U.S. NUCLEAR REGULATORY COMMISSION PLAN FOR MONITORING DISPOSAL ACTIONS TAKEN BY THE U.S. DEPARTMENT OF ENERGY AT THE IDAHO NATIONAL LABORATORY IDAHO NUCLEAR TECHNOLOGY AND ENGINEERING CENTER TANK FARM FACILITY IN ACCORDANCE WITH THE NATIONAL DEFENSE AUTHORIZATION ACT FOR FISCAL YEAR 2005

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ACRONYMS AND ABBREVIATIONS

ALARA	As Low As Is Reasonably Achievable
ASTM	American Society of Testing and Materials
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CNWRA	Center for Nuclear Waste Regulatory Analyses
DEQ	Department of Environmental Quality
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	Data Quality Objective
HCM	Hydrogeologic Conceptual Model
HRR	Highly Radioactive Radionuclide
HWMA	Hazardous Waste Management Act
Idaho DEQ	Idaho Department of Environmental Quality
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
KMA	Key Monitoring Area
M&O	Management and Operation
NDAA	National Defense Authorization Act for Fiscal Year 2005
PA	Performance Assessment
RAI	Request for Additional Information
RCRA	Resource Conservation and Recovery Act
ROD	Record of Decision
RPP	Radiation Protection Program
SAP	Sampling and Analysis Plan
SRPA	Snake River Plain Aquifer
TER	Technical Evaluation Report
TFF	Tank Farm Facility
USGS	U.S. Geological Survey

DEFINITIONS

Closed activity	A monitoring activity where a key assumption made or key parameter used by the U.S. Department of Energy (DOE) in its assessment has been either substantiated or determined not to be important in meeting the performance objectives of 10 CFR Part 61, Subpart C.
Disposal	The isolation of radioactive wastes from the biosphere.
Highly radioactive radionuclides	Those radionuclides that contribute most significantly to risk to the public, workers, and the environment.
Key monitoring area	Areas that the U.S. Nuclear Regulatory Commission (NRC) has determined to be important, through the review of DOE waste determination that describes its waste disposal actions, to demonstrating that performance objectives listed in 10 CFR Part 61, Subpart C, will be met.
Monitoring activities	NRC and state activities to monitor DOE disposal actions to assess compliance with the performance objectives listed in 10 CFR Part 61, Subpart C.
Noncompliance	A conclusion that DOE's disposal actions will not be in compliance with the performance objectives of 10 CFR Part 61, Subpart C, or that there is an insufficient basis to assess whether DOE's waste disposal action will result in compliance with the performance objectives.
Onsite	Areas of the DOE site where monitoring activities will be carried out. This may include areas of the site outside of the Tank Farm Facility.
Open activity	Monitoring activity that has not been closed and for which sufficient information has not been obtained to fully assess compliance with a 10 CFR Part 61, Subpart C, performance objective.
Open-noncompliant activity	An ongoing monitoring activity that has provided evidence that the performance objectives of 10 CFR Part 61, Subpart C, are currently not being met or will not be met in the future or for which insufficient competent technical bases have been provided to determine that the performance objectives will be met.

DEFINITIONS (continued)

Operations	The time frame during which DOE carries out its waste disposal actions, through the end of the institutional control period. For the purpose of this plan, DOE actions involving waste disposal are considered to include performance assessment development (analytical modeling), waste removal, grouting, stabilization, observation, maintenance, or other similar activities.
Performance assessment	A type of systematic (risk) analysis that addresses (a) what can happen, (b) how likely it is to happen, (c) what the resulting impacts are, and (d) how these impacts compare to specifically defined standards.
Performance objectives	NRC 10 CFR Part 61, Subpart C, requirements for low-level waste disposal facilities that include protection of the general population from releases of radioactivity (10 CFR 61.41), protection of individuals from inadvertent intrusion (10 CFR 61.42), protection of individuals during operations (10 CFR 61.43), and stability of the disposal site after closure (10 CFR 61.44).
Waste determination (or non-high-level waste determination)	DOE documentation required by Section 3116 of the Ronald Reagan National Defense Authorization Act of Fiscal Year 2005, that to demonstrates a specific waste stream is not high-level waste.
Worker	DOE personnel or contractors who carry out operational activities at the disposal facility. For the purpose of this plan, 10 CFR Part 835 dose limits (comparable to 10 CFR Part 20) would apply for radiation workers.

EXECUTIVE SUMMARY

The Ronald Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA) authorizes the U.S. Department of Energy (DOE) in consultation with the U.S. Nuclear Regulatory Commission (NRC) to determine whether certain radioactive waste related to reprocessing of spent nuclear fuel is not high-level waste, provided certain criteria are met. The NDAA only applies to DOE facilities in South Carolina and Idaho. The NDAA also requires NRC to coordinate with the covered state (i.e., South Carolina or Idaho) to monitor DOE disposal actions to assess compliance with 10 CFR Part 61, Subpart C, performance objectives for low-level waste. These performance objectives include (i) protection of the general population from releases of radioactivity (10 CFR 61.41), (ii) protection of individuals against inadvertent intrusion (10 CFR 61.42), (iii) protection of individuals during operations (10 CFR 61.43), and (iv) stability of the disposal site after closure (10 CFR 61.44). This monitoring plan details NRC plans to assess compliance with each of these performance objectives for residual waste remaining in the high-level waste tanks at the Idaho National Laboratory (INL) near Idaho Falls, Idaho. NRC began interacting with the State of Idaho (see Section 1.3) while performing its consultative role with DOE under the NDAA.

On September 7, 2005, DOE submitted a draft waste determination for residual waste incidental to reprocessing, including sodium-bearing waste, in the Idaho Nuclear Technology and Engineering Center Tank Farm Facility (INTEC TFF) at INL. DOE prepared a draft waste determination and supporting performance assessment (PA) to demonstrate compliance with NDAA criteria including demonstration of compliance with the performance objectives listed above. In its consultative role, the NRC staff reviewed the draft waste determination and PA and concluded with reasonable assurance that 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. DOE issued a final waste determination in November 2006 taking into consideration the assumptions, conclusions, and recommendations documented in NRC's TER.

NRC identified key attributes of the disposal facility, or key monitoring areas (KMAs), in its TER that are important to mitigating releases of radioactivity to the environment or that are otherwise important to DOE's demonstration of compliance with 10 CFR Part 61, Subpart C, performance objectives listed above. These KMAs are reproduced in Appendix A of this monitoring plan and are discussed in detail in the sections that follow. NRC plans to perform three types of activities to fulfill its NDAA monitoring responsibilities, focusing on these KMAs: (i) technical reviews, (ii) onsite observations, and (iii) data reviews. Technical reviews generally focus on obtaining additional model support for assumptions DOE makes in its PA that are considered important to DOE's compliance demonstration. For each of the technical review areas, onsite observations will be generally performed to either (i) ensure data collected for detailed technical review are of sufficient quality (e.g., observation of waste sampling used to generate data on residual waste inventories evaluated under KMA 1, "Residual Waste Sampling") or (ii) to 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 related to KMA 2, "Grout Formulation and Performance"). Data reviews will supplement technical reviews focusing on real-time monitoring data that may also indicate future system performance (e.g., sampling and analysis of perched water underneath grouted vaults for changes in chemical conditions) or review of records or reports that can be used to directly assess compliance with performance objectives

(e.g., review of radiation records).

DOE typically uses a PA to demonstrate compliance with requirements provided in 10 CFR 61.41 and 61.42, recognizing that long-term modeling predictions are needed to establish compliance with performance objectives today. NRC considers sufficient PA model support coupled with observation of disposal actions that are carried out in conformance with detailed closure plans necessary for NRC to assess that these performance objectives can be met in the future. For example, NRC developed KMA 1, "Residual Waste Sampling," to ensure that the final postcleaning inventory that is developed for each cleaned tank is consistent with assumptions made in DOE's waste determination and PA model regarding the final waste inventory at closure (see Sections 3.1.1, 3.2.1, 4.1, and 4.2). The final inventory of cleaned tanks is important to DOE's demonstration of compliance with 10 CFR 61.41 and 61.42. NRC will also perform technical reviews and observations related to KMA 2, "Grout Formulation and Performance" (see Sections 3.1.2 and 3.2.2) to ensure that reducing conditions will be maintained in the grouted tank and that the short-term performance of the grouted vaults will mitigate the release of Tc-99 and short-lived radionuclides from the disposal facility, respectively (important model assumptions in DOE's demonstration of compliance with 10 CFR 61.41). Technical reviews and onsite observations of KMAs 3 and 5 related to "Hydrological Uncertainty" and "Engineered Surface Barrier and Infiltration Reduction" (see Sections 3.1.3, 3.1.4, and 3.2.3) are also important to DOE's 10 CFR 61.41 compliance demonstration, providing additional model support for infiltration rates and other modeling assumptions regarding natural attenuation processes operable in the subsurface at INTEC. If cementitious materials do not perform as well as expected, KMAs 3 and 5 can provide an additional safety margin. Environmental data reviews (see Sections 3.1.6 and 3.2.4) will also be important to supporting technical reviews and onsite observations related to KMAs 2, 3, and 5 by providing performance indicator data and support for modeling assumptions regarding both engineered and natural system performance.

Any change to DOE's PA affects its compliance demonstration; therefore, NRC will also evaluate any future revisions or updates to DOE's PA (see Section 3.1.5). Additionally, onsite observations of access controls are important to verify DOE's assumptions regarding the compliance point for members of the public, including inadvertent intruders, during the institutional control period; therefore, NRC will also ensure that controls to limit site access by members of the public are effective (see Sections 3.2.5 and 4.2).

Compliance with the 10 CFR 61.43 performance objective can be more easily assessed by direct observation of DOE closure activities. NRC plans to perform a graded review of DOE's radiological protection program while observing DOE's most risk-significant closure activities (e.g., tank cleaning and grout placement activities) to assess compliance with 10 CFR 61.43. For example, NRC will review radiation records and environmental data or reports, possibly interview workers during closure activities, or observe environmental data collection to assess compliance with 10 CFR 61.43, "Protection of Individuals During Operations," addressed under KMA 4 (see Sections 5.1 and 5.2). Finally, monitoring activities to assess compliance with 10 CFR 61.44, "Stability of the Disposal Site After Closure," (see Sections 6.1 and 6.2) partially overlap the technical review and onsite observation performed for KMA 2 discussed above. Observations of disposal facility maintenance may also be conducted to gain insights regarding the potential long-term performance of engineered barriers.

This monitoring plan also provides information regarding the types of monitoring reports NRC plans to prepare to document its monitoring activities (see Section 7). For example, NRC plans to issue a report following each onsite observation and will summarize monitoring activities and changes to the status of its monitoring activities in periodic reports. If NRC is unable to conclude that performance objectives are currently being met or will be met in the future, NRC will notify DOE, the covered State, and Congress. The types of notification letters related to a finding of noncompliance are listed in Section 7.3. Appendix B summarizes NRC planned monitoring activities by the performance objectives and monitoring plan chapter.

1 INTRODUCTION

1.1 Background

To initiate consultation activities under the National Defense Authorization Act for Fiscal Year 2005 (NDAA) for the Idaho Nuclear and Engineering Center (INTEC) tank farm facility (TFF) at the Idaho National Laboratory (INL), U.S. Department of Energy (DOE) submitted its draft waste determination to the U.S. Nuclear Regulatory Commission (NRC) (DOE Idaho, 2005), on September 7, 2005. This waste determination addressed waste incidental to reprocessing, including sodium-bearing waste, stored in the INTEC TFF. NRC concluded that there is reasonable assurance that the applicable criteria of the NDAA could be met for the INTEC TFF in its technical evaluation report (TER) issued in October 2006 (NRC, 2006b). In the TER, NRC staff identified several key monitoring areas (KMAs) that would assess whether DOE is in compliance with performance objectives listed in 10 CFR Part 61, Subpart C. These KMAs are listed and described in Section 4.4 of NRC staff's TER (see Appendix A).

On November 19, 2006, DOE issued its final waste determination[1] for waste incidental to reprocessing, including sodium-bearing waste, stored in the INTEC TFF at INL in Idaho Falls, Idaho. The disposal plans described in the final waste determination were generally consistent with plans described in the draft waste determination. The specific technical guidance in this monitoring plan is based on the analyses of DOE's draft waste determination as documented in NRC's TER. Consequently, changes that DOE may have made to the disposal plan since the September 7, 2005, submittal of the draft waste determination are not necessarily reflected in this document. NRC staff expects to update this monitoring plan as necessary to reflect changes in DOE's disposal plans.

1.2 Objective

The NDAA requires NRC to coordinate with the covered state (i.e., South Carolina or Idaho) to monitor DOE disposal actions to assess compliance with 10 CFR Part 61, Subpart C, performance objectives for low-level waste. These performance objectives include (i) protection of the general population from releases of radioactivity (10 CFR 61.41), (ii) protection of individuals against inadvertent intrusion (10 CFR 61.42), (iii) protection of individuals during operations (10 CFR 61.43), and (iv) stability of the disposal site after closure (10 CFR 61.44). This document describes the NDAA-required activities that NRC will use to monitor DOE actions related to *in-situ* disposal of residual waste stored at the INTEC TFF at INL. The focus of the monitoring is specifically tailored for each waste determination. This document includes NRC plans for monitoring the INTEC TFF at INL; additional monitoring information can be found in NRC's guidance document for waste incidental to reprocessing consultation activities.

1.3 Interfacing With the State of Idaho

Regarding DOE's INTEC TFF waste determination, the staff began interacting with State of

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[1] For the first two non-high-level waste determinations under the NDAA, DOE provided NRC staff a draft waste determination for NRC technical review as part of the consultation process. Following completion of NRC staff's technical evaluation, DOE finalized the waste determinations, taking into consideration the NRC's analyses and technical comments documented in the TERs.

Idaho during the consultation phase with DOE. Through discussions with staff at Idaho Department of Environmental Quality (Idaho DEQ), it was established that State of Idaho has two primary regulatory responsibilities related to the INTEC TFF: (i) Resource Conservation and Recovery Act (RCRA) closure under the Hazardous Waste Management Act (HWMA) and (ii) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulatory activities associated with historical releases from ancillary equipment associated with the TFF that resulted in soil and groundwater contamination.

Additionally, Idaho DEQ participates in a wide variety of nonregulatory sampling activities at the INL site. A division of Idaho DEQ, INL Oversight, performs various activities including environmental surveillance, impact assessment, emergency planning and response, and risk communication. INL Oversight maintains an independent environmental surveillance program (e.g., air, surface water, groundwater, soil, and milk sampling from onsite and offsite). The environmental surveillance program verifies and supplements DOE Idaho monitoring programs. The environmental surveillance data collected by INL Oversight can be accessed through the Idaho DEQ website. INL Oversight uses specifically designed data collection to assess background radiation levels, to determine the impact of radioactivity releases from facilities on the environment, and to provide valuable information regarding contaminant transport in the environment and potential pathways of exposure to human and ecological receptors. INL Oversight also maintains real-time radiological and meteorological information to assist responders in the event of an emergency. Additionally, INL Oversight publishes technical reports and a newsletter to let the public know how INL affects the environment.

