

DEFENSE NUCLEAR FACILITIES SAFETY BOARD

July 23, 1997

MEMORANDUM FOR: G. W. Cunningham, Technical Director

COPIES: Board Members

FROM: L. M. Jellett

SUBJECT: Review of Tank Safety at the Hanford Site, June 23–26, 1997

This report documents a review by members of the staff of the Defense Nuclear Facilities Safety Board (Board) R. Arcaro, L. Jellett, and R. Robinson regarding safety issues at the Hanford tank farms.

Flammable Gas Safety Issue. Sampling operations to support characterization of the waste tanks have recently revealed significant quantities of flammable gases stored in the floating solids layers of tanks A-101 and AN-103. The largest known floating solids layer, in tank A-101, is approximately 425 cm deep and contains up to 18 percent void space, with hydrogen concentrations as high as 75 percent by volume. Pacific Northwest National Laboratory (PNNL) researchers believe that the crust does not pose a major deflagration hazard. Two factors lead to the conclusion that the layer will not support a self-propagating burn. First, the crust is wet, which raises the energy required for its ignition. Second, the void spaces are not thought to be interconnected. Laboratory studies indicate that approximately 30 percent void is necessary for pores to become interconnected throughout the crust. The lack of connectivity severely limits the propagation of a crust burn. Flame propagation studies in porous media are planned in collaboration with the California Institute of Technology (CalTech) to validate these conclusions. PNNL researchers are working with CalTech to ensure that the experiments are representative of tank conditions with respect to solid and gas compositions and moisture content.

Potential release mechanisms for the gas stored in the crust include bubble migration, percolation, and waste disturbance. Disturbances include intrusions, earthquakes, gas release events from lower layers in the tank, and very large water additions such as those associated with saltcake retrieval. The history of tank intrusive activities indicates no large releases in the course of approximately 80 intrusive events; nevertheless, the staff believes that because of the large variations in tank conditions, past intrusive events may not reflect potential consequences in all 177 tanks. Diffusion is another mechanism for gas transfer; however, the concentration profiles of the various gas species in the layer do not indicate a diffusion rate large enough to account for the steady-state release rate of hydrogen to the tank headspace.

Flammable Gas Unreviewed Safety Question (USQ) Closure Activities. The path forward for closure of the flammable gas USQ involves expert elicitation methods in a process called Safety Controls Optimization by Performance Evaluation (SCOPE). The goal of SCOPE is to use expert elicitation to quantify the uncertainty associated with flammable gas parameters, such as the volume of retained gas in the tanks and the probability of an ignition. Currently, conservative bounding values for these parameters result in unacceptably high frequency and consequences of a tank deflagration. Once the uncertainty of these parameters has been quantified, the relative risk reduction resulting from different control strategies for the tanks will be calculated. This information will be used to compare the strategies and make decisions based on their cost-effectiveness. The staff is concerned that the outcome of this work may simply be a reduction in the perceived risk, as opposed to selection of the most effective control strategy or acknowledgment that more data may be needed to make valid decisions. In addition, the staff is concerned that using SCOPE will set a precedent for relying on expert elicitation when the acquisition of technical data to reduce uncertainty is deemed too difficult and/or expensive. The DOE Richland Operations office (DOE-RL) cites the use of expert elicitation in NUREG 1150 to support its use in this instance; however, in the evaluation of NUREG 1150, NUREG 1420 cautions against using expert elicitation to make regulatory decisions.

Recommendation 95-2. The Hanford tank farms are scheduled for implementation of an Integrated Safety Management System (ISMS) by March 1999. Following the May approval of the Basis for Interim Operations (BIO), actions are now directed at developing the ISMS at the activity level. As the first steps in this effort, Tank Waste Remediation System (TWRS) management is evaluating integrated safety management of two major TWRS activities. Based on the results of these demonstrations, TWRS management will refine its ISMS Plan for TWRS and begin formal implementation in September 1997. An additional demonstration and evaluation will then be performed at the facility level, probably at the West Tank Farms. The ISMS Plan will be further refined based on lessons learned from this demonstration by the spring of 1998. Concurrently, the TWRS authorization basis will transition from the BIO to a fully compliant Final Safety Analysis Report (FSAR) by September 1998. The staff believes several opportunities for schedule acceleration exist. The time required for transition from BIO to FSAR implementation and that needed to complete ISMS implementation after September 1998 can both be reduced with increased management attention and commitment.

The staff believes the above path forward provides an opportunity for an interim step in which partial implementation of an ISMS could be declared. After the first activity-level demonstrations, the contractor could identify those elements of an ISMS already existing and those requiring improvement or integration. Based on these findings, the contractor could propose to DOE that an adequate safety management system or appropriate compensatory measures existed to justify continued operation of the tank farms. DOE-RL would then have sufficient information on which to base an interim authorization agreement for tank farm operations.