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NRC Periodic Compliance Monitoring Report for U.S. Department of Energy Non-High-Level Waste Disposal Actions

Annual Report for Calendar Year 2007

Office of Federal and State Materials and Environmental Management Programs

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ABSTRACT

This is the U.S. Nuclear Regulatory Commission (NRC) staff's report of its monitoring of U.S. Department of Energy (DOE) non-high-level waste disposal actions in calendar year 2007, pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, or the NDAA. The NDAA requires that DOE consult with the NRC on its non-high-level waste determinations and plans and that the NRC, in coordination with the covered States of South Carolina and Idaho, monitor disposal actions that DOE takes to assess compliance with NRC regulations in Title 10, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart C, "Performance Objectives," of the *Code of Federal Regulations* (10 CFR Part 61). The NRC has prepared this report in accordance with NUREG-1854, "NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations," issued August 2007.

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EXECUTIVE SUMMARY

The purpose of this report is to document the U.S. Nuclear Regulatory Commission (NRC) staff's monitoring of U.S. Department of Energy (DOE) non-high-level waste disposal actions in calendar year (CY) 2007. The NRC monitors DOE disposal actions in covered States pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, or the NDAA. Section 3116 of the NDAA has two main subsections, one that requires that DOE consult with the NRC on its non-high-level waste determinations and plans, and a second that requires that the NRC, in coordination with the covered States of South Carolina and Idaho, monitor the disposal actions that DOE takes to assess compliance with NRC regulations in Title 10, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart C, "Performance Objectives," of the *Code of Federal Regulations* (10 CFR Part 61). This report is concerned primarily with the second of the two major parts of Section 3116, namely Section 3116(b). Appendix A to this report provides the complete text of Section 3116 of the NDAA. This report is the first of what the NRC anticipates will be an annual report during the early phases of its monitoring activities pursuant to the NDAA. The content of this report follows the guidance in Section 10.4.2 of NUREG-1854, "NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations," issued August 2007.

In CY 2007, the NRC completed two monitoring plans in accordance with the guidance in NUREG-1854. The monitoring plans cover DOE disposal actions at the Saltstone Facility at the Savannah River Site (SRS) in South Carolina and the Tank Farm Facility (TFF) at the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Laboratory (INL) in Idaho. In each plan, the staff identified a hierarchy of elements defining the overall scope of monitoring at each site. The scope of monitoring was defined by those factors that were most uncertain and/or significant in the DOE analysis of whether the disposal of non-high-level waste meets NRC performance objectives, which are aimed at protection of public health and safety. For the Saltstone Facility, the NRC staff identified eight "factors," which are important model assumptions or parameter values described in its December 2005 technical evaluation report. For each factor, there is one or more planned monitoring activities (i.e., specific tasks or actions). For Saltstone, 39 distinct monitoring activities exist to assess compliance with the performance objectives in 10 CFR Part 61, Subpart C. Similarly, for the INL INTEC TFF, the staff identified 5 key monitoring areas (which are analogous to "factors" at Saltstone) from its October 2006 technical evaluation report, and 31 separate monitoring activities. Monitoring activities can be either onsite observations of disposal activities or in-office reviews of documents.

In CY 2007, in accordance with the monitoring plans described above, the staff performed technical reviews and onsite observation visits at both the SRS Saltstone Facility and the INL INTEC TFF.

As the staff completed technical reviews and onsite observations, it identified open issues that arose during monitoring activities that require additional followup by the NRC staff or additional information from DOE to address questions that the NRC staff has raised regarding the DOE disposal actions. The NRC staff also provided DOE with recommendations offering insights on one or more aspects of the disposal action that the NRC is monitoring. Recommendations may address ways that DOE can make progress on closing any open activities in the staff's monitoring plan; a monitoring area for which an open issue has been previously identified and closed and for which the NRC staff recommends further action to strengthen some aspect of the

DOE disposal action; and monitoring areas that had no open issues or previously raised concerns, but where the NRC staff recommends further improvements to DOE disposal actions.

In CY 2007, the staff did not make any findings of noncompliance arising from its monitoring activities. The staff did, however, provide seven recommendations to DOE and identified three open issues that it will continue to monitor in CY 2008. Summaries of the recommendations and open issues appear below. The body of this report presents more information about the staff's observations; Appendix C to this report includes the observation reports.

In this report, each monitoring activity described in the staff's monitoring plans for the SRS Saltstone Facility and the INL INTEC TFF is assigned a unique alphanumeric monitoring activity code for NRC staff tracking purposes. Tables B-1 and B-2 in Appendix B to this report list the monitoring activities and monitoring activity codes. The monitoring activity code contains information about the DOE site, facility, the primary applicable 10 CFR Part 61, Subpart C, performance objective, the monitoring area, and the type of monitoring performed (e.g., onsite observation (O) or technical (T) review). The key for the monitoring activity codes is as follows:

Site	Facility	Performance Objective	Key Monitoring Area or Factor	Activity Number	Type of Activity
SRS- or INL-	SLT- or TFF-	41- 42- 43- 44-	01- 02- 03- RE[1] etc.	01- 02- 03- etc.	T or O

For example, the third monitoring activity listed in the NRC monitoring plan for the SRS Saltstone Facility (and thus the third entry in Table B-1 of this report) is coded "SRS-SLT-41-01-03-T." For tracking purposes, at least one monitoring activity code is cited for each open issue and recommendation described in this report.

Savannah River Site Saltstone Facility

Saltstone Grout Formulation and Placement

During an October 2007 visit to SRS, the NRC staff reviewed information regarding what tests had been performed to ensure that blast furnace slag, an ingredient of the saltstone grout, contains sufficient amounts of sulfur. The NRC staff noted that the slag supplier had performed tests, but DOE had not performed confirmatory tests.

> Recommendation 2007-1
> The NRC staff recommends that independent verification of the material characteristics of blast furnace slag would provide additional assurance of the quality of saltstone grout.
> (SRS-SLT-41-01-05-O)

[1] RE stands for "Radiation Protection or Environmental Protection" monitoring area, not separately identified as either a key monitoring area or factor in the NRC's review of the DOE performance assessment.

The NRC staff also observed that DOE has not generated hydraulic and chemical properties of saltstone grout over the range of compositions actually produced at the Saltstone Production Facility (SPF). The NRC staff believes that additional data over a range of compositions will greatly reduce the uncertainty in estimating the future performance of the Saltstone Disposal Facility (SDF).

Open Issue 2007-1 The NRC staff will continue to monitor this issue of final product characterization because inadequate quality of saltstone could result in the disposal of saltstone being noncompliant with the 10 CFR 61.41 performance objective. (SRS-SLT-41-01-04-O)

The NRC staff also observed that, at the end of a production run, DOE uses water to flush transfer lines between the SPF and SDF. The flush water is added directly to the SDF and may be blending with grout that has not yet set. The NRC staff believes that this may have a deleterious effect on the hydraulic properties of the saltstone grout.

Open Issue 2007-2 The NRC staff believes that DOE should demonstrate that the hydraulic and chemical properties of the final product are consistent with the assumptions in the waste determination or show that any deviations are not significant with respect to demonstrating compliance with the performance objectives. Staff will continue to monitor this issue. (SRS-SLT-41-01-04-O)

Vault Construction

During the October 2007 visit to SRS, the NRC staff observed contaminated seeps on the exterior wall of the above-ground vault being filled in the SDF. The NRC observed that DOE has not assessed the risk significance of the impact of the differences in observed conditions of the vaults to conditions assumed in its final waste determination and performance assessment (PA).

Open Issue 2007-3 The NRC staff will continue to monitor DOE efforts to reassess the risk significance of the as-built vault conditions. This is an open issue that the NRC staff will follow during future site monitoring activities. (SRS-SLT-41-02-05-O)

Waste Sampling

During the October 2007 visit to SRS, the NRC staff reviewed the process for waste transfers from the F-area tank farm to the SPF. Staff noted that agitation pumps that could suspend particles that are present in the Tank 50 feed tank are not in operation during current liquid transfers. However, in the future, DOE plans to operate the Tank 50 agitation pumps during liquid transfers. Staff believes this practice could result in unexpectedly high transfers of solids to the SPF feed tank, especially when the level of liquid in the Tank 50 feed tank is low. The NRC staff further noted that the SPF feed tank has a mixer that can be operated only when the pump used to transfer salt waste to the blending system is not in operation. The NRC staff believes this configuration could lead to an accumulation of solids within the SPF feed tank, as solids transferred from Tank 50 would be allowed to settle during transfers of salt waste from the SPF feed tank. The NRC staff believes that the accumulation of solids within the SPF feed tank could impact wasteform composition. The accumulation of solids could also result in additional radiological exposure to workers if new systems are required to mobilize accumulated solids.

> Recommendation 2007-2
> The NRC staff recommends that DOE either ensure that the accumulation of solids is monitored during processing or act to mitigate the potential for solids accumulation.
> (SRS-SLT-41-06-02-T)

DOE provided additional information during a March 2008 observation visit and plans to address the open issues noted during the October 2007 observation visit. The NRC staff will review this information and issue an observation report for the March 2008 visit approximately 60 days following the closeout of that visit. The CY 2008 version of this Periodic Compliance Monitoring Report will also summarize the results of the March 2008 visit.

Idaho National Laboratory Idaho Nuclear Technology and Engineering Center Tank Farm Facility

During technical reviews that it performed in 2007, the NRC staff evaluated information that DOE continues to develop pertaining to hydrological uncertainties at the TFF and environmental monitoring data produced by both the State of Idaho and DOE. The NRC staff did not identify any open issues but will continue to review additional information as it is developed. The NRC staff made the following two recommendations.

> Recommendation 2007-3
> The NRC staff recommends that DOE evaluate any new and significant information related to hydrogeological system uncertainty at INTEC and requests that DOE provide any recent reports or data related to hydrogeological system uncertainty at INTEC of which the NRC staff may not be cognizant.
> (INL-TFF-41-03-03-T)

> Recommendation 2007-4
> The NRC staff recommends that DOE provide information on any violations of requirements related to workers and the general public (10 CFR Part 835 or DOE Order 5400.5) during its waste disposal operations. As information provided on the Web may not be timely, the NRC staff requests that DOE provide information regarding worker or public dose exceedances within a reasonable time after their occurrence.
> (INL-TFF-43-04-01-T)

During an observation visit to INL in April 2007, the NRC staff observed that three of four small (110,000-liter (30,000-gallon)) tanks had been filled with grout containing a high water-to-cement ratio. The staff noted that although the permeability of the resultant grout is higher than assumed in the DOE PA, the tanks are small and are not likely to result in a significant increase in dose to the public. Nonetheless, the NRC staff believes that DOE should evaluate the impacts of operational deviations.

Recommendation 2007-5 The NRC staff recommends that DOE document deviations from assumptions made in its final waste determination and PA and assess the risk significance of these deviations. (INL-TFF-41-PA-01-T)

During the August 15, 2007, visit, the staff confirmed that DOE has a process in place to review and disposition noted deviations.

During the observation visit to INL in April 2007, the NRC staff observed that DOE does not perform additional testing of blast furnace grout for sulfur content. This is similar to the first recommendation noted above for the SRS Saltstone Facility.

Recommendation 2007-6 The NRC staff recommends that DOE consider whether specific additional requirements should be added to its contractor quality assurance program to address nonstandard grout characteristics that are relied on in the PA. (INL-TFF-41-02-04-O)

The NRC staff also requested information during its visit regarding the basis for using a minimum cure time of 30 minutes between grout pours. During reviews of information provided by DOE after the visit, the staff concluded that temperatures would remain within acceptable levels, but the staff's review led to a follow-on question regarding the potential for early age cracking of the grout as a result of temperature gradients that may form. In subsequent communication, the NRC staff agreed that such cracking is bounded by conservative assumptions in the DOE PA, but the staff believes that, in the future, engineering calculations would be useful before grouting at other DOE sites.

Recommendation 2007-7 The NRC staff recommends that DOE consider performing engineering calculations before tank grouting at other DOE sites such that steps could be taken to limit temperature gradients and the potential for crack formation. (INL-TFF-44-02-08-T)

In 2008, the NRC staff intends to return to both the INL INTEC TFF and SRS Saltstone Facility to continue to observe DOE disposal actions pursuant to its monitoring plans and to follow up on the open issues and recommendations identified above.

The NRC staff opened no new monitoring activities as a result of the technical reviews and observation visits and closed three monitoring activities at the INL INTEC TFF. No open activities have been identified as open-noncompliant. Therefore, the NRC plans no revisions to either monitoring plan in response to monitoring activities in CY 2007.

Conclusion

Based on its observations, the NRC staff continues to conclude that there is reasonable assurance that the applicable criteria of the NDAA can be met if key assumptions made in the DOE waste determinations prove to be correct. In accordance with the requirements of the NDAA and consistent with the NRC's monitoring plans, the NRC staff will continue to monitor DOE disposal actions at SRS and INL. The monitoring activities are expected to be an iterative process and several onsite observation visits and technical reviews of various reports, studies, and other documents may be necessary to obtain the information needed to close all of the current open issues, as well as issues that may be opened in the future.

ABBREVIATIONS

ADAMS	Agencywide Documents Access and Management System
ALARA	as low as reasonably achievable
ASTM	American Society for Testing and Materials
Bq	becquerel
CAP88-PC	Clean Air Act Assessment Package—1988
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	*Code of Federal Regulations*
CWI	CH2M*WG Idaho, LLC
CY	calendar year
DDA	deliquification, dissolution, and adjustment
DEQ	(Idaho) Department of Environmental Quality
DOE	U.S. Department of Energy
EM	environmental monitoring
HLW	high-level waste
HRR	highly radioactive radionuclides
ICRP	International Commission on Radiological Protection
INTEC	Idaho Nuclear Technology and Engineering Center
KMA	key monitoring area
L	liter
MDIFF	mesoscale diffusion air dispersion model
mrem	millirem
mSv	millisievert
NDAA	Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005
NRC	U.S. Nuclear Regulatory Commission
PA	performance assessment
pCi	picocurie
SAP	sampling and analysis plan
SDF	Saltstone Disposal Facility
SPF	Saltstone Production Facility
SRS	Savannah River Site
Tc	technetium

TEDE	total effective dose equivalent
TER	technical evaluation report
TFF	Tank Farm Facility
WAC	waste acceptance criteria
wt. %	weight percent
μSv	microsievert

1. INTRODUCTION

In this report, the first use of a word or phrase that is defined in the glossary is shown in *italics.*

In October 2004, the U.S. Congress passed legislation that allows the Secretary of Energy to determine, in consultation with the U.S. Nuclear Regulatory Commission (NRC), whether radioactive waste resulting from the reprocessing of spent nuclear fuel is not high-level radioactive waste. The legislation in Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, or NDAA, requires that the U.S. Department of Energy (DOE) consult with the NRC on its non-high-level waste (non-HLW) determinations and plans and that the NRC, in coordination with the covered State, monitor disposal actions that DOE takes to assess compliance with NRC regulations in Title 10, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart C, "Performance Objectives," of the *Code of Federal Regulations* (10 CFR Part 61). The covered States under Section 3116 of the NDAA are South Carolina and Idaho.

Under the NDAA, DOE will identify specific inventories of radioactive waste and associated facilities and equipment (e.g., tanks, piping, disposal vaults) that are candidates for non-HLW decisions. The Secretary's decision is based on whether the residual radioactive waste meets several criteria in Section 3116 of the NDAA. For example, the subject of a Secretary's decision may be residual radioactive waste remaining in an HLW storage tank after the *highly radioactive radionuclides* have been removed to the maximum extent practicable. Appendix A to this report provides the full text of Section 3116 of the NDAA, including the criteria.

To support the Secretary's decision, DOE prepares a document that describes its basis for a determination pursuant to Section 3116 of the NDAA. Called a *waste determination*, this document describes the DOE analysis of whether a particular type of waste meets the NDAA criteria. As described in NUREG-1854, "NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations," issued August 2007 (NRC, 2007d), the NRC staff consults with DOE on the draft waste determination and prepares a technical evaluation report (TER) that documents the NRC staff's evaluation. If the Secretary decides that all of the Section 3116 criteria are met, the Secretary may make a non-HLW determination, and DOE may publish a final waste determination.

After the Secretary's determination, NRC staff will, in coordination with the covered State and as described in NUREG-1854, prepare a written plan to monitor DOE's disposal actions for the purpose of assessing compliance with the performance objectives set out in 10 CFR Part 61, Subpart C. NRC monitoring is risk-informed and performance-based, and therefore, is focused on assumptions, parameters, and features that are expected to have a large influence on the performance demonstration and/or have relatively large uncertainties. The 10 CFR Part 61, Subpart C performance objectives.

Since the NDAA was enacted in 2004, DOE has completed two waste determinations in consultation with the NRC staff. The first, in January 2006, was the waste determination for salt waste disposal at the Savannah River Site (SRS) in South Carolina (DOE, 2006a). DOE issued a second waste determination under Section 3116 on the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) in November 2006 (DOE, 2006d).

