

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

July 11, 1996

MEMORANDUM
FOR: G. W. Cunningham, Technical Director
COPIES: Board Members
FROM: Cliff Moore
SUBJECT: Update on Flammable Gas and Lightning Mitigation Issues for the Hanford Site High-Level Waste Tanks, June 25-26, 1996

1. **Purpose:** This trip report documents a visit by the Defense Nuclear Facilities Safety Board's (Board) staff members (Ralph Arcaro and Cliff Moore) to the Hanford Site on June 25-26, 1996. The review covered the status of Department of Energy (DOE) and Westinghouse Hanford Company (WHC) efforts to resolve the flammable gas and lightning safety issues for the high-level waste tanks.
2. **Summary:**
 - a. A DOE review team recently recommended that additional tanks not be added to the Flammable Gas Watch List (FGWL) because the current methodology for adding tanks involves the use of low-precision data, overly-conservative assumptions, and models which do not always represent the physical conditions in the tanks. The Board staff feels that this recommendation is appropriate based on the fact that the flammable gas controls are currently applied on all tanks and the tanks identified as having a significant potential for release are addressed by the flammable gas Unreviewed Safety Question (USQ).
 - b. WHC has committed to provide a Justification for Continued Operations (JCO) for the flammable gas USQ. The JCO will cover all 177 tanks except 101-SY and includes other smaller tanks identified by the Board's staff members as potential flammable concerns, such as the Double Contained Receiver Tanks (DCRTs) and the Inactive Miscellaneous Underground Storage Tanks (IMUSTs).
 - c. Tank 105-AN, a FGWL tank with known episodic release behavior, experienced a gas release event (GRE) on May 30, 1996, while WHC was preparing to sample the tank. The authorized "window" for intrusive activities in tank 105-AN had been extended through the end of May by WHC so that sampling in the tank could be completed even though the most recent GRE in 105-AN occurred over nine months ago. This situation reveals a major inadequacy in the procedures used to ensure that intrusive activities can be safely performed in tanks that experience GREs.
 - d. A recently completed evaluation of lightning strikes in the tank farms identified approximately 250 single-shell tank (SST) risers with unacceptably high riser-to-ground resistances. Some of these risers contain instruments which are grounded through the waste. A lightning strike on these risers could result in large energy deposition in the waste. The Board staff believes priority for implementation of lightning mitigation should be given to the instruments grounded through the waste and to the tanks with episodic GREs.
3. **Background:** A WHC preliminary screening of all 177 tanks for trapped gas indicated

that an additional 25 tanks met the criteria for addition to the FGWL, most based on a new correlation between surface level changes and fluctuations in atmospheric pressure. In December, 1995, DOE-Richland (DOE-RL) assembled a team to review this selection methodology and to determine if any new tanks should be added to the FGWL. In a parallel effort, WHC completed and documented its tank-by-tank assessment of trapped gas.

Until recently, lightning strikes in the Hanford tank farms were considered improbable and thus were not adequately analyzed. In light of weather data which shows lightning strikes in the 200-East and West (tank farms) areas occur with a frequency of twice per year and the fact that other DOE sites provide lightning protection, the Board encouraged DOE and WHC to perform a comprehensive assessment of lightning strikes in the tank farms. This assessment, formally incorporated into the Recommendation 93-5 Implementation Plan, was recently completed.

4. **Discussion:**

- a. ***FGWL Tank Addition:*** The DOE review of additional FGWL tanks focused on tank level and pressure data and assumed gas composition and quantity involved in a release. The review team was led by Don Vieth, DOE-RL technical advisor for the Tank Waste Remediation System, and involved individuals from Los Alamos National Laboratory, Pacific Northwest National Laboratory, and the Chemical Reaction Sub-Panel. The review determined that the majority of the data was inconclusive due to infrequent measurements, low precision, and high noise levels in the signals. The team also determined that the assumption of a gas composition of 97% hydrogen was excessively conservative based on analysis of gas releases in tanks 101-SY and 105-AN and preliminary data from retained gas samples. For these reasons, the team concluded that the 25 tanks previously identified for addition to the FGWL should not be added. The Board staff feels that this conclusion is appropriate based on the fact that the flammable gas controls are currently applied to all tanks and the tanks identified as having a significant potential for release are addressed by the flammable gas USQ.
- b. ***Tank-by-tank Assessment of Flammable Gases:*** The recently completed flammable gas tank-by-tank evaluation identified a total of 53 tanks which contain detectable quantities of trapped gas based on surface level changes due to either slurry growth or barometric pressure fluctuations. The 53 tanks included those currently on the FGWL. All 53 tanks are now included in the flammable gas USQ. A letter forwarding the trapped gas evaluation for commitment closeout was received at the Board on July 3rd and the staff is currently reviewing its adequacy.

