June 1, 2007

Keith Lockie
NE-ID/ID-S
FACILITY AND MATERIAL DISPOSITION
U.S. Department of Energy
Idaho Falls, ID 83401

SUBJECT: NUCLEAR REGULATORY COMMISSION ONSITE OBSERVATION REPORT FOR THE IDAHO NATIONAL LABORATORY IDAHO NUCLEAR TECHNOLOGY AND ENGINEERING CENTER TANK FARM FACILITY

Dear Mr. Lockie:

The enclosed document describes the U.S. Nuclear Regulatory Commission's (NRC's) onsite observation activities on April 24-25, 2007, at the Idaho National Laboratory (INL), Idaho Nuclear Technology and Engineering Center Tank Farm Facility (INTEC TFF). This onsite observation was conducted in accordance with the Ronald Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), which requires NRC to monitor disposal actions taken by the Department of Energy (DOE) for the purpose of assessing compliance with the performance objectives set out in 10 CFR Part 61, Subpart C. The activities conducted during the site visit were consistent with those described in the NRC's monitoring plan, dated May 3, 2007, for INTEC TFF.

NRC's onsite observation at INL was primarily focused on two performance objectives, 10 CFR 61.41, *protection of the general population from releases of radioactivity*, and 10 CFR 61.43, *protection of individuals during operations*, by observing DOE's tank grouting operations and verifying DOE's radiation protection measures in its INTEC TFF tank closure operations. Since the tank grouting operations will impact the long-term stability of the tank farm facility after its closure, this observation also partially assessed the performance objective in 10 CFR 61.44, *stability of the disposal site after closure*. Additional visits will be conducted in the future to assess compliance with these and other performance objectives in 10 CFR Part 61, Subpart C.

If you have any questions or need additional information regarding this report, please contact Xiaosong Yin, project manager on my staff, at 301-415-7640

Sincerely,

/RA/

Scott Flanders, Deputy Director
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Enclosure: NRC Observation Report

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IDAHO NATIONAL LABORATORY IDAHO NUCLEAR TECHNOLOGY AND ENGINEERING CENTER TANK FARM FACILITY
NRC ONSITE OBSERVATION REPORT

EXECUTIVE SUMMARY

NRC staff conducted its first onsite observation visit of the INTEC TFF on April 24 to 25, 2007. This visit was intended to focus on two of the four performance objectives—10 CFR 61.41, *protection of the general population from releases of radioactivity*, and 10 CFR 61.43, *protection of individuals during operations*—by observing DOE tank grouting operations and verifying DOE's radiation protection measures for its INTEC TFF tank closure operations. Because the tank grouting operations will impact the long-term stability of the TFF after its closure, this observation also was intended to partially assess compliance with the performance objective in 10 CFR 61.44, *stability of the disposal site after closure*. This report provides a description of NRC onsite observation activities and identifies NRC findings from the visit.

Grout Formulation and Performance

NRC staff evaluated the implementation of the quality assurance program and reviewed the records pertaining to tank grouting operations. NRC staff also observed and reviewed data collected to assess consistency with assumption made in the waste determination.

- The observation determined that the quality assurance program of DOE and its contractor, CH2M-WG Idaho, LLC (CWI), is being implemented effectively. NRC staff also determined CWI has a robust program for verifying that the grout components conform to applicable ASTM standards and that the final grout formulations are consistent with the design specifications assumed in the waste determination.

- NRC has requested additional information regarding (i) the qualifications required of vendors to be on DOE's "approved vendors" list and (ii) the minimum cure time between grout pours. NRC staff also recommended that DOE provide documentation to demonstrate that the high water to cement ratio used in grouting tanks WM-104, WM-105, and WM-106 will not adversely impact the expected performance of the grout.

- NRC recommended that DOE document deviations result from implementation and evaluation with respect to assumptions made in its final waste determination and performance assessment (PA) to assess the risk significance of these deviations.

Radiation Protection Program

NRC staff interviewed DOE and its contractor's radiation protection personnel, reviewed the radiological control documents associated with TFF tank closure operations, and reviewed the associated worker dose records.

- The observation determined that DOE has an adequate program for protecting its personnel from radiation exposures during TFF tank closure operations.

1.0 BACKGROUND

The National Defense Authorization Act for Fiscal Year 2005 (NDAA) authorizes the DOE, in consultation with the NRC, to determine that certain radioactive waste related to the reprocessing of spent nuclear fuel is not high-level waste, provided certain criteria are met. The NDAA also requires NRC to monitor DOE disposal actions to assess compliance with the performance objectives in 10 CFR Part 61, Subpart C.