Table 1 Performance Objectives of 10 CFR Part 61, Subpart C

Section	Title	Text
10 CFR 61.40[2]	General requirement	Land disposal facilities must be sited, designed, operated, closed, and controlled after closure so that reasonable assurance exists that exposures to humans are within the limits established in the performance objectives in §§ 61.41 through 61.44.
10 CFR 61.41[3]	Protection of the general population from releases of radioactivity	Concentrations of radioactive material which may be released to the general environment in ground water, 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.
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.
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.
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.

[2] In general, to assess compliance with the requirements of §61.40, NRC will rely upon its assessment of DOE's compliance with 10 CFR 61.41 through 61.44. Specifically, the 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] As stated in the Staff Requirements Memorandum for SECY-05-0073 (NRC, 2005a), the dose standard is 25 mrem TEDE using ICRP-26 methodology.

The NRC staff prepared a TER (NRC, 2005b, 2006) and monitoring plan (NRC, 2007a, 2007b) for each facility. Section 1.1 of this report summarizes the NRC staff's approach to developing monitoring plans for DOE facilities in covered States. Additionally, DOE, on its own initiative, occasionally consults with NRC staff on its non-HLW determinations at the Hanford site in the State of Washington and the West Valley Demonstration Project in the State of New York. However, neither Washington nor New York are covered States under the NDAA. Therefore, the NRC does not have a monitoring role at these sites under Section 3116 of the NDAA, and this report does not address these sites.

1.1 Summary of the NRC's National Defense Authorization Act Monitoring Approach

Section 10 of NUREG-1854 (NRC, 2007d) gives a complete description of the NRC's approach to compliance monitoring pursuant to Section 3116 of the NDAA. Some of the information in Section 10 of NUREG-1854 is summarized here to provide context for the NRC staff's observations in calendar year (CY) 2007.

Paragraph (b)(1) of Section 3116 of the NDAA requires that the NRC shall "...in coordination with the covered State, monitor disposal actions taken by the Department of Energy...for the purpose of assessing compliance with the performance objectives set out in subpart C of Part 61 of title 10, Code of Federal Regulations." Therefore, as described below, the NRC staff develops its monitoring plans in coordination with the covered States of Idaho and South Carolina.

The NRC has adopted a risk-informed and performance-based approach to monitoring DOE disposal activities pursuant to Section 3116 of the NDAA. A cornerstone of the NRC's approach is the identification of key monitoring areas related to DOE disposal actions that should be the focus of its monitoring efforts. The NRC staff identifies one or more monitoring activities to support each key monitoring area in facility-specific monitoring plans. The performance objectives, key monitoring areas, and monitoring activities form a hierarchy of plan elements that serves as the structure of each monitoring program.

Figure 1 summarizes the hierarchy of elements in an NRC monitoring plan. The following discussion summarizes the NRC staff's process for developing these elements.

Monitoring Areas

As the first step in the preparation of a monitoring plan for a specific waste determination, the NRC staff identifies monitoring areas. Monitoring areas are either programmatic or technical subject matter areas within which the staff will focus its monitoring efforts, and which are important to DOE demonstration of compliance with the performance objectives of 10 CFR Part 61, Subpart C (see Table 1). The NRC staff typically identifies the monitoring areas during its review of the DOE draft waste determination and documents them in the TERs.

The NRC staff typically derives assurance that the requirements of 10 CFR 61.41, 61.42, and 61.44 will be met on the basis of DOE predictions of long-term disposal site performance. As described further below, DOE uses a *performance assessment* (PA) to predict disposal site

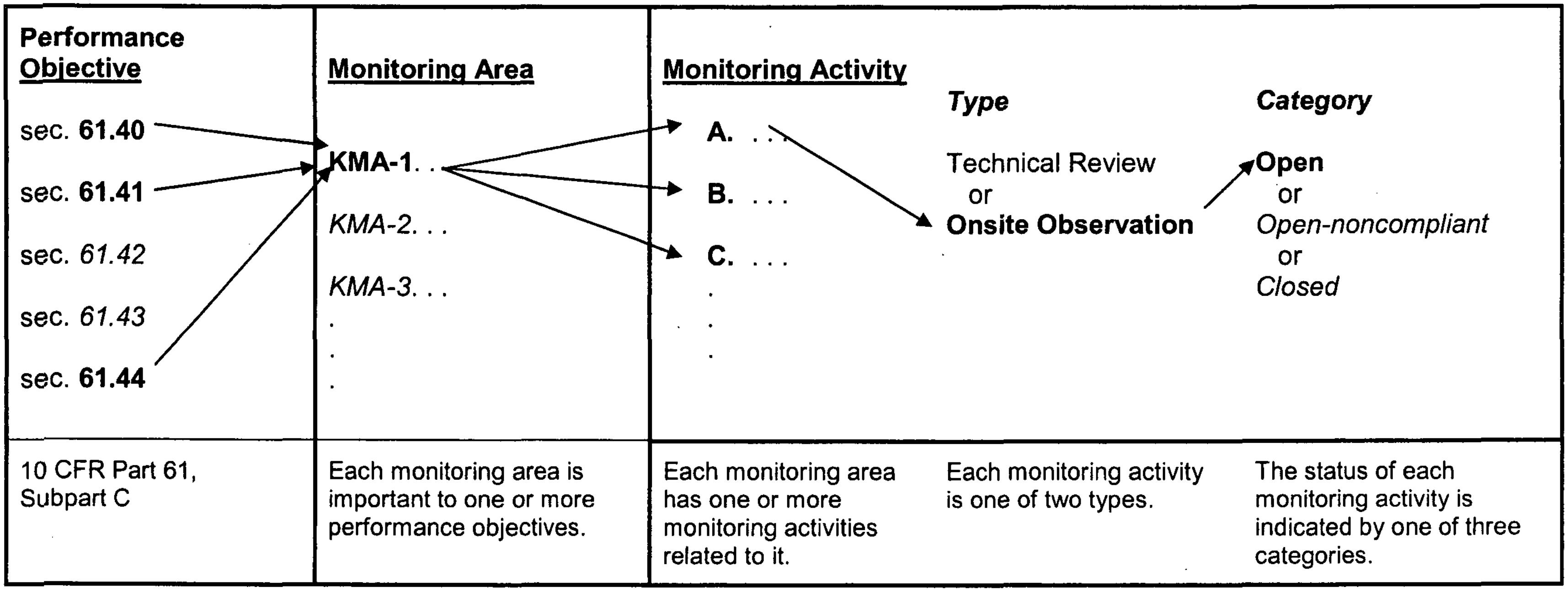

Figure 1 A hypothetical example of the relationship between 10 CFR Part 61 performance objectives, a single monitoring area, and the different types and categories of monitoring activities

performance, which most often involves calculations performed with the aid of computer-based models. This involves making certain assumptions about physical and chemical parameter values that DOE believes are appropriate for the disposal action. As such, monitoring areas that build confidence in the DOE selection of parameters and models are typically termed *key monitoring areas*, or KMAs.

A PA is an important tool used by both DOE and the NRC to identify which facility attributes are important to meeting the 10 CFR Part 61, Subpart C, performance objectives. In fact, DOE typically uses a PA to demonstrate compliance with requirements provided in 10 CFR 61.41, 61.42, and 61.44, recognizing that long-term modeling predictions are needed to demonstrate compliance with performance objectives. A PA is a type of systematic (risk) analysis that addresses (1) what can happen, (2) how likely it is to happen, (3) what the resulting impacts are, and (4) how these impacts compare to specifically defined standards. The NRC staff believes that sufficient PA model support, coupled with observation of disposal actions carried out in conformance with detailed closure plans, is necessary for the staff to assess whether these performance objectives can be met in the future. Therefore, the designation of KMAs under 10 CFR 61.41, 61.42, and 61.44 is generally related to the assumptions and parameter values chosen by DOE in its PA.

Additional monitoring areas are identified for compliance with 10 CFR 61.43. These additional monitoring areas are not typically derived from the NRC staff's review of a DOE PA, as are KMAs. For example, the requirements of 10 CFR 61.43 apply to facility *operations*, including DOE site programs for ongoing personnel site access control, *worker* and public radiation protection, and environmental monitoring (EM) and surveillance. These DOE site programs are required to ensure compliance with the 10 CFR 61.43 performance objective but are not evaluated as part of the long-term PA of the disposal facility.

As noted in Table 1 above, there are generally no specific monitoring areas specified for the requirements of 10 CFR 61.40. The NRC staff will rely on its assessment of DOE compliance with 10 CFR 61.41 through 10 CFR 61.44. Specifically, the NRC will view DOE as being in compliance with 10 CFR 61.40 as long as DOE is deemed to be in compliance with the other performance objectives.

Monitoring Activities

The next step in the preparation of a monitoring plan is the designation of one or more *monitoring activities* associated with each monitoring area. A monitoring activity is a specific type of NRC or covered State task or action with the purpose of monitoring DOE disposal actions to assess compliance with the performance objectives listed in 10 CFR Part 61, Subpart C. Examples of monitoring activities include NRC and/or covered State staff reviews of the results of DOE measurements of residual radioactivity in tanks before tank closure, NRC and/or covered State staff observations of periodic maintenance of disposal facility closure caps, and NRC and/or covered State staff observations of onsite radiation safety procedures during waste handling operations. These examples show that some monitoring activities are near term, short-duration activities that will be closed by the NRC and/or covered States soon after the completion of the DOE disposal action. Other monitoring activities are long term in nature and may be conducted by the NRC and/or the affected covered State staff *in perpetuity*.

In a few instances, the staff identified monitoring activities during preparation of the monitoring plan that were not previously identified in the corresponding TER. As a result, these activities are not related to any particular monitoring area but are tied directly to a 10 CFR Part 61, Subpart C, performance objective. The first two monitoring activities listed in Table B-1 are examples of such activities.

For NRC staff planning purposes, monitoring activities are also categorized by type as either technical reviews or onsite observations. Technical reviews may take the form of reviews of data, such as from EM and surveillance programs, or reviews of technical literature that supports important assumptions or parameter values in DOE performance assessments. Data reviews are a subset of and supplement technical reviews by 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). Onsite observations are coordinated with the affected covered State and the DOE site to ensure that the NRC staff has an opportunity to observe specific DOE disposal actions. The NRC staff conducts onsite observations in accordance with observation plans that are prepared in advance of the visits. The staff summarizes its conclusions in an observation report typically issued within 2 months of the onsite observation, unless DOE provides additional information following the site visit. In those cases, the reports are typically completed within 60 days of the staff completing its review of the additional information.

The status of monitoring activities (and associated key monitoring areas) is tracked as *open*, *open-noncompliant*, or *closed*. The NRC characterizes a monitoring activity as an open activity when it has not obtained sufficient information to fully assess compliance with one or more 10 CFR Part 61, Subpart C, performance objectives. Should an ongoing open activity provide 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 if key aspects of the waste determination relied on to demonstrate compliance with the performance objectives are no longer supported, then the monitoring activity is categorized as an open-noncompliant activity. An open-noncompliant activity may also be identified in the NRC staff's TER and initial monitoring plan when the staff believes that insufficient technical bases were provided in the draft waste determination to determine that the performance objectives will be met. Finally, the NRC staff may categorize an ongoing monitoring activity as closed when it has either obtained sufficient information or received technical bases to fully assess compliance with one or more 10 CFR Part 61, Subpart C, performance objectives. However, the NRC staff may on its own initiative, upon evaluation of new information, re-open a closed activity or open a new monitoring activity relating to any monitoring area. Any DOE revisions to its PAs may also trigger a review and possible revision of the NRC's monitoring plans.

Coordination with Covered States

The NRC staff consulted with the States of South Carolina and Idaho during the preparation of the monitoring plans for Saltstone and the Idaho National Laboratory (INL) INTEC TFF. For Saltstone, the staff had early interactions with the South Carolina Department of Health and Environmental Control during its review of the waste determination and later sought comments on the draft monitoring plan. As a result of these interactions, the staff considered in the development of its plan the regulatory activities of South Carolina relating to both a State wastewater permit for the Saltstone Production Facility (SPF) and a State industrial solid waste permit for the Saltstone Disposal Facility (SDF). The staff plans to leverage South Carolina's activities pertaining to these permits and avoid duplication of effort.

Similarly, for the INL INTEC TFF, the staff engaged the Idaho Department of Environmental Quality early in the consultation process, during the staff's review of the DOE waste determination. The two primary State regulatory responsibilities related to the TFF are (1) Resource Conservation and Recovery Act (RCRA) closure under the Hazardous Waste Management Act and (2) Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) regulatory activities associated with historical releases from the ancillary equipment associated with the TFF that resulted in soil and ground water contamination. In its monitoring plan, the NRC considered these and other nonregulatory environmental surveillance activities and plans to leverage Idaho's activities and avoid duplication of effort.

Status of Monitoring Activities

Tables B-1 and B-2 in Appendix B to this report summarize the monitoring areas and the current types and categorization of monitoring activities for SRS Salt Waste Disposal and the INL INTEC TFF, and Sections 2 and 3, respectively, in the body of this report discuss them in detail. The information presented in Appendix B is obtained from monitoring plans developed in consultation with the covered States (NRC, 2007a,b)

As the NRC staff completes technical reviews and onsite observations, it may identify *open issues* that arise during monitoring activities that require additional followup by the staff or additional information from DOE to address questions the NRC staff has raised regarding DOE disposal actions. The NRC staff also provides *recommendations* to DOE, the purpose of which is to provide DOE with the NRC staff's insights on one or more aspects of the disposal action that NRC is monitoring. Recommendations may address ways that DOE could make progress on closing any open activities in the staff's monitoring plan; a monitoring area for which an open issue has been previously identified and closed and for which the NRC staff recommends further action to strengthen some aspect of the DOE disposal action; and monitoring areas where no open issues or concerns were previously raised, but for which the NRC staff recommends further improvements to DOE disposal actions.

In this report, each monitoring activity described in the staff's monitoring plans for the SRS Saltstone Facility and the INL INTEC TFF is assigned a unique alphanumeric monitoring activity code for NRC staff tracking purposes. Table B-1 and B-2 in Appendix B to this report list the monitoring activities and monitoring activity codes. The monitoring activity code contains information about the DOE site, facility, the primary applicable 10 CFR Part 61, Subpart C performance objective, the monitoring area, and the type of monitoring which is performed (e.g., onsite observation (O) or technical review (T)). The key for the monitoring activity codes is as follows:

Site	Facility	Performance Objective	Key Monitoring Area or Factor	Activity Number	Type of Activity
SRS- or INL-	SLT- or TFF-	41- 42- 43- 44-	01- 02- 03- RE[4] etc.	01- 02- 03- etc.	T or O

For example, the third monitoring activity listed in the NRC monitoring plan for the SRS Saltstone Facility (and, thus, the third entry in Table B-1 of this report) is coded "SRS-SLT-41-01-03-T." For tracking purposes, at least one monitoring activity code is cited for each open issue and recommendation described in this report.

Section 10 of the staff's guidance in NUREG-1854 (NRC, 2007d) contains a complete description of the NRC staff's procedures for reporting instances of *noncompliance* pursuant to Section 3116(b)(2) of the NDAA.

1.2 Contents of This Report

This report summarizes monitoring activities conducted by the NRC staff in CY 2007 pursuant to two active monitoring plans (NRC, 2007a and 2007b). As described in the monitoring plans and Section 10 of NUREG-1854 (NRC, 2007d), the NRC will provide this periodic compliance monitoring report to DOE and the State for information purposes. In addition, the report will be made publicly available on the NRC's Web site.

In this report, separate sections address the NRC staff's monitoring activities corresponding to each NRC-published monitoring plan. For each NRC-published monitoring plan, this report covers the following topics:

- NRC staff technical reviews, including:
  - monitoring activities conducted this year
  - whether the NRC staff continues to have reasonable assurance that performance objectives are met and will be met in the future
  - the basis for the NRC staff's conclusions (e.g., independent analysis, supporting studies, expert opinion)
  - NRC staff recommendations
  - open issues that the NRC staff identified during this year's monitoring activities
- NRC staff observation visits to sites in covered States

[4] RE stands for Radiation Protection or Environmental Protection monitoring area, not separately identified as a either a key monitoring area or factor in the NRC's review of the DOE PA.

- whether DOE has revised or plans to revise PAs
- whether NRC staff monitoring activities are closed, open, or open-noncompliant
- monitoring activities that were previously closed but re-opened this year
- new monitoring activities identified during the year
- actions or results that might change the status of any open-noncompliant activities
- activities that were closed and conditions for re-opening closed activities
- new developing issues and disposition of prior years' developing issues
- significant changes to the disposal design

This report focuses on the open issues identified by the NRC staff and its recommendations to DOE pertaining to NRC monitoring activities in CY 2007. With regard to the NRC staff's observation visits, Appendix C contains the observation visit reports, which provide a more complete description of the visits, including the staff's activities for which no open issues were raised, no recommendations were provided, and no findings of noncompliance were made. However, since there were no previous reports on the staff's technical reviews in CY 2007, this report provides a complete discussion of the staff's technical reviews.