In the meantime, DOE has committed to providing a JCO for the flammable gas USQ. The JCO will cover all 177 tanks with the exception of 101-SY. The JCO will also cover smaller tanks identified by the Board's staff as potential flammable concerns including the DCRTs, IMUSTs, and the 244-AR vault. Routine tank farm operations such as push-mode sampling and saltwell pumping in non-FGWL tanks are within the scope of the JCO and will continue utilizing current controls while the JCO is drafted. Rotary mode sampling and saltwell pumping in FGWL tanks are not within the scope of the JCO and will be

covered by separate safety assessments.

- c. **Scheduling Intrusive Activities in Flammable Gas Watchlist Tanks**: Six double-shell tanks are known to undergo episodic GREs, in which a plume of flammable gases is released from the wastes. GREs have the potential to temporarily create ignitable concentrations of flammable gases either locally or throughout the affected tank's headspace. To minimize potential ignition sources during GREs, WHC attempts to schedule intrusive activities in flammable gas tanks to avoid GREs.

WHC was preparing to sample tank 105-AN, an FGWL tank with known episodic release behavior, during May 1996. However, the authorized "window" for intrusive activities in the tank was to expire before the sampling effort could be accomplished. To avoid delaying sampling the tank, WHC extended the authorized period for intrusive activities, and planned to begin sampling on May 30; however, this effort was delayed. The delay was fortunate because tank 105-AN experienced a GRE on May 30. Approximately 1260 cubic feet of gas was released, bringing the entire headspace to approximately 40% of the lower flammability limit (LFL) and probably creating a transient localized plume above the LFL.

WHC reported that the chronology of GREs in tank AN-105 is too inconsistent to make a reasonable determination of the window of opportunity for sampling. This situation reveals a major inadequacy in the procedures used to ensure that intrusive activities can be safely performed in tanks that experience GREs. DOE-HQ (EM-38) has identified this occurrence as a potential USQ.

- d. **Lightning Mitigation**: WHC recently completed a Board Recommendation 93-5 commitment to perform a comprehensive assessment of lightning strikes in the tank farms. The assessment covered the probability, consequences, and mitigation alternatives for lightning. In support of this assessment, WHC performed a field inspection of SST riser resistances and of tall objects located near the tanks. The lightning assessment concluded that lightning strikes affecting tank waste are credible and recommended the following mitigative actions:
- Tank risers with unacceptable riser-to-ground resistance measurements should be grounded (~250 risers).
 - Tank instruments grounded through the waste should be grounded through other means (~16 tanks).
 - Air terminals should be installed on light poles near tanks (~40 poles).

WHC has initiated a change request to install the air terminals and plans to use a graded approach based on tank contents and overlapping protection zones to determine corrective actions of the high resistance risers. The Board staff believes that careful consideration should be given to tanks with instruments grounded through the waste and tanks with episodic GREs as these tanks present the largest potential for lightning-induced accidents. If actions are taken to prevent the formation of flammable atmospheres in the tanks, correcting the

instruments grounded through the waste may be sufficient by itself to mitigate the threat of lightning strikes.

5. **Future Staff Actions:** The Board's staff will perform the following:
 - a. Continue to follow the development of improved flammable gas models and FGWL selection criteria. Incorporation of results from retained gas sampling into these models and criteria will also be monitored.
 - b. Review for adequacy the recently completed evaluation of tanks for trapped gas.
 - c. Review criteria for determination of tank "windows" for tanks which have episodic GREs.
 - d. Follow DOE and WHC efforts to implement lightning protection. The staff will also review the design of proposed mitigative measures.