On September 7, 2005, DOE submitted a draft waste determination for residual waste stored in the INTEC TFF to demonstrate compliance with the NDAA criteria including demonstration of compliance with the performance objectives in 10 CFR Part 61, Subpart C. In its consultation role, the NRC staff reviewed the draft waste determination and concluded that the NDAA criteria could be met for residual waste stored in the INTEC TFF. NRC documented the results of its review in a technical evaluation report (TER) issued in October 2006 (NRC, 2006). DOE issued a final waste determination in November 2006 taking into consideration the findings documented in NRC's TER.

To carry out its monitoring responsibility under the NDAA, NRC plans to perform three types of activities focusing on key monitoring areas (KMAs) identified in its monitoring plan for the INTEC TFF (NRC, 2007): (i) technical reviews, (ii) onsite observations, and (iii) data reviews. Technical reviews generally will focus on obtaining additional model support for assumptions DOE made in its PA that are considered important to DOE's compliance demonstration. Onsite observations generally will be performed to (i) observe and review data collected to assess consistency with assumption made in the waste determination (e.g., observation of waste sampling used to generate data on residual waste inventories) or (ii) observe key disposal (or closure) activities related to technical review areas (e.g., slag and other material storage, grout formulation and preparation, and grout placements). Data reviews will supplement technical reviews focusing on real-time monitoring data that may also indicate future system performance or review of records or reports that can be used to directly assess compliance with performance objectives.

NRC's April 2007 onsite observation at INL was focused primarily on two performance objectives, 10 CFR 61.41, *protection of the general population from releases of radioactivity*, and 10 CFR 61.43, *protection of individuals during operations,* by observing DOE's tank grouting operations and verifying DOE's radiation protection measures in its INTEC TFF tank closure operations. Because the tank grouting operations will impact the long-term stability of the tank farm facility after its closure, this observation also was to partially assess the performance objective in 10 CFR 61.44, *stability of the disposal site after closure*. Additional visits will be conducted in the future to assess the performance objective in 10 CFR 61.42, *protection of individuals against inadvertent intrusion,* and to continue assessing DOE compliance with the other performance objectives.

2.0 NRC ONSITE OBSERVATION ACTIVITIES

2.1 Grout Formulation and Performance

2.1.1. Observation Scope

The observation of DOE tank grouting operations is related to KMA 2, "Grout Formulation and Performance" identified in the NRC monitoring plan for the INTEC TFF (NRC, 2007). An objective of NRC monitoring activities related to KMA 2 is to ensure that the final grout formulation used to stabilize the TFF waste is consistent with design specifications assumed in the final waste determination [DOE Idaho Operations (DOE-ID), 2006], or that significant deviations from design specifications will not negatively impact the expected performance of the grout. As stated in the NRC monitoring plan (NRC, 2007), technical reviews and observations related to KMA 2 will be performed to ensure that reducing conditions will be maintained in the grouted tank and the short-term performance of the grouted vaults will be sufficient to mitigate the release of short-lived radionuclides from the disposal facility. The reducing capacity of the tank grout is important in mitigating the release of Tc-99, whereas the short-term performance of the grouted vault is important in mitigating the release from the contaminated sand pads of short-lived radionuclides, such as Sr-90, that could potentially dominate the predicted doses from the TFF within the first few hundred years (NRC, 2006).

2.1.2 Observation Results

NRC staff had intended to observe ongoing tank operations at the TFF. However, several days prior to the scheduled NRC visit, operational problems were encountered by the DOE contractor, CWI, during grouting of tank WM-182. Apparently, during the first day of engineered placement grout pours, adequate spacing was not maintained between the bottom of the two articulating tank grout arms and the top of the grout placements. Both grout arms were found the next day to be encased in the hardened grout at the bottom of the tank. The steam jet also was found to be buried in several inches of hardened grout after one of the grout pours flowed closer to the jet suction than anticipated. DOE-ID suspended grouting operations to allow CWI to fix the problem. Thus, NRC staff was unable to observe any tank grouting operation and its activities were limited to a tour of the grout batch plant, review of records, and interviews with CWI staff.

NRC staff evaluated the implementation of the quality assurance program pertaining to tank grouting in relation to the (i) "Farm Facility Grout Design Mix and Quality Assurance/Quality Control Testing" (DOE-ID, 2006; Appendix C) and (ii) SPC-763, "INTEC Grout and CLSM Supply Project" (CWI, 2007). The staff utilized information in these documents to select a sample of project records to review and CWI personnel to interview. Another document the staff reviewed was the "Compliance and Monitoring Plan for Performing Grouting at the INTEC Tank Farm Facility Closure Project" (CWI, 2007b). This document identified activities to be conducted by CWI, including verification of grout formulas and performance of quality assurance testing, in order to ensure the correct placement of grout in the TFF tanks and ancillary equipment according to closure requirements and design specifications.