2. MONITORING AT THE SAVANNAH RIVER SITE SALTSTONE FACILITY IN 2007

In May 2007, the NRC staff issued its monitoring plan for salt waste disposal at the SRS (NRC, 2007b), for which DOE had previously issued its final waste determination (DOE, 2006a). Table 2 provides a list of current NRC monitoring plans. In the salt waste disposal monitoring plan, the NRC staff identified 8 key monitoring areas, or "factors," an additional monitoring area for EM and radiation protection during facility operations, and a total of 39 monitoring activities. Table B-1 describes all monitoring areas and related monitoring activities for salt waste disposal.

In 2007, the NRC staff conducted one observation visit on October 29–30. As a result of the visit, staff also initiated several technical reviews. The monitoring activities conducted during this visit are shaded grey in Table B-1.

2.1 Onsite Observation

The staff's October 29–30, 2007, onsite observation visit focused primarily on two performance objectives—10 CFR 61.41, "Protection of the General Population from Releases of Radioactivity," and 10 CFR 61.43, "Protection of Individuals during Operations." Specifically, the staff observed operations at both the DOE SPF and SDF, and the DOE radiation protection measures associated with those operations. Appendix C contains the observation report dated January 31, 2008 (NRC, 2008). Since saltstone production operations could impact the long-term stability of the SDF after its closure, this observation also partially assessed the performance objective in 10 CFR 61.44.

2.2 Monitoring Areas Reviewed during the Observation Visit

As discussed more fully in the observation report (Appendix C), the NRC staff evaluated saltstone grout formulation and placement activities, the construction of the current operational vault (Vault 4), the waste sampling program, and the radiation protection and EM programs. The NRC staff observed operation of the SPF and Vault 4 of the SDF and interviewed key DOE and DOE contractor personnel. The staff observed activities and reviewed documents to assess whether salt waste processing operations are being conducted in a manner consistent with assumptions made by DOE in its waste determination (DOE, 2006a).

Saltstone Grout Formulation and Placement

The observation of DOE saltstone grout processing and disposal operations is related to Factor 1,"Oxidation of Saltstone", and Factor 2, "Hydraulic Isolation of Saltstone," identified in the NRC monitoring plan for the SRS SPF and SDF (NRC, 2007b). The general objectives of NRC monitoring activities related to Factors 1 and 2 are to ensure that the saltstone grout that is produced is of sufficient quality such that there is reasonable assurance that the performance

Table 2 Current NRC Monitoring Plans under the National Defense Authorization Act

Facility	Monitoring Plan Title	Date	ADAMS Accession No.
SRS Salt Waste Disposal	U.S. NRC Plan for Monitoring Disposal Actions Taken by the U.S. DOE Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005	May 3, 2007	ML070730363
INL INTEC Tank Farm Facility	U.S. NRC Plan for Monitoring Disposal Actions Taken by the U.S. DOE at the Idaho Nuclear Technology and Engineering Center Tank Farm Facility in Accordance with the National Defense Authorization Act for Fiscal Year 2005	April 13, 2007	ML070650222

objectives of 10 CFR Part 61 will be met. As discussed in the NRC TER for review of salt waste disposal at the SRS, the hydraulic and chemical properties of the saltstone grout are important for isolating the radioactivity contained in the saltstone grout from the environment (NRC, 2005b). A specific objective of the monitoring visit was to ensure that the saltstone grout formulation produced in the SPF and emplaced in the SDF is consistent with the design specifications assumed in the final waste determination (DOE, 2006a), or that significant deviations from design specifications will not negatively impact the expected performance of the saltstone grout. The staff also sought to obtain information that DOE has collected to further evaluate uncertainties, as discussed in the NRC TER (NRC, 2005b).

Vault Construction

The observation of DOE saltstone disposal operations is related to Factor 1, "Oxidation of Saltstone", and Factor 2, "Hydraulic Isolation of Saltstone," identified in the NRC monitoring plan for the SRS SPF and SDF (NRC, 2007b). The reinforced concrete vaults of the SDF were assumed in the DOE waste determination to provide secondary containment for the radioactivity contained in saltstone grout and to limit the exposure of the saltstone grout to aggressive environmental conditions. A specific objective of the monitoring visit was to observe the saltstone disposal vaults to ensure that the actual performance of the vaults is consistent with the assumptions in the waste determination.

Waste Sampling

The objective of monitoring waste sampling is to evaluate the methodology used to quantify the inventory of radionuclides sent to the SDF. This review is being performed as part of the evaluation of Factor 6, "Feed Tank Sampling," which was identified in the NRC monitoring plan (NRC, 2007b). As stated in the monitoring plan, the total inventory of radionuclides disposed of in the SDF is an important part of meeting the performance objectives of 10 CFR 61.41. Tank 50 in the H-area tank farm serves as the feed tank for transfers from the tank farms to the SPF and is the point of compliance for demonstrating that the waste meets the Saltstone waste acceptance criteria (Culbertson, 2007). As no sampling was ongoing at the time of the observation, the NRC staff's activities focused on reviewing the DOE methodology for waste sampling and analysis. The staff achieved this by interviewing site personnel and reviewing relevant documents.

Radiation Protection Program

The NRC staff interviewed DOE contractor EM personnel and reviewed records of the EM program pertaining to SDF Vault 4 (designated "451-Z" in EM records) and the SPF stack (designated "210-Z building" in EM records). The staff focused specifically on the 2007 ground water monitoring program results for three ground water monitoring wells installed downgradient of Vault 4, and the 2007 air effluent monitoring program for the SPF stack and Vault 4. Staff toured the SPF and the vicinity of Vault 4 to develop an understanding of the facility layout.

2.3 Results of the Observation Visit

Grout Formulation and Placement

The NRC staff concluded that the quality assurance program of DOE and its contractor is effective. The NRC staff also determined that DOE has a program for verifying that saltstone grout components conform to applicable standards of the American Society for Testing and Materials (ASTM).

During its visit, the NRC staff verified that the measured sulfide content of the blast furnace slag supplied by the vendor is consistent with the quality assurance receipt inspection procedures supplied by DOE staff during the observation visit. The amount of sulfide in the slag is important because it imposes a reducing condition on the grout that helps mitigate the release of technetium-99. The measured sulfide sulfur content should be greater than 0.6 weight percent (wt. %) by inspection procedure but less than 2.5 wt. % in accordance with ASTM requirements in ASTM C989 (ASTM, 2006). Representative test reports were provided to verify that blast furnace slag content is within this range. However, the staff noted that all test reports were from the material vendor. Other than the receipt inspection procedures conducted for each truckload of material, DOE conducts no confirmatory chemical analyses.

> Recommendation 2007-1
> The NRC staff recommends that independent verification of the material characteristics of blast furnace slag would provide additional assurance of the quality of saltstone grout.
>
> SRS-SLT-41-01-05-O[5]

The NRC staff also observed the procedures for mixing saltstone grout ingredients at the SPF. As noted in more detail in the attached observation report (Appendix C), the staff observed some variability in the amounts of each dry bulk material supplied for successive batches of saltstone grout. The staff observed that although DOE has a system to verify the total quantity of dry bulk materials input to a batch, DOE has not generated hydraulic and chemical properties of saltstone grout over the range of compositions actually produced at SPF (NRC, 2005b). The NRC staff believes that additional data on the hydraulic and chemical properties of saltstone grout will greatly reduce the uncertainty in estimating future performance of the SDF.

No additional information was available at the time of the NRC staff's observation, beyond that supplied with the performance assessment and supporting documentation provided with the waste determination, to support the physical characteristics of the saltstone. Current characterization processes of the final saltstone grout (or lack thereof) do not allow for a verification of physical properties assigned in the final waste determination.

> Open Issue 2007-1
> The NRC staff will continue to monitor this issue of final product characterization because inadequate quality of saltstone could result in the disposal of saltstone being noncompliant with the 10 CFR 61.41 performance objective.
>
> SRS-SLT-41-01-04-O

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5 For NRC staff tracking purposes, this is the monitoring activity code for the monitoring activity, as described on page 7 of this report. Tables B-1 and B-2 list the codes.

The NRC staff observed that at the end of a production run (typically at the end of a workday), the SPF wetted equipment and saltstone grout transfer line is flushed with approximately 4500 liters (1200 gallons) of water. The flush water is sent directly to the saltstone vault cell that is in use for the production run. During the observation visit, DOE personnel stated that they did not know the impact of the flush water on the quality of the saltstone grout. The NRC staff believes that if the flush water blends with the saltstone grout that has not yet set in the SDF, the water to cement ratio of this portion of the saltstone grout would be much higher than that assumed in the waste determination. Very high water to cement ratios could result in the affected fraction of the saltstone grout having inferior hydraulic properties. Based on processing rates and current system operation, the NRC staff estimated that the fraction of saltstone grout that may be impacted by a high water to cement ratio is less than 5 volume percent.

> Open Issue 2007-2
> The NRC staff believes that DOE should demonstrate that the hydraulic and chemical properties of the final product are consistent with the assumptions in the waste determination, or demonstrate that any deviations are not significant with respect to demonstrating compliance with the performance objectives. Staff will continue to monitor this issue.
>
> SRS-SLT-41-01-04-O

Vault Construction

The NRC staff observed that DOE has acted to mitigate the impact of previously identified vault construction defects (e.g., cracking) on facility performance (DOE, 2006c). However, these efforts have not been fully effective. During the observation visit, the staff observed contaminated seeps as a cell of Vault 4 was filled. The staff observed that DOE appropriately characterizes and manages the contamination. The level of contamination measured on the outside of the vault does not pose an immediate health and safety concern to workers or the public. The area is maintained as a radiologically controlled area, and workers and authorized visitors can safely walk next to the vaults.

The NRC staff observed that DOE has not assessed the risk significance of the impact of differences in observed conditions of the vaults to conditions assumed in its final waste determination and PA. Depending on whether the saltstone quality is assured (see *Grout Formulation and Placement*, above), inadequate quality of SDF vaults could result in the disposal of saltstone being noncompliant with the 10 CFR 61.41 performance objective.

> Open Issue 2007-3
> The NRC staff will continue to monitor DOE efforts to reassess the risk significance of the as-built vault conditions. This is an open issue that the NRC staff will follow during future site monitoring activities.
>
> SRS-SLT-41-02-05-O

Waste Sampling

During the observation visit, the NRC staff observed that the procedures used by DOE to assess the inventory of radionuclides in the SPF feed tank appeared to be adequate. The staff observed no issues with the methodology used to obtain samples from Tank 50 or from other inputs to Tank 50.

The NRC staff observed that the tank farm waste currently in Tank 50 is from Tanks 23 and 49. The waste in these tanks has been characterized through sampling. Tank 49 contains salt waste resulting from the use of the deliquification, dissolution, and adjustment (DDA) process on Tank 41 salt waste. In this process, salt cake in Tank 41 was dissolved and sent to Tank 49, and during this process, it is possible that sludge particles entrained in the salt in Tank 41 could be carried over to Tank 49. Tank 49 serves as a settling tank for these particles before the transfer of the Tank 41 salt waste to Tank 50. To ensure that radionuclide removal efficiencies were as expected during the DDA process, DOE took samples at various depths in Tank 49 to verify that settling occurs and that the amount of particles transferred to Tank 50 is limited. Currently, the waste in Tank 50 is not being slurried during transfers to the SPF, so only supernate is being transferred. However, in the future, the agitation pumps will be run and the tank will be slurried during transfers to the SPF, and any settled particles in Tank 50 will be transferred along with the supernate.

The NRC staff noted that agitation pumps that could suspend particles that are present in the Tank 50 feed tank are not in operation during current liquid transfers. However, in the future, DOE plans to operate the Tank 50 agitation pumps during liquid transfers. The staff believes this practice could result in unexpectedly high transfers of solids to the SPF feed tank, especially when the level of liquid in the Tank 50 feed tank is low. The NRC staff further noted that the SPF feed tank has a mixer that can be operated only when the pump used to transfer salt waste to the blending system is not in operation. The staff believes that this configuration could lead to an accumulation of solids within the SPF feed tank, as solids transferred from Tank 50 would be allowed to settle during transfers of salt waste from the SPF feed tank. The NRC staff believes that if solids accumulation were to occur within the SPF feed tank, it could impact wasteform composition. The accumulation of solids could also result in additional radiological exposure to workers if new systems are required to mobilize accumulated solids.

> <u>Recommendation 2007-2</u>
> The NRC staff recommends that DOE either ensure that the accumulation of solids is monitored during processing or act to mitigate the potential for solids accumulation.
>
> SRS-SLT-41-06-02-T

Radiation Protection Program

As described in more detail in the Observation Report (Appendix C), the NRC staff observed that DOE has an adequate program for protecting its personnel and the public from radiation exposures during operations at the SPF and SDF. Although the review resulted in no open issues, the staff will continue monitoring activities related to radiation protection during future onsite observation visits to SRS.

2.4 Future Changes to Disposal Design

The current operational disposal vault at the Saltstone Facility (Vault 4) has dimensions of approximately 60 meters (200 feet) in width, by 180 meters (600 feet) in length, by 8 meters

(26 feet) in height. It is divided into twelve cells, with each cell measuring approximately 30 meters (100 feet) by 30 meters (100 feet). The vault is covered with a sloped, permanent roof, and the vault walls are approximately 0.5 meters (1.5 feet) thick. The basemat is 0.6 meters (2 feet) thick. DOE is currently considering the use of future vaults that will be cylindrical concrete tanks approximately 6 meters (20 feet) high and 45 meters (150 feet) in diameter, which will hold 5.7 million liters (1.5 million gallons) of saltstone grout. This design is used commercially for water storage. One vault will consist of two tanks, so that each vault will have a capacity of approximately 11.4 million liters (3 million gallons) of saltstone grout (DOE, 2006b). As noted in the Saltstone monitoring plan and Appendix B to this report, the NRC staff will continue monitoring activities that pertain to vault construction and operations and will review any update to the DOE PA that may reflect the updated design.

2.5 Summary of Open Issues and Recommendations

The following is a summary of the recommendations and open issues from the NRC staff's monitoring activities of DOE salt waste disposal activities in CY 2007 that the staff will continue to monitor in CY 2008.

Saltstone Grout Formulation and Placement

During the October 2007 visit to SRS, the NRC staff reviewed information regarding what tests had been performed to ensure that blast furnace slag, an ingredient of the saltstone grout, contains sufficient amounts of sulfur. The staff noted that the supplier had performed tests, but DOE had not performed confirmatory tests.

> Recommendation 2007-1
> The NRC staff recommends that independent verification of the material characteristics of blast furnace slag would provide additional assurance of the quality of saltstone grout.
>
> SRS-SLT-41-01-05-O

The NRC staff also observed that DOE has not generated hydraulic and chemical properties of saltstone grout over the range of compositions actually produced at the SPF. The staff believes that additional data over a range of compositions will greatly reduce the uncertainty in estimating the future performance of the SDF.

> Open Issue 2007-1
> The NRC staff will continue to monitor this issue of final product characterization because inadequate quality of saltstone could result in the disposal of saltstone being noncompliant with the 10 CFR 61.41 performance objective.
>
> SRS-SLT-41-01-04-O

The NRC staff also observed that at the end of a production run, DOE uses water to flush transfer lines between the SPF and SDF. The flush water is added directly to the SDF and may be blending with grout that has not yet set. The NRC staff believes that this may have a deleterious effect on the hydraulic properties of the saltstone grout.

Open Issue 2007-2
The NRC staff believes that DOE should demonstrate that the hydraulic and chemical properties of the final product are consistent with the assumptions in the waste determination, or demonstrate that any deviations are not significant with respect to demonstrating compliance with the performance objectives. The staff will continue to monitor this issue.

SRS-SLT-41-01-04-O

Vault Construction

During the October 2007 visit to the SRS, the NRC staff observed contaminated seeps on the exterior wall of the vault being filled in the SDF. The NRC observed that DOE has not assessed the risk significance of the impact of the differences in observed conditions of the vaults to conditions assumed in its final waste determination and PA.

Open Issue 2007-3
The NRC staff will continue to monitor DOE efforts to reassess the risk significance of the as-built vault conditions. This is an open issue that the NRC staff will follow during future site monitoring activities.

SRS-SLT-41-02-05-O

Waste Sampling

During the October 2007 visit to SRS, the NRC staff reviewed the process for waste transfers from the F-area tank farm to the SPF. The staff noted that agitation pumps that could suspend particles present in the tanks are not in operation during current liquid transfers. However, in the future, DOE plans to operate the agitation pumps during liquid transfers. The staff believes that this practice could result in unexpectedly high transfers of solids, especially when the sending tank liquid level is low.

Recommendation 2007-2
The NRC staff recommends that DOE either ensure that the accumulation of solids is monitored during processing or act to mitigate the potential for solids accumulation.

SRS-SLT-41-06-02-T

The NRC staff returned to SRS in March 2008, to observe saltstone production, characterization, and disposal operations, and to follow up on the open issues and recommendations identified above. DOE provided additional information during a March 2008 observation visit and plans to address the open issues noted during the October 2007 observation visit. The NRC staff will review this information and issue an observation report for the March 2008 observation approximately 60 days following the close-out of the March 2008 visit.

The NRC staff opened no new monitoring activities as a result of the observation visit, and no monitoring activities were closed. The staff identified no open activities as open-noncompliant. Therefore, the staff plans no revisions to the monitoring plan in response to monitoring activities in CY 2007.