To the extent that Idaho DEQ continues to collect environmental and radiological data at the site, the NRC will seek to leverage the state's review and not duplicate the efforts by performing a similar review. For example, the NRC may be able to rely upon Idaho DEQ review of environmental data for assessing whether or not there have been releases to the environment or exposures to offsite members of the public. However, the NRC may still need to review some environmental data for other purposes (e.g., to address issues related to KMA 3). Idaho DEQ's review of this data should allow the NRC to reduce the scope and level of its review.

2 MONITORING TO ASSESS COMPLIANCE WITH 10 CFR 61.40—GENERAL REQUIREMENT

Section 3116 (a)(3)(A) and (B) of the NDAA states that for radioactive waste from reprocessing of spent nuclear fuel to be determined to be non-high-level waste, it must be shown that it will be disposed of in compliance with the performance objectives in Subpart C of Part 61 of Title 10, Code of Federal Regulations. Subpart C of 10 CFR Part 61 requires that disposal facilities must be sited, designed, operated, closed, and controlled after closure to ensure compliance with the performance objectives in 10 CFR 61.41 through 61.44, according to requirements in 10 CFR 61.40. To assess compliance with the requirements of §61.40 for INTEC TFF waste disposal, NRC will rely upon its assessment of DOE's compliance with 10 CFR 61.41 through 61.44. Specifically, the U.S. Department of Energy (DOE) will be viewed as being in compliance with 10 CFR 61.40 as long as it is viewed as being in compliance with the other performance objectives.

3 MONITORING TO ASSESS COMPLIANCE WITH 10 CFR 61.41—PROTECTION OF GENERAL POPULATION

10 CFR 61.41—Protection of the general population from releases of radioactivity. "Concentrations of radioactive material that may be released to the general environment in groundwater, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable."

To assess compliance with 10 CFR 61.41, the U.S. Nuclear Regulatory Commission (NRC) will review the U.S. Department of Energy's (DOE's) (i) performance assessment that demonstrates the performance objective will be met, (ii) environmental data that can provide an early indication of the facility performance, and (iii) the as low as is reasonably achievable (ALARA) provision in 10 CFR 61.41. NRC plans to carry out three primary activities to assess compliance with 10 CFR 61.41: technical reviews (Section 3.1), onsite observations (Section 3.2), and long-term monitoring (Section 3.3).

Section 4.4 of the technical evaluation report (TER) summarizes the key monitoring area (KMA) staff determined to be important in assessing DOE compliance with 10 CFR Part 61, Subpart C. Of the five KMA identified, all but one (KMA 4, which deals with assessing compliance with 10 CFR 61.43) relate to assessing compliance with 10 CFR 61.41.

3.1 Technical Reviews of KMAs

3.1.1 KMA 1—Residual Waste Sampling

"DOE should sample tanks WM-187 through WM-190 after cleaning as stated in Section 2.3 of the Draft Section 3116 Determination Idaho Nuclear Technology and Engineering Center Tank Farm Facility (DOE Idaho, 2005). Sampling data and analysis of tanks WM-187 through WM-190 after cleaning should be reviewed to ensure that the inventory for these tanks was not significantly underestimated (i.e., similar or better waste retrieval will be achieved) (NRC, 2006b)."

The assumed inventory for the uncleaned tanks is an important parameter that affects demonstration of compliance with NDAA criteria (e.g., removal to the maximum extent practical), including the performance objectives in 10 CFR Part 61, Subpart C, germane to NRC's monitoring responsibilities. DOE Idaho cleaned and sampled tanks WM-180 through WM-186 from 2002 to 2005. The inventory of the remaining uncleaned tanks (WM-187 through WM-190) was estimated using sampling data from one cleaned tank and an assumption regarding the cleaning efficiency for uncleaned tanks. Although the NRC TER concluded (NRC, 2006b) that DOE Idaho used reasonable approaches in developing the TFF inventory, NRC staff recognized the importance of obtaining additional sampling data after the remaining tanks are cleaned to support the assumptions made in DOE Idaho's analysis.

One of the most significant issues NRC identified with respect to DOE's approach to developing a final inventory was related to the number and quality of solid sample results obtained from the cleaned tanks. Note that most of the radionuclide inventory for the Tank Farm Facility (TFF) is associated with the solid residual waste, and only a small amount of activity is associated with the liquid residual waste. DOE Idaho was not able to meet its data quality objectives (DQOs) for solids analysis for any of the samples taken from cleaned tanks. Nonetheless, DOE Idaho analyzed and presented results for a composite sample for one cleaned tank, WM-183, which was used as the basis for almost the entire TFF inventory.

Future sampling and analysis plans (SAPs) and data quality assessments (DQAs) prepared for tanks WM-187 through WM-190 should be evaluated as part of NRC monitoring activities. For each cleaned tank, a SAP was developed that used the DQO process to determine the sampling strategy, location and number of samples, laboratory methods, data management, and quality assurance controls to be used to collect, analyze, and evaluate data to support the decisionmaking process for TFF closure. The sampling data is used to determine whether (i) the waste is characteristic hazardous waste due to toxicity or corrosivity, (ii) Hazardous Waste Management Act (HWMA)/Resource Conservation and Recovery Act (RCRA) action levels for closure can be met, and (iii) DOE performance objectives for low-level waste disposal (consistent with 10 CFR Part 61, Subpart C) can be met. The DQO process helps ensure that the type, quantity, and quality of data used in decisionmaking are appropriate for the intended data application. Due to the anticipated effectiveness of cleaning activities and difficulty in obtaining a solid sample from the cleaned tanks, NRC staff recommended that DOE Idaho use lessons learned from previous sampling campaigns to identify a sampling strategy with the highest probability of success of obtaining representative samples of the waste for the uncleaned tanks (e.g., use of a small submersible pump moved across the bottom of the tank to collect residual heel samples to capture a representative collection of residual materials from a larger portion of the tank). NRC staff should evaluate the sampling approach DOE used to ensure that it is reasonably robust and will, to the extent practical, obtain quality data for the uncleaned tanks despite the sampling difficulties inherent in characterizing the small quantity of waste residuals remaining following waste retrieval activities. Specifically, NRC staff should confirm that DOE develops and follows an SAP that addresses appropriately defined DQOs related to sampling to assess compliance with 10 CFR Part 61, Subpart C, performance objectives.

A series of DQA reports provides a scientific and statistical evaluation of the quality of the cleaned tank data to determine whether the DQOs established for sampling can be met (DOE Idaho, 2005). NRC staff was concerned about the variability in concentrations of highly radioactive radionuclides (HRRs) from tank to tank that could potentially affect the conclusions in the waste determination. Based on information that DOE Idaho presented to support their inventory estimates in response to a request for additional information (DOE Idaho, 2006a), NRC staff analyzed solids data from a number of additional pre- and postcleaning sampling events. After reviewing this limited information, NRC staff concluded that there is significant variability (an order of magnitude or higher) in the solid concentrations from tank to tank (e.g., Sr-90 and Cs-137). There is also significant variability in concentration from pre- and postcleaning sampling for certain radionuclides (e.g., Sr-90 concentrations vary over an order of magnitude). Uncleaned tank WM-188 appears to have a significantly higher concentration of the relatively insoluble constituent Cs-137 than is present in cleaned tanks. The Cs-137 variability is especially important for the intruder analysis performed to demonstrate compliance with 10 CFR 61.42 (see Section 5), because Cs-137 is the single most important radionuclide contributing to dose for the intruder analyses. Additionally, tank WM-187 is the holding tank for waste removed from tanks WM-180 through WM-186; therefore, additional challenges with cleaning tank WM-187 may arise due to solid residual accumulation from multiple cleaned tanks. NRC staff included this KMA to address these uncertainties with the inventory for the uncleaned tanks. NRC staff should evaluate the postcleaning sampling inventories for tanks WM-187 through WM-190 to be presented in DOE Idaho-developed DQAs. These DQAs should ensure that HRR concentration variability is appropriately addressed in DOE Idaho's waste determination (DOE Idaho, 2005) for tanks WM-187 through WM-190.

The HRRs for groundwater that are particularly pertinent to NRC staff's assessment of compliance with 10 CFR 61.41 are Sr-90, Tc-99, I-129, and C-14. NRC staff's independent analysis using site-specific sorption coefficients also identified U-234, Am-241, and Np-237 as potential HRRs for groundwater, however, NRC staff managed this uncertainty through review of monitoring well data from historical contamination from the TFF. This data currently shows low or nondetectable levels of these constituents in perched groundwater and saturated groundwater below the site, possibly due to significant attenuation in the subsurface. Because in-growth of Np-237 may increase the concentration and potential risk of Np-237 over time, it is important to assess any early indication of greater than expected mobility of this constituent in the subsurface at INL, as discussed in Section 3.1.6. Any potential HRRs for groundwater DOE Idaho does not identify in its screening analysis will be addressed through review of monitoring data described in Sections 3.1.3, 3.1.6, and 3.2.4.

Tables 1 and 2 provide the assumed inventory for HRRs for the groundwater pathway, as well as other HRRs identified for intruder and worker risk for the bounding tank (tank WM-182) and bounding, single sand pad. To close this KMA, NRC staff must conclude that the inventory DOE used in its performance assessment reasonably represents the inventory remaining in the tanks after cleaning. To complete this assessment, NRC staff must evaluate DOE Idaho's sampling methodology, results, and analysis to estimate the postcleaning inventory for tanks WM-187 through WM-190, expected to be completed before the scheduled year of closure, 2012. This would also entail review of DOE Idaho's calculation of the remaining solid residual volume in the tanks left to be cleaned [e.g., solid residual depth estimates and kriging analysis – see Sections 3.1.1 and 3.2.2 of the INL TER (NRC, 2006b)] and the assumed density of the solid residual heel. NRC staff should be particularly cognizant of interference issues that have historically plagued Tc-99 and I-129 analysis, making it necessary for DOE Idaho to use modeling to determine the inventories for these two radionuclides in the past [e.g., ORIGEN2 modeling was used to develop the inventories in DOE's performance assessment (DOE Idaho, 2003)]. DOE Idaho addressed analytical issues associated with these two radionuclides in updating the inventory estimates for tanks WM-180 through WM-186 to support the postcleaning inventory presented in its waste determination (DOE Idaho, 2005). DOE Idaho should continue to sample all HRRs to support the postcleaning inventory estimates for tanks WM-187 through WM-190.

NRC staff should evaluate sampling data associated with the tank WM-187 vault to determine whether the sand pad inventory developed to address first-cycle extraction fluid contamination of the tank WM-187 vault from a 1962 back-siphoning event is bounding. DOE Idaho used indirect analysis from the vault samples in cleaned tank WM-185, which was also contaminated in 1962 from a back-siphoning event, to demonstrate that the sand pad inventory it developed through modeling is bounding. The sand pad inventory for Sr-90 is particularly relevant for assessing compliance with 10 CFR 61.41, as short-lived radionuclides have the greatest potential to drive the risk from TFF waste residuals (e.g., Sr-90 release and transport have the

Table 1. Assumed Single Tank Inventories for Tanks WM-187 Through WM-190

Radionuclide	Total Residuals (Ci) From DOE Waste Determination*†
Am-241	4.2×10^{-01}‡
Ba-137m§	$1.14 \times 10^{+03}$
Cm-242	1.32×10^{-03}
Cs-137	$1.14 \times 10^{+03}$
C14	4.96×10^{-06}
Co-60‖	6.3×10^{-02}
I-129	7.74×10^{-04}
H-3	7.17×10^{-01}
Nb-94	2.06×10^{-01}
Ni-59	2.51×10^{-02}
Ni-63	2.86
Np-237	4.70×10^{-02}
Pu-238	$1.14 \times 10^{+01}$
Pu-239	3.4
Pu-240	1.35
Pu-241	$1.95 \times 10^{+01}$
Pu-242	9.88×10^{-04}
Sr-90	$2.34 \times 10^{+01}$
Tc-99	7.64×10^{-01}
Y-90	$2.34 \times 10^{+01}$
Total Ci all radionuclides	$2.4 \times 10^{+03}$

*1Ci = $3.7 \bullet 10^4$ MBq.
†Draft waste determination radionuclide inventories are based on (i) waste residuals estimated using remote video inspection of cleaned tank internals to map out depth estimates of remaining residual solids and liquids across tank bottoms using tank internal reference points of known height, (ii) best estimate radionuclide concentrations from past and recent samples, and (iii) radioactive decay to 2012. Analytical results for tank WM-182 were used to calculate the liquids inventory at closure for Am-241, C-14, Cs-137, Eu-154, H-3, I-129, Np-237, Pu-238, Pu-239, Pu-241, Sb-125, Sr-90, Tc-99, U-234, and Y-90. Analytical results for Tank WM-183 were used to calculate the solids inventory at closure for Am-241, Ba-137m, Co-60, Cs-137, I-129, Nb-94, Pu-238, Pu-239, Sb-125, Sr-90, Tc-99, U-234, and Y-90.
‡The value of 0.42 Ci was taken from Table A-7 and A-12 of DOE Idaho (2005). The value in Table 1 of DOE Idaho (2005) appears to be a typographical error.
§A 1:1 ratio is assumed for Cs-137 to Ba-137m as a conservative estimate of radionuclide inventory; based on decay probability, Ba-137m is approximately 95 percent of the Cs-137 inventory.
‖Co-60 was not listed in Table 1 of the draft waste determination (DOE Idaho, 2005); however, it is listed in Table 2 of 10 CFR 61.55 and is therefore an HRR by default (using DOE Idaho's methodology). It is also included on DOE Idaho Table 5 of HRRs (2005).
Radionuclides shown are contributors in PA dose calculations or regulated by concentration limits in 10 CFR 61.55. The waste determination total is based on the entire inventory of radionuclides.

Table 2. Assumed Tank WM-187 Sand Pad Inventory	
Radionuclides	**(Ci)*†**
Am-241‡	1.89
Ba-137m	1.65×10^{3}
Cm-242	1.38×10^{-5}
Cs-137‡	1.65×10^{3}
C-14‡	3.90×10^{-7}
I-129‡	1.08×10^{-6}
H-3	3.10×10^{-22}
Nb-94	2.29×10^{-2}
Ni-63	1.69×10^{-10}
Np-237	3.72×10^{-4}
Pu238‡	2.06
Pu-239‡	1.57
Pu-240‡	3.54×10^{-1}
Pu-241	2.28
Pu-242	5.69×10^{-5}
Sr-90‡	2.49×10^{2}
Tc-99‡	2.02×10^{-12}
Y-90	2.49×10^{2}
Total Ci§	3.85×10^{3}

*1Ci = 3.7×10^{4} Mbq.
†Radioactive decay to 2012.
‡Radionuclides based on results from the PA (DOE Idaho, 2003).
§Radionuclides shown are contributors in DOE PA dose calculations or regulated by concentration limits in 10 CFR 61.55. The total is based on the entire inventory of radionuclides, not just the highly radioactive radionuclides presented in this table.

greatest uncertainty and potential consequences compared to other HRRs DOE Idaho identified for the groundwater pathway). Additional conceptual model implementation and sensitivity analysis DOE Idaho performed (DOE Idaho, 2006a) in response to an NRC request for additional information showed that the inventory for Sr-90 and other radionuclides could be around an order of magnitude higher. Based on calculations and analysis performed by DOE and NRC staff, it appears that, at least for Sr-90, the inventory for the sand pad is bounding. NRC staff should evaluate liquid vault samples from tank WM-187 using the approach detailed in Section 3.2.6 of NRC's TER for INL (NRC, 2006b) to determine whether the inventory developed for the sand pad presented in Table 3 is also bounding for the tank WM-187 sand pad.