NRC staff reviewed CWI records and verified that the received grout materials had certified chemical and physical test reports that are based on ASTM standards (e.g., ASTM C 989 for blast furnace slag, ASTM C 618-03 for fly ash, and ASTM C 150 for Portland cement). A review of representative test reports indicated the received materials conformed to the standards. NRC staff verified from CWI records that the engineered grout pour mix conforms to the specific requirements in the waste determination and in SPC-763. CWI staff explained that preparation of grout mixtures at the batch plant is computer controlled and that for each batch (or truckload) of grout, a ticket is prepared documenting the mix description, volume of material in the mix, percent moisture of the sand, and water to cement ratio. NRC staff examined representative batch tickets and verified that the measured weights of the engineered grout pour components (Portland cement, fly ash, slag, sand, water, and admixture) reported in the tickets were within 1 percent of the grout mix design specifications.

The water to cement ratios recorded in the batch tickets for tank WM-182 were found to be within the maximum limit of 0.65 specified in SPC-763. However, the batch tickets for the grouting performed in 2006 on three of the four small (30,000 gal) tanks (WM-104, WM-105, and WM-106) showed water to cement ratios in the range 0.92 to 0.94. These values exceeded the SPC-763 specification and are greater than the ratio (0.63) for the fourth small tank (WM-103), which was grouted in March 2007. SPC-763 was prepared after grouting of the three small tanks had been completed. The water to cement ratios used for the first three tanks are less than 1.0, the maximum value calculated from the formulation for controlled low-strength grout specified in Appendix C of the waste determination document (DOE-ID, 2006). However, the correlation between water to cement ratio and permeability presented in Thorne (2007; Figure 2) indicates the resulting permeability of grout with a water to cement ratio of 0.90 would be about 2×10^{-10} m/s, two orders of magnitude higher than for grout with a water to cement ratio of 0.65 and three orders of magnitude higher than the initial grout permeability assumed in the PA degradation analysis. The residual radionuclide inventory in the three small tanks is small and the higher permeability of the grout likely would not lead to a significant increase in dose to the general population. NRC recommended that DOE document deviations with respect to assumptions made in its final waste determination and PA and assess the risk significance of these deviations. DOE is considering how best to document these deviations as disposal actions progress.

NRC staff also verified that the measured sulfide sulfur content of the blast furnace slag supplied by the vendor is consistent with SPC-763. The amount of sulfide in the slag is important because it imposes on the grout a reducing condition that helps mitigate the release of Tc-99. The measured sulfide sulfur content of the slag listed in representative chemical test reports was found to be greater than the specified 0.7 weight percent minimum.

NRC staff verified the grout mixture that arrives at the TFF from the batch plant is sampled and tested by CWI to ensure it meets the grout composition requirements. A logbook documenting grout placement activities is maintained by CWI staff and includes a copy of the batch ticket and a grout placement log on which the result of the slump test (ASTM C 143/C 143M), as well as any upset condition, is recorded. The logbook also includes an Inspection Planning Package, which lists specific inspections required

to be performed for each TFF closure activity and has a summary of inspection and test results. NRC verified from selected grout placement logs that grout mixtures that do not meet the specifications are sent for disposal at a landfill.

During its visit to the grout batch plant facility, NRC staff observed the weather-tight silos for storage of the slag and cementitious materials. The silos appeared to be adequate for preventing precipitation from contacting the grout materials to minimize the degradation in the quality and chemical reactivity of the slag and Portland cement.

2.1.3 Conclusions and Followup Actions

The NRC staff determined that the DOE and CWI quality assurance program pertaining to tank grouting is being implemented effectively. However, additional site visits will be conducted to observe tank grouting operations. DOE-ID should consider developing additional controls or procedures based on lessons learned from the operational problems encountered during the grouting of tank WM-182.

CWI records indicate the grout components conform to ASTM standards and the grout formulations are consistent with the design specifications assumed in the waste determination. However, because DOE and CWI do not conduct independent sampling and analysis of the grout materials but rely, instead, on test reports provided by the vendor, NRC staff has requested information regarding the qualifications, e.g., quality assurance program, of vendors on DOE's approved vendor list.

