September 25, 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) onsite observation activities on August 15, 2007, for monitoring disposal actions taken by the Department of Energy (DOE) 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 for the purpose of assessing compliance with the performance objectives set out in Subpart C of Part 61 of Title 10 of the Code of Federal Regulations.

NRC's onsite observation at INL was primarily focused on performance objective, 10 CFR 61.41 by observing DOE=s tank grouting operations. Since the tank grouting operations will impact the long-term stability of the tank farm facility after its closure, this observation had also partially assessed the performance objective in 10 CFR 61.44. 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 call me at 301-415-6717, or call 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

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.

The U.S. Nuclear Regulatory Commission (NRC) conducted its first onsite observation at the Idaho National Laboratory Idaho Nuclear Technology and Engineering Center Tank Farm Facility (INTEC TFF) on April 24–25, 2007. NRC activities during this visit 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. NRC also partially assessed the performance objective in 10 CFR 61.44, stability of the disposal site after closure. A report that provided the results of the NRC onsite observation was transmitted to DOE on June 1, 2007 (Flanders, 2007).

NRC had intended during the April visit to observe ongoing tank operations at the INTEC TFF. However, several days prior to the scheduled NRC trip, operational problems were encountered by the U.S. Department of Energy (DOE) contractor, CH2M-HILL and Washington Group, Idaho (CWI), during grouting of tank WM-182 and grouting operations were suspended in order to fix the problem. NRC was unable to observe any tank grouting operations in progress and its activities during the April visit were limited to a tour of the grout batch plant, review of records, and interviews with CWI staff. Thus, NRC conducted a second onsite observation at the INTEC TFF on August 15, 2007, to observe ongoing tank grouting operations and to followup on issues remaining from its first visit.

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 Key Monitoring Area (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 INTEC TFF waste is consistent with design specifications assumed in the final waste determination (DOE-ID, 2006), or that significant deviations from design specifications will not negatively impact the expected performance of the grout.

2.1.2 Observation Results

NRC observed ongoing tank grouting operations at the INTEC TFF. NRC visited the batch plant and observed the preparation of controlled low-strength material (CLSM) grout components and placement into cement mixer trucks. Preparation of grout mixtures at the batch plant is computer controlled and 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, using State-certified calibrated equipment. At the INTEC TFF, NRC observed the transfer of the grout mixture from the mixer truck to the boom pump truck and subsequently to the waste tank's surrounding vault. NRC observed that procedures are being implemented to ensure radiation protection of workers at the INTEC TFF during the tank grouting activity. In the control trailer, NRC viewed the placement of the CLSM grout into tank WM-181 through a video camera located inside the tank. The tank video camera is able to pan and zoom on different areas inside the tank. NRC also observed through in-tank video cameras the condition of the grout that had been placed inside the large tanks WM-180 through WM-186. While residual flush water, which was used to rinse off the grout mast, was observed to be present in some tanks, no surface cracking of the hardened grout in any of the tanks was visible. Addition of the residual rinse water to the CLSM will not increase the water to cement ratio appreciably as the water was very small compared to the large volume of CLSM in the tank.

NRC also watched videos of the engineered grout placement in tank WM-185. Two purposes of the segmented engineering grouting pours was to (1) attempt to remove additional liquid waste by directing it toward the pump and (2) to promote mixing of the engineering grout with the remaining waste that could not be extracted. By observing the video, the segmented pours provided opportunity to remove additional liquid waste as flow of water toward the pump could be seen. The star patterned segmented pours fold in the waste as they are placed. Layering of the grout pours was evident on the video.

CWI staff indicated that sampling and testing of the CLSM grout is done twice a day—once in the morning (typically the first batch) and another in the afternoon. NRC observed the sampling of grout from the first grout batch of the day and the measurements of temperature, air content, unit weight, and puddle size, which were conducted in accordance with the "Compliance and Monitoring Plan for Performing Grouting at the INTEC Tank Farm Facility Closure Project" (CWI, 2007). NRC noted that cylinder samples of the grout were set aside by CWI staff for later 7-, 28- and 56-day strength tests.