The status of this KMA will remain open until postcleaning sampling and analysis of tanks WM-187 through WM-190 is completed (expected prior to 2012). At that time, the status of this KMA can be closed if (i) the postcleaning inventory estimates for tanks WM-187 through WM-190 are less than or equal to the values provided in Table 1 and (ii) analysis of sampling data shows the sand pad inventory for tank WM-187 is expected to be bounded by the values provided in Table 2. If the assumed inventory is less than the actual inventory based on postcleaning sampling and analysis, NRC staff may need to have DOE Idaho evaluate the significance of the inventory underestimation with respect to DOE Idaho demonstration of compliance with 10 CFR 61.41 and 61.42 performance objectives.

3.1.2 KMA 2—Grout Formulation and Performance

"The final grout formulation used to stabilize the TFF waste should be consistent with design specifications or significant deviations should be evaluated to ensure that they will not negatively impact the expected performance of the grout. The reducing capacity of the tank grout is important to mitigating the release of Tc-99. Short-term performance of as-emplaced grout should be similar to or better than that assumed in the performance assessment (PA) release modeling or significant deviations should be evaluated to determine their significance with respect to the conclusions in the PA and TER. The short-term performance of the grouted vault is especially important to mitigate the release of short-lived radionuclides such as Sr-90 from the contaminated sand pads that could potentially dominate the predicted doses from the TFF within the first few hundred years (NRC, 2006b).*"*

In its technical evaluation of the INTEC TFF (NRC, 2006b), NRC staff concluded that the 10 CFR Part 61.41 performance objective could be met based on the assumed performance of a combination of multiple barriers that mitigate the release of radioactivity into the environment, including the performance of the grouted concrete vault and tank system. For example, NRC staff identified the reducing capacity of the tank grout as an important barrier to mitigate the Tc-99 release due to the presence of ground blast furnace slag in the grout formulation. The hydration of slag in the grout mixture releases sulfide species, predominantly S^{2-}, into the pore fluid, which imposes strongly reducing conditions on the system and chemically binds several contaminants as insoluble species. Technetium is believed to react with the sulfide to form Tc_3S_{10} (Lukens, et al., 2005), mitigating the potential release of Tc-99 through the groundwater pathway. Thus, the reducing capacity of the tank grout is important to DOE Idaho's demonstration of compliance with 10 CFR 61.41.

The effectiveness of blast furnace slag in mitigating Tc-99 release depends on its sulfide content. The sulfide sulfur content of commercial blast furnace slag typically varies from 0.7 to 1.1 wt%. In response to an NRC staff request for additional information [clarifying request for additional information (RAI) 3], DOE Idaho (DOE Idaho, 2006a) provided information on the vendor slag specification to be used in the TFF encapsulation pours and, in a followup response to NRC clarifying RAI 3 (DOE Idaho, 2006b), indicated the vendor will be contractually required to meet American Society of Testing and Materials (ASTM) C-989 (ASTM International, 2006). Although ASTM C-989 sets a maximum sulfide content limit of 2.5 wt%, no minimum sulfide content is specified in the standard. Thus, meeting the requirements of ASTM C–989 does not necessarily mean sulfide will be present in the vendor-supplied ground blast furnace slag in sufficient concentration to ensure that reducing conditions will be maintained. DOE Idaho (DOE Idaho, 2006b) indicated that its vendor slag specifications will require a minimum amount of sulfide sulfur that it believes will be sufficient to induce a reducing environment. However, DOE Idaho did not specify the minimum amount.

DOE needs to provide the minimum sulfide content it will require in its vendor slag specification. Because the minimum slag content required to achieve reducing conditions is uncertain, closure of this KMA will require information on the reducing capacity of the grout. This will demonstrate that the minimum value selected for the specific DOE grout formulation will result in a reducing condition sufficient to mitigate the release of technetium for the specific formulation. A procedure for such measurements is presented in Kaplan, et al. (2005).

In addition, although blast furnace slag is stable under most conditions, deterioration of the quality and chemical reactivity of the slag can occur if it is not stored properly or is exposed to moisture. In a followup response to an NRC clarifying RAI 3, DOE Idaho indicated it plans to store the grout mixture in a silo to prevent contact with moisture. NRC staff onsite observations will be necessary to confirm that the grout components are being stored in watertight silos or bins (see Section 3.2.2).

NRC staff's conclusion that the 10 CFR Part 61.41 performance objective could be met is also dependent on the assumed short-term performance of the as-emplaced grout (e.g., the grouted vault maintains its structural integrity and ability to serve as an effective hydraulic barrier in the near term). While NRC staff generally concluded that DOE's concrete vault and grout performance assumptions were pessimistic, it is not clear whether DOE explicitly considered the effects of Big Lost River seepage on the degradation of the vaults and grout [DOE's PORFLOW (ACRI, 2000) model results indicated that Big Lost River seepage significantly affects flow in the immediate vicinity of the TFF, although there is uncertainty regarding the significance of this effect]. Additionally, it is not clear whether DOE considered the potential impact of infiltration of highly acidic waste into the TFF vaults. The short-term performance of the grouted vault is especially important to mitigate the release of short-lived radionuclides such as Sr-90 from the contaminated sand pads. Some method to ascertain that the short-term performance of the grout is similar to or better than assumed in the PA release model is necessary. For example, a monitoring system could be put in place to detect early release of Sr-90 from the sand pad. The monitoring system could involve measuring the Sr-90 concentration in perched groundwater samples taken from monitoring wells located underneath or adjacent to the grouted vaults. Such a system could use sampling methodologies already used at other DOE sites, such as the West Valley Demonstration Project (Klenk, 2005) and the Hanford site (Washington State Department of Health, 2006). Where perched water is not present, water samples from the hydrologically unsaturated horizon could be taken. Sampling from the unsaturated zone would be more difficult, but techniques are available to do this [some are discussed in Orr et al. (2006)]. In addition, new technologies currently under development, such as the Sr-90 sensor being tested for the Advanced Monitoring Systems Initiative of DOE (http://www.nv.doe.gov/emprograms/environment/technology/amsi/default.htm), could eventually be deployed to monitor early release of Sr-90 or Cs-137 from the sand pad.

The status of this KMA will be considered open until DOE Idaho's demonstration
(i) substantiates that reducing slag will provide enough sulfur content to support reducing

conditions in the tank grout (expected to be addressed within 5 years of closure or the year 2017) and (ii) substantiates that the short-term performance of the grouted tank and vault system will mitigate the release of Sr-90 and other short-lived radionuclides.

3.1.3 KMA 3—Hydrological Uncertainties

"Relevant recent and future monitoring data and modeling activities should continue to be evaluated to ensure that hydrological uncertainties that may significantly alter the conclusions in the PA and TER are addressed. If significant new information is found, this information should be evaluated against the PA and TER conclusions (NRC, 2006b)*."*

DOE Idaho's PA assumptions regarding the natural system performance are important to its demonstration of compliance. Based on the assumptions made in DOE's performance assessment, DOE Idaho must take credit for a combination of both engineered and natural system barriers to meet the 10 CFR 61.41 performance objective. This KMA was developed as a result of NRC staff's analysis that showed a number of uncertainties associated with DOE Idaho's groundwater model. These uncertainties include the following:

- Hydrogeologic Conceptual Model (HCM)—NRC staff analysis of groundwater data reflecting contamination of the subsurface from historical releases from the TFF revealed that the HCM implemented in DOE Idaho's groundwater model (PORFLOW model) may not be supported. DOE's PORFLOW model predicts 600 m [2,000 ft] of lateral transport away from the TFF (DOE Idaho, 2003), which does not appear consistent with monitoring data in the perched and saturated zones underneath the INTEC TFF. The uncertainty in travel paths and distances is especially important for short-lived radionuclides such as Sr-90 that can decay to insignificant levels during transport through the unsaturated zone prior to entry into the saturated zone where a receptor could be exposed.

- Infiltration Rates—Infiltration rates used in a recent Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) risk assessment model for the INTEC TFF (DOE Idaho, 2006c) were much higher than assumed in DOE Idaho's PA model (DOE Idaho, 2003). Increased infiltration rates could lead to decreased travel times and dilution of contaminants in the Snake River Plain Aquifer (SRPA). Thus, assumed infiltration rates significantly affect predicted doses to potential receptors, particularly for short-lived radionuclides such as Sr-90.

- Big Lost River Seepage Rates—NRC staff evaluated Big Lost River seepage rates in the PORFLOW model and concluded that the seepage rates may have unrealistically diluted concentrations of radiological constituents in the unsaturated zone. Incorporation of constant Big Lost River seepage rates as a boundary condition in the PORFLOW model resulted in the addition of a significant amount of water to the system. Overly optimistic dilution factors affect predicted concentrations and dose for all constituents.

Based on its own calculations, NRC staff provided a defensible dilution factor for SRPA flow that was sufficient for DOE Idaho to demonstrate compliance with performance objectives. NRC staff concluded that with more optimistic assumptions regarding engineered barrier system performance, the Sr-90 risk could be completely eliminated (i.e., Sr-90 activity can be reduced to insignificant levels prior to release from the grouted vaults). Thus, if short-term performance of the grouted tank and vault system is significantly better than assumed in the PA, then hydrological uncertainty associated with Sr-90 becomes irrelevant. If short-term performance of the grouted tank and vault system is significantly worse than assumed in the PA (evaluated under KMA 2), then hydrological uncertainties associated with the transport of Sr-90 in the subsurface basalt and sedimentary interbeds will need to be addressed [e.g., the expected flow paths, direction, and attenuation (dilution and sorption) of Sr-90 in the unsaturated zone]. Sedimentary interbed sorption provides a significant barrier to mitigate the release of Sr-90 to the unsaturated zone. A significant amount of information (e.g., laboratory and field-derived sorption coefficients) has been collected for Sr-90 sorption to basalts and sedimentary interbeds. However, less information is available regarding the potential for TFF infiltration to bypass sedimentary interbeds along preferential flow pathways through fractured basalt. This information is important to predicting natural attenuation of Sr-90 in the subsurface at TFF.

Based on DOE's performance assessment, a combination of performance from both engineered and natural barriers is needed to meet the performance objectives for Tc-99 and I-129. If the tank grout performance (evaluated under KMA 2) becomes an issue, natural system performance for Tc-99 and I-129 becomes increasingly important. However, natural attenuation of Tc-99 and I-129 in the subsurface is primarily limited to dilution and dispersion, as these two constituents are relatively nonsorbing in the subsurface at TFF. DOE could take additional credit for infiltration controls (see Section 3.1.4), if needed, once a final remedial decision under the CERCLA program is made for the INTEC TFF.

Closure of KMAs 2 and 3 are intimately related for all constituents. NRC staff should continue to stay abreast of relevant monitoring and modeling activities conducted by DOE, other agencies [e.g., U.S. Geological Survey (USGS), Idaho Department of Environmental Quality (Idaho DEQ), National Oceanic and Atmospheric Administration], or independent research. For example, NRC staff should request any new and significant information related to hydrological studies at INTEC or INL, if relevant, and continue to review monitoring data (e.g., perched groundwater and saturated zone monitoring well data collected and reports generated as part of the CERCLA remedial alternative for the TFF, groundwater data collected, and reports generated by USGS and Idaho DEQ) until such time that NRC staff thinks that risk-significant hydrologic uncertainties are adequately addressed and overall system performance is adequately constrained.

Although not required to demonstrate compliance with performance objectives, NRC staff recommended that DOE Idaho consider updating or revising its PA model to reflect recent monitoring data (e.g., calibration to existing groundwater data) and modeling activities performed for the TFF under the CERCLA program (e.g., DOE Idaho, 2006b, 2004) to ensure HCM uncertainty is appropriately addressed. Specific recommendations included consideration of (i) the effects of historical releases on future releases from the INTEC TFF, (ii) additional data to support a hydrology model oriented in the principal unsaturated zone flow direction (i.e., generally to the southeast) if a two-dimensional model is retained for modeling contaminant flow and transport in the PA, and (iii) consideration of additional data on Big Lost River seepage rates and underflow rates. DOE Idaho should also consider the effects of infiltration controls and future construction of a cap over the TFF on contaminant flow and transport. If DOE Idaho revises its PA model to address these recommendations, these issues may be relevant to evaluations performed under Section 3.1.5, Performance Assessment Process Reviews.

The status of this KMA will remain open until KMA 2 related to grout performance is closed. If issues arise during evaluation of KMA 2 (e.g., NRC staff have concerns that the tank grout will provide reducing conditions and that the grouted tank and vault system will provide a hydraulic barrier in the short term), then KMA 3 will become increasingly important. KMAs 2 and 3 are therefore expected to be closed in tandem.

3.1.4 KMA 5—Engineered Surface Barrier/Infiltration Reduction

"INTEC infiltration controls and construction and maintenance of an engineered cap over the TFF under the CERCLA program should be monitored to ensure that PA assumptions related to infiltration and contaminant release are bounding (NRC, 2006b).*"*

The infiltration rate through the grouted waste form was found to be an important parameter in DOE Idaho's PA model (DOE Idaho, 2003), significantly affecting DOE Idaho's demonstration of compliance with 10 CFR 61.41. Among other things, the assumed infiltration rate affects mass flux into the unsaturated zone and the amount of dilution in the SRPA. Predicted concentrations and dose from short-lived, sorbing constituents such as Sr-90 are especially sensitive to this parameter value as increased infiltration rates lead to decreased transport times and decay. The infiltration rate DOE Idaho used in its PA (DOE Idaho, 2003) compliance case of 4 cm/yr [2 in/yr] was significantly less than the infiltration rate of 18 cm/yr [7 in/yr] used in the latest Remedial Investigation/Baseline Risk Assessment (RI/BRA) that evaluated the risks associated with historical releases from TFF piping (DOE Idaho, 2006c). The increased infiltration rate is thought to be due to impervious areas at INTEC that focus much of the surface runoff into gravelly areas or unlined drainage ditches (DOE Idaho, 2006c). Therefore, future infiltration controls implemented under the CERCLA program to mitigate risks associated with TFF soils and groundwater are important to demonstrating that 10 CFR Part 61, Subpart C, performance objectives can be met.

Additionally, Idaho DEQ has identified another positive effect associated with construction of an engineered cap: it dramatically slows corrosion and degradation of the grouted tank and vault system and associated piping to help ensure that these systems, structures, and components remain intact for at least 100 years after closure. The PA model assumption that the vault will not degrade until after 100 years is important to demonstrating compliance with the 10 CFR 61.41 performance objective for Sr-90 as discussed under KMA 2. Idaho DEQ reached its conclusions regarding the benefits of an infiltration barrier on engineered barrier performance by reviewing grouting literature (both DOE and independent research) that describes grouting longevity and various methodologies used for stabilizing residual tank waste (Hardesty, 2006). Note that Big Lost River seepage and underflow may also affect TFF vault and tank degradation, providing a driving force for increased infiltration of deleterious species into cracks that may form in these structures. However, the direct contribution Big Lost River underflow and seepage has on flow in the vicinity of the TFF is uncertain.