Based on its observations, the NRC staff continues to conclude that there is reasonable assurance that the applicable criteria of the NDAA can be met if key assumptions made in the DOE waste determination analyses prove to be correct. In accordance with the requirements of the NDAA and consistent with the NRC's monitoring plan for the salt waste disposal facility, the NRC will continue to monitor DOE disposal actions at the SRS. The monitoring activities are expected to be an iterative process and several onsite observation visits, and technical reviews of various reports, studies, and other documents may be necessary to obtain the information needed to close all of the current open issues, as well as issues that may be opened in the future.

3. MONITORING AT THE IDAHO NATIONAL LABORATORY IDAHO NUCLEAR TECHNICAL AND ENGINEERING CENTER IN 2007

The NRC issued its monitoring plan for INTEC on April 13, 2007 (see Table 2). The NRC staff identified five key monitoring areas, one monitoring area on radiation protection and EM areas pursuant to 10 CFR 1.43, and a total of 31 monitoring activities in this plan. Table B-2 summarizes the monitoring areas and related monitoring activities.

3.1 Monitoring Areas at the INTEC Tank Farm Facility

In 2007, the NRC staff conducted two observation visits on April 24–25, 2007, and August 15, 2007. The staff also performed several technical reviews identified in the monitoring plan.

3.1.1 Technical Reviews

Technical Review Area for Key Monitoring Area-3

> 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…." (description of KMA-3; see Table B-2)

Key monitoring area (KMA)-3 was developed as a result of the NRC staff's analysis in the TER for the INTEC TFF draft waste determination (NRC, 2006), which showed a number of uncertainties associated with the DOE ground water model used to support demonstration of compliance with the performance objective found in 10 CFR 61.41 for protection of the general population from releases of radioactivity. Uncertainties included (1) hydrogeologic conceptual model uncertainty broadly affecting flow and transport of radiological constituents in the subsurface; (2) infiltration rates that affect travel times and flux of contaminants to the Snake River Plain Aquifer; and (3) Big Lost River seepage rates that affect travel paths/lengths and dilution of radiological constituents during unsaturated zone transport. However, assuming that the engineered barrier system performs as well as is assumed in the DOE PA, the NRC staff concluded in the TER that natural system uncertainty could be managed with conservative assumptions. The NRC's monitoring efforts under KMA-3 are focused on identifying any new and significant information that would invalidate the NRC's previous conclusions. For example, dilution from Snake River Plain Aquifer flow alone for the risk-significant radionuclides technetium-99 and iodine-129 and dilution and some credit for sorption and decay for strontium-90 during transport through the vadose zone are sufficient for DOE to demonstrate compliance with 10 CFR 61.41. The NRC staff's monitoring plan for the INL INTEC TFF (NRC, 2007a) provides additional details on how hydrogeological uncertainties affect the potential risk from highly radioactive radionuclides identified for the INTEC TFF.

As stated in the NRC's monitoring plan (NRC, 2007a), the NRC staff will continue to stay abreast of relevant monitoring and modeling activities conducted by DOE, other agencies, or independent researchers until such time that the NRC staff concludes that risk-significant hydrologic uncertainties are adequately addressed and overall system performance is adequately constrained. However, because only minimum credit for natural system performance is needed if the engineered system performs as well as assumed in the DOE PA, the status of this KMA will remain open until KMA-2 related to engineered barrier system performance is closed. If issues arise during evaluation of KMA-2 (e.g., if the NRC staff has concerns that the tank grout will provide reducing conditions or that the grouted tank and vault system will provide a hydraulic barrier to limit releases of short-lived radionuclides in the near-term), then KMA-3 will become increasingly important. KMAs 2 and 3 are, therefore, expected to be closed in tandem.

The NRC staff reviewed a number of documents related to the hydrogeological system at INTEC. These documents include publications generated from research conducted at the Vadose Zone Research Park (VZRP) near INTEC (e.g., Baker, 2006, and other information provided at http://vadosezone.inel.gov/vzrp/index.htm). The VZRP is the site of field-scale experiments used to study the movement of water and solutes through alluvium, sediment, and basalt between land surface and the underlying Snake River Plain Aquifer. Two new percolation ponds constructed at the park and the losing Big Lost River recharge the subsurface at VZRP located southwest of the INTEC TFF.

One goal of the research park is to improve the understanding of vadose zone processes that can be applied to the INL environmental restoration, waste management, and facility operations. Predicting fluid and contaminant transport in the vadose zone near INTEC at INL has been problematic because of the complex geology underlying the site. In 2002, in an attempt to better understand the controlling mechanisms of subsurface fluid transport, DOE installed a system of monitoring instruments in boreholes around the perimeter of the percolation ponds and extending to the Big Lost River. DOE plans to study important mechanisms, including hydraulic spreading, formation of perched water, fluid transport through fast pathways, extent of vertical and lateral infiltration, aquifer recharge, contaminant retardation capacity of porous media, and Big Lost River recharge to the vadose zone.

Data collected by DOE at the VZRP indicate that perched water persists in the absence of local recharge, that water infiltration is complex and can reach large distances laterally and vertically in a nonsequential manner, and that flow paths are highly sensitive to discharge location and surface flux rates. DOE continues to study the characteristics of perched zones that may increase transport rates and lead to the bypassing of attenuating materials in the vadose zone and to study the affect of fracture flow and preferential pathways on solute flow and transport. Information collected at the VZRP is pertinent to the hydrological uncertainties identified in the NRC's TER (NRC, 2006) and addresses each technical review activity identified in the INL monitoring plan (NRC, 2007a). The NRC staff will continue to review information as it is developed.

The NRC staff also reviewed ground water monitoring data of perched and saturated ground water at INTEC, as well as perched water response to Big Lost River flow that occurred in 2006. This monitoring was conducted under the CERCLA program (Forbes, 2007). Data from historical releases collected under the CERCLA program provide a basis for the NRC staff to evaluate the hydrogeological system at INTEC TFF (e.g., flow directions, transport rates, and potential dilution). As discussed in the NRC's monitoring plan (NRC, 2007a), the NRC staff will continue to evaluate ground water data to assess hydrogeological uncertainties identified in its TER (NRC, 2006), including the relative risk and mobility of radiological constituents at INTEC TFF. It is important to note that historical releases are addressed under the CERCLA program and are not considered to be releases from the disposal facility under the NDAA. Concentrations of strontium-90 and technetium-99 exceeded their respective drinking water standards in one or more of the aquifer monitoring wells at or near the INTEC.[6] One aquifer well located southeast of INTEC showed an increase in strontium-90 from the previous year. Consistent with data collected in 2005, technetium-99 was detected at concentrations above drinking water standards in two aquifer wells. The highest technetium-99 concentration of 80 becquerel per liter (Bq/L) (2,150 picocuries per liter (pCi/L)) was observed at a monitoring well located just north of the INTEC TFF. The second highest technetium-99 concentration of 45.9 Bq/L (1240 picocuries (pCi)/L) was observed at a new aquifer well located just southeast of the tank farm. DOE has attributed detectable concentrations of technetium-99 to historical releases from the INTEC TFF. Iodine-129 concentrations were below drinking water standards at all aquifer locations. None of the aquifer wells showed increases in iodine-129 concentration.

DOE perched water monitoring data from historical releases indicate that strontium-90 was the principal radionuclide detected in shallow perched water at INTEC (Forbes, 2007). Perched water wells located at and southeast of the INTEC TFF exhibited the highest levels of strontium-90 contamination. The maximum strontium-90 activity concentration observed in perched water in 2006 was 7290 Bq/L (197,000 pCi/L). Consistent with recent detections in 2005, cesium-137 was detected at a lower concentration in one shallow perched water well located at the INTEC TFF. Cesium-137 is less mobile than technetium-99, iodine-129, and strontium-90. Thus, this constituent was not detected in INTEC ground water until 2005, long after technetium-99, iodine-129, and strontium-90 were detected in monitoring wells at INTEC. The NRC staff continues to review new data on cesium-137 and other less mobile radionuclides for discernible trends and to gather information regarding the attenuation of these constituents in the subsurface at INTEC to compare against DOE assumptions in its PA. The highest levels of technetium-99 in shallow perched water were observed in monitoring wells located southeast of the INTEC TFF consistent with strontium-90 monitoring data at levels lower than drinking water standards. Iodine-129 was detected in only one perched water well located south of the INTEC TFF at a concentration of 0.2 Bq/L (5 pCi/L), higher than reported in 2005, and the highest concentration reported in any well in recent years. Iodine-129 concentration trends were either relatively constant or slowly declining over time at all other locations.

The losing Big Lost River flowed past INTEC from April 16 until July 3, 2006. The effect on perched water levels was observed only at the monitoring wells located closest to the river (within 150 meters (500 feet)). Little or no water level response was observed in wells located further from the river. A combination of precipitation infiltration (rainfall and snowmelt) and discharges and leaks of water from facility pipelines appears to account for continued recharge of the perched water beneath the northern part of INTEC (Forbes, 2007). The extent of shallow perched water beneath the northern portion of INTEC expanded eastward during 2005–2006, primarily because of an increase in onsite precipitation infiltration.

The information provided in the 2006 monitoring report for INTEC (Forbes, 2007) is reasonably consistent with information reviewed by the NRC staff during development of its TER (NRC,

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6 NRC low-level waste regulations in 10 CFR Part 61, Subpart C, do not provide concentration limits for radioactive constituents in ground water. Comparisons to drinking water standards are made to provide a relative indication of the levels of contamination in the subsurface at INTEC and in no way imply that these standards are necessary to demonstrate compliance with NRC low-level waste performance objectives. Drinking water standards are generally more limiting than 10 CFR 61.41 performance objective standards for highly radioactive radionuclides based on the DOE PA results.

2006). The NRC staff will continue to assess the mobility of radiological constituents such as cesium-137 and neptunium-237 through continued review of INTEC monitoring data. Wells located close to the INTEC TFF to the north and southeast continue to show the presence of elevated technetium-99 and strontium-90 concentrations among other constituents, consistent with the NRC staff's understanding of the contaminant footprint and magnitude of contaminant concentrations from historical releases from the INTEC TFF.

While review of data analysis generated at the VZRP reinforced the complex nature of the hydrogeological system at INL, the NRC staff identified no new and significant information that would invalidate its TER conclusions. It appears that Big Lost River seepage has the ability to propagate or lead to the development of new perched water at large distances away from the stream. The NRC staff believes the magnitude of this effect appears to be less pronounced at the INTEC TFF. Data reviewed on Big Lost River seepage rates, infiltration rates, and potential contaminant flow and transport mechanisms are reasonably consistent with previous information evaluated by the NRC staff. The staff continues to have reasonable assurance that performance objectives can be met for residual waste disposal at the INTEC TFF.

The NRC staff will continue to review information and data generated from the VZRP and CERCLA monitoring program to support each technical review activity for KMA-3.

> Recommendation 2007-3
> The NRC staff recommends that DOE evaluate any new and significant information related to hydrogeological system uncertainty at INTEC and requests that DOE provide any recent reports or data related to hydrogeological system uncertainty at INTEC of which the NRC staff may not be cognizant.
> INL-TFF-41-03-03-T[7]

Technical Review Area for Key Monitoring Area-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, 2006). (Description of KMA-4. See Table B-2)

KMA-4 in the NRC's TER for the INTEC TFF addresses DOE compliance with the performance objective found in 10 CFR 61.43 related to protection of individuals during operations. Tank stabilization activities conducted in 2006 and 2007 could potentially lead to releases of radioactivity to the environment through the air pathway during waste disposal operations. Because institutional controls are 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 as the result of stabilization activities are expected to be indistinguishable from other INL sources and background radioactivity levels at the site boundary where a member of the public could be exposed. Results from previous environmental surveillance reports have indicated that

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[7] For NRC staff tracking purposes, this is the monitoring activity code for the monitoring activity, as described on page 7 of this report. Tables B-1 and B-2 list the codes.

radioactivity from operations could not be distinguished from worldwide fallout and natural radioactivity in the region surrounding INL. The NRC staff plans to evaluate this performance objective through evaluation of the DOE bounding analysis of the radiological impact of all INL operations at the facility boundary.

To evaluate this performance objective, the INL monitoring plan provides that the 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. The NRC staff observed the DOE worker protection program and reviewed worker radiation records during grouting operations conducted in 2007, as discussed in Section 3.1.2 of this report. Technical review activities associated with protection of members of the public under KMA-4 discussed in this section included review of environmental surveillance data and analysis performed by Stoller Corporation and Idaho Department of Environmental Quality (DEQ), as discussed below.

The NRC staff reviewed DOE environmental surveillance reports providing measurements of radionuclide concentrations in various media located at INL (e.g., DOE, 2007). The DOE EM program is used 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 Environmental Surveillance, Education, and Research Program, managed by S.M. Stoller Corporation for DOE, performed environmental surveillance of offsite locations. DOE evaluated potential radiological doses to the public from INL site operations to determine compliance with pertinent regulations and limits. DOE used two different computer programs to estimate doses resulting from inhalation of radioactive material in the air. These programs were the Clean Air Act Assessment Package, 1988 (CAP-88) computer code and the mesoscale diffusion (MDIFF) air dispersion model. The maximum calculated dose to an individual by either of the methods was well below the applicable radiation protection standard of 0.10 millisieverts per year (mSv/yr) (10 mrem/year) and background radiation dose estimates of around 3.6 mSv/yr (360 mrem/yr). The dose to the maximally exposed individual, as determined by the CAP-88 program, was 0.4 microsieverts (μSv) (0.04 mrem); using the MDIFF dispersion guide, the dose was 0.5 μSv (0.05 mrem). The maximum potential individual doses from consuming waterfowl and big game animals at the INL, based on the highest concentrations of radionuclides measured in samples of these animals, were estimated to be 0.13 μSv (0.01 mrem), and 0.07 μSv (0.007 mrem), respectively, which are well below the applicable standard. These estimates were characterized as being conservatively high (DOE, 2007).

The NRC staff also reviewed environmental data collected by the State of Idaho. The Idaho DEQ also maintains an environmental surveillance program (e.g., air, water (surface and ground water), soil, and milk sampling from on and off the INL site) to help independently evaluate the DOE monitoring program and assess environmental impacts from INL facilities. The Idaho DEQ publishes quarterly and annual reports that provide monitoring data or analysis. When the NRC staff developed this monitoring activity (see Table B-2, fourth monitoring activity under "Environmental Review and Environmental Sampling"), the staff assumed it would either observe DOE sampling activities or rely on the Idaho DEQ oversight program. The NRC staff has since concluded that the Idaho DEQ independent environmental surveillance program is sufficient to address this monitoring area. Therefore, the NRC staff plans to continuously review data, analysis, and conclusions provided in Idaho DEQ quarterly and annual reports to help reach its conclusions regarding compliance with the 10 CFR 61.43 performance objective.

The latest annual report currently available on the Idaho DEQ Web site is for CY 2006 (Idaho DEQ, 2007). Quarterly reports for the first two quarters in 2007 are also available on the INL Oversight Web page (see http://www.deq.idaho.gov/inl_oversight/). The NRC staff reviewed this information to determine potential offsite impacts to members of the public, unexplained or unexpected releases of radioactivity resulting from operations at INTEC, as well as to identify trends with respect to contaminant concentrations from onsite monitoring wells. While the monitoring network at INTEC is not as extensive as it is for the CERCLA program, onsite ground water monitoring data collected by the Idaho DEQ also helps to validate data collected by DOE and its contractors.

As indicated in the Idaho DEQ "INL Oversight Annual Report 2006" (Idaho DEQ, 2007), results for 2006 monitoring show that measurements are generally consistent[8] with historic trends. Concentrations of radioactivity in air, soils, and milk and radiation levels continue to be unchanged from previous years and were consistent with background levels. In general, there appears to be good agreement between the EM data reported by the Idaho DEQ and data collected by DOE or its contractors.

The NRC staff thinks that the consistency of data collected by the Idaho DEQ and DOE provides confidence that both programs can be used to evaluate offsite environmental impacts associated with INL operations. Based, in part, on review of environmental surveillance data collected by DOE and the State, the NRC staff continues to have reasonable assurance that the 10 CFR 61.43 performance objective related to protection of individuals during operations will be met.

The NRC staff will continue to evaluate worker and public exposure data or estimates through review of worker radiation records and environmental surveillance reports as the INTEC TFF closure activities progress in support of the technical review activities identified for KMA-4 in the INL monitoring plan (NRC, 2007a). The level of monitoring is expected to be higher during active closure operations conducted through the year 2012.

> Recommendation 2007-4
> The NRC staff recommends that DOE provide information on any violations of requirements related to workers and the general public (10 CFR Part 835 or DOE Order 5400) during its waste disposal operations. As information provided on the Web may not be timely, the NRC staff requests that DOE provide information regarding worker or public dose exceedances within a reasonable time after their occurrence.
>
> INL-TFF-43-04-01-T

[8] Isolated iodine-131 detections that were below U.S. Environmental Protection Agency limits were reported from charcoal cartridges collected at the Atomic City air monitoring station during 1 week in October 2006. The INL offsite contractor did not report any iodine-131 detections at a monitoring station located a quarter mile away. No known releases from INL operating facilities occurred during this time period.