NRC staff requested a copy of engineering calculations that CWI used as the basis for using a minimum cure time of 30 minutes between grout pours. NRC staff also recommends that DOE provide documentation regarding the risk significance of the higher water to cement ratios—compared to that assumed in the PA supporting the waste determination—of grout used to fill three of the four small tanks.

NRC staff plans to conduct additional site visits in the future to observe grouting of the large tanks WM-180 through WM-186 and to followup on any remaining issues identified above.

2.2 Radiation Protection Program

2.2.1 Observation Scope

To verify that DOE's radiation protection program is in place for its tank closure operations to assess compliance with 10 CFR Part 61.43, *protection of individuals during operations*, the onsite observation included (i) interviews with DOE and its contractor's radiation protection personnel; (ii) reviews of radiological control documents associated with TFF tank closure operations, e.g., the Idaho Cleanup Project Radiation Control Manual (CWI 2006a), and ALARA Program and Implementation (CWI 2006b); and (iii) reviews of associated worker dose records. NRC staff toured the INTEC site to verify the level of access control in general and TFF-specific access control. The onsite tour also included observation of the operation of the Radiological Control Information

Management System (RCIMS), which controls individual radiological worker doses specifically associated with TFF tank closure activities.

2.2.2 Observation Results

DOE-ID contracted with CWI to provide radiological protection for site personnel during TFF tank closure operations. The regulation that establishes DOE's standards for protection against ionizing radiation is 10 CFR 835, *Occupational Radiation Protection*. Other radiation protection requirements for TFF tank closure operations are the applicable provisions of DOE Order 5400.5, *Radiation Protection of the Public and the Environment*. DOE-ID is providing systematic oversight of the radiation protection program of CWI, which includes daily communications on TFF tank closure operations, quarterly program assessment, ALARA benchmark review, and annual input towards CWI's overall contract reviews.

Through interviews with site radiation protection personnel, NRC staff determined that CWI has adequate programmatic radiation protection measures. The radiological control director, who reports directly to the CWI vice-president, has direct responsibility for overall TFF tank closure radiological control operations. Because the Idaho cleanup and tank closure project involves many simultaneous individual projects, all radiation protection measures are project oriented. The radiation control manager on site reports to the CWI radiological control director while providing supervision to lower level site operational foremen and radiological control technicians and/or engineers. The operational foremen have the authority to stop an operation if unsafe radiological conditions have been determined or suspected.

Radiation levels at the TFF are typically low when there are no tank waste removal or in-tank retrieval operations ongoing, and the TFF is posted as a radiation buffer area under these conditions. However, the TFF is fenced with a limited access point and personnel entering the TFF are required to have a personal radiation monitoring device and to have undergone radiation worker training, in addition to other industrial worker requirements. During tank grouting operations, all personnel entering the TFF are required to have a radiation work permit that needs three levels of management approval. ALARA review is required for all tank grouting activities. There are additional controls for each tank inside the TFF, including control tents. When the tank cap is open, the area is re-posted as a high radiation area and only specially trained personnel with special personal protective equipment, e.g., respirators, are allowed to enter the tents. A bioassay is conducted after each such operation.

Because all Idaho cleanup and tank closure operations are project oriented, a special personal ED (Electronic Dosimeter) monitoring device is required for each person conducting a specific project. While a TLD (Thermoluminescence Dosimeter) that is exchanged every quarter provides a total personal radiological dose received over that period, an ED can provide a specific dose associated with a specific activity, e.g., TFF tank closure operation. Through interviews with radiation protection personnel and

observing the RCIMS operation, it was determined that the use of EDs can provide accurate information on worker dose associated with TFF tank closure operations.

A review of TFF operation personnel dose records for 2006 and the first quarter of 2007 indicated there were no personal overexposure or overdose incidents involving TFF tank closure operations. The maximum dose received by a worker during the first quarter of 2007 was 37 mrem. There were no incidents involving personal contamination or loss of control of radioactive material during TFF tank closure operations.

Through interviews with radiation protection personnel, it was determined there are adequate programs in place that provide radiation training for new and experienced workers. NRC staff also found that there is an emergency program in place with an adequate level of reporting and response procedures and adequate equipment to provide the first level of emergency decontamination operations.

2.2.3. Conclusions and Followup Actions

Through a review of the radiation protection program implemented by DOE-ID and CWI at the INTEC TFF facility, interviews with radiation protection personnel, and a tour of the facility, NRC staff determined that DOE-ID has an adequate radiation protection program in place for TFF tank closure operations. No specific items were identified for followup. NRC will continue monitoring activities related to radiation protection.

3.0 PARTICIPANTS

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