NRC also reviewed CWI records, including the "Grout Supervisor Tracking Form," "Truck Supervisor Tracking Form," and "Tank Farm Inspection Planning Package" and verified that the required information have been filled in. The "Grout Supervisor Tracking Form" recorded the required and actual volume of each grout pour, the start and stop times of grout placement, and the tank riser number through which the grout was placed. The "Truck Supervisor Tracking Form" recorded the required slump range and the actual slump measured. Information in these forms is monitored by the Grout Supervisor and Truck Supervisor as they are entered into the forms for any possible variance that could impact assumptions made in the final waste determination. Additional documents included with the "Tank Farm Inspection Planning Package" include the INEEL Construction Concrete Control Report, which provides results of laboratory material testing (e.g., 7–, 28–, and 56–day strength test) and of field tests (e.g., slump or puddle size, air content, grout temperature). The values recorded in the reviewed documents were determined to be within DOE specifications.

DOE and CWI staff also indicated that grouting procedures have been revised to take into account the lessons learned from grouting tank WM 182. Prior to the previous observation trip, during tank WM-182's engineered grout placement, both arms became lodged into an engineering grout pour. The lower section of one arm was left in place. Even with the one arm left in place in the grout, CWI was able to finish the star pattern, consistent with the planned approach for all the tanks. No appreciable effect on the degree of mixing is expected, however, a smaller amount of excess liquid was able to be extracted from the tank. This excess is

expected to be a very small fraction of the total activity remaining in the tank, and therefore, will have negligible impacts on performance. In addition to changing the procedures, the cameras in the tanks were upgraded to assist in avoiding similar problems in the future, as positional awareness of the end of the arms was identified as a contributor to the incident.

2.1.2 Review of DOE Response to Request for Additional Information

As a result of its first onsite observation visit in April 2007, NRC requested additional information from DOE regarding (i) the qualifications required of vendors to be on the approved vendor list and (ii) the minimum cure time between grout pours. NRC also requested documentation regarding the risk significance of the higher water to cement ratios, compared to that assumed in the performance assessment supporting the waste determination, of grout used to fill tanks WM-104, WM-105, and WM-106. In response, the DOE transmitted additional information to NRC on August 6, 2007 (van Camp, 2007). NRC staff reviewed the information after returning from its August 2007 onsite observation visit.

Qualifications of Vendors on the Approved Vendor List

DOE indicated in its response that the subcontract with Valley Ready Mix, the grout component supplier, was developed and approved consistent with the CWI Management Control Procedure (MCP)–540, "Assigning Quality Levels" and MCP-1186, "Service Acquisitions," which do not require Valley Ready Mix to be on an approved vendor list. However, DOE indicated that CWI evaluated Valley Ready Mix, including its Quality Assurance Plan, and determined that the company has the ability to comply with the contractual requirements of the tank farm grouting subcontract. NRC reviewed the Quality Assurance Plan of Valley Ready Mix and determined that Valley Ready Mix has procedures in place to ensure the grout materials it supplies CWI meet DOE specifications, in terms of constituent formulation and standard grout characteristics.

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 INTEC TFF within the first few hundred years. This is accomplished at INTEC TFF by adding blast furnace slag to the concrete. 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, during our April monitoring visit. However, these reports were from Valley Ready Mix's supplier and not apparently independently verified. While Valley Ready Mix had procedures in place to ensure that it supplied grout materials consistent with DOE specifications for normal characteristics, it does not appear that any additional testing for sulfide content was performed by Valley Ready Mix of the slag they received from their supplier or that Valley Ready Mix verified, by independent testing, that their supplier had a proper quality assurance plan for the DOE application. In the future, DOE should consider whether specific additional requirements added to their contractor quality assurance program should be included to address non-standard grout characteristics that are relied on in the safety assessment. Additional quality assurance would strengthen their safety case. The NRC considers this issue closed.