3.1.2 Onsite Observations

The staff's April 24–25, 2007, and August 15, 2007, onsite observation visits focused primarily on two performance objectives, 10 CFR 61.41, "Protection of the General Population from Releases of Radioactivity," and 10 CFR 61.43, "Protection of Individuals during Operations," by observing DOE tank grouting operations and verifying DOE radiation protection measures associated with those operations (Appendix C to this report contains the onsite observation reports). Since wasteform production operations could impact the long-term stability of the disposal facility after its closure, this observation also partially assessed the performance objective in 10 CFR 61.44, "Stability of the Disposal Site after Closure."

3.1.2.1 Areas Reviewed

Grout Formulation and Performance

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

Radiation Protection Program

To verify that the DOE radiation protection program is in place for its tank closure operations to assess compliance with 10 CFR 61.43, the onsite observation included (1) interviews with DOE and its contractor's radiation protection personnel, (2) reviews of radiological control documents associated with TFF tank closure operations (e.g., the Idaho Cleanup Project Radiation Control Manual (CWI, 2005), and ALARA Program and Implementation (CWI, 2006), and (3) reviews of associated worker dose records. The NRC staff toured the INTEC site to verify the level of access control in general and TFF-specific access control. The onsite tour also included observation of the operation of the Radiological Control Information Management System, which controls individual radiological worker doses specifically associated with TFF tank closure activities.

3.1.2.2 Results of the Observation Visits

Grout Formulation and Performance

As noted in the first observation report for the TFF (NRC, 2007c), the NRC staff had planned to observe ongoing tank operations at the TFF during its visit on April 24–25, 2007. However, several days before the visit, CH2M*WG Idaho, LLC (CWI), a DOE contractor, encountered operational problems during the grouting of a tank. During the first day of engineered placement grout pours, two articulating tank grout arms and a steam jet were inadvertently encased in hardened grout inside Tank WM-182. As a result, there were no grouting operations during the staff's visit, and staff activities involved a tour of the grout batch plan, record reviews, and interviews with CWI staff. The NRC staff recommended that DOE-ID consider developing additional controls or procedures based on lessons learned from the operational problems encountered during the grouting of Tank WM-182. During its subsequent visit on August 15, 2007, the NRC staff learned that DOE had revised its operational procedures and placed additional cameras in the tanks to avoid a recurrence of the problem.

During the April 2007 observation, the staff initially identified three open issues pertaining to grout formulation and performance. The first issue pertained to documents reviewed by the NRC staff that showed that three of four small (110,000-liter (30,000-gallon)) tanks were filled with grout containing a high water-to-cement ratio. The NRC staff noted that the high water-to-cement ratios would result in a final grout with permeability as much as 1000 times higher than assumed in the DOE PA. However, the affected tanks are small and are not likely to result in a significant increase in dose to the public over the long term. Therefore, the staff closed this open issue in 2007. Nonetheless, the staff believes that DOE should evaluate the impact of this operational deviation on performance of the disposal facility.

Recommendation 2007-5
The NRC staff recommends that DOE document deviations from assumptions made in its final waste determination and PA and assess the risk significance of these deviations.
INL-TFF-41-PA-01-T

During the August 15, 2007, visit, the staff confirmed that DOE has a process in place to review and disposition noted deviations.

The second open issue is related to the sulfur content of the blast furnace slag used in the tank grout. The NRC staff verified that the sulfur content of the blast furnace slag supplied by the DOE vendor is consistent with DOE specifications. The amount of sulfide is important because it imposes a reducing condition in the grout that mitigates the release of technetium-99. However, the NRC observed that neither DOE nor its contractor, CWI, perform independent sampling and analysis of the grout materials. DOE chooses to rely on test reports provided by a vendor. The NRC staff requested additional information regarding the qualifications of vendors on the DOE approved vendor list. Following the staff's visit, DOE provided additional information which provides reasonable assurance that the DOE supplier has procedures in place to ensure that grout materials meet DOE specifications, in terms of both normal formulation and grout characteristics. Therefore, this open issue was closed in 2007. However, it does not appear that CWI is performing any additional confirmatory testing for sulfide content.

Recommendation 2007-6
The NRC staff recommends that DOE consider whether specific additional requirements should be added to its contractor quality assurance program to address nonstandard grout characteristics that are relied on in the PA.
INL-TFF-41-02-04-O

Finally, the third open issue is related to the cure time for the grout. During the April 2007 observation visit, the NRC staff requested engineering calculations used by the DOE contractor as the basis for using a minimum cure time of 30 minutes between grout pours. Upon review of the information provided by DOE, the NRC staff performed independent calculations of the maximum temperature within the controlled low-strength material grout and verified that temperatures would be significantly below the acceptance criterion. However, the NRC staff raised the issue of early age cracks forming in the grout as a result of temperature gradients that may form during cure. In response, DOE stated, and the NRC staff concurs, that early age cracking at the INTEC TFF is bounded by the conservative assumptions used in the PA calculations. Therefore, this open issue was closed in 2007. Nevertheless, the NRC staff believes that engineering calculations of this type may be useful before tank grouting at other sites.

<u>Recommendation 2007-7</u>
The NRC staff recommends that DOE consider performing engineering calculations before tank grouting at other DOE sites such that steps can be taken to limit temperature gradients and the potential for crack formation.
INL-TFF-44-02-08-T

During its visit to the grout batch plant facility, the NRC staff observed the weather-tight silos for storage of the slag and cementitious materials. The silos appeared to be adequate for preventing precipitation from contacting the grout materials. Therefore, monitoring activity INL-TFF-41-02-02-T, in which the staff determines whether slag storage is sufficient to maintain the quality and chemical reactivity of the slag, is closed.

Based on the staff's onsite observations of the DOE program for sampling, testing, and accepting grout materials described above, the NRC staff has closed monitoring activities INL-TFF-41-02-06-O and INL-TFF-41-02-07-O (see Table B-2).

Radiation Protection Program

As noted in further detail in the observation reports in Appendix C, the NRC staff found that DOE has an adequate program for protecting its personnel from radiation exposures during TFF tank closure operations.

3.2 Summary of Open Issues and Recommendations

The following is a summary of the recommendations and open issues from the NRC staff's monitoring activities of the DOE INTEC TFF activities in CY 2007 that the staff will continue to monitor in CY 2008.

During technical reviews performed by the NRC staff in 2007, the NRC staff evaluated information that DOE continues to develop pertaining to hydrological uncertainties at the TFF and EM data produced by both the State of Idaho and DOE. The NRC staff did not identify any open issues but will continue to review additional information as it is developed.

Recommendation 2007-3
The NRC staff recommends that DOE evaluate any new and significant information related to hydrogeological system uncertainty at INTEC and requests that DOE provide any recent reports or data related to hydrogeological system uncertainty at INTEC of which the NRC staff may not be cognizant.
INL-TFF-41-03-03-T

Recommendation 2007-4
The NRC staff recommends that DOE provide information on any violations of requirements related to workers and the general public (10 CFR Part 835 or DOE Order 5400.5) during its waste disposal operations. As information provided on the Web may not be timely, the NRC staff requests that DOE provide information regarding worker or public dose exceedances within a reasonable time after their occurrence.
INL-TFF-43-04-01-T

During an observation visit to INL in April 2007, the NRC staff observed that three of four small 110,000-liter (30,000-gallon) tanks had been filled with grout containing a high water-to-cement ratio. The staff noted that although the permeability of the resultant grout is higher than assumed in the DOE PA, the tanks are small and are not likely to result in a significant increase in dose to the public. Nonetheless, the NRC staff believes that DOE should evaluate the impacts of operational deviations.

Recommendation 2007-5
The NRC staff recommends that DOE document deviations from assumptions made in its final waste determination and PA and assess the risk significance of these deviations.
INL-TFF-41-PA-01-T

During the August 15, 2007, visit, the staff confirmed that DOE has a process in place to review and disposition noted deviations.

During an observation visit to INL in April 2007, the NRC staff observed that DOE does not perform additional testing of blast furnace grout for sulfide content. This is similar to the first recommendation noted above for the SRS Saltstone Facility.

Recommendation 2007-6
The NRC staff recommends that DOE consider whether it should include specific additional requirements in its contractor quality assurance program to address nonstandard grout characteristics that are relied on in the PA.
INL-TFF-41-02-04-O

During an observation visit to INL in April 2007, the NRC staff requested information regarding the basis for using a minimum cure time of 30 minutes between grout pours. During reviews of information provided by DOE after the visit, the NRC staff concluded that temperatures would remain within acceptable levels, but the staff's review led to a follow-on question regarding the potential for early age cracking of the grout as a result of temperature gradients that may form. In subsequent communication, the NRC staff agreed that such cracking is bounded by conservative assumptions in the DOE PA, but believes that, in the future, engineering calculations would be useful before tank grouting at other DOE sites.

Recommendation 2007-7
The NRC staff recommends that DOE consider performing engineering calculations before tank grouting at other DOE sites such that steps could be taken to limit temperature gradients and the potential for crack formation.
INL-TFF-44-02-08-T

The NRC staff intends to return to INL in 2008 to follow up on the activities described above.

The NRC staff opened no new monitoring activities as a result of the issues raised and recommendations made during these observations and closed three monitoring activities (see Table B-2). No open activities have been identified as open-noncompliant. Therefore, the NRC plans no revisions to the monitoring plan in response to monitoring activities in CY 2007.

The NRC staff continues to have reasonable assurance that the 10 CFR Part 61, Subpart C, performance objectives are being met and will be met in the future.

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5. GLOSSARY

Closed activity
: A monitoring activity where a key assumption made or key parameter used by 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.

Factor
: Assumptions made or parameters used by DOE in its performance demonstration that the NRC considers important, through the review of DOE waste determination which describes its waste disposal actions and demonstrates that there is reasonable assurance that the performance objectives listed in 10 CFR Part 61, Subpart C, will be met.

Highly radioactive radionuclides
: Those radionuclides that contribute most significantly to risk to the public, workers, and the environment.

Key monitoring area
: Areas that the NRC has determined to be important, through the review of DOE waste determination that describes its waste disposal actions, to demonstrating that there is reasonable assurance that the 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 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 the DOE waste disposal action will result in compliance with the performance objectives.

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 issue
: Issues that arise during monitoring activities that require additional followup by the NRC staff or additional information from DOE to address questions that the NRC staff has raised regarding DOE disposal actions.

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 technical bases have been provided to determine that the performance objectives will be met.
Operations	The timeframe 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 PA 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).
Recommendation	As used in this report, suggestions to DOE that address ways that DOE can make progress on closing any open activities in the staff's monitoring plan; a monitoring area for which an open issue has been previously identified and closed, and for which the NRC staff suggests further action to strengthen some aspect of the DOE disposal action; and monitoring areas where no open issues or concerns were previously raised but the NRC staff recommends further improvements to DOE disposal actions.
Waste determination	DOE documentation demonstrating that a specific waste stream is not high-level waste (also known as non-high-level waste determination).
Worker	DOE personnel or contractors who carry out operational activities at the disposal facility. For the purpose of this plan, 10 CFR Part 835, "Occupational Radiation Protection," dose limits (comparable to those in 10 CFR Part 20, "Standards for Protection against Radiation") would apply for radiation workers.

Appendix A

Section 3116, Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005

SEC. 3116. DEFENSE SITE ACCELERATION COMPLETION.

(a) IN GENERAL—Notwithstanding the provisions of the Nuclear Waste Policy Act of 1982, the requirements of section 202 of the Energy Reorganization Act of 1974, and other laws that define classes of radioactive waste, with respect to material stored at a Department of Energy site at which activities are regulated by a covered State pursuant to approved closure plans or permits issued by the State, the term "high-level radioactive waste" does not include radioactive waste resulting from the reprocessing of spent nuclear fuel that the Secretary of Energy (in this section referred to as the "Secretary"), in consultation with the Nuclear Regulatory Commission (in this section referred to as the "Commission"), determines—

(1) does not require permanent isolation in a deep geologic repository for spent fuel or high-level radioactive waste;

(2) has had highly radioactive radionuclides removed to the maximum extent practical; and

(3)(A) does not exceed concentration limits for Class C low-level waste as set out in section 61.55 of title 10, Code of Federal Regulations, and will be disposed of—

(i) in compliance with the performance objectives set out in subpart C of part 61 of title 10, Code of Federal Regulations; and

(ii) pursuant to a State-approved closure plan or State-issued permit, authority for the approval or issuance of which is conferred on the State outside of this section; or

(B) exceeds concentration limits for Class C low-level waste as set out in section 61.55 of title 10, Code of Federal Regulations, but will be disposed of—

(i) in compliance with the performance objectives set out in subpart C of part 61 of title 10, Code of Federal Regulations;

(ii) pursuant to a State-approved closure plan or State-issued permit, authority for the approval or issuance of which is conferred on the State outside of this section; and

(iii) pursuant to plans developed by the Secretary in consultation with the Commission.

(b) MONITORING BY NUCLEAR REGULATORY COMMISSION—(1) The Commission shall, in coordination with the covered State, monitor disposal actions taken by the Department of Energy pursuant to subparagraphs (A) and (B) of subsection (a)(3) for the purpose of assessing compliance with the performance objectives set out in subpart C of part 61 of title 10, Code of Federal Regulations.

(2) If the Commission considers any disposal actions taken by the Department of Energy pursuant to those subparagraphs to be not in compliance with those performance objectives, the Commission shall, as soon as practicable after discovery of the noncompliant conditions, inform the Department of Energy, the covered State, and the following congressional committees:

(A) The Committee on Armed Services, the Committee on Energy and Commerce, and the Committee on Appropriations of the House of Representatives.

(B) The Committee on Armed Services, the Committee on Energy and Natural Resources, the Committee on Environment and Public Works, and the Committee on Appropriations of the Senate.

(3) For fiscal year 2005, the Secretary shall, from amounts available for defense site acceleration completion, reimburse the Commission for all expenses, including salaries, that the Commission incurs as a result of performance under subsection (a) and this subsection for fiscal year 2005. The Department of Energy and the Commission may enter into an interagency agreement that specifies the method of reimbursement. Amounts received by the Commission for performance under subsection (a) and this subsection may be retained and used for salaries and expenses associated with those activities, notwithstanding section 3302 of title 31, United States Code, and shall remain available until expended.

(4) For fiscal years after 2005, the Commission shall include in the budget justification materials submitted to Congress in support of the Commission budget for that fiscal year (as submitted with the budget of the President under section 1105(a) of title 31, United States Code) the amounts required, not offset by revenues, for performance under subsection (a) and this subsection.

(c) INAPPLICABILITY TO CERTAIN MATERIALS—Subsection (a) shall not apply to any material otherwise covered by that subsection that is transported from the covered State.

(d) COVERED STATES—For purposes of this section, the following States are covered States:

(1) The State of South Carolina.

(2) The State of Idaho.

(e) CONSTRUCTION—(1) Nothing in this section shall impair, alter, or modify the full implementation of any Federal Facility Agreement and Consent Order or other applicable consent decree for a Department of Energy site.

(2) Nothing in this section establishes any precedent or is binding on the State of Washington, the State of Oregon, or any other State not covered by subsection (d) for the management, storage, treatment, and disposition of radioactive and hazardous materials.

(3) Nothing in this section amends the definition of "transuranic waste" or regulations for repository disposal of transuranic waste pursuant to the Waste Isolation Pilot Plant Land Withdrawal Act or part 191 of title 40, Code of Federal Regulations.

(4) Nothing in this section shall be construed to affect in any way the obligations of the Department of Energy to comply with section 4306A of the Atomic Energy Defense Act (50 U.S.C. 2567).

(5) Nothing in this section amends the West Valley Demonstration Act (42 U.S.C. 2121a note).

(f) JUDICIAL REVIEW—Judicial review shall be available in accordance with chapter 7 of title 5, United States Code, for the following:

(1) Any determination made by the Secretary or any other agency action taken by the Secretary pursuant to this section.

(2) Any failure of the Commission to carry out its responsibilities under subsection (b).

Appendix B

Summary Tables of NRC Monitoring Plans

Table B-1 Monitoring at Savannah River Site Saltstone Facilities[1] (NRC, 2007b)

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities (Monitoring Activity Code)	Activity Type[2]	Activity Status[3]
61.41	Data review		Review information on reported inventories and concentrations in the SDF. (SRS-SLT-41-00-01-T)	T	Open
	Data review		Review groundwater monitoring data, updates to the monitoring plan, and quality assurance plans for sampling. (SRS-SLT-41-00-02-T)	T	Open
	Factor 1, Oxidation of Saltstone	The rate of waste oxidation is a key factor in the future performance of the saltstone disposal facility because the release of technetium is very dependent on the extent of oxidation of the saltstone wasteform. Realistic modeling of waste oxidation is needed to assure that the performance objectives of 10 CFR 61.41 will be met. Adequate model support is essential to providing the technical basis for the model results.	Review information on vault design as it relates to oxidation. (SRS-SLT-41-01-01-T)	T	Open
			Review information on gas phase transport of oxygen within the saltstone. (SRS-SLT-41-01-02-T)	T	Open
			Review field and laboratory experiments and any additional modeling of saltstone oxidation and Tc release. (SRS-SLT-41-01-03-T)	T	Open
			Review information on grout formulation and grout curing conditions. (SRS-SLT-41-01-04-O)	O	Open

[1] Monitoring areas and/or monitoring activities conducted in 2007 are shown with grey background.
[2] There are two main types of monitoring activities: T=technical review activities; O=on-site observation activities.
[3] The activities are tracked as open, open-noncompliant, or closed. Definitions of these terms are in the Glossary.