DOE Idaho selected a preferred remedial alternative for contaminated soils and groundwater at the INTEC under the CERCLA program that includes an infiltration-reducing cap and worker protection cap (DOE Idaho, 2006d). The U.S. Environmental Protection Agency and Idaho

DEQ concur with DOE Idaho's selection. The infiltration-reducing cap is less than 0.3 m [1 ft] thick and will consist of a 10-cm [4-in] infiltration-reducing layer and a 15-cm [6-in] layer of gravel constructed over the existing tank farm soils. The cap will have a minimum slope of one percent and a concrete drainage collection ditch for surface water runoff. This cap requires ongoing) maintenance (e.g., patching to ensure its effectiveness and lift stations to remove surface water accumulating in low areas and to transport this water to a lined evaporation pond (see Figure 1). The worker protection cap varies in thickness from 1.8 m [6 ft] at the edges to 5.5 m [18 ft] at the crown and will protect workers from external exposures, as well as reduce water infiltration and prevent biointrusion (see Figure 2). This type of cap requires less maintenance than the infiltration cap because it minimizes recharge by storing moisture and returning it to the air using plants and evaporation.

The preferred alternative will be implemented in stages with the worker protection cap constructed on top of the infiltration-reducing cap over the central tank farm once the interfering infrastructure is demolished (DOE Idaho, 2006d).

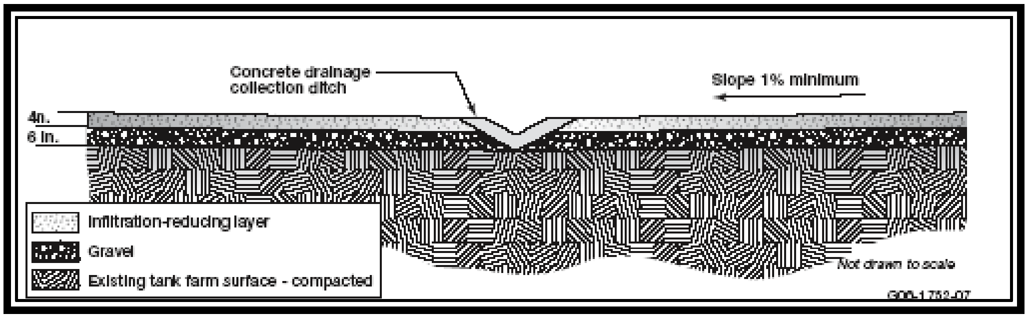

Figure 1. Conceptual Design Features of the Infiltration-Reducing Cap

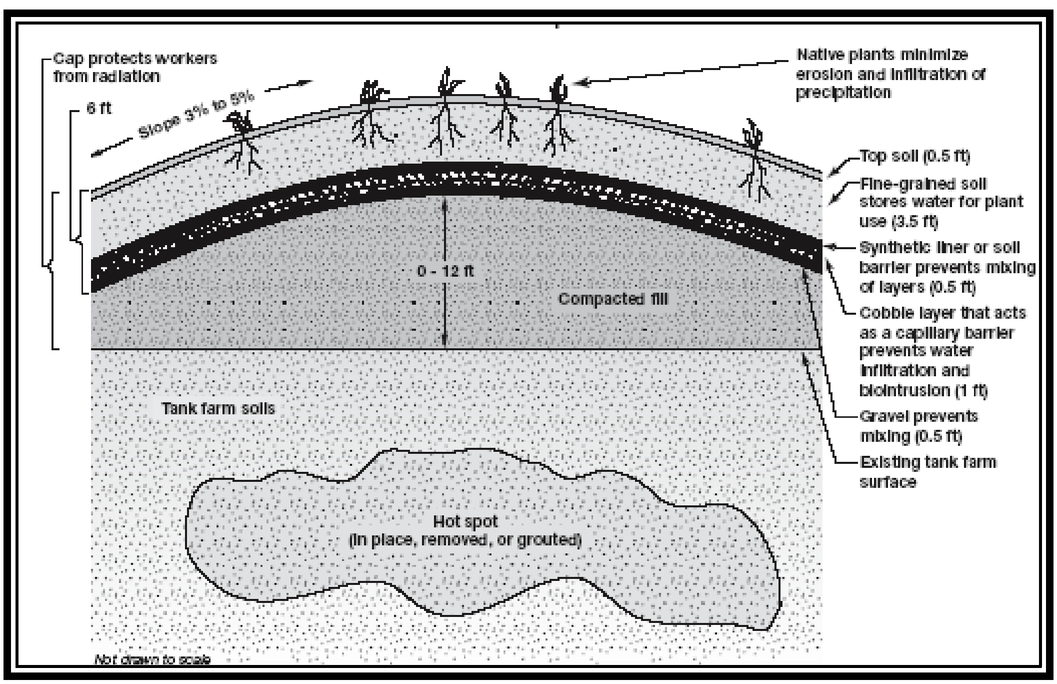

Figure 2. Conceptual Design Features of the Worker Protection Cap

DOE Order 435.1 requires that the environmental monitoring program for the disposal facility be designed to include measuring and evaluating releases, migration of radionuclides, disposal unit subsidence, and changes in disposal facility and disposal site parameters that may affect long-term performance. Although the infiltration barrier will affect long-term performance of the disposal facility, DOE Idaho did not take credit for a robust engineered barrier in its PA (DOE Idaho, 2003); therefore, it is not clear whether DOE plans to monitor the infiltration barrier installed under the CERCLA program. Nonetheless, NRC staff should remain cognizant of activities related to construction and maintenance of the infiltration-reducing cap to ensure that it will be properly constructed to reduce infiltration to levels equal to or below those assumed in the PA model (DOE Idaho, 2003). Technical reviews should focus on design, construction, and maintenance activities during the institutional control period. This will ensure the engineered barrier can mitigate the releases of short-lived radionuclides into the environment.

The main concern is to ensure that failure of the barrier does not create a situation that enhances infiltration into the facility beyond what would naturally occur. NRC staff should review any projected water balance analysis associated with the infiltration control design. Components of the water budget would include precipitation, surface drainage and runoff, evapotranspiration, subsurface drainage away from the vaults, cap water storage, and infiltration. Attention should be paid to the seasonal variation in precipitation and infiltration (e.g., increased infiltration from spring snowmelts) and evapotranspiration. Staff should be cognizant of final construction of the surface barrier as either one closure cap covering all of the TFF boundary or constructed in sections over the TFF during and following closure. Changes in the gradation at the surface and within the hydrologic barrier due to erosion or nonuniform subsidence between the areas covering the TFF should be investigated to ensure that these processes are not negatively affecting system performance. Staff should understand how the engineered surface barrier is designed, constructed, and performs over time.

The technical review activity shall be considered closed when sufficient support demonstrates that PA assumptions regarding infiltration rates in the compliance case are effective during and possibly beyond the assumed institutional control period. Drainage, runoff, and infiltration rates of the final closure cap may be measured and monitored for a designated time period to fully substantiate the model assumption concerning infiltration rates at the TFF. Various techniques related to monitoring moisture content in the unsaturated zone are discussed under KMA 2. These techniques can be used to ensure the cap is functioning as designed.

3.1.5 Performance Assessment Process Review

DOE performance assessment is a critical element for demonstrating compliance with the performance objectives for 10 CFR 61.41 and 42 because it considers the types of releases that could occur, transport of radionuclides through the environment, and doses to humans. In its PA for the INTEC TFF, DOE undertook a series of sequential analyses to predict doses that a hypothetical residential farmer could receive. Specifically, DOE performed the following analyses: (i) DUST-MS (Sullivan, 2001) was used to estimate the rate of release of radionuclides; (ii) the flux of radionuclides calculated leaving the source area were then input into the PORFLOW code, which was used to analyze their transport through the unsaturated and saturated zones to a hypothetical well; and (iii) a DOE-developed FORTRAN program calculated the resulting all-pathway doses.

With respect to the PA model, NRC staff identified a number of issues with the release and groundwater submodels. These concerns included the following:

- Orientation of the model—NRC staff analysis of perched water levels, structure contour maps, and the geometry of the Big Lost River in relation to the TFF revealed that the two-dimensional PORFLOW model should have been more appropriately oriented in a northwest-to-southeast versus north-to-south orientation.

- Discretization of model—NRC staff analysis of DOE Idaho's PORFLOW model revealed that the discretization of the hydrostratigraphy (i.e., sedimentary interbeds) may have artificially created thicker, more continuous low permeability zones. In general, discretization of hydrostratigraphic layers can significantly affect constituent travel distances and times.

- Calibration of model—It was not clear to NRC staff whether DOE Idaho's PORFLOW model was well calibrated to water-level or analytical measurements. In fact, monitoring data appeared to be inconsistent with model predictions. Additionally, DOE Idaho did not consider or address pertinent analytical data that would provide more confidence in DOE Idaho's model and model predictions. Future analyses should consider insights gained through evaluation of historical releases. Additional data is also needed to support the assumed Big Lost River seepage and underflow rates that significantly affect contaminant flow and transport and potentially engineered barrier system performance.

- NRC staff also recommended that DOE Idaho continue to evaluate and enhance radionuclide release models for grouted systems, which may include assessing (i) the applicability of the K_d approach, (ii) the appropriateness of using cementitious material K_ds for waste that may not be thoroughly mixed with the poured grout, (iii) the need for leaching experiments on expected wasteforms in the potential range of physical and chemical conditions, and (iv) grout pore water chemistry effects on future releases from the TFF.

Although not required to demonstrate compliance with performance objectives, given the nature and extent of these issues and new insights gained from other assessments at INL, DOE may revise or update its PA model to support future waste determinations at INTEC. Further, DOE Order 435.1 requires that DOE's PA be reviewed and revised when there are changes in its waste form or containers, radionuclide inventories, facility design or operation, or closure concepts or there is an improved understanding of facility performance. On at least an annual basis, DOE should determine the continued adequacy of its performance assessment considering the results of data collected and analyses from research, field studies, and monitoring.

Given the importance of the PA to the performance demonstration, NRC staff must evaluate the adequacy of future revisions and updates to DOE PA. Presumably, revisions to the PA should be developed to provide greater confidence in the results. However, even an analysis that is intended to be conservative may be nonconservative in some areas. Previous PAs completed by DOE for the INTEC TFF have been deterministic analyses. Accordingly, any future revisions or updates to the PA may also be deterministic. If so, it is important for the analysis to appropriately account for uncertainty in demonstrating that the performance objectives will be met. Therefore, NRC staff review of PA revisions must ensure the PA adequately demonstrates that the performance objectives can be met. Sensitivity and uncertainty analyses can be especially useful in determining the effects and importance of changes to the performance assessment model(s). In reviewing updates or revisions to DOE's PA, NRC staff should evaluate how DOE has addressed the issues listed above.

DOE may continue to revise its PA throughout its waste disposal activities and into facility closure. DOE may develop a final PA to represent the updated HCM and consider the final design of the infiltration barrier constructed as part of the final action under the CERCLA program. Thus, activities related to reviewing DOE's PA may continue through closure of the INTEC TFF.

3.1.6 Review of Environmental Data

Environmental monitoring is a relatively direct method of assessing compliance with the performance objectives in 10 CFR Part 61, Subpart C (i.e., concentrations of radionuclides in the environment can be used to assess potential doses to receptors using an exposure model or using concentration to dose ratios calculated from risk model results). However, analysis of direct environmental monitoring data at INTEC is confounded by the presence of significant radioactivity released into the environment from accidental leaks and direct injection of radioactivity into the SRPA. Additionally, because NRC must assess compliance with today's performance objectives based on PA modeling predictions of natural and engineered barrier performance over a long time frame (e.g.,10,000 years), collection of short-term, environmental data when a receptor may be exposed thousands of years in the future is of limited use. Nonetheless, other types of environmental data collected by DOE, other agencies, and independent researchers is also valuable with respect to validating long-term PA model predictions. For example, as discussed in Sections 3.1.2 through 3.1.4, NRC staff should review all types of environmental monitoring data (e.g., moisture content within or underneath engineered barriers, suction lysimeter and perched groundwater analytical data, Big Lost River seepage rates, neutron moisture logging data to estimate infiltration rates) DOE collects to both evaluate hydrogeological conceptual model uncertainty and alert NRC of potential early failure. Performance indicators such as changes in alkalinity below the TFF can be used as an early warning system of potential failure of the engineered barrier system (e.g., early warning of preferential flow paths through the engineered barrier system).

Because the subsurface at INTEC is contaminated, NRC staff must evaluate baseline monitoring and trend data to identify and evaluate significant changes in geochemical data. A significant amount of groundwater monitoring data has been collected at INTEC to characterize the subsurface, to provide data for three-dimensional modeling implementation and calibration to estimate risks to potential receptors, and as part of remedial alternative selection for INTEC under the CERCLA program. For example, a record of decision[2] (ROD) for INTEC perched water was completed in 1999. This ROD requires that perched water zones be monitored to assess perched water drain out and downward contaminant flux to the SRPA. The "Long-Term Monitoring Plan for OU–3–13, Group 4 Perched Water" specifies the wells to be sampled, as

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[2]A legally binding public document that identifies the remedy that will be used at a group of sites under the CERCLA program and explains why this remedy was selected. Public comments on remedial alternatives are also addressed in this document.

well as the required field and laboratory parameters, to satisfy ROD requirements. More information regarding the monitoring plan and DQOs for monitoring can be found in the latest report entitled "Annual INTEC Water Monitoring Report for Group 4–Perched Water" (2005) published in January 2006 (DOE Idaho, 2006d). Additionally, groundwater sampling will be performed as part of the remedial alternative for saturated groundwater. An updated Remedial Investigation/Baseline Risk Assessment (DOE Idaho, 2006c), Feasibility Study (DOE Idaho, 2006d), and Proposed Plan (DOE Idaho, 2006e) for remediation of INTEC soils and groundwater under the CERCLA program were completed in 2006. An ROD is expected to be issued in 2007. Following issuance of this ROD, DOE will develop a plan for INTEC that will list the DQOs for monitoring. The monitoring plan will specify the locations, frequency, field, and laboratory parameters to be sampled, as well as the quality assurance procedures to be followed as part of the monitoring program.

NRC staff should particularly note environmental data that serve as performance indicators to evaluate engineered barrier performance. These data reviews should be coordinated with reviews of KMAs 2 and 3 discussed previously. NRC staff should become familiar with groundwater conditions at the site (e.g., INL groundwater is oxidized and slightly basic). Geochemical changes such as increasing trends in pH or concentrations of more mobile species such as Tc-99 (the bulk of mass of more mobile species have already been transported away from the near-field environment at TFF) in moisture samples obtained directly underneath the TFF may be an early indication of cementitious material degradation. Likewise, increasing concentrations of Sr-90 in suction lysimeters or perched groundwater may also signal problems with engineered barrier performance. As discussed in Section 3.1.1, NRC staff should also monitor the relative mobility of key groundwater constituents identified in NRC's independent modeling (e.g., U-234, Am-241, and Np-237). Although these constituents have not been detected in perched water samples to date, these constituents may be slightly less mobile than other constituents such as Sr-90 that are pervasive in perched water today or may become a greater risk in the future due to increased activity from in-growth over time (e.g., Np-237). Thus, analysis of groundwater trend data collected under the CERCLA program will be a useful tool in evaluating key modeling assumptions and assessing compliance with the 10 CFR 61.41 performance objectives. Figure 3 shows locations of monitoring well and suction lysimeters at INTEC.

