will address the apparent inconsistencies.

Comment: "(1) Additional Flammable Gas Watch List (FGWL) Tanks: WHC recently completed an analytical study of all 177 tanks to determine if additional tanks should be added to the FGWL.

Each tank was evaluated for the potential to exceed 25 percent of the LFL under steady state or episodic gas release conditions. Criteria used for the evaluation were: (1) calculated steady state gas concentration, (2) surface level increase (slurry growth), and (3) correlation of surface level fluctuations with changes in atmospheric pressure (CLAP). Where possible, actual vapor space sample results were used in place of calculated steady-state gas

concentrations. Preliminary results of the survey prompted DOE-RL to formally recommend the addition of 25 tanks to the FGWL.

Nine of the 25 formally-recommended tanks exceeded the LFL criteria based only on CLAP data. However, this methodology relies on level and pressure measurements made by low precision instruments. Uncertainties from these instruments can introduce large uncertainties in estimated trapped gas volumes because changes in waste level and atmospheric pressure used in the correlation are very small relative to the size of the tank. While adding suspect tanks to the FGWL is conservative, the addition of tanks without a sound technical basis makes removal of the tanks from the FGWL very difficult, and has the potential to impede sampling and saltwell pumping of the single-shell tanks (SSTs). Further investigation and validation of the technical biases [basis] of current gas screening models would provide a definitive methodology for identifying tanks for addition to the FGWL."

Response: The DOE-RL withdrew the recommendation to add more tanks to the FGWL. Furthermore, a review team was established for the purpose of evaluating the technical basis used by WHC in analyzing and recommending tanks for the FGWL. The review team determined that no additions should be made to the FGWL because the data for the tanks in question were highly variable and lack both the precision and accuracy necessary to make estimates of the retained gas. In addition, the models used did not always represent the physical situation within the waste. Finally the criteria could not be used to both add and remove tanks from the FGWL; it would be easy to add tanks and very difficult to remove them because of the intrinsic uncertainty in the models and data. An overview of the effort of the review team was presented to the Board staff on June 25, 1996. The review team report along with the reports for the flammable gas methodology and the evaluation have been transmitted to the Board in response to the Recommendation 93-5 Implementation Plan Milestone 5.4.3.5.a.

Comment: "(2) Single-shell tanks (SST): A Los Alamos National Laboratory (LANL) report on SST bounding gas releases identified eight tanks on the FGWL that represented the most serious flammable gas deflagration risk. WHC plans to "interim stabilize" these tanks by pumping their liquid contents to double-shell tanks (DSTs) once the LANL safety assessment on saltwell pumping of FGWL SSTs is complete."

Response: Safety Assessments (SA) are being prepared by LANL for WHC to cover rotary mode core sampling and interim stabilization of flammable gas tanks. Both of these safety documents are going through a three-tier review. It is anticipated that the rotary mode SA will be approved in July 1996 and the interim

stabilization SA will be approved by early September 1996. In addition the rotary mode SA will be updated to cover push mode sampling and this update should also be approved by early September 1996.

Comment: "(3) Double contained receiver tanks: As reported in a January 12, 1996, Board staff trip report, the ASA concluded that the double contained receiver tanks (DCRTs) could develop a flammable atmosphere within several days of receiving waste. Although not all controls recommended in the ASA are practical, WHC still has not implemented acceptable controls to prevent a deflagration in the DCRTs. Instead, WHC has sought to determine the level of ventilation currently provided for the DCRTs. WHC stated that the DCRTs have diptube bubblers that they are now using to purge the tanks. However, for at least two DCRTs, the purge supplied by the bubblers does not meet the purge rate recommended in the ASA. Furthermore, WHC does not know the contents of some DCRTs so the ASA may not have used conservative waste types for hydrogen generation calculations."