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.41 (*cont.*)	Factor 1, Oxidation of Saltstone (continued)		Evaluate the adequacy of DOE's program for verifying the specifications of blast furnace slag. (SRS-SLT-41-01-05-O)	O	Open
	Factor 2, Hydraulic Isolation of Saltstone	To better understand the future performance of the disposal facility, it is important to understand the mechanisms of degradation of the wasteform to predict the rate of degradation, as well as the expected physical properties of the degraded wasteform, such as hydraulic conductivity and diffusivity.	Review information to support the exclusion from consideration of specific saltstone degradation mechanisms. (SRS-SLT-41-02-01-T)	T	Open
			Review information on curing technique and curing time for grout and concrete. (SRS-SLT-41-02-02-T)	T	Open
			Review information on water condensation within the vaults. (SRS-SLT-41-02-03-T)	T	Open
			Review information on the dissolution of salts and low-solubility matrix phases within the grout. (SRS-SLT-41-02-04-T)	T	Open
			Observe vault construction and performance. (SRS-SLT-41-02-05-O)	O	Open

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.41 (*cont.*)	Factor 3, Model Support	Adequate model support is essential to assessing whether the saltstone disposal facility can meet 10 CFR 61.41. The model support for the following items is key to confirming the performance assessment results: (i) moisture flow through fractures in the concrete and saltstone located in the vadose zone, (ii) realistic modeling of waste oxidation and release of technetium, (iii) the extent and frequency of fractures in saltstone and vaults that will form over time, (iv) the plugging rate of the lower drainage layer of the engineered cap, and (v) the long-term performance of the engineering cap as an infiltration barrier.	Review any new moisture characteristic data for concrete and saltstone. (SRS-SLT-41-03-01-T)	T	Open
			Review available information on the rate of equilibrium of water content within the saltstone. (SRS-SLT-41-03-02-T)	T	Open
			Review any additional modeling analysis of moisture flow in the saltstone. (SRS-SLT-41-03-03-T)	T	Open
			Review DOE conceptual model for oxidation and Tc release and any support for the model. (SRS-SLT-41-03-04-T)	T	Open
			Review laboratory and field studies on concrete and saltstone cracking. (SRS-SLT-41-03-05-T)	T	Open
			Observe any experiments performed to address issues related to Factor 3. (SRS-SLT-41-03-06-O)	O	Open

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.42	Factor 4, Erosion Control Design	Implementation of an adequate erosion control design is important to ensuring that 10 CFR 61.42 can be met, because the erosion control barrier will help to maintain a thick layer of soil over the vaults, which reduces the potential for intrusion into the waste.	Evaluate technical details of the proposed closure cap. (SRS-SLT-42-04-01-T)	T	Open
			Evaluate the design of erosion control features. (SRS-SLT-42-04-02-T)	T	Open
			Evaluate updates or revisions to DOE intruder analysis. (SRS-SLT-42-04-03-T)	T	Open
61.41	Factor 5, Infiltration Barrier Perf.	The design and performance of the infiltration control system is important for ensuring that 10 CFR 61.41 can be met, because the release of contaminants from the saltstone to the ground water is predicted to be sensitive to the amount of infiltration.	Review experiments and field studies that simulate processes related to plugging of the drainage layer through colloidal clay migration. (SRS-SLT-41-05-01-T)	T	Open
			Review any experiments, analyses, or expert elicitation regarding the long-term performance of the infiltration barrier. (SRS-SLT-41-05-01-T)	T	Open
	Factor 6, Feed Tank Sampling	Implementation of an adequate waste sampling plan is important to ensuring that 10 CFR 61.41 and 10 CFR 61.42 can be met, because it is necessary to confirm that the concentration of highly radioactive radionuclides (HRRs) in treated salt waste (or grout) is less than or equal to the concentration assumed in the waste determination.	Review DOE waste sampling plan and quality assurance procedures for sampling waste. (SRS-SLT-41-06-01-T)	T	Open
			Review waste sampling data for the feed tank (Tank 50). (SRS-SLT-41-06-02-T)	T	Open
			Observe waste sampling activities. (SRS-SLT-41-06-03-O)	O	Open

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.41 *(cont.)*	Factor 7, Tank 48 Wasteform	The chemical composition of the salt waste in Tank 48 differs from the salt waste in other tanks because it contains a substantial amount of organic salts. To ensure that Tank 48 waste can be safely managed, tests are needed to measure the physical properties of the wasteform made from this waste to confirm that it will provide suitable performance.	Review DOE approach for treating waste in Tank 48. (SRS-SLT-41-07-01-T)	T	Open
			Review characterization information for Tank 48. (SRS-SLT-41-07-02-T)	T	Open
			Review information on the expected physical properties of the Tank 48 wasteform. (SRS-SLT-41-07-03-T)	T	Open
61.41 (*cont.*)	Factor 8, Removal Efficiencies	The removal efficiencies of HRRs by each of the planned salt waste treatment processes are a key factor in determining the radiological inventory disposed of in saltstone, which, in turn, is an important factor in determining that 10 CFR 61.41 and 10 CFR 61.42 can be met.	Review information on radionuclide removal efficiencies by the various treatment processes. (SRS-SLT-41-08-01-T)	T	Open
			Review estimates of the amount of sludge entrained in the salt waste during the DDA process. (SRS-SLT-41-08-02-T)	T	Open
			Evaluate updates or revisions to DOE PA and special analysis. (SRS-SLT-41-08-03-T)	T	Open

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.43	Radiation Protection and Environ-mental Protection		Review reports related to worker and general public doses. (SRS-SLT-43-RE-01-T)	T	Open
			Review air effluent data from the salt waste processing facility. (SRS-SLT-43-RE-02-T)	T	Open
			Review information on DOE quality assurance program for monitoring air emissions. (SRS-SLT-43-RE-03-T)	T	Open
			Review DOE radiation protection program. (SRS-SLT-43-RE-04-O)	O	Open
			Observe DOE process for obtaining air effluent data. (SRS-SLT-43-RE-05-O)	O	Open
			Review DOE ground water sampling process and installation of new wells. (SRS-SLT-43-RE-06-O)	O	Open
61.44			Observe the disposal facility for obvious signs of degeneration. (SRS-SLT-44-XX-01-O)	O	Open

Table B-2 Monitoring at Idaho National Laboratory Idaho Nuclear Technology and Engineering Center Tank Farm Facility[4] (NRC, 2007a)

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities (Monitoring Activity Code)	Activity Type[5]	Activity Status[6]
61.41	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). After cleaning, DOE should review sampling data and analysis of tanks WM-187 through WM-190 to ensure that the inventory for these tanks is not significantly underestimated (i.e., similar or better waste retrieval will be achieved).	Review Sampling and Analysis Plans (SAPs) and Data Quality Assessments (DQAs) for tanks WM-187 through WM-190. (INL-TFF-41-01-01-T)	T	Open
			Compare post-cleaning WM-182 tank inventory to postcleaning tank inventories developed for WM-187 through WM-190. (INL-TFF-41-01-02-T)	T	Open
			Compare vault WM-187 liquid sampling to vault WM-185 liquid sampling. (INL-TFF-41-01-03-T)	T	Open
			Observe post-cleaning sampling of tanks WM-187 through WM-190 against the sampling and analysis plan (SAP). (INL-TFF-41-01-04-O)	O	Open
			Observe use of video equipment to map out waste residual depths in the cleaned tanks to estimate waste residual volumes. (INL-TFF-41-01-05-O)	O	Open

4 Monitoring areas and/or monitoring activities conducted in calendar year 2007 are shown with grey background.
5 There are two main types of monitoring activities: T=technical review activities; O=on-site observation activities.
6 The activities are tracked as open, open-noncompliant, or closed. Definitions of these terms are in the Glossary.

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities (Monitoring Activity Code)	Activity Type	Activity Status
61.42	KMA-1, Residual Waste Sampling (continued)		Compare post-cleaning WM-182 tank inventory to the postcleaning tank inventories developed for WM-187 through 190. (INL-TFF-42-01-06-T)	T	Open
61.41	KMA-2, Grout Formulation and Perf.	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.	Determine whether the vendor-supplied slag has sufficient sulfide content to maintain reducing conditions in the tank grout. (INL-TFF-41-02-01-T)	T	Open
			Determine whether slag storage is sufficient to maintain the quality and chemical reactivity of the slag. (INL-TFF-41-02-02-T)	T	Closed
			Assess the short-term performance of the as-emplaced grout. (INL-TFF-41-02-03-T)	T	Open
			Evaluate the final grout formulation for consistency with design specifications. (INL-TFF-41-02-04-O)	O	Open
			Evaluate the risk-significance of any deviations in the final grout formulation from design specifications. (INL-TFF-41-02-05-O)	O	Open

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities (Monitoring Activity Code)	Activity Type	Activity Status
61.41 (*cont.*)	KMA-2, Grout Formulation and Perf. (continued)		Evaluate the U.S. Department of Energy (DOE) program for sampling, testing, and accepting grout materials. (INL-TFF-41-02-06-O)	O	Closed
			Verify conditions of grout placement in terms of temperature and humidity. (INL-TFF-41-02-07-O)	O	Closed
61.44			Review information on grout formulation, placements, and pours. (INL-TFF-44-02-08-T)	T	Open
61.41	KMA-3, Hydrologic 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.	Evaluate and assess the risk significance of any variations in DOE PA-predicted natural attenuation of Sr-90 through the vadose zone. (INL-TFF-41-03-01-T)	T	Open
			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. (INL-TFF-41-03-02-T)	T	Open
			Review hydrological studies and monitoring data for new and significant information related to natural attenuation at the INTEC TFF. (INL-TFF-41-03-03-T)	T	Open

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.43	KMA-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.	Review DOE Idaho radiation protection program to ensure it is consistent with that described in its waste determination. (INL-TFF-43-04-01-T)	T	Open
			Review pathway analysis, environmental data collected, and DOE estimate of doses to members of the public. (INL-TFF-43-04-02-T)	T	Open
			Observe risk-significant DOE closure activities. (INL-TFF-43-04-03-O)	O	Open
			Observe air sampling activities and DOE meteorological program or rely on Idaho DEQ environmental surveillance program.[7] (INL-TFF-43-04-04-O)	O	Open
61.41	KMA-5, Engineered Surface Barrier/ Infiltration Reduction	INTEC 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.	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. (INL-TFF-41-05-01-T)	T	Open

[7] As noted in the body of the report, NRC relies on the Idaho DEQ environmental surveillance program for this monitoring activity.

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.41	KMA-5, Engineered Surface Barrier/ Infiltration Reduction (continued)		Remain cognizant of any changes to the preliminary design of the infiltration-reducing cap. (INL-TFF-41-05-02-O)	O	Open
			Observe maintenance activities of the cap. (INL-TFF-41-05-03-O)	O	Open
61.41	Update Performance Assessment	DOE Order 435.1 requires that the DOE PA be reviewed and revised when there are changes in wasteform or containers, radionuclide inventories, facility design or operation, or closure concepts or there is an improved understanding of facility performance.	Review any revisions and updates to the DOE PA model to assess the impact of changes on conclusions regarding compliance with the performance objectives. (INL-TFF-41-PA-01-T)	T	Open
61.41	Environmental Review and Environmental Sampling		Review analytical data on perched and saturated ground water at the INTEC TFF. (INL-TFF-41-RE-01-T)	T	Open
			Review hydrological studies relevant to flow and transport at the INTEC TFF. (INL-TFF-41-RE-02-T)	T	Open

10 CFR 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.41 and 61.43	Environmental Review and Environmental Sampling (continued)		Observe the installation of monitoring wells and instrumentation. (INL-TFF-41-RE-03-O)	O	Open
			Observe sampling activities or Rely on Idaho DEQ oversight program.[8] (INL-TFF-41-RE-04-O)	O	Open
61.44	N/A		Observe signs of system failure. (INL-TFF-44-XX-01-O)	O	Open
			Observe system performance after extreme events. (INL-TFF-44-XX-02-O)	O	Open

[8] As noted in the body of the report, NRC relies on the Idaho DEQ environmental surveillance program for this monitoring activity.

Appendix C

NRC Observation Reports for Calendar Year 2007

June 1, 2007

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

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

Dear Mr. Lockie:

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

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

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

Sincerely,

/RA/

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

Enclosure: NRC Observation Report

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

EXECUTIVE SUMMARY

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

Grout Formulation and Performance

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

- The observation determined that the quality assurance program of DOE and its contractor, CH2M-WG Idaho, LLC (CWI), is being implemented effectively. NRC staff also determined CWI has a robust program for verifying that the grout components conform to applicable ASTM standards and that the final grout formulations are consistent with the design specifications assumed in the waste determination.
- NRC has requested additional information regarding (i) the qualifications required of vendors to be on DOE's "approved vendors" list and (ii) the minimum cure time between grout pours. NRC staff also recommended that DOE provide documentation to demonstrate that the high water to cement ratio used in grouting tanks WM-104, WM-105, and WM-106 will not adversely impact the expected performance of the grout.
- NRC recommended that DOE document deviations result from implementation and evaluation with respect to assumptions made in its final waste determination and performance assessment (PA) to assess the risk significance of these deviations.

Radiation Protection Program

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

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

1.0 BACKGROUND

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

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

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

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

2.0 NRC ONSITE OBSERVATION ACTIVITIES

2.1 Grout Formulation and Performance

2.1.1. Observation Scope

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

2.1.2 Observation Results

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

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

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

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

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

NRC staff verified the grout mixture that arrives at the TFF from the batch plant is sampled and tested by CWI to ensure it meets the grout composition requirements. A logbook documenting grout placement activities is maintained by CWI staff and includes a copy of the batch ticket and a grout placement log on which the result of the slump test (ASTM C 143/C 143M), as well as any upset condition, is recorded. The logbook also includes an Inspection Planning Package, which lists specific inspections required to be performed for each TFF closure activity and has a summary of inspection and test results. NRC verified from selected grout placement logs that grout mixtures that do not meet the specifications are sent for disposal at a landfill.

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

2.1.3 Conclusions and Followup Actions

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

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

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

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

2.2 Radiation Protection Program

2.2.1 Observation Scope

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

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

2.2.2 Observation Results

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

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

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

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

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

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

2.2.3. Conclusions and Followup Actions

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

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September 25, 2007

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

Dear Mr. Lockie:

The enclosed document describes the U.S. Nuclear Regulatory Commission=s (NRC) onsite observation activities on August 15, 2007, for monitoring disposal actions taken by the Department of Energy (DOE) at the Idaho National Laboratory (INL), Idaho Nuclear Technology and Engineering Center Tank Farm Facility (INTEC TFF). This onsite observation was conducted in accordance with the Ronald Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), which requires NRC to monitor disposal actions taken by the Department of Energy for the purpose of assessing compliance with the performance objectives set out in Subpart C of Part 61 of Title 10 of the Code of Federal Regulations.

NRC's onsite observation at INL was primarily focused on performance objective, 10 CFR 61.41 by observing DOE=s tank grouting operations. Since the tank grouting operations will impact the long-term stability of the tank farm facility after its closure, this observation had also partially assessed the performance objective in 10 CFR 61.44. Additional visits will be conducted in the future to assess compliance with these and other performance objectives in 10 CFR Part 61, Subpart C.

If you have any questions or need additional information regarding this report, please call me at 301-415-6717, or call Xiaosong Yin, project manager on my staff, at 301-415-7640.

Sincerely,

/RA/

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

Enclosure: NRC Observation Report

Keith Lockie

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

1.0 BACKGROUND

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

The U.S. Nuclear Regulatory Commission (NRC) conducted its first onsite observation at the Idaho National Laboratory Idaho Nuclear Technology and Engineering Center Tank Farm Facility (INTEC TFF) on April 24–25, 2007. NRC activities during this visit focused primarily on two performance objectives, 10 CFR 61.41, protection of the general population from releases of radioactivity, and 10 CFR 61.43, protection of individuals during operations. NRC also partially assessed the performance objective in 10 CFR 61.44, stability of the disposal site after closure. A report that provided the results of the NRC onsite observation was transmitted to DOE on June 1, 2007 (Flanders, 2007).

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

2.0 NRC ONSITE OBSERVATION ACTIVITIES

2.1 Grout Formulation and Performance

2.1.1. Observation Scope

The observation of DOE tank grouting operations is related to Key Monitoring Area (KMA) 2, "Grout Formulation and Performance" identified in the NRC monitoring plan for the INTEC TFF (NRC, 2007). An objective of NRC monitoring activities related to KMA 2 is to ensure that the final grout formulation used to stabilize the INTEC TFF waste is consistent with design specifications assumed in the final waste determination (DOE-ID, 2006), or that significant deviations from design specifications will not negatively impact the expected performance of the grout.