Idaho DEQ also conducts an environmental monitoring and survelliance program on and around the INL site (see Figure 4 for monitoring well locations). The Idaho DEQ environmental monitoring program includes collecting air, water (surface water and groundwater), soil, and milk samples. This data collection allows an evaluation of impacts of radioactivity releases from INL facilities and provides information regarding potential pathways of exposure. This monitoring data may be of less use to NRC in assessing compliance with 10 CFR 61.41 (due to the scale of monitoring), but may be more useful in assessing compliance with 10 CFR 61.43 (see Section 5.1.2). A team led by S.M. Stoller Corporation collects monitoring data and compiles an

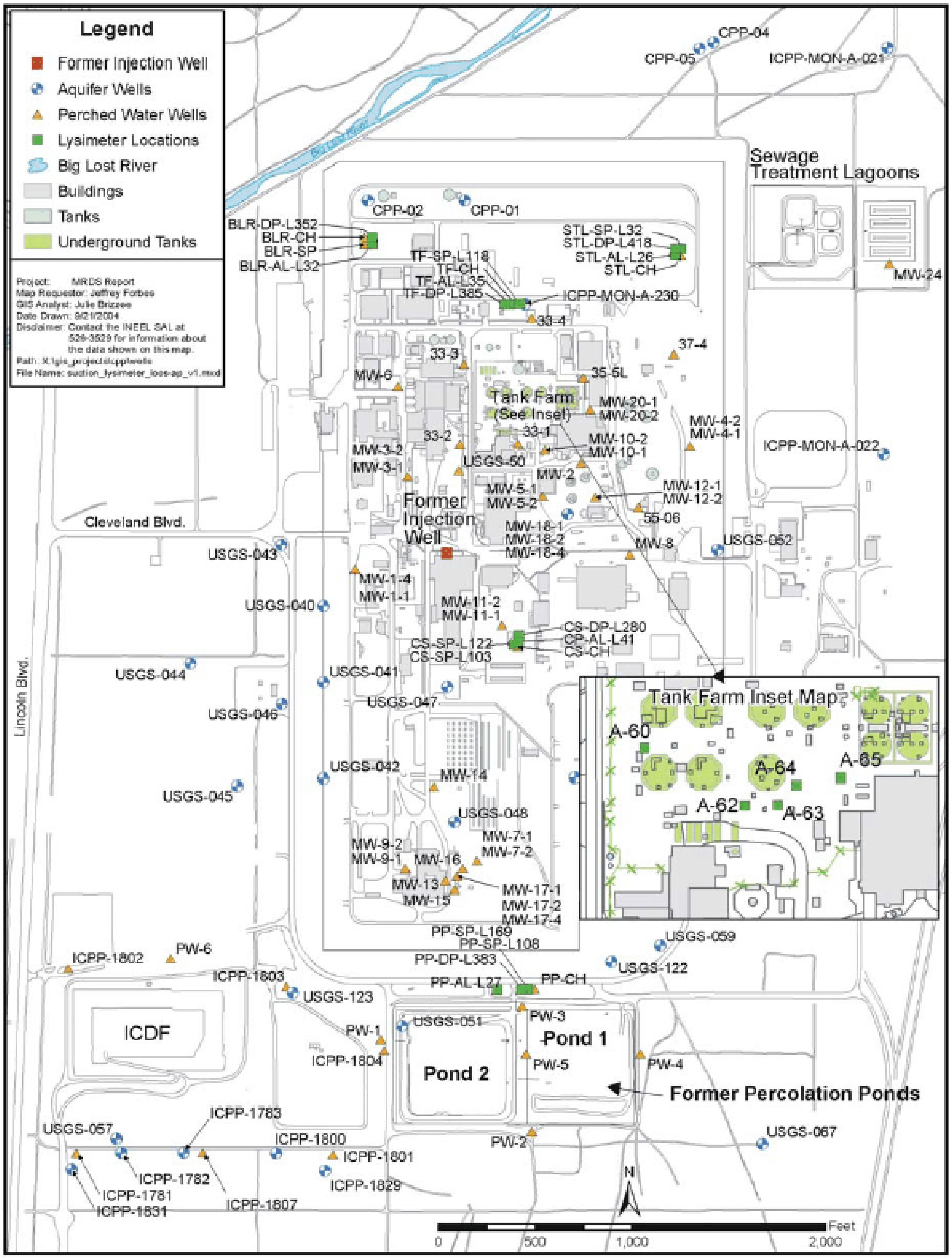

Figure 3. INTEC Monitor Well and Lysimeter Locations (Taken From DOE Idaho, 2006f)

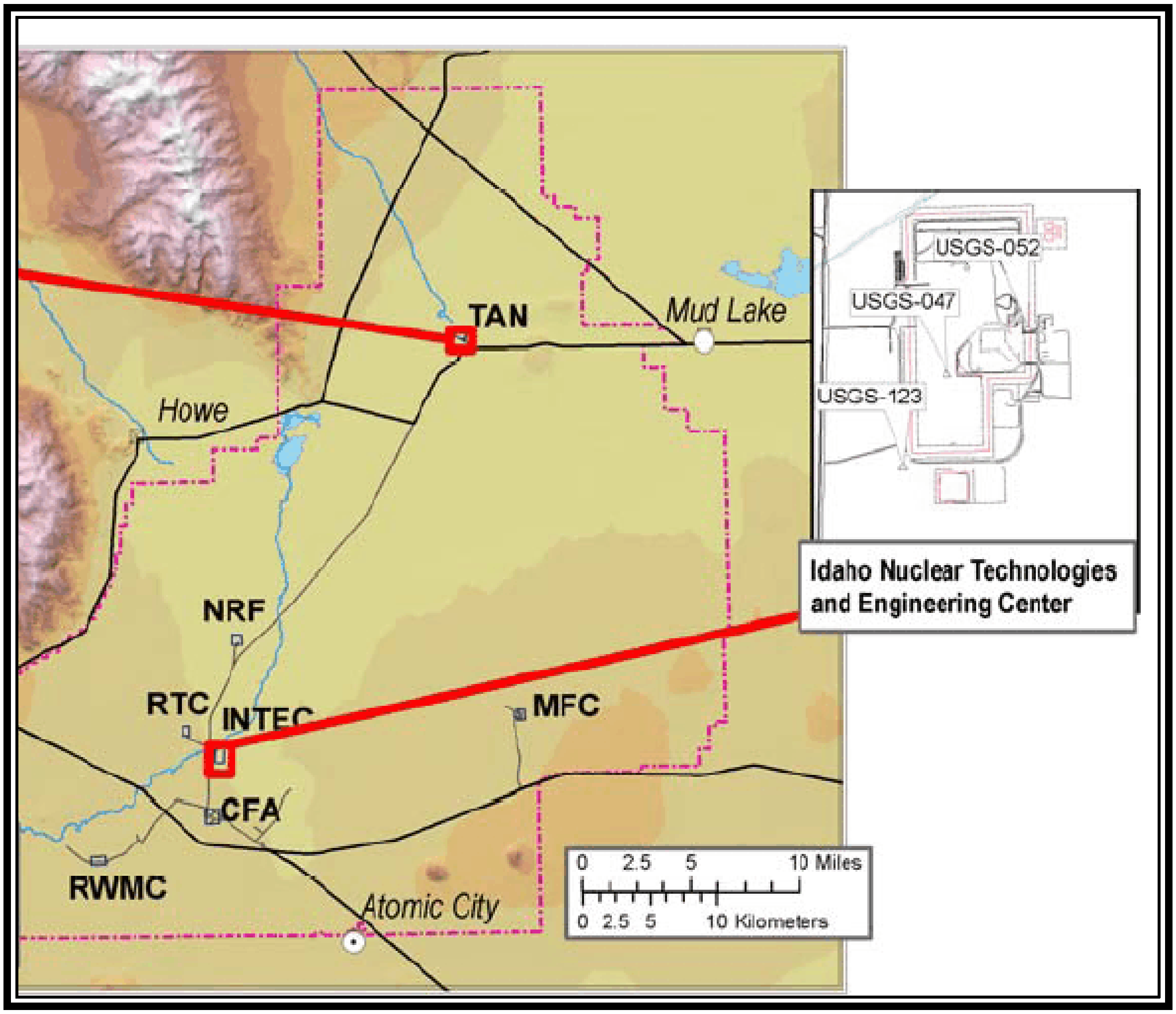

Figure 4. Idaho DEQ Monitoring Locations (http://www.deq.state.id.us/)

annual report for DOE Idaho. The last report published as of the date of this monitoring plan is entitled "Idaho National Engineering and Environmental Laboratory Site Environmental Report Calendar Year 2004." DOE Idaho concluded that radioactivity from current operations could not be distinguished from worldwide fallout and natural radioactivity in the region surrounding the INL site. The 2005 report is expected to be published during the first quarter of 2007. Additionally, the Management and Operating (M&O) contractor is responsible for monitoring effluents from operating facilities.

Monitoring will continue for an indefinite period under the CERCLA program. The monitoring program for INTEC is quite extensive and should meet the needs of NRC staff in monitoring short-term performance of engineered barriers. This data has also been used (and should continue to be used) by NRC staff to address hydrogeological uncertainty at INTEC (NRC, 2006b). NRC staff evaluating this monitoring area should remain cognizant of the future monitoring plan that will address soil and SRPA contamination under the CERCLA program once a final ROD is issued. Changes made to INTEC monitoring plans over time should be evaluated to ensure that DOE's monitoring program can adequately assess compliance with

10 CFR Part 61, Subpart C, performance objectives. If the scope of monitoring under the CERCLA program does not appear adequate, then NRC staff should determine whether hydrological uncertainty has been adequately constrained in DOE's performance assessment modeling or additional information is needed to provide confidence in long-term modeling predictions.

The review of environmental data to assess compliance with 10 CFR 61.41 will be an open issue at the onset of monitoring and will remain open indefinitely. The environmental monitoring data should be reviewed annually, and the conclusions should be included in the annual monitoring report (it may be necessary to review quarterly reports because annual reports for the previous year may not be available until the year after sampling). It is anticipated that the initial reviews of DOE's monitoring plans, which include the DQOs for monitoring, will require more effort on the part of NRC staff, but in subsequent years, only review of monitoring data collected and analyzed in accordance with these plans will be necessary.

3.2 Onsite Observations

3.2.1 Residual Waste Sampling (KMA 1)

As discussed in Section 3.1.1, the inventory of radionuclides disposed of in the INTEC TFF is important to assessing compliance with 10 CFR 61.41. To accurately estimate the postcleaning inventory disposed of in tanks WM-187 through WM-190 (and the contaminated tank WM-187 vault), DOE Idaho must obtain quality solids data from these tanks (and vaults) subsequent to cleaning activities scheduled to be completed by 2012. This onsite observation supports the technical review described for KMA 1 in Section 3.1.1. Thus, technical review efforts performed for waste sampling under KMA 1 should be coordinated with onsite observations of waste sampling that are performed to evaluate whether samples are being collected in accordance with SAPs and the quality of data is sufficient to meet DQOs. NRC staff should also observe DOE Idaho's use of video equipment to estimate solids residual depths; this is used as input data for the kriging analysis that estimates the residual volume in the cleaned tanks.

This monitoring activity supports KMA 1 "Residual Waste Sampling;" therefore, the status of this monitoring activity should be open after the INTEC TFF final waste determination is issued. This onsite monitoring area can be closed with KMA 1, after cleaning activities and subsequent postcleaning sampling activities are completed for tanks WM-187 through WM-190.

3.2.2 Grout Formulation, Sampling, and Placement (KMA 2)

For 10 CFR Part 61.41, "Protection of the General Population," NRC staff should evaluate DOE's final grout formulation used to stabilize the TFF waste for consistency with design specifications assumed in the final waste determination (DOE Idaho, 2006g). Significant deviations from the design specifications should be evaluated to ensure the expected grout performance will not be negatively affected. In addition, NRC staff should evaluate DOE's program for sampling, testing, and accepting grout materials to ensure the materials conform to DOE specifications and national standards, such as ASTM C–989. The verification program should incorporate a comprehensive record-keeping system to include, for example: (i) plant operation records, (ii) ground granulated blast furnace slag production records, (iii) laboratory test results of composite or grab samples, and (iv) certification of shipping records. The sulfur sulfide content listed in DOE vendor slag specifications should sufficiently ensure a reducing environment in the tank grout, as determined by laboratory measurements of the reducing capacity of the grout formulation.

During onsite observations, NRC staff should verify that the actual grout formulation DOE uses to stabilize the tank waste is consistent with the formulation specified in the waste determination. Also, NRC staff should evaluate the adequacy of the verification program pertaining to its supply of grout components, such as blast furnace slag. NRC staff's evaluation should be based, to the extent practicable, on direct observation of ongoing activities and interviews with key DOE personnel. The review should evaluate certain aspects of the program, such as

- Representativeness of the samples collected
- Adequacy of the analytical equipment
- Calibration of the analytical equipment
- Adequacy of verification records

To minimize the degradation in the quality and chemical reactivity of the slag and Portland cement, the material must be stored in weather-tight silos or bins to prevent contact with moisture. During onsite observations, NRC staff should examine the silos or bins for storage of the slag and cementitious materials. This monitoring activity supports KMA 2 "Grout Formulation and Performance"; therefore, the status of this monitoring activity will remain open until KMA 2 is closed (see Section 3.1.2).

In addition to the grout formulation, curing conditions are also expected to have a significant effect on the short- and long-term performance of the emplaced grout. Numerous studies have shown that improper curing results in a variety of undesirable effects, such as lower strength, high permeability, and several types of cracking. For example, early age cracking could occur due to thermal and self-dessication stresses. Thus, staff performing onsite observations should verify grout placement is conducted under proper temperature and humidity conditions, or that steps are taken to ensure proper curing of the grout.

3.2.3 Engineered Surface Barrier Construction (KMA 5)

As discussed in Section 3.1.4, the proposed engineered cap that will be constructed over the TFF will serve multiple purposes, including (i) limiting infiltration into the tanks and tank facility, (ii) protecting workers, and (iii) slowing the degradation of the grouted tanks and tank system. In terms of demonstrating compliance with the requirements of 10 CFR 61.41, because the vaults are assumed to remain intact for 100 years within the PA, the cap is expected to have some bearing on the ability of the facility to achieve that goal.

A conceptual design for the cap is described in Section 3.1.4 (see Figure 2). However, the final cap design may change before cap installation begins. Any changes in the cap design should be evaluated in terms of their effect on the performance demonstration. This should be undertaken as part of the activities under Section 3.1.4. Staff should also be cognizant of cap design changes based upon site observations or through discussion with DOE staff.

Assuming that the final cap design is consistent with the features described in Section 3.1.4, the infiltration barrier is expected to require active maintenance to ensure its effectiveness, at least until the final cap is constructed. For example, the cap is expected to periodically require patching. Further, lift stations will be used to remove surface water accumulating in low areas and will transport it to a lined evaporation pond. NRC staff, as part of onsite observation activities, should evaluate the effectiveness of maintenance activities on the cap. This may provide insights on long-term cap performance.