Response: Some of the analyses in the development of the draft ASA concluded that the DCRTs could develop a flammable atmosphere within several days of receiving waste, based on the characteristics of a composite of waste types from several tanks. However, this composite waste type does not exist and could not be pumped to any DCRT. The controls associated with the analyses in the draft ASA were not implemented because the completion of the ASA was abandoned in favor of the FSAR now being prepared.

An initial analysis was performed based on the actual waste that was either stored in the DCRTs or was planned to be pumped to the DCRTs prior to the end of September 1996. That analysis concluded that an air flow of at least 1.0 cubic foot per hour (cfh), supplied by the dip tubes, was sufficient to ensure adequate dilution of hydrogen gas generated from current and near-term waste sources. For practicality and conservatism, 4.5 cfh is actually supplied to the tanks. Of these current waste sources in DCRT tanks, the waste with the highest hydrogen generation rate could not reach flammable levels in the DCRT in less than 231 days, if all dip tubes ceased to function.

The contents of DCRTs are known since the liquid of all source SSTs are sampled and analyzed for compatibility prior to pumping to a DCRT. Flows to the DCRTs are well documented so the contents of the DCRTs are known at all times.

A SA has subsequently been developed by WHC and provides analyses related to all source SSTs which are scheduled to be pumped to the DCRTs. This report addresses all flammable gas hazards, including potential entrained gas in saltwell pumping liquids, potential for gas transport as a result of a Gas Release Event (GRE) in an SST,

as a result of saltwell pumping, and potential ammonia issues. WHC contends that dip tube flow mitigates the effects of flammable gas which is present in DCRTs. Formal acceptance of this position will be documented in RL's completion of tier II review. The SA is in the final stages of WHC functional review and parallel DOE-RL Tier II review. Tier II approval is expected by July 25, 1996, at which time it will be sent to the Idaho National Engineering Laboratory for Tier III review. Final approval by RL, after Tier III comments are incorporated, is expected by September 11, 1996.

The preliminary conclusion of the SA is that existing controls are appropriate for current DCRT contents and for SST liquids to be pumped prior to October 1, 1996. For pumping activities after October, analyses have shown a slightly higher flow rate (1.3 cfh) could be needed in certain circumstances. Accordingly, the minimum flow rate prior to start of pumping of FGWL tanks will be revised to a conservative 3.0 cfh, and the actual rate of 4.5 cfh will continue to be used for practicality and additional conservatism.

Item c.

Comment: "C-103 Organics: SST 241-C-103 has a two-inch floating organic layer (~5000 gallons) composed primarily of tributyl phosphate and normal paraffin hydrocarbons. The original method proposed by WHC for removing leakable liquids from this tank was saltwell pumping the liquids to a double-shell tank without first removing the organic layer.

However, this method provides the undesirable potential for separable phase organics in later sludge wash and filtration/ion exchange operations. Thus, plans for skimming the organic before pumping the supernatant to a double-shell tank are being explored. Subsequent to this site visit, WHC completed a systems engineering study for the interim stabilization of tank 241-C-103; however, a preferred alternative was not identified. A topical paper will be prepared on solvent fires in tank 241-C-103 to assist in the development of the FSAR evaluation of this hazard."

Response: Substantial progress was made on the tank 241-C-103 systems engineering study since the presentation to the Board staff on February 12, 1996. The preliminary conclusion at that time was that the organic layer might have to be separately removed before stabilization could be initiated. The draft report was subsequently issued to DOE-RL on April 12, 1996, with no recommendation at that time. Subsequently, the WHC Decision Support Board studied the issue and recommended that tank 241-C-103 should be interim stabilized without separately removing the organic layer.

Developments which led to changing the preliminary conclusion in February 1996 included the following:

1. Additional Organics Identified

Separable organics have been identified in sludge samples from additional tanks. In addition, three separate studies have predicted significant organic concentrations in a number of additional tanks. Whatever the decision for tank 241-C-103, organics in other tanks would have to be accommodated in the Privatization Phase 2 pretreatment process.