2.1.2 Observation Results

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

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

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

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

DOE and CWI staff also indicated that grouting procedures have been revised to take into account the lessons learned from grouting tank WM 182. Prior to the previous observation trip, during tank WM-182's engineered grout placement, both arms became lodged into an engineering grout pour. The lower section of one arm was left in place. Even with the one arm left in place in the grout, CWI was able to finish the star pattern, consistent with the planned approach for all the tanks. No appreciable effect on the degree of mixing is expected, however, a smaller amount of excess liquid was able to be extracted from the tank. This excess is expected to be a very small fraction of the total activity remaining in the tank, and therefore, will have negligible impacts on performance. In addition to changing the procedures, the cameras in the tanks were upgraded to assist in avoiding similar problems in the future, as positional awareness of the end of the arms was identified as a contributor to the incident.

2.1.2 Review of DOE Response to Request for Additional Information

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

<u>Qualifications of Vendors on the Approved Vendor List</u>

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

The reducing capacity of the tank grout is important in mitigating the release of Tc-99, whereas the short-term performance of the grouted vault is important in mitigating the release from the contaminated sand pads of short-lived radionuclides, such as Sr-90, that could potentially dominate the predicted doses from the INTEC TFF within the first few hundred years. This is accomplished at INTEC TFF by adding blast furnace slag to the concrete. The amount of sulfide in the slag is important because it imposes on the grout a reducing condition that helps mitigate the release of Tc-99. The measured sulfide sulfur content of the slag listed in representative chemical test reports was found to be greater than the specified 0.7 weight percent minimum, during our April monitoring visit. However, these reports were from Valley Ready Mix's supplier and not apparently independently verified. While Valley Ready Mix had procedures in place to ensure that it supplied grout materials consistent with DOE specifications for normal characteristics, it does not appear that any additional testing for sulfide content was performed by Valley Ready Mix of the slag they received from their supplier or that Valley Ready Mix verified, by independent testing, that their supplier had a proper quality assurance plan for the DOE application. In the future, DOE should consider whether specific additional requirements added to their contractor quality assurance program should be included to address non-standard grout characteristics that are relied on in the safety assessment. Additional quality assurance would strengthen their safety case. The NRC considers this issue closed.

<u>Minimum Cure Time Between Grout Pours</u>

DOE provided a copy of a CWI engineering study documented in Engineering Design File (EDF)-8059, "Grout Temperature Increase for the INTEC Tank Farm Closure" (CWI, 2007), which calculated the maximum temperature of the grout that would result from heat generation during cure of the CLSM. Two mathematical models were evaluated–an adiabatic model and a kinetic model–and conservative assumptions were used with respect to the placement temperature and the volume of each of the three grout lifts emplaced in the tank. Based on the results of the kinetic model, DOE indicated that the maximum temperature within the CLSM was 142 °F, which is significantly below the acceptance criterion of 170 °F, and that no additional thermal-related controls need to be implemented by CWI. The 170 °F acceptance criterion was reported to have been conservatively selected from the literature for materials of higher strength than required of CLSM.

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

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

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

2.1.3 Conclusions

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

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

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

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

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

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4.0 REFERENCES

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January 31, 2008

Lawrence T. Ling, Director
Waste Disposition Programs Division
U.S. Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, SC 29802

SUBJECT: NUCLEAR REGULATORY COMMISSION ONSITE OBSERVATION REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE PRODUCTION AND DISPOSAL FACILITIES

Dear Mr. Ling:

The enclosed document describes the U.S. Nuclear Regulatory Commission's (NRC's) onsite observation activities on October 29-30, 2007, at the Savannah River Site (SRS), Saltstone Production Facility (SPF) and Saltstone Disposal Facility (SDF). This onsite observation was conducted in accordance with the Ronald Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), which requires NRC to monitor disposal actions taken by the Department of Energy (DOE) for the purpose of assessing compliance with the performance objectives set out in 10 CFR Part 61, Subpart C. The activities conducted during the site visit were consistent with those described in the NRC's monitoring plan for salt waste disposal at SRS (dated May 3, 2007) and NRC's staff guidance for activities related to waste determinations (NUREG-1854, dated August, 2007).

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

The enclosed report indicates that, during our visit, we were unable to obtain some information needed to fully assess whether current operations are consistent with assumptions made in the waste determination (DOE 2006) with respect to vault integrity and the characterization of the final saltstone wasteform. As such, we plan to conduct another onsite monitoring visit during the first quarter of 2008 to follow up on our observations regarding: 1) final product (wasteform) characterization; 2) impacts of the differences in observed conditions of Vault 4 with the waste determination; and 3) impacts on the final product properties of the intra-batch variations from flush water additions and additives used to ensure processability. The fact that NRC staff is requesting more information regarding these areas does not mean that the NRC has concluded that DOE disposal activities are not in compliance with 10 CFR 61, Subpart C, but rather that more information is needed to support DOE's assumptions and approaches. We recognize that, consistent with NRC's monitoring plan for the salt waste disposal facility, monitoring can be iterative and several onsite observation visits may be necessary in order to obtain all the information needed to close an issue. During a conference call on January 28, 2008, between NRC and DOE, DOE indicated that some of the information requested by the NRC may be available and will be made accessible to the NRC at the next observation visit to SRS. If DOE would like to provide this information in advance of the next onsite observation visit, you may send it to us, and we will evaluate it.

On October 30, 2007, at the conclusion of the onsite observation activities, members of my staff discussed the topics addressed in this report with you and members of your staff. If you have any questions or need additional information regarding this report, please contact Michael Fuller, Project Manager on my staff, at 301-415-0520.

Sincerely,

/RA/

Scott Flanders, Deputy Director
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
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Enclosure:
NRC Observation Report

cc w encl:
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SAVANNAH RIVER SITE SALTSTONE PRODUCTION AND DISPOSAL FACILITIES
NRC ONSITE OBSERVATION REPORT

EXECUTIVE SUMMARY

NRC staff conducted its first onsite observation visit of the Saltstone Production Facility (SPF) and Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) on October 29-20, 2007. This visit was intended to focus on two of the four performance objectives—10 CFR 61.41, *protection of the general population from releases of radioactivity*, and 10 CFR 61.43, *protection of individuals during operations*—by observing DOE saltstone wasteform production operations and verifying DOE's radiation protection measures for relevant operations. Because the saltstone wasteform production operations could impact the long-term stability of the disposal facility after its closure, this observation also was intended to partially assess compliance with the performance objective in 10 CFR 61.44, *stability of the disposal site after closure*. This report provides a description of NRC onsite observation activities and identifies NRC observations from the visit.

NRC staff evaluated the implementation of the grout quality assurance program, the construction of the vault, the waste sampling program, the radiation protection program, and also reviewed pertinent records. NRC staff observed operation of the SPF and toured the SDF (Vault 4), and interviewed key SRS and contractor personnel. NRC staff observed activities and reviewed data collected to assess consistency with assumptions made in the waste determination (DOE, 2006).

Grout Formulation and Placement

- The observation determined that the quality assurance program of DOE and its contractor is effective. NRC staff also determined DOE has a program for verifying that the grout components conform to applicable American Society for Testing and Materials (ASTM) standards. NRC recommended that DOE consider performing independent verification of vendor material characterization.

- Additional information beyond that supplied with the performance assessment and supporting documentation provided with the waste determination was not available during the monitoring visit to support the physical characteristics of the saltstone wasteform. Current characterization processes, as described to NRC by DOE during the monitoring visit, does not allow for a verification of physical properties assigned in the final waste determination. Final product characterization is an open issue because inadequate quality of saltstone could result in the disposal of saltstone being non-compliant with the 61.41 performance objective.

- Additional information is needed on the impact on the properties of the final product from potential intra-batch variability in bulk components, flush water additions, and additives used to ensure processability. Inadequate quality of saltstone could result in the disposal of saltstone being non-compliant with the 61.41 performance objective; therefore this is an open issue that NRC will follow up on during future monitoring activities.

Vault Construction

- The observation determined that DOE has taken action in an attempt to mitigate the impact of previously identified vault construction defects (e.g., cracking) on facility performance. However these efforts have not been fully effective as contaminated seeps were noted while observing the current cell of Vault 4 being filled. The observation determined that DOE appropriately characterizes and manages the contamination. The level of contamination measured on the outside of the vault does not pose an immediate health and safety concern to workers or the public. The area is maintained as a radiologically controlled area but workers or authorized visitors can safely walk next to the vaults.

- NRC was unable to determine that DOE has assessed the risk significance of the impact of differences in observed conditions of the vaults to conditions assumed in its final waste determination and performance assessment (PA). If the quality of the saltstone wasteform proves to be inadequate, failures of the SDF vaults to adequately contain the waste, could result in the disposal of saltstone being non-compliant with the 61.41 performance objective. Therefore, this is an open issue that NRC will follow up on during future site monitoring activities.

Waste Sampling

- The observation determined that DOE's procedures used to characterize the waste in Tank 50, the feed tank to the SPF, appeared to be adequate to determine the inventory of radionuclides that are sent to the SPF, and ultimately to the SDF. However, NRC staff plans to examine sampling activities and results in more depth, during future monitoring visits. Therefore, this is an open issue that NRC will follow up on during future monitoring activities.

- NRC recommends that DOE either confirm that the build up of solids be readily identified during processing or take actions to mitigate such build up. Therefore, this is an open issue that NRC will follow up on during future monitoring activities.

Radiation Protection Program

- The observation determined that DOE has an adequate program for protecting its personnel and the public from radiation exposures during operations at the SPF and SDF. Although the review resulted in no open issues, NRC will continue monitoring activities related to radiation protection during future onsite observation visits to SRS.

1.0 BACKGROUND

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

On March 31, 2005, DOE submitted a "Draft Section 3116 Determination, Salt Waste Disposal Savannah River Site" to demonstrate compliance with the NDAA criteria including demonstration of compliance with the performance objectives in 10 CFR Part 61, Subpart C. In its consultation role, the NRC staff reviewed the draft waste determination and concluded that there was reasonable assurance that the applicable criteria of the NDAA could be met, provided certain assumptions made in DOE's analyses are verified via monitoring. NRC documented the results of its review in a technical evaluation report (TER) issued in December 2005. DOE issued a final waste determination in January 2006 taking into consideration the assumptions, conclusions, and recommendations documented in NRC's TER.

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

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

2.0 NRC ONSITE OBSERVATION ACTIVITIES

2.1 Grout Formulation and Placement

2.1.1. Observation Scope

The observation of DOE saltstone production and disposal operations is related to Factor 1 - "Oxidation of Saltstone", and Factor 2 - "Hydraulic Isolation of Saltstone" identified in the NRC monitoring plan for the SRS SPF and SDF (NRC, 2007). The general objectives of NRC monitoring activities related to Factor 1 and Factor 2 are to ensure that the saltstone that is produced is of sufficient quality such that there is reasonable assurance that the performance objectives of 10 CFR Part 61 will be achieved. As discussed in the NRC TER for review of salt waste disposal at the SRS, the hydraulic and chemical properties of the wasteform are important for isolating the radioactivity contained in the waste from the environment (NRC, 2005). A specific objective of the monitoring visit was to ensure that the saltstone formulation produced in the SPF and emplaced in the SDF is consistent with the design specifications assumed in the final waste determination [DOE Savannah River Site (DOE-SRS, 2006)], or that significant deviations from design specifications will not negatively impact the expected performance of the wasteform. Staff also attempted to obtain information that DOE has collected to further evaluate uncertainties (discussed in the NRC TER).

2.1.2 Observation Results

NRC staff observed ongoing saltstone facility operations at SRS. NRC visited the SPF and observed the preparation of saltstone grout components and placement into the vault. Preparation of saltstone at the SPF is remotely controlled by a group of operators in the control room using a digital control system (DCS). NRC observed the mixing of the saltstone wasteform and transfer of the grout mixture from the SPF to the SDF via video cameras located in the plant and vault and displayed in the control room. DOE staff indicated that the plant is able to fill a vault cell at the rate of approximately 4 cm per hour for an approximately 0.3 m per daily shift lift in a vault cell.

NRC staff observed the bins used to store the dry slag and cementitious materials prior to mixing with dissolved salt waste. The bins appeared adequate for preventing precipitation from contacting the grout materials to minimize the degradation in the quality and chemical reactivity of the slag and Portland cement. The grout materials include blast furnace slag, fly ash, and Portland cement which are delivered by truck to the saltstone bins and are mixed in a 45-wt% slag, 45-wt% fly ash, and 10-wt% Portland cement formulation. NRC staff reviewed sample quality assurance records and verified that the received grout materials had certified chemical and physical test reports that are based on ASTM standards (e.g., ASTM C 989 for blast furnace slag, ASTM C 618-03 for fly ash, and ASTM C 150 for Portland cement). A review of representative test reports indicated the received materials conformed to the standards.

NRC staff also verified that the measured sulfide sulfur content of the blast furnace slag supplied by the vendor is consistent with the quality assurance receipt inspection procedures supplied by DOE staff during the observation visit. The amount of sulfide in the slag is important because it imposes a reducing condition on the grout that helps mitigate the release of Tc-99. The measured sulfide sulfur content should be greater than 0.6 wt% by inspection procedure but less than 2.5 wt% in accordance with ASTM C 989 requirements. Representative test reports were provided to verify that blast furnace slag content is within this range. However, it should be noted that all test reports were from the material vendor and other than the receipt inspection procedures conducted for each truckload of material, no confirmatory chemical analyses are conducted by DOE. Independent verification of the material characteristics would provide additional assurance of the product quality.

Bulk material (slag, fly ash, cement) proportions are controlled by weighing the components. Target masses for each batch are 2700 lb fly ash, 2700 lb slag, and 600 lb cement. An alarm is activated if the component masses are +/- 300 lb from the targets. NRC staff observed a number of alarm notifications for masses deviating from the targets. These alarm notifications were verbally acknowledged between operators in the control room and were part of normal operations. The alarms are a warning to the operators to check the masses of the dry bulk materials being input to the process to ensure product composition specifications could be met and do not represent a failure of the process. The dry bulk materials were blended prior to transfer to a hopper for mixing with salt waste in the SPF. DOE stated that the dry bulk materials have different particle size distributions and different flowability characteristics. DOE does not have a system to evaluate the relative proportion of the saltstone components within a batch once mixed with salt waste, although as stated above they do have a system to verify the total quantity of dry bulk materials input to a batch. However, product quality was evaluated when the facility was initially placed into operation (e.g., cold "non-radioactive" samples were produced using surrogate waste streams and were characterized for bulk properties such as strength). Toxicity Characteristics Leaching Procedure (TCLP) tests were previously completed over a range of compositions; however, as previously noted in the TER, DOE has not generated hydraulic and chemical properties of saltstone over a similar range of compositions (NRC, 2005). No additional data on the hydraulic and chemical properties of saltstone was available at the time of the monitoring visit. Additional data on the hydraulic and chemical properties of saltstone will greatly reduce the uncertainty in estimating future performance of the SDF.

Salt waste is sent from Tank 50 to a feed tank at the SPF. The feed tank has a mixer that can be operated only when the pump used to transfer salt waste to the blending system is not in operation. Waste that has been processed to date has not had a significant amount of solids. However there may be the potential for buildup of solids in the feed tank with current mixing and mobilization systems. If solids build up were to occur, it could impact wasteform composition. Solids buildup could result in additional radiological exposure to workers if new systems need to be used to mobilize the solids. NRC recommends that DOE either ensure that solids build up can be clearly identified during processing or take actions to mitigate the potential for solids build up.

The specification for the water (salt solution) to cement (dry components) ratio is 0.6. Set retardant (0.3 gpm) and anti-foam agents (0.1 gpm) are added to the dry components and salt waste to facilitate processing. After blending of salt waste and the dry components in the SPF, saltstone is transferred to the SDF where it is emplaced in the vaults through fill pipes. Temperatures within the vault and saltstone are measured with thermocouples. Temperatures are limited to 85 C and the maximum observed temperature has been approximately 50 C. Relative humidity is not monitored within the disposal cells, which is noted as a limitation of the system but is not otherwise expected to impact final product quality. During cold weather, a significant quantity of condensation has been observed within the cells. Visual inspection of the final wasteform is completed to a limited degree; however condensation limits the ability to conduct remote visual inspections. NRC staff inquired, but no still or video images were available for staff review. At the end of a production run (typically at the end of a work day), the system is flushed with approximately 1200 gallons of water. The flush water is sent directly to the saltstone vault in use for the production run. The ultimate disposition and impact of the flush water on the final product was not known by DOE. If the flush water blends with the saltstone that has not yet set in the SDF, the water cement ratio of this portion of the product would be much higher than that assumed in the waste determination. Very high water to cement ratios could result in the affected fraction of the saltstone wasteform having inferior hydraulic properties. Based on processing rates and current system operation, it is estimated the fraction of saltstone that may be impacted by high water to cement ratio is less than 5 volume percent.