NRC staff will monitor construction and maintenance activities of the cap throughout the institutional control period as maintenance of the cap may provide valuable information on the long-term performance, which could be important to protecting members of the public (i.e., 10 CFR 61.41).

3.2.4 Environmental Sampling

As discussed in Section 3.1.6, NRC staff review of environmental data collected by DOE Idaho is important to assess compliance with performance objectives in 10 CFR Part 61, Subpart C. Review of environmental data provides a straightforward method of determining whether doses to members of the public meet dose-based criteria [e.g., 0.25 mSv/yr [25 mrem/yr] total effective dose equivalent to a member of the general population from releases of radioactivity from the disposal facility], as well as valuable information to provide confidence in long-term modeling predictions that are used to demonstrate compliance with performance objectives. The onsite observation of DOE's environmental sampling program supports the data review discussed in Section 3.1.6. NRC staff should be cognizant of results of onsite observations of environmental sampling programs to ensure that samples are collected in accordance with SAPs and that the quality of data is sufficient to meet DQOs established for sampling. NRC staff's evaluation of environmental sampling should be based, to the extent practical, on direct observation of ongoing activities and interviews with key DOE personnel. The review could include evaluation or direct observation of certain aspects of the environmental sampling program such as

- Installation of wells, lysimeters, or piezometers
- Well development
- Well purging
- Sample collection, preservation, storage, and shipment
- Management of investigation-derived wastes
- Quality assurance and control

Types of documentation NRC staff could review prior to the onsite observation include DOE Idaho standard operating procedures related to instrumentation installation and sampling (e.g., Technical Procedure 6572, "Installing Lysimeters and Sampling Soil Pore Water;" GDE–126, "Measuring Groundwater Levels;" GDE–127, "Sampling Groundwater;" GDE–162, "Decontaminating Sampling Equipment") and relevant well installation and monitoring plans as discussed in more detail next.

New well construction may be observed to ensure that quality groundwater data are collected to assess compliance with performance objectives. All new wells are installed in accordance with monitoring installation plans. For example, new INTEC wells were recently installed under the

“INTEC 2005 Monitoring Well Installation Plan.” This plan provides information regarding the selection of well locations (e.g., based on colloidal boroscope monitoring well results that provided flow direction information away from the contaminated zone), drilling methods (e.g., air rotary drill), downhole geophysical logging (e.g., video, gamma, caliper, and neutron moisture logging), management of investigation-derived wastes (e.g., management of contaminated drill cuttings, aquifer and perched purge water, personal protective equipment, and equipment), and document management (e.g, field log books, chain of custody forms, sample packaging for shipment to analytical laboratories) related to well installation and associated sampling. NRC staff should review this information prior to the onsite observation and observe well installation activities (e.g., drilling, geophysical logging, development, and waste management) against applicable DOE Idaho procedures and provisions discussed in the installation plans. Wells should be constructed properly to ensure that vertical cross-contamination is avoided. Information obtained during downhole logging (e.g., identification of stratigraphy, fracture zones, perched zones) provides valuable litho- and hydrostratigraphic information that can be used to identify zones to be targeted for monitoring, as well as information that can be used to construct complex groundwater models. Following well installation, NRC staff can compare well construction information regarding screen depths with geologic interpretations of the subsurface at INTEC to ensure that wells are screened in the proper or intended locations (e.g., upper perched zones, lower perched zones, or upper SRPA). NRC staff may also want to review well completion reports or other documentation for the existing well network to verify that older wells were installed and are functioning properly. Field data obtained during sampling (e.g., field notes, purge volumes, and water quality parameters) can be reviewed for all wells to ensure that sample data obtained from these wells is of sufficient quality.

NRC staff can also prepare for onsite observations of DOE Idaho’s environmental sampling program by reviewing relevant monitoring plans (e.g, “Long-Term Monitoring Plan for Operable Unit 3-13, Group 4, Perched Water”) that provide important information regarding constituents of concern to be monitored, frequency of sampling, and types of groundwater samples to be taken (e.g., analytical measurements or water levels from wells, piezometers, and suction lysimeters and soil matric potential from tensiometers and pressure transducers). NRC staff should focus on ensuring that sampling procedures, field quality assurance (e.g., field duplicates, equipment blanks, field blanks), laboratory quality assurance (e.g., calibration, laboratory control samples, matrix spikes), and other quality assurance and control plans are in place and followed. Because most analytical analyses are performed at offsite laboratories (e.g., General Engineering Laboratory in Charleston, South Carolina), NRC staff may not be able to directly observe laboratory quality assurance and control programs, but can review sample preparation and shipment documentation for transport to an offsite laboratory and possibly laboratory statements of work or contracts to ensure these programs are in place. NRC staff should ensure that groundwater samples are appropriately obtained in accordance with relevant site procedures and SAPs (e.g., the wells are purged and water quality parameters are checked and are within limits).

INTEC monitoring of perched water currently occurs on a monthly basis. The frequency of monitoring activities will be revisited in a five-year review (monitoring initiated in 2005). NRC staff should review the monitoring plan for soils and groundwater at the INTEC TFF once it is completed and any other relevant monitoring plans (e.g., Idaho DEQ monitoring program discussed in Section 1.3 and pertinent M&O facility monitoring).

Observation of the environmental sampling will be an open issue at the onset of monitoring and will remain open indefinitely. NRC staff should use a graded approach in determining the level of effort expended in performing onsite observations of DOE Idaho's environmental sampling program. NRC staff may be able to rely on Idaho DEQ's oversight program to address this monitoring area. As always, NRC staff should also coordinate any onsite observations of the environmental sampling program with other onsite observations to reduce the number of trips and burden on DOE to the extent practical. The results of the onsite observations should be documented as discussed in Section 7.1.

3.2.5 Site Access Control

While performing onsite observations, NRC staff should assess the measures DOE takes to control access to the site to understand the type of individuals that could become exposed. This assessment can be made through various means. One approach may be for the staff to interview members of DOE's security department and review cognizant records and reports. In addition, staff may decide to tour portions of the facility to ensure that fences and other barriers designed to prevent access to the site are intact and performing as designed. Other approaches may be developed over time, as NRC and DOE gain experience in this arena.

3.3 Potential Long-Term Compliance Monitoring

Probabilistic performance assessment may allow results which have a low likelihood of occurring, but relatively high consequences. Epistemic uncertainties can include unexpected failure modes, design and construction errors, as well as analysis errors, which are difficult to bound in any manner. Significant, low probability events may occur and cause changes to the overall conceptual model of the facility. A long-term environmental monitoring plan normally is designed and implemented to detect substantial deviations from expected disposal system performance after operations. Such a monitoring plan would be implemented after final facility closure, but would be developed before and at closure using and incorporating the results of data collected under the preclosure monitoring program. The environmental monitoring activities would focus on environmental sampling and data, usually monitoring the groundwater at various monitoring points (see Section 3.1.6). Potential long-term compliance monitoring activities may include changes in groundwater levels, in the groundwater flow direction, and hydrogeochemistry. If contaminants are in the saturated zone due to intentional or unintentional preoperational releases as is the case at INL, the existing groundwater plume may be used to monitor changes to the groundwater system. Environmental monitoring activities may also include tracking changes in the unsaturated zone or changes in soil gases.

Potential long-term compliance monitoring activities for the INTEC TFF could include more than environmental monitoring activities. The infiltration barrier could be subject to long-term monitoring activities. If the model assumptions pertaining to infiltration can only be partially substantiated or if other barriers are not expected to perform as well as assumed in the PA, then NRC staff may recommend longer term monitoring activities after the engineered surface barrier is built. Depending on the technology and knowledge at the time of cap construction, drainage, runoff, and infiltration rates of the final closure cap may be measured and monitored for a designated time period to fully substantiate the model assumption concerning vault infiltration. For example, at present, test-pad lysimeters are generally reliable to test minimal infiltration rates of less than a few mm/yr for extended times.

4 MONITORING TO ASSESS COMPLIANCE WITH 10 CFR 61.42—PROTECTION FROM INADVERTENT INTRUSION

10 CFR 61.42—Protection of individuals from inadvertent intrusion.
"Design, operation, and closure of the land disposal facility must ensure protection of any individual inadvertently intruding into the disposal site and occupying the site or contacting the waste at any time after active institutional controls over the disposal site are removed."

4.1 Technical Reviews

No key monitoring area (KMA) important to assessing compliance with 10 CFR 61.42 was specifically identified in the U.S. Nuclear Regulatory Commission's (NRC's) technical evaluation report (TER) for the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) (NRC, 2006b); however, several KMAs addressed for 10 CFR 61.41 are important to demonstrating compliance with this performance objective as well. In general, erosional processes are an important factor to consider in assessing compliance with 10 CFR 61.42, because erosion can expose contamination and provide additional pathways of exposure and increased dose to inadvertent intruders. However, as discussed in NRC's TER for the TFF (NRC, 2006b), Idaho National Laboratory is located in a depositional environment, and erosion is not expected to be a concern at the site. Furthermore, the preferred remedial alternative under the Comprehensive Environmental Response, Compensation, and Liability Act program includes an engineered cap for the INTEC TFF, which is expected to provide an additional barrier to further mitigate potential intrusion into the waste disposal facility.

Technical review of residual waste sampling results (KMA 1) is being monitored (see Sections 4.1.1 and 4.2.1) to assess compliance with 10 CFR 61.41. Review of residual waste sampling results is also pertinent to assessing 10 CFR 61.42 compliance, as the residual inventory affects the U.S. Department of Energy's (DOE's) ability to meet the performance objective related to inadvertent intrusion. Thus, the status of the residual waste sampling technical review under 10 CFR 61.41 is directly tied to the status of technical reviews discussed in this chapter. If the status of the residual waste sampling technical review area (Section 3.1.1) and related onsite observation area (Section 3.2.1) are closed and compliant under 61.41, then the status of inadvertent intruder performance objective will be considered closed and compliant.

Residual waste sampling (KMA 1) is particularly relevant for assessment of compliance with 10 CFR 61.42 as discussed in Section 3.1.1. Significantly higher concentrations of Cs-137 in uncleaned tanks WM-187 or WM-188 could potentially lead to intruder doses above 5 mSv/yr [500 mrem/yr], which is the dose limit NRC uses to assess compliance with 10 CFR 61.42 (NRC, 2006a). The inventory for Cs-137 is a good indicator of the expected intruder dose because it dominates the intruder scenarios. The inventory of Cs-137 assumed for a bounding single tank is 1140 Ci. The final inventory for tank WM-187, which contains a contaminated sand pad, should be evaluated against this bounding single tank inventory. The largest combined inventory from the tank and sand pad for tank WM-185 is 2,800 Ci. Because tank WM-188 does not have a contaminated sand pad, the tank inventory for WM-188 should be compared to the combined Cs-137 inventory of 2800 Ci to assess whether further investigation related to intruder dose from uncleaned tanks is necessary. Other highly radioactive radionuclides (HRRs) related to the intruder risk are Am-241, Pu-238, Pu-239, Sr-90, and

Np-237. If the estimated inventory for these HRRs is significantly higher based on postcleaning sampling for tanks WM-187 through WM-190, then the reviewer should investigate the impact of the increased inventories on the predicted intruder dose.

Because it provided the computational basis for showing compliance, DOE's intruder analysis is a critical component of its demonstration of compliance with the protection of inadvertent intruder performance objective (i.e., 10 CFR 61.42). In its waste determination for INTEC TFF, DOE evaluated both acute and chronic radiological impacts for an intruder-well drilling and intruder-construction scenario. As discussed in NRC TER (NRC, 2006b), DOE appropriately demonstrated that the requirements for protection against inadvertent intrusion will be achieved. As noted in the TER (NRC, 2006b), results from the intruder analysis were sensitive to assumptions regarding inventory and the assumed distribution of this inventory over the exposure area.

Future revisions or updates to the intruder analysis may be warranted if DOE changes its inventory estimates or closure plans. NRC staff will need to be cognizant of any increases in the projected inventory and consider the impacts of these increases on DOE's performance demonstration. A projected increase in the inventory could occur if DOE is not able to retrieve as much waste from the remaining uncleaned tanks (i.e., tanks WM-187 through WM-190) as planned. The projected inventory could also increase if a new, future method is found for characterizing the inventory in the tank WM-187 sand pad and the inventory is found to be higher than assumed in DOE's performance assessment.

4.2 Onsite Observations

Onsite observations related to residual waste sampling (Section 3.2.1) and site access controls (Section 3.2.5) are pertinent to onsite observations that should be performed for assessment of compliance with 10 CFR 61.42. Site access controls are especially pertinent to assessing compliance with 10 CFR 61.42, as DOE relies on institutional controls to prevent inadvertent intrusion into the waste disposal facility for 100 years postclosure in its performance assessment (estimated to be the year 2112). The maximum dose for the intruder scenarios occurs immediately after failure of institutional controls, because relatively short-lived Cs-137 drives the intruder dose and is at its peak activity at this time. If the status of onsite observation areas mentioned above (i.e., residual waste sampling and site access controls) are closed under 10 CFR 61.41 and all are found to be compliant, then the status of the inadvertent intruder performance objective will be considered closed and compliant.

As with any compliance monitoring activity, the status could change from closed to open if new information becomes available or significant events occur that indicate that the monitoring area should be reopened. For example, if at some time in the future visible surface changes occur due to erosional processes, biotic intrusion, earthquakes, or other geological processes that could expose piping or other auxiliary equipment and potentially lead to increased doses or additional pathways of exposure, then NRC may consider reopening this technical review or onsite observation area to understand the effect of these changes on compliance with 10 CFR 61.42.

5 MONITORING TO ASSESS COMPLIANCE WITH 10 CFR 61.43—PROTECTION DURING OPERATIONS

10 CFR 61.43—Protection of individuals during operations.
"Operations at the land disposal facility must be conducted in compliance with the standards for radiation protection set out in part 20 of this chapter, except for releases of radioactivity in effluents from the land disposal facility, which shall be governed by 61.41 of this part. Every reasonable effort shall be made to maintain radiation exposures as low as is reasonably achievable."

5.1 Technical Review of KMA 4

"Closure and post-closure operations (until the end of active institutional controls, 100 years) will be monitored to ensure that the 10 CFR 61.43 performance objective (protection of individuals during operations) can be met. As part of this assessment radiation records, environmental monitoring, and exposure assessment calculations may be reviewed (NRC, 2006b)*."*

KMA 4 identified in the U.S. Nuclear Regulatory Commission's (NRC's) technical evaluation report (TER) for the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) (NRC, 2006b) specifically addresses assessment of compliance with 10 CFR 61.43. 10 CFR 61.43 is directly related to protection of individuals during operations. NRC interprets the term "operations" as those U.S. Department of Energy (DOE) activities related to waste removal, grouting, stabilization, observation, maintenance, or other similar activities. NRC intends to evaluate this KMA from the time that DOE issues its final waste determination until the end of the institutional control period. Assuming that workers will most likely be performing duties on a controlled DOE site under DOE's radiation protection program, the 50 mSv/yr [5000 mrem/yr] radiation worker dose limit will apply. For members of the public, including workers performing limited activities not covered under a DOE radiation protection program, the 1 mSv/yr [100 mrem/yr] dose limit for members of the public will apply. To evaluate this performance objective, NRC staff will review DOE worker radiation records, the as low as is reasonably achievable (ALARA) program, and offsite dose assessment methods and results to assess compliance with 10 CFR 61.43.

