February 11, 2011

Site Visit Report
Waste Encapsulation Storage Facility, January 2011

INTRODUCTION

This report documents the results of a review conducted by the Office of Health, Safety and Security (HSS) of the Waste Encapsulation Storage Facility (WESF) documented safety analysis (DSA) at the Hanford Site. During discussions with the U.S. Department of Energy Richland Operations Office (DOE-RL), the review of WESF was jointly selected by HSS and DOE-RL based on the high hazards of the facility and the need to periodically evaluate the facility and DSA by independent reviewers.

SCOPE

The scope of the review was to evaluate the WESF safety and support systems in detecting, preventing and mitigating analyzed events as described in the facility's DSA, PRC-EDC-10-45190, 2010, Executive Summary and Chapter 1, *Site Characteristics*; Chapter 2, *Facility Description*; Chapter 3, *Hazard and Accident Analysis*; and Chapter 4, *Safety Structures, Systems and Components.* The review was conducted utilizing select parts of the HSS criteria review and approach document, *Nuclear Facility Safety System Functionality Inspection Criteria, Inspection Activities, and Lines of Inquiry, September 25, 2009 (HSS CRAD 64-17, Rev 0)*, which is available on the HSS website at http://www.hss.doe.gov/IndepOversight/ESHE/docs.html.

The review was performed from July 2010 to January 2011. HSS personnel conducted four site visits to walk through the facility and meet with the DOE-RL and WESF contractor managers to discuss and resolve the review's observations, which were documented and provided to DOE-RL in August 2010. At the concluding visit in January 2011, all items were dispositioned; most of the observations were resolved and closed, and two items involving incomplete accident analyses assumptions were being further reviewed using the potential inadequacy of the safety analysis (PISA) process.

BACKGROUND

The WESF was designed and constructed to process, encapsulate, and store ^{90}Sr (decay half-life 29 years) and ^{137}Cs (decay half-life 30 years) separated from wastes generated during the chemical processing of defense fuel on the Hanford Site. Waste processing in the facility was shut down in September 1985, followed by deactivation of equipment and instruments (except those required for cell maintenance and surveillance). The current WESF mission is to store cesium and strontium capsules, primarily in the pool cells, in a safe manner and in compliance with all applicable rules and regulations. These capsules contain a significant amount of radioactive material. Mission activities are limited to inspection, decontamination, shipment, storage, and surveillance of these capsules.

RESULTS

The HSS review identified observations in such diverse technical topics as aircraft accidents; safety classification of structures, systems, and components; differential-temperature-induced concrete stresses; hydrogen control passive ventilation; volcanic ashfall; and loss of pool cooling and inventory. All but two of these observations had been fully resolved by January 2011. The contractor's responses to HSS

questions revealed DSA accident analysis weaknesses in two areas: (1) hydrogen release from the pool for the loss-of-active-facility-ventilation event, and (2) consequences associated with a load-drop-into-the-pool event.

For the loss-of-active-facility-ventilation event, the supporting calculation for the DSA's analysis attempted to demonstrate that the resultant maximum facility atmosphere hydrogen concentration of 1% would not be exceeded within the 50-hour safety basis limit. (The 1% hydrogen concentration is equivalent to 25% of the lower flammability limit (LFL). However, the calculation did not consider that the loss of active ventilation could also be accompanied by loss of active pool cooling for a loss-of-normal-power event. Therefore, the calculation did not consider the additional release that could occur if the hydrogen that was saturated in the pool water was driven out of saturation as it heated up (which would add to the radiolytic hydrogen generation rate in the pool). In response to this discovery, the contractor promptly identified this as a PISA and determined that the facility was in a safe condition, that the existing 50-hour safety basis time to reach 1% hydrogen concentration was still enveloping, that existing technical safety requirement (TSR) controls were still valid, and that no additional protective actions were warranted. An unreviewed safety question (USQ) evaluation and an Occurrence Reporting and Processing System (ORPS) report were also promptly initiated.

Subsequent analyses resulting from the USQ evaluation determined that the time to reach the 1% concentration, using the DSA assumptions, was 47 hours – three hours less than the 50-hour safety basis limit and one hour under the TSR's 48-hour limiting condition for operation. This resulted in the declaration of a USQ. In response to this discovery, an additional analysis was performed that accounted for the radioactive decay of the stored materials to the current source term from the DSA-assumed conditions. This analysis showed that the current time to reach the 1% hydrogen concentration was well enveloped by the 50-hour safety basis limit. Therefore, no physical changes were required to address this item.

Currently, the only remaining activity to fully close this item is to incorporate the new information generated by this review into the annual DSA update, which is planned for the spring of 2011.

For the load-drop-into-the-pool event, one of the HSS observations concerned the supporting consequence calculation for the DSA analysis. Although the calculation considered failure of all of the capsules as a result of the load drop, it did not consider that the load drop also could damage pool cooling equipment located in the pool, thereby also causing the loss of pool cooling, which could ultimately result in pool boiling. This scenario has the potential to increase the event consequences as a result of the loss of the substantial radionuclide retention capability of the pool water, if the pool water were to boil. The contractor promptly initiated the PISA process, determined that the facility was in a safe condition, verified the adequacy of the existing controls to limit lifts over the pool, declared a USQ, and submitted an ORPS report. Efforts are ongoing to reanalyze the consequences of this event considering pool boiling, but contractor staff indicated that they expect the result of the new analyses will not change the DSA's conclusions or result in the revision, addition to, or reclassification of controls. (The original analysis was very conservative, in that one of its basic assumptions was that all of the source term in all of the capsules would be released into the pool, which would be virtually unachievable. It also considered a source total term considerably larger than the source total term which presently exists in the pool due to the radioactive decay since the analyses were performed for the safety analysis report.)

Beyond completion of this analysis the only remaining activity to fully close this item will be to incorporate the new information generated into the annual DSA update currently scheduled for the spring of 2011.

CONCLUSIONS

HSS's review of the WESF DSA, subsequent discussions with DOE-RL and contractor management, walkthrough of the facility, and responses to HSS observations demonstrated a commendable nuclear safety performance in the WESF organization in the areas reviewed. The DSA, with the two exceptions discussed above, was clear and complete; it fully and accurately identified, described, and analyzed the credible hazards and accidents associated with the facility, and identified effective engineered and administrative controls for accident prevention and mitigation. The facility and its operation, based on HSS observations, accurately reflect DSA descriptions, analyses, and commitments. The commendable performance was also reflected in DOE-RL's and the contractor's significant efforts in addressing HSS's questions. This performance was particularly evident in their prompt, complete, and thorough responses, per DOE requirements, to the HSS concerns about the DSA analyses of hydrogen release for a loss-of-ventilation and pool-cooling event, and their response to the load-drop accident scenario.

ITEMS FOR FOLLOW-UP

As a follow-up to the open actions described above, HSS will review the updated WESF DSA to verify incorporation of the new information generated by the two USQs associated with a hydrogen release from the pool for the loss-of-active-facility-ventilation event and the consequences associated with a load-drop-into-the-pool event.