2. Pretreatment Change

When the engineering study was commissioned, one of the basic assumptions was that the pretreatment system was not going to change. The pretreatment system design specifically excluded organics. Based on this, any impacts of a separable organic phase on the pretreatment system were considered to be significant. During the February 1996 Board meeting, this was the primary driver for skimming.

It is now known that the Privatization Phase 2 pretreatment flowsheet must change to accommodate separable organics from other tanks as well as dissolved organics from many tanks. This is a result of the information gathered for this study and the additional organic core and vapor analyses information gained since February 1996. The need for this change was accepted and endorsed by the Decision Support Board.

3. DST Storage Capacity

In February 1996, there was no clear projection as to which tank could be used for receiving the organic. When the WHC Decision Review Board convened in March 1996 they reviewed the data and indicated that regardless of what actions taken on tank 241-C-103, a tank must be made available for this type of material. With the management authority of this group, tank 241-AP-107 was identified for receiving this type of waste, consistent with the waste volume projection planning for the tank to receive complexant concentrate waste.

4. Impacts of Soluble Organic, Particularly TBP

One key piece of information not known in February 1996 was the impacts of soluble organic, particularly tributyl phosphate (TBP). Soluble TBP is nearly as damaging to the pretreatment ion exchange system as a separable phase TBP. The estimated soluble TBP limit for ion exchange is < 1 mg/L. The aqueous layer in tank 241-C-103 is saturated with TBP at approximately 80 mg/L. Even if the organic is skimmed, this concentration will remain. When the pH is raised, both during sludge washing and in the receiving DST, some separable organic phase will be created. This means that

even if all of the separable organic phase is removed from tank 241-C-103 prior to stabilization (which cannot happen), an additional separable organic phase will form. Chemical and system compatibility issues will have to be addressed regardless of the skimming decision.

A presentation was made to the Chemical Reactions SubTAP on June 11, 1996, summarizing key elements of the systems engineering study. The SubTAP again recommended that the organic be removed separately, based on their belief that its removal would provide the basis for resolution of the solvent safety issue in C-103. This issue is yet to be resolved.

Item d.

Comment: "Inactive Facilities: Field inspections and inquiries by the Board's Hanford Site Representative revealed several inactive facilities that were abandoned without proper equipment cleanout and inventory removal. Hazards posed by this situation include hydrogen generation, spread of contamination, and loss of radioactive material containment. Specific observations are noted below."

Response: The three inactive facilities listed by the Board staff are the responsibility of WHC whereas most other Hanford inactive facilities are the responsibility of Bechtel Hanford Incorporated. Potential issues associated with the three WHC facilities have been addressed as highlighted in the following paragraphs in order to verify that there are no hazards requiring urgent attention. Their condition is sufficiently well known at this time to provide assurance that they do not present an immediate threat, such as from buildup of explosive gases or other major safety perturbations, to workers and the public. Also, there is a routine contamination monitoring program in place and areas around the facilities are routinely monitored so if any spread of contamination occurs, it will be detected and immediately corrected.

The three WHC inactive facilities are included, along with all other inactive Hanford facilities, in the budget prioritization process, and specific activities towards their cleanup are included in the FY 1997 Multi-Year Program Plan.

Planned changes in the primary Hanford contractor is not a consideration affecting the actions described above.

Comment: "(1) 244-AR Vault: The 244-AR vault was an interim holding station for waste transfers between PUREX and B-Plant. The facility contains four tanks in underground cells. One of these tanks contains 23,000 gallons of waste including 600 gallons of neutralized current acid waste (NCAW) from PUREX. The estimated

source term for this tank is 120,000 curies. While the actual configuration of the tank is uncertain, WHC stated that it is isolated from the ventilation system. The staff expressed concern about hydrogen generation in the tank and WHC agreed to take a vapor space sample. WHC plans to upgrade mechanical systems and restore steam service to the building in the near term so that they can empty the tanks."