5.1.1 Review of Radiation Data

The performance objective in 10 CFR 61.43 for protection of individuals during operations requires that waste disposal activities be carried out such that the radiation protection standards set forth in 10 CFR Part 20 are met and that doses are maintained ALARA. DOE's approach to demonstrating protection of individuals during operations is to cross-walk the relevant DOE regulation or limit found in 10 CFR Part 835 and relevant DOE orders with 10 CFR Part 20. NRC has agreed that an equivalent level of protection is provided by the relevant DOE regulations or limits to the requirements found in 10 CFR 20.1101(d), 10 CFR 20.1201(a)(i), 10 CFR 20.1201(a)(1)(ii), 10 CFR 20.1201(a)(2)(I), 10 CFR 20.1201(a)(2)(ii), 10 CFR 20.1201(e), 10 CFR 20.1208(a), 10 CFR 20.1301(a)(1), 10 CFR 20.1301(a)(2), and 10 CFR 20.1301(b). In addition, NRC has agreed that DOE has applied a number of measures to ensure that exposure of individuals are maintained ALARA.

NRC staff should, on an annual basis, request information from DOE on any violations of 10 CFR Part 835 requirements related to workers and the general public (DOE Order 5400.5) during its waste disposal operations. NRC may also request reports such as incident reports, annual site worker dose reports and site environmental reports for review.

5.1.2 Review of Environmental Data

Tank and auxiliary equipment cleaning and stabilization activities can lead to releases of radioactivity to the environment during waste disposal operations. Monitoring and maintenance activities during postclosure can also lead to releases and potential exposure of members of the public involved in or observing these activities. During closure operations and until the end of the institutional control period (assumed by DOE to be 100 years postclosure), the primary pathway of exposure is expected to be through the air. Because institutional controls will be in place to prevent access to the site and INTEC is located 10 miles from the closest INL site boundary and even further away from the site boundary in the prominent wind direction (from the southwest), releases of radioactivity from the INTEC TFF due to cleaning and stabilization activities are expected to be indistinguishable from other Idaho National Laboratory (INL) sources and background radioactivity levels at the site boundary where a member of the public could be exposed. In fact, based on the “Idaho National Engineering and Environmental Laboratory Site Environmental Report Calendar Year 2004,” DOE Idaho concluded that radioactivity from current operations could not be distinguished from worldwide fallout and natural radioactivity in the region surrounding INL. Nonetheless, NRC staff must evaluate DOE Idaho’s approach to calculating offsite doses to members of the public from disposal facility operations as part of its responsibility to assess compliance with 10 CFR 61.43. The most efficient means of evaluating this performance objective may be through evaluation of DOE Idaho’s bounding analysis for all INL operations. Additionally, members of the public can obtain escorted access to the site; therefore, review of this monitoring area should also entail requesting information from DOE on any exceedances of the public dose limit.

As discussed in Section 3.1.6, DOE Idaho maintains an environmental monitoring program to evaluate the impacts of INL operations on members of the public. The environmental surveillance program includes sampling air, soil, water, vegetation, animals, and foodstuffs on and around the INL site to confirm compliance with applicable laws and regulations. The Management and Operation (M&O) contractor monitors airborne effluents at individual INL facilities (including INTEC) and ambient air outside the facilities to comply with appropriate regulations and DOE orders. Particulate filters are used to monitor gross alpha-, beta-, and gamma-emitting radionuclides such as Am-241, Pu-238, and Pu-239/240. Charcoal cartridges are used to monitor I-131. Tritium is monitored in atmospheric moisture and precipitation. Filters from a network of low-volume air monitors are collected and analyzed weekly for gross alpha and gross beta activity. Filters are then composited quarterly by location for analysis of gamma-emitting radionuclides using gamma spectrometry and for specific alpha- and beta-emitting radionuclides using radiochemical techniques. In addition to the membrane filter samples, charcoal cartridges are collected and analyzed weekly for gaseous radionuclides such as I-131 using gamma spectrometry. Tritium in water vapor in the atmosphere is monitored using samplers located at two onsite locations and five offsite locations (DOE Idaho, 2005).

As discussed in Section 1.3, Idaho Department of Environmental Quality (Idaho DEQ) also maintains an environmental surveillance program [e.g., air, water (surface and groundwater), soil, and milk sampling from on and off the INL site] to help independently evaluate DOE's monitoring and assess environmental impacts from INL facilities. Idaho DEQ publishes quarterly and annual reports that analyze this data. Idaho DEQ has several air and radiation monitoring stations on the INL site. To detect gamma radiation, each station is instrumented with an electret ionization chamber, and 11 of the stations also have high-pressure ion chambers. To the extent that Idaho DEQ continues to independently evaluate environmental data at the site, the NRC staff should leverage the state's evaluation in determining whether or not there have been releases to the environment as opposed to conducting its own review of environmental data. If Idaho DEQ indicates that there have been releases to the environment, then the NRC staff should evaluate the significance of the release to determine whether DOE is meeting the performance objectives.

During the operational period, DOE Idaho must demonstrate that predicted doses to members of the public are less than 10 CFR Part 20 dose limits of 1 mSv/yr [100 mrem/yr] at the site boundary (or to members of the public granted access to the site) from all pathways and less than 0.1 mSv/yr [10 mrem/yr] dose limit for air emissions at the maximum point of impact at the INL boundary. DOE Idaho must also demonstrate that the dose in any one hour in an unrestricted area is less than 0.02 mSv [2 mrem]. DOE must use effluent concentration data described above and pathway analysis to demonstrate compliance with the portion of the 10 CFR 61.43 performance objective pertaining to members of the public. NRC staff should evaluate the quality of the data collected by DOE (e.g., monitoring locations, frequency, analytical methods, quality assurance and control), as well as the dose calculation methods used to estimate doses to members of the public. Information regarding the dose methodology used to calculate doses to members of the public are contained in DOE Idaho's annual site environmental reports (see DOE Idaho, 2005). These reports should be reviewed by NRC technical staff on a periodic basis during the institutional control period. To the extent that the Idaho DEQ continues to collect environmental data (e.g., air and radiation) at the site, the staff should consider using the state's data and analysis to confirm that the public dose limits have not been exceeded.

NRC staff should use a graded approach to evaluating this technical review area. Idaho DEQ's independent environmental sampling program may sufficiently address this technical review area. The review of environmental data to assess compliance with 10 CFR 61.43, the protection of individuals during operations, will be classified as an open issue at the onset of monitoring. This monitoring area can be permanently closed following the end of the institutional control period (100 years after closure of the INTEC TFF). NRC staff should consider independent information to assess the quality of DOE data (e.g., Idaho DEQ environmental monitoring data and data analysis).

5.2 Onsite Observations of KMA 4

As discussed in Sections 3.2.5 and 4.2, NRC staff will perform onsite observations of DOE's program to control access to the site. The effectiveness of access controls is pertinent to assessing compliance with the 10 CFR 61.43 performance objective with respect to determining the exposure pathways and point of compliance for members of the public during operations. NRC staff also plan to perform onsite observations of DOE's radiation protection and environmental sampling programs as indicated next.

5.2.1 Radiation Protection Program

In order to determine the validity of the various reports and records discussed in Section 5.1.1, NRC staff should review, with the aid of key DOE personnel, the Radiation Protection Program (RPP) responsible for producing such reports and records while performing onsite observations.

Through discussions, interviews, and perhaps onsite tours with DOE or DOE contractor personnel, NRC staff should assess whether the programs and policies are consistent with the description presented in the draft waste determination (DOE Idaho, 2005). Specifically, NRC staff should verify that personnel involved in the waste disposal operations are provided dosimetry and are familiar with the requirements of the RPP.

5.2.2 Environmental Sampling

During the operational period, NRC staff may participate in onsite observations of DOE Idaho's environmental sampling program. As discussed in more detail in Section 3.2.4, NRC staff should identify relevant DOE procedures related to environmental sampling to ensure that the quality of data DOE is obtaining is adequate to assess public dose. NRC staff should consider evaluating, at least once, sample locations, frequency, methodology, and collection techniques, as well as quality assurance documentation such as chain of custody forms and sample identification information to understand the overall quality of the program. Given the relevance of the air pathway for evaluating doses to members of the public during operations, NRC staff should consider reviewing data associated with DOE Idaho's onsite meteorological program that is used to collect data for use in air dispersion models (e.g., wind speed and differential temperature to determine stability class).

NRC staff should coordinate onsite observations of environmental sampling with those conducted under Section 3.2.4 or other onsite observations to the extent practical. A graded approach should be used to evaluate DOE Idaho's environmental monitoring program with the level of effort expected to be greater at the onset of monitoring and much less in subsequent years, after NRC staff is confident that DOE Idaho's environmental surveillance program can adequately estimate doses to members of the public. Additionally, Idaho DEQ's independent environmental surveillance program can be used to evaluate the adequacy of DOE Idaho's monitoring program to estimate offsite doses. This onsite observation monitoring area should be closed after the end of institutional controls.

6 MONITORING TO ASSESS COMPLIANCE WITH 10 CFR 61.44—SITE STABILITY

10 CFR 61.44—Stability of the disposal site after closure.
"The disposal facility must be sited, designed, used, operated, and closed to achieve long-term stability of the disposal site and to eliminate to the extent practicable the need for ongoing active maintenance of the disposal site following closure so that only surveillance, monitoring, or minor custodial care are required."

6.1 Technical Reviews

No KMA important to assessing compliance specifically for 10 CFR 61.44 was identified in the U.S. Nuclear Regulatory Commission (NRC) staff's Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) technical evaluation report (TER) (NRC, 2006b); however, the key attribute of the disposal facility responsible for providing site stability is the structural integrity provided by the grout mortar. The structural stability of the TFF relies on grouting the space between the tank and the concrete vault and the space inside the tank. Grout will create a solid monolith with little void space and eliminate differential settlement; significant structural collapse is not anticipated. The process piping will be filled with grout upon facility closure to ensure structural stability, and erosion processes would not be expected to imperil site stability. Monitoring activities to assess compliance with 10 CFR 61.44 will therefore concentrate on the structural integrity of the grout that is being monitored within the technical review and onsite observation areas of another performance objective. Technical reviews of grout formulation and performance, as identified in KMA 2, and onsite grout formulation and sampling reviews will be conducted to determine compliance with 10 CFR 61.41. Compliance or noncompliance with the performance objective for 10 CFR 61.44 is associated with the status of the aforementioned monitoring activities. As with any compliance monitoring activity, the status could change from closed to open if new information becomes available or significant events occur that indicate that the monitoring area should be reopened. For example, new insights on the structural performance of the grout or on dramatic climate changes may indicate that the monitoring activity status would need to be changed. In addition, if minimal surveillance, monitoring, and custodial care are carried out after closure, NRC staff expects to be informed of changes to features in the immediate area that might effect the stability of the disposal site. These changes may include erosional features caused by extreme precipitation events or long-term processes or visible surface changes due to significant biotic intrusion, earthquakes, or other geological processes.

6.2 Onsite Observations

U.S. Department of Energy (DOE) Idaho plans to fill the tanks and vaults with 10 m [33 ft] or more of grout to ensure that the requirements of 10 CFR 61.44 are achieved. The grouted facility is expected to have minimal void space, eliminating concern about differential settlement; NRC should verify this during its observation of the grout pour. Figure 2 shows DOE's conceptual design of the engineered cap for the INTEC TFF. The cap is expected to provide protection against the natural elements and thus help slow facility degradation. In its TER (NRC, 2006b) and as noted previously, NRC staff concluded that DOE Idaho had appropriately demonstrated that the 10 CFR 61.44 performance objective could be met.

As noted previously, NRC staff will rely upon monitoring activities carried out to determine compliance with 10 CFR 61.41. NRC staff will visually observe the facility for obvious signs of failure as part of its normal onsite activities. For example, evidence of ponded water on the cap surface may be a sign of differential settlement. Surface fractures may be evidence of underlying displacement. Staff may also plan site visits to observe the facility after severe weather events (e.g., storms, tornados, etc.) to ascertain how well the facility can withstand these events. DOE is expected to carry out an active maintenance program for the facility through the end of the institutional control period; therefore, any obvious signs of facility degradation should be repaired. However, such degradation can provide insights on potential long-term facility performance. NRC staff should also discuss any maintenance activities that are performed at the disposal facility (e.g., repairs to engineered surface barriers) with DOE Idaho staff.

This monitoring activity is not expected to begin in earnest until the tanks are grouted and the engineered cap is placed over the disposal facility. This monitoring activity is expected to remain open indefinitely.

7 DOCUMENTATION OF FINDINGS AND IMPLEMENTATION PLAN REVISIONS

7.1 Onsite Observation Reports

The U.S. Nuclear Regulatory Commission (NRC) staff participating in onsite observations will be required to develop a report after each site visit. This report will provide a written summary of what was done and any findings from the visit. The report should include a list of the participants, a description of the activities undertaken, and any staff assessment. This report should also describe any issues that may warrant additional investigation through either the staff's technical review or future site visits. Activities that are deemed "closed" as a result of the onsite observation should be so designated in the report.

The report of the onsite monitoring results will be provided to the U.S. Department of Energy (DOE) and State of Idaho by letter within 60 days following the site visit.

7.2 Annual Compliance Monitoring Reports

Staff findings for the various technical and onsite reviews completed throughout the year will be documented in an annual report.[3] It is anticipated that staff will develop a written report of its findings immediately following any onsite visits (see Section 7.1). In addition, the annual report will also document the staff's technical reviews of data, its review of reports or analyses to address the KMAs, and its review of any updates or revisions to DOE's performance assessment.

In documenting its review, the staff will need to specifically describe what was reviewed, whether there is reasonable assurance that the performance objectives can be met (this will include a description of the specific performance objectives that apply), and the basis for the staff findings (e.g., independent analyses conducted by the staff, supporting studies, expert opinion, etc.). In addition, the staff should describe any recommended action (e.g., additional studies or analyses) that should be undertaken to close out open activities.

The annual monitoring report should also serve as a vehicle for tracking whether monitoring activities discussed in Sections 2–6 of this report are considered closed, open, or open-noncompliant. For any activity that was previously closed but is being reopened, the staff should describe its basis for reopening the activity and its expected plans for monitoring the activity. The annual monitoring report should also describe any new monitoring activities identified during the year and the basis for opening them. The staff should also identify any open and open-noncompliant activities that are expected to be carried out for the upcoming year. The annual compliance monitoring report should document any actions or results that might change the status of noncompliant activities. For activities that have been closed, the staff should document its basis for closing the review and any conditions that could prompt reopening.

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[3]It is anticipated that during the early phases of carrying out its monitoring activities, NRC will develop an annual report. However, as the monitoring program progresses and the number of monitoring activities diminish, the staff will need to reassess whether less frequent reporting is warranted.

It is envisioned that staff will meet with DOE and the State on an annual[4] basis to discuss the status of the monitoring program. This meeting could help determine which activities are still open, what actions are needed to close activities, and potential areas of concern. The staff may also want to use this meeting to identify potential revisions that need to be made to the monitoring program in the future.[5]

Lastly, the monitoring report should describe any developing issues that should be brought to the attention of management. For example, the staff may have identified issues through either its technical review or onsite visits that are not significant enough to prevent performance objectives from being met, but could affect the performance demonstration over time. The disposition of any issues raised during the previous year should also be described in the report.