Minimum Cure Time Between Grout Pours

DOE provided a copy of a CWI engineering study documented in Engineering Design File (EDF)-8059, "Grout Temperature Increase for the INTEC Tank Farm Closure" (CWI, 2007),

which calculated the maximum temperature of the grout that would result from heat generation during cure of the CLSM. Two mathematical models were evaluated–an adiabatic model and a kinetic model–and conservative assumptions were used with respect to the placement temperature and the volume of each of the three grout lifts emplaced in the tank. Based on the results of the kinetic model, DOE indicated that the maximum temperature within the CLSM was 142 °F, which is significantly below the acceptance criterion of 170 °F, and that no additional thermal-related controls need to be implemented by CWI. The 170 °F acceptance criterion was reported to have been conservatively selected from the literature for materials of higher strength than required of CLSM.

NRC conducted independent calculations of the maximum temperature within the CLSM during cure using the method discussed in Bamforth (2007) and verified that the maximum temperature would be significantly below 170 °F. NRC noted that the analysis presented in EDF-8059 did not consider the temperature gradients in the grout monolith that could occur during cure. Temperature gradients lead to stresses that could result in formation of surface and interior cracks in the monolith (Bamforth, 2007). In a followup conference call, the DOE stated that the formation of early age cracks is bounded by the conservative assumptions regarding grout degradation used in the performance assessment supporting the waste determination. NRC concurs that the effect of early age cracking on radionuclide release is likely bounded by the conservative assumptions used in the performance assessment calculations and considers this issue closed. Nevertheless, engineering calculations may be useful prior to tank grouting at other DOE sites such that steps could be taken to limit temperature gradients and the potential for crack formation. The NRC considers this issue closed.

Risk Significance of High Water to Cement Ratio Used for Grouting the 113.6-cubic meter (30,000-gallon) Tanks WM-104, WM-105, and WM-106

DOE stated in its response that no specific release model was developed for the 113.6 m3 (30,000 gal) tanks for the performance assessment calculations supporting the 3116 waste determination. Therefore, no specific water-to-cement ratio for the 113.6 m3 (30,000 gal) tanks was assumed in the performance assessment supporting DOE's waste determination. The reason for not including a release model for the 113.6 m3 (30,000 gal) tanks is the small radionuclide inventory in those tanks compared to the inventory in the 1,136 m3 (300,000 gal) tanks, and it was concluded that, for performance assessment purposes, the inventory for the large 1,136 m3 (300,000 gal) tanks bound any additional contamination that may be released from the 113.6 m3 (30,000 gal) tanks. Based on the small radionuclide inventory in the 113.6 m3 (30,000 gal) tanks, the high water to cement ratio of the grout used in three of the four 30,000-gallon tanks poses a low risk of significantly increasing the dose to the general population. The NRC considers this issue closed.

2.1.3 Conclusions

The NRC observation team observed ongoing tank grout operations and reviewed records at the INTEC TFF. NRC determined that the DOE and CWI quality assurance program pertaining to tank grouting, grout formulation, and placement is being implemented effectively.

NRC has reviewed the documents DOE provided in response to an NRC request made during its April 2007 onsite observation visit. NRC is closing the issues from the April 2007 observation report as it has determined that satisfactory information has been received.

For the issue on the qualification for vendors on the approved vendor list, DOE supplied

information on the quality assurance program of its vendor, Valley Ready Mix, which ensure the grout materials it supplies to CWI meet DOE specifications, in terms of constituent formulation and standard grout characteristics. NRC is recommending that if specific characteristics of the grout material, which are not part of the standard grout characteristics, such as the sulfide level of the slag, are being relied on for performance, specific requirements for testing should be added to the quality assurance programs.

DOE provided adequate information for NRC to close the issue on the minimum cure time for the grout lifts. NRC is recommending that DOE remain cognizant of the potential for crack formation, which may be more of an issue at other sites which have not used very conservative assumptions for concrete degradation.

The third issue addressed the water to cement ratio used in three of the small tanks, as compared to the water to cement ratio assumed in the waste determination. NRC determined that, based on the small radionuclide inventory in the 113.6 m3 (30,000 gal) tanks, the high water to cement ratio of the grout used in three of the four 113.6 m3 (30,000 gal) tanks poses a low risk of significantly increasing the dose to the general population

3.0 PARTICIPANTS

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