Response: The 244-AR Vault tank #2 contains a nominal 23,000 gallons of waste, which includes 600 gallons of neutralized current acid waste sludge; the balance of the waste is flush water. The estimated source term is 120,000 curies, principally Cesium and Strontium. As stated in the Board report, the tank is isolated from the ventilation system. However, flammable gas dilution air is provided to the tank through the dip tubes with an air flow rate of 5 cfh.

Based on tank head space sample taken February 29, 1996, the hydrogen concentration is 2,200 ppm, or the equivalent of approximately 4.5 percent of the LFL. For this tank, 4.1 vol percent hydrogen can be used for total flammable gas concentrations since the measured concentrations of methane and ammonia are less than 0.001 vol percent. Hydrogen generation analytical modeling of this tank, assuming the highest Total Organic Carbon (TOC) reported for single-shell tanks, predicts a steady-state headspace atmosphere of 6.4 percent LFL.

Plans indicate that the steam supply may need to be restored to allow pumping of tank #2 waste; however, other options, such as peristaltic pumping may be effective in the other tanks. Cost-benefit analyses of potential options are being performed.

Extensive work has been accomplished in recent months to clean up the Wind Reduction Facility attached to the 244-AR facility. Minor housekeeping remains to be completed.

Comment: "(2) 242-T Evaporator: The 242-T evaporator facility concentrated T-Plant waste until shutdown in 1976. The configuration of the facility at the time of shutdown is unknown; however, radiation levels of 1 R/hr at the condensate cell doors (one cell away from the evaporator pot) indicate the presence of radioactive material in the evaporator facility's vessels. At present, no tank level or floor sump monitoring capability exists and no records indicate if the evaporator pot was drained prior to shutdown. WHC plans to use robotics to obtain radiation level readings at the evaporator cell doors to help determine if the evaporator pot contains radioactive material. Because the evaporator vessels are carbon steel and thus susceptible to corrosion, long-term storage of material in them presents a potential for gross contamination should they fail."

Response: A radiological survey was performed in June 1995 which reflects the actual contact readings and contamination levels. The following is offered to clarify readings mentioned in the report: the actual reading of 1 R/hr is actually in the evaporator room versus at the condensate cell doors. A video was also taken of the facility at the same time the survey was conducted. Further survey work is still planned in FY 1996 to gain additional readings in the feed cell and evaporator room to prepare for sampling of the evaporator pot.

With reference to the comment regarding drainage of the evaporator pot prior to shutdown, WHC has yet to confirm if drainage occurred. Document RHO-CD-1410, Rev. 0, dated April 1981, "242T Evaporator Facility Shutdown/Standby Plan," reflects that the evaporator was chemically flushed. The lines to and from the cell were not completely blanked. A plan has been developed and further work is underway to evaluate the plant configuration, including the Board staff concerns about tank level and floor sump monitoring, and corrosion of carbon steel vessels.

Comment: "(3) 209-E Critical Mass Laboratory (CML): The Critical Mass Laboratory (CML) is an inactive part of the 209-E waste handling facility. The current condition of the CML is not known. However, a 1994 criticality assessment of the 209-E facility stated that the CML contains approximately 500 grams of plutonium.

WHC personnel stated that this plutonium was held up in the ventilation equipment, which is isolated, but they are not sure if any of the processing equipment in the CML contains residual plutonium. (As of March 27, 1996, WHC had not yet found the CML layup records provided to WHC by Pacific Northwest National Laboratory [PNL] in 1992.)"

Response: The PNL layup records for the facility have been assembled and are available for review. A budget plan and work scope have been prepared as a part of the Multi-Year Program planning efforts to initiate deactivation work during FY 1997. The budget and work scope outline the tasks required to initiate deactivation endpoint planning for the facility. The Multi-Year Program Plan is pending final issuance and RL management approval.

The results of the criticality assessment regarding the 500 grams of plutonium in the ductwork will be addressed during deactivation endpoint planning for the 209-E facility. Management for the 209-E facility is currently reviewing the results of the plutonium vulnerability assessment for Z-Plant for potential lessons learned that may be applied to 209-E.