Figure 5 shows the topical areas that are likely to be covered in the annual monitoring report. A copy of the report will be provided to DOE and the State for information purposes. In addition, the report will be made publicly available on NRC's website.

7.3 Noncompliance Letters

In accordance with the NDAA, NRC is required to inform DOE, the covered State, and Congress if it considers any of DOE's waste disposal actions to be noncompliant with the performance objectives of 10 CFR Part 61, Subpart C. The specific congressional committees that NRC is required to inform are the Committee on Armed Services, Energy and Commerce, and Appropriations in the House of Representatives and the Committee on Armed Services, Energy and Natural Resources, Environment and Public Works, and Appropriations in the Senate. NRC is required to make this notification as soon as practicable after discovery of noncompliant conditions. In addition, the noncompliance notification letter will be made publicly available on NRC's website.

As the staff carries out monitoring activities outlined in this monitoring plan, it will determine whether or not DOE is in compliance with the performance objectives. As shown in Figure 6, there are two primary ways that DOE will be considered noncompliant: (i) if there are sufficient indications that the criteria for one or more performance objective is currently being exceeded or (ii) if there are sufficient indications that the criteria for one or more performance objectives could be exceeded in the future. Possible indications that the performance objectives are currently being exceeded would be environmental concentrations at locations where individuals could be exposed to a dose exceeding the dose criteria. Other possible indications that the performance objectives are currently being exceeded would be radiation doses to workers or members of the public that exceed the dose limit or evidence of structural failure of the disposal facility.

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[4]The frequency of these meetings is expected to change as implementation of the NRC monitoring program progresses. As the number of monitoring activities diminish, NRC staff will reevaluate the meeting frequency.

[5]This could also include determining the need for less frequent reporting and meetings.

Topical Areas
Annual Compliance Monitoring Report

Onsite Reviews
- Areas reviewed
- Findings
- Basis for findings
- Recommended actions

Technical Reviews
- Areas reviewed
- Findings
- Basis for findings
- Recommended actions

New and Reopened Activities
- Area of concern
- Significance to performance demonstration
- Expected monitoring activities

Open-Noncompliant Activities
- Basis for status
- Actions or results that might change the status

Summary of Annual Meeting

Revisions to the Monitoring Plan

Potential Problems

Activities Closed

Figure 5. Topical Areas Expected in the Annual Monitoring Report

NRC cannot base noncompliance solely on contemporaneous noncompliance. First, given the nature of the highly engineered facilities involved, evidence of problems meeting the performance objectives may not be observable for hundreds of years in the future. Thus, solely relying upon observable system failure may not allow the NRC to make a timely notification as required by the NDAA. In addition, assessing compliance for some performance objectives (e.g., 10 CFR 61.42) is difficult to accomplish through direct observation. Thus, the second means by which NRC may make a finding of noncompliance is through predictive modeling that indicates one or more of the performance objectives may not be met in the future. An indication that DOE may exceed the performance objective(s) would be if key assumptions relied upon in its performance demonstration cannot be substantiated as previous technical information and evidence had indicated. “Key” in this sense means that without the assumption, the performance demonstration cannot be made. Another indication would be if trends in the data indicate that at some future time the performance objective criteria would be exceeded.

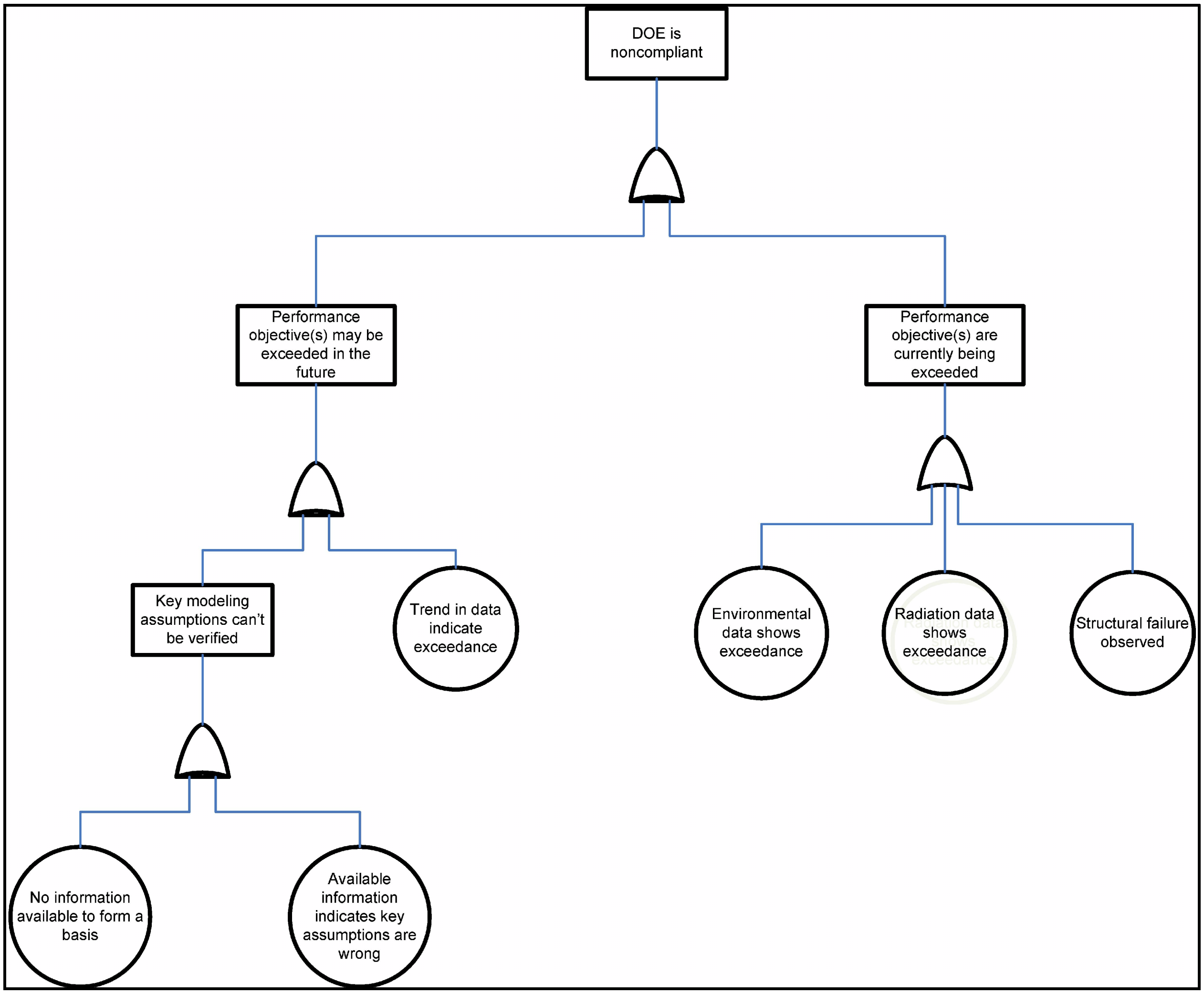

Figure 6. Potential Sources of DOE Noncompliance

Given the different types of noncompliance, NRC anticipates using several different types of notification letters, listed in Table 3. A Type I letter would state that there are sufficient indications that DOE is currently not in compliance with one or more of the performance objectives. Within the letter, NRC would describe the performance objective that may not be met and the basis for NRC staff's conclusion that the disposal action may not be in compliance with the performance objective. A Type II letter would state whether there is sufficient evidence to indicate that a performance objective will be met at some point in the future. Again, this letter would identify the specific performance objective(s) that may not be met and the basis for NRC staff's conclusion that the disposal action may not be in compliance with the performance objective. The third type of notification letter (Type III) would state whether there is an insufficient basis to conclude that DOE will be in compliance with one or more of the performance objectives. In this letter, NRC would identify the specific performance objectives in which a finding cannot be made, along with the reason(s) why no finding can be made. Because of their significance and distribution, Type I–III letters would be sent out under the signature of NRC Chairman. While each of the three types of notification letters are important, the Type I letter is the most serious because it pertains to an immediate potential threat to public health and safety.

Prior to sending out Type I–III letters, NRC will review its concerns in a letter (Type IV) to DOE and the State. This will give the State an opportunity to provide input and comment and provide DOE with an opportunity to provide information that demonstrates its compliance with the performance objectives. Assuming that DOE provides information to support its performance demonstration, NRC will need to review this information and decide whether it is sufficient to conclude that the performance objectives will be met. If the staff determines that, based on the information provided by DOE, there is sufficient basis to conclude that DOE is in compliance, NRC will send out a notification of resolution letter (Type V). Types IV and V letters will be made publicly available on NRC's website. These letters formally document resolution of the issue. If the staff determines that, based on the information DOE provides, there is still a basis for concluding that DOE is noncompliant, NRC will send out the notification of noncompliance letter (i.e., Type I–III).

Table 3. Types of Notification Letters

Type	Notification	Signature	Distribution
I	Indication that performance objective(s) are currently not being met	Chairman	DOE, covered State, and Congress
II	Indication that performance objective(s) will not be met in the future	Chairman	DOE, covered State, and Congress
III	Insufficient basis to determine that the performance objective(s) will be met	Chairman	DOE, covered State, and Congress
IV	Concerns with the performance demonstration	Staff	DOE and covered State
V	Resolution of concerns with the performance demonstration	Staff	DOE and covered State

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APPENDIX A

FACTORS

FACTORS

Key Monitoring Area (KMA)	Area	Description
1	Residual Waste Sampling	The U.S. Department of Energy (DOE) should sample tanks WM-187 through WM-190 after cleaning, as stated in Section 2.3 of the Draft Section 3116 Determination Idaho Nuclear Technology and Engineering Center Tank Farm Facility (DOE Idaho, 2005). After cleaning, sampling data and analysis of tanks WM-187 through WM-190 should be reviewed to ensure that the inventory for these tanks is not significantly underestimated (i.e., similar or better waste retrieval will be achieved).
2	Grout Formulation and Performance	The final grout formulation used to stabilize the Tank Farm Facility (TFF) waste should be consistent with design specifications, or significant deviations should be evaluated to ensure that they will not negatively impact the expected performance of the grout. The reducing capacity of the tank grout is important to mitigating the release of Tc-99. Short-term performance of as-emplaced grout should be similar to or better than that assumed in the performance assessment (PA) release modeling, or significant deviations should be evaluated to determine their significance with respect to the conclusions in the PA and technical evaluation report (TER). The short-term performance of the grouted vault is especially important to mitigate the release of short-lived radionuclides such as Sr-90 from the contaminated sand pads that could potentially dominate the predicted doses from the TFF within the first few hundred years.
3	Hydrological Uncertainty	Relevant recent and future monitoring data and modeling activities should continue to be evaluated to ensure that hydrological uncertainties that may significantly alter the conclusions in the PA are addressed. If significant new information is found, it should be evaluated against the PA and TER conclusions.

Key Monitoring Area (KMA)	Area	Description
4	Monitoring During Operations	Closure and postclosure operations (until the end of active institutional controls, 100 years) will be monitored to ensure that the 10 CFR 61.43 performance objective (protection of individuals during operations) can be met.
5	Engineered Surface Barrier/ Infiltration Reduction	Idaho Nuclear Technology and Engineering Center infiltration controls and the construction and maintenance of an engineered cap over the TFF under the Comprehensive Environmental Response, Compensation, and Liability Act program should be monitored to ensure that the PA assumptions related to infiltration and contaminant release are bounding.

Reference:

DOE Idaho. DOE/NE–ID–11226, “Draft Section 3116 Determination Idaho Nuclear Technology and Engineering Center Tank Farm Facility–Draft.” Rev. 0. Idaho Falls, Idaho: DOE Idaho. September 2005.

APPENDIX B

SUMMARY OF MONITORING ACTIVITIES

SUMMARY OF MONITORING ACTIVITIES

Performance Objective	Chapter	Technical Review Activities	Onsite Observation Activities
61.41	3	*KMA 1* A. Review Sampling and Analysis Plans (SAPs) and Data Quality Assessments (DQAs) for tanks WM-187 through WM-190. B. Compare postcleaning WM-182 tank inventory to postcleaning tank inventories developed for WM-187 through WM-190. C. Compare vault WM-187 liquid sampling to vault WM-185 liquid sampling.	*KMA 1* A. Observe postcleaning sampling of tanks WM-187 through WM-190 against SAP. B. Observe use of video equipment to map out waste residual depths in the cleaned tanks to estimate waste residual volumes.
		KMA 2 A. Determine whether the vendor-supplied slag has sufficient sulfide content to maintain reducing conditions in the tank grout. B. Determine whether slag storage is sufficient to maintain the quality and chemical reactivity of the slag. C. Assess the short-term performance of the as-emplaced grout.	*KMA 2* A. Evaluate the final grout formulation for consistency with design specifications. B. Evaluate the risk-significance of any deviations in the final grout formulation from design specifications. C. Evaluate the U.S. Department of Energy (DOE) program for sampling, testing, and accepting grout materials. D. Verify conditions of grout placement in terms of temperature and humidity.

Performance Objective	Chapter	Technical Review Activities	Onsite observation Activities
61.41	3	*KMA 3* A. Evaluate and assess the risk significance of any variations in DOE PA-predicted natural attenuation of Sr-90 through the vadose zone. B. Evaluate and assess the risk significance of any increased estimates of infiltration rates at the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) above those assumed in DOE's PA. C. Review hydrological studies and monitoring data for new and significant information related to natural attenuation at the INTEC TFF.	
		KMA 5 Evaluate and assess the design, construction, maintenance, and as-emplaced performance of engineered barriers installed at the INTEC TFF against DOE PA assumptions regarding infiltration.	*KMA 5* A. Remain cognizant of any changes to the preliminary design of the infiltration-reducing cap. B. Observe maintenance activities of the cap.
		PA Review Review any revisions and updates to DOE's PA model to assess the impact of changes on conclusions regarding compliance with the performance objectives.	

Performance Objective	Chapter	Technical Review Activities	Onsite observation Activities
		Environmental Data Review A. Review analytical data of perched and saturated groundwater at the INTEC TFF. B. Review hydrological studies relevant to flow and transport at the INTEC TFF.	*Environmental Sampling Review* A. Observe the installation of monitoring wells and instrumentation. B. Observe sampling activities. or C. Rely on Idaho Department of Environmental Quality (DEQ) oversight program.
61.42	4	*KMA 1* Compare post-cleaning WM-182 tank inventory to the postcleaning tank inventories developed for WM-187 through190.	
61.43	5	*KMA 4* A. Review DOE Idaho radiation protection program to ensure it is consistent with that described in its waste determination. B. Review pathway analysis, environmental data collected, and DOE estimate of doses to members of the public.	*KMA 4* A. Observe risk-significant DOE closure activities. B. Observe air sampling activities and DOE's meteorological program. or C. Rely upon Idaho DEQ's environmental surveillance program.
61.44	6	*KMA 2* Review information on grout formulation, placements, and pours.	
			A. Observe signs of system failure. B. Observe system performance after extreme events.

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