During the monitoring visit, no additional information was provided to characterize the hydraulic and chemical properties of the final product emplaced within the SDF (e.g., core or other samples). As discussed in Section 2.2.2, the hydraulic properties of the vaults are not likely to be consistent with the assumptions in the waste determination. Because the vaults were envisioned to provide secondary containment, a less robust secondary containment places more burden on the primary containment (i.e. saltstone) to provide the degree of isolation assumed in the waste determination. In addition, the implied deviation of the observed properties of the vaults highlights the difficulty of achieving in the field the properties observed in laboratory samples or in analogous facilities. No information to verify the properties of saltstone emplaced in the SDF was available for the NRC staff to review. DOE staff interviewed were not aware of any plans to characterize the emplaced saltstone. Information is needed from DOE to demonstrate that the hydraulic and chemical properties of the final product are consistent with the assumptions in the waste determination, or demonstrate that any deviations are not significant with respect to demonstrating compliance with the performance objectives.

2.1.3 Conclusions and Followup Actions

The NRC staff determined that the DOE quality assurance program pertaining to the specification of dry bulk materials is being effectively implemented. However, considering the importance of reducing capacity of saltstone to achieving the 61.41 performance objective, DOE should consider performing independent characterization of the slag upon receipt of the material rather than relying upon the vendor's documentation.

Records indicate the saltstone components conform to ASTM standards and the wasteform formulations are consistent with the assumed composition in the waste determination, with one exception. As discussed in Section 2.1.2, system flushing at the end of a production run likely results in a portion of the saltstone having a much higher water to cement ratio than assumed in the waste determination. NRC staff will follow up on this issue during future monitoring visits.

Current DOE effort has been focused on process implementation and control. Although physical properties of saltstone (hydraulic conductivity and diffusivity) were identified as the most sensitive parameters in the analysis supporting the waste determination, DOE has not completed final product characterization nor were any plans to complete characterization of the final product provided during the observation. Intra-batch variability in product composition is not characterized. As discussed in Section 2.2.3, the observed quality of the secondary containment (the SDF vaults) is not as effective as previously assumed. Verifying the quality of the saltstone wasteform is important to ensuring that the 61.41 performance objective will be satisfied. Final product characterization is identified as an open issue that will be evaluated during future site visits. NRC staff intends to return to SRS, in the first quarter of 2008, to observe future saltstone production, characterization, and disposal operations, and follow up on the issues identified above.

2.2 Vault Construction

2.2.1. Observation Scope

The observation of DOE saltstone disposal operations is related to Factor 1 -"Oxidation of Saltstone", and Factor 2 - "Hydraulic Isolation of Saltstone" identified in the NRC monitoring plan for the SRS SPF and SDF (NRC, 2007). The reinforced concrete vaults of the SDF were assumed in the DOE waste determination to provide secondary containment for the radioactivity contained in saltstone and to limit the exposure of the saltstone wasteform to aggressive environmental conditions. A specific objective of the monitoring visit was to observe the saltstone disposal vaults to ensure that the assumptions regarding vault performance in the waste determination were valid. Because the vault currently in operation was previously constructed, construction of the vault was not observed by NRC staff.

2.2.2 Observation Results

A number of problems were observed with vault performance during early operations by DOE. Cell A of Vault 4 had bulging, primarily at the bottom of the vaults, and weep sites where contamination was observed on the exterior surfaces of the vaults. These problems were discussed in detail in a variety of DOE reports and other forms of communication with State regulators [for example, an October 19, 2006 Letter from DOE to John McCain (DHEC)]. The primary mitigating action was to add a geotextile fabric membrane with an impervious backing to the vault walls.

Although the currently used cells have the geotextile fabric and impervious backing on the interior walls, the vaults continue to have contaminated seeps that appear on the exterior surface of the vaults as they are filled with saltstone. NRC staff observed seeps on one wall of the vault currently being filled. The seeps appeared to be less than a meter in length. DOE stated that the seeps dry relatively quickly as the vaults are filled and the saltstone sets, sealing the fractures that are the source of the seeps. Information to indicate that the seeps are no longer active was not available at the time of the onsite observation visit. Because the seeps, if active, could influence the rate of release of radionuclides from the vaults, it is recommended that DOE quantify or provide information as to the degree of sealing of the fractures. One approach to evaluating whether the existing fractures are active would be to introduce water into inactive disposal cells and observe the resulting response of the vaults. Nondestructive techniques could also be used to quantify the status of the fractures.

The area adjacent to the vaults is maintained as a radiologically controlled area. Contamination samples are taken of the seeps to characterize the amount of removable radioactive contamination. The area is roped off with appropriate signs and markers.

NRC noted during the monitoring visit that DOE observed Cs-137 in the ditch adjacent to Vault 4, Cell G [October 19, 2006 letter from DOE to John McCain (DHEC)], and that remedial action had been taken (e.g., contaminated soil was removed from the ditch).

The vaults are intended to provide secondary containment for the radioactivity contained in saltstone and limit the exposure of the saltstone wasteform to aggressive environmental conditions. However, the current containment is not complete as assumed in the base case analysis supporting the waste determination [DOE, 2006]. The waste determination and supporting performance objective demonstration document assumed the hydraulic conductivity of the vault would be less than or equal to 1E-12 cm/s for 100 years after facility closure. The hydraulic conductivity of the saltstone was assumed to be 1E-11 cm/s over this time. The analysis increased the hydraulic conductivity in a stepwise manner over the 10,000 year performance period. The observation of seeps suggest that the vaults are of insufficient quality to achieve 1E-12 cm/s (which is representative of a very high quality concrete). DOE stated that the cracks (which result in the seeps) were attributed to the way the vaults were poured and cured. NRC previously documented the importance and relevance of the physical properties of the vaults and saltstone in the NRC TER documenting the review of the waste determination [NRC, 2005]. The hydraulic conductivity potentially affects the rate of release of waste from the facility as well as the degradation of the materials over time. During the onsite observation, DOE stated they had not completed an evaluation to assess the impact of the observed condition of the vault on the waste determination (i.e., the difference between observed and assumed conditions). DOE plans to update the performance assessment supporting the saltstone waste determination in fiscal year 2009. Currently, DOE is envisioning a new vault design based on commercial water storage tank technology.

The risk implications of the vault quality being less than assumed in the waste determination should be quantified by DOE with further analysis. However a summary of previous calculations can provide valuable risk context. DOE assumed that the complete saltstone inventory was in one vault for purposes of estimating the radiological impacts in the performance assessment supporting the final waste determination, even though it would actually be placed in up to fourteen vaults [DOE, 2006]. In addition, the peak whole body dose was estimated to be approximately 2.3 mrem/yr (compared to a 25 mrem/yr performance objective for 61.41). Therefore, there is margin for deviation from the assumptions in the final waste determination without DOE's disposal actions being non-compliance with the performance objectives. However, lack of robust secondary containment places more importance on: 1) verifying the physical properties of the saltstone wasteform, and 2) ensuring that the saltstone is likely to be sufficiently resistant to degradation under anticipated future exposure conditions. In addition, the observation of the seeps suggests that the vaults should possibly be represented as sources of contamination in future performance assessment calculations rather than barriers to contamination.

2.2.3 Conclusions and Followup Actions

The NRC staff determined that the vaults provide adequate containment from a waste processing standpoint. That is, the vaults isolate the vast majority of the radioactivity in saltstone from the environment while the saltstone sets. However, quality issues previously identified by DOE continue to persist irrespective of mitigating actions. Seeps result in contamination reaching the exterior surfaces of the vaults. Based upon NRC staff observations, DOE appears to have appropriately characterized and managed the contamination such that it does not pose an immediate health and safety concern to workers or the public.

The impact of the seeps on the long-term performance of saltstone will need to be quantified by DOE and reviewed by NRC. This is identified as an open issue that will be evaluated during future site visits.

2.3 Waste Sampling

2.3.1 Observation Scope

The objective of monitoring waste sampling is to evaluate the methodology used to quantify the inventory of radionuclides that is sent to the SDF. This review is being performed as part of the evaluation of Factor 6, Feed Tank Sampling, which was identified in the NRC monitoring plan (NRC, 2007). As stated in the monitoring plan, the total inventory of radionuclides disposed of in the SDF is an important part of meeting performance objectives of 10 CFR 61.41. Tank 50 in H-Tank Farm serves as the feed tank for transfers from the tank farms to the SPF and is the point of compliance for demonstrating that the waste meets the Saltstone Waste Acceptance Criteria (WAC) (Culbertson, 2007). As no sampling was ongoing at the time of the observation, the NRC staff's activities focused on reviewing DOE's methodology for waste sampling and analysis. This was achieved by conducting interviews with site personnel and reviewing relevant documents.

2.3.2 Observation Results

As stated above, Tank 50 is the point of compliance for waste that is being transferred to the SPF and any waste transferred from this tank must meet the Saltstone WAC (Culbertson, 2007). The Saltstone WAC ensures that waste entering the SPF is within the Documented Safety Analysis, Performance Assessment, and Operating Permitted values. The Tank 50 contents must remain in compliance with the Saltstone WAC when transfers to the SPF are occurring, though the WAC limits may be met either prior to the waste being transferred to Tank 50 or by blending of the waste with a lower concentration waste stream within Tank 50.

The sampling plan for Tank 50 is documented in the "Sampling Strategy for Tank 50 Point of Compliance Transfers to Saltstone" (Ketusky, 2005). Samples are taken quarterly for chemical constituents and semi-annually for radionuclides.

In addition, a sample is taken for both chemical and radiological contents for each salt batch. NRC staff discussed the methodology used to obtain samples from Tank 50 with site personnel. The site personnel stated that samples from Tank 50 are taken from near the surface of the waste. Agitation pumps are run for several hours before the tank is sampled in order to ensure a representative sample and to ensure that particles in Tank 50 are adequately characterized. During sample collection, the pump nearest the location where the sample is being taken is shut down, but the other pumps continue to run. After the samples are collected, they are sent to a lab for quantification. A data integrity review is performed on the results of the analytical measurements prior to the acceptance of the data. In addition, samples are periodically sent to two different labs for quantification to evaluate the precision of the measurements.

A materials balance is maintained for the radionuclides in Tank 50 in order to track the inventory in the tank in between when samples are taken. In this materials balance, all inputs to and outputs from the tank are tracked and this information is used to calculate the current conditions in the tank. After new sampling results are obtained, the materials balance is re-baselined to the values measured in the samples.

In addition to transfers from other tanks in the tank farm, Tank 50 also receives waste streams from the general purpose evaporator and from Effluent Treatment Process (ETP) concentrate. Site personnel stated that these waste streams are required to meet the WAC for Saltstone before being transferred to Tank 50. Compliance with the WAC is demonstrated through periodic sampling of the waste streams and process knowledge. Waste streams were characterized initially through sampling, and periodic samples are taken to ensure that the assumptions regarding the system waste characterization have not changed. Site personnel stated that there was not a lot of variability observed in these waste streams over time.

The tank farm waste currently in Tank 50 is from Tanks 23 and 49. The waste in these tanks has been characterized through sampling. Tank 49 contains salt waste resulting from the use of the Deliquification, Dissolution, and Adjustment (DDA) process on Tank 41 salt waste. In this process, salt cake in Tank 41 was dissolved and sent to Tank 49, and during this process it is possible for any sludge particles that are entrained in the salt in Tank 41 to be carried over to Tank 49. Tank 49 serves as a settling tank for these particles prior to the transfer of the Tank 41 salt waste to Tank 50. In order to ensure that radionuclide removal efficiencies were as expected during the DDA process, samples were taken at various depths in Tank 49 to verify that settling occurs and that the amount of particles transferred to Tank 50 is limited. Currently, the waste in Tank 50 is not being slurried during transfers to the SPF, so only supernate is being transferred. However, in the future, the agitation pumps will be run and the tank will be slurried during transfers to the SPF and any settled particles in Tank 50 will be transferred along with the supernate.

2.3.3 Conclusions and Followup Actions

NRC staff determined that the procedures used to assess the inventory of radionuclides in the feed tank that are sent to the SDF appeared to be adequate. No issues were observed with the methodology used to obtain samples from Tank 50 or from other inputs to Tank 50. In addition, the approach of only taking samples from Tank 50 twice a year and using a material balance to calculate the inventory in the tank may prove to be acceptable because DOE's procedures call for characterization of the inputs to Tank 50. It is important for the inventory of radionuclides that is sent to the SPF to be based on sampling results instead of process knowledge when possible.

Site personnel stated that waste transferred to Tank 50 from other tanks in the tank farms did not have to meet the WAC for Saltstone and that some credit could be taken for mixing with other waste streams. NRC staff believes that this approach is acceptable, but it is important for Tank 50 to be well mixed and for the waste that is sent to the SPF to meet the WAC prior to transfer. Problems could arise if transfers from Tank 50 to the SPF were to be made while Tank 50 is receiving a significant transfer because mixing of the waste streams may not occur in the tank before the waste is removed. In addition, when the agitation pumps are turned on during transfer of waste from Tank 50 to the SPF, it is important to monitor the amount of solids in the waste to ensure that plugs of abnormally large concentrations of solids are not sent to the SPF. For example, if agitation pumps do not adequately suspend all particles, then there is the potential for higher concentrations of solids in the waste when the level of liquid in the tank is low. The potential for solids to build up in the Salt Feed Tank in the SPF also should be considered. During future monitoring visits, NRC staff plans to examine records relating to sampling activities as well as to examine sampling results in more depth. In particular, NRC staff plans to compare the analytical results from the samples to the inventories of radionuclides calculated in the materials balance to verify the accuracy of the materials balance calculations used to predict the concentration of radionuclides in Tank 50. NRC staff also plans to review the QA plans related to obtaining and analyzing samples in more detail. In addition, NRC staff plans to observe waste sampling activities during a future monitoring visit. More information on the site's waste characterization methods, waste sampling quality assurance program, and confirmation that the measured radionuclide concentrations are as predicted is needed for closure of this monitoring activity.

2.4 Radiation Protection Program

2.4.1 Groundwater and Air Effluent Monitoring

2.4.1.1 Observation Scope

NRC staff interviewed DOE's contractor environmental monitoring personnel and reviewed records of the environmental monitoring (EM) program pertaining to SDF Vault 4 (designated

"451-Z" in EM records) and the SPF stack (designated "210-Z building" in EM records). The staff focused specifically on the 2007 groundwater monitoring program results for three groundwater monitoring wells installed downgradient of Vault 4, and the 2007 air effluent monitoring program for the SPF stack and Vault 4. Staff toured the SPF and the vicinity of Vault 4 to develop an understanding of the facility layout. The staff's reviews were guided by Sections 3.2.6 and 5.2.2 of the May 3, 2007, "U.S. NRC Plan for Monitoring the U.S. DOE Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005." (NRC, 2007)

2.4.1.2 Observation Results

With regard to groundwater monitoring, NRC staff and DOE contractor personnel discussed the location of downgradient wells, sample collection methods, frequencies of sample collection, sample analysis, and recent sample results. NRC staff requested copies of and reviewed: (1) three procedures relating to groundwater monitoring well installation, sampling methods, and sample packaging (WSRC, 2006a, 2007a, 2007b); and (2) Revision 4 of the Groundwater Monitoring Plan for the Z-Area Saltstone Disposal Facility (WSRC, 2006b). The staff also reviewed preliminary sample results for calendar year 2007.

NRC staff found no indication in the sampling results that potential monitored contaminants from Vault 4 have entered nearby groundwater. Of particular interest to NRC staff was the results for nitrate analysis, a major soluble component of the grouted wastes in Vault 4. The nitrate concentration in downgradient wells was similar to the nitrate concentration in the upgradient well.

With regard to air effluent monitoring, NRC staff and DOE contractor personnel discussed the SRS program for demonstrating compliance with the requirements of 40 CFR Part 61, Subpart H, "National Emission Standards for Emissions of Radionuclides Other Than Radon From Department of Energy Facilities" at the SPF and the SDF (Vault 4). The DOE program for compliance with 40 CFR Part 61, Subpart H, an EPA rule, addresses the 10 mrem constraint on total effective dose equivalent (TEDE) to an individual member of the public cited in 10 CFR 20.1101(d), which, in turn, is among the applicable portions of 10 CFR Part 20 that must be met for NRC to have reasonable assurance that the 10 CFR 61.43 performance objectives will be met during facility operation. DOE contractor personnel explained that processing of low curie salt (LCS) solution containing up to 0.2 curies per gallon is not expected to result in radionuclide emissions from the SPF due to the configuration of the blender and the screw-type mixer. Therefore, air effluent monitoring is only performed on air exhausted from Vault 4 during loading of LCS grout. NRC staff reviewed the basis for the type and frequency of air effluent monitoring at Vault 4 (SRS, 2005). Since the maximum effective dose equivalent (MEDE) and potential effective dose equivalent (PEDE) is less than 0.1 mrem/year, no control devices are used on the Vault 4 air effluent, and periodic quarterly sampling with offline analysis is performed during facility operations.

NRC staff reviewed the preliminary 2007 air effluent monitoring data for gross alpha- and beta-emitting radionuclides and specific radionuclides (cobalt-60, strontium-89/90, cesium-137, uranium-235/238, plutonium-238/239, americium-241, and curium-244). All monitoring results indicate that the public total effective dose equivalent remains below the 0.0816 millirem per year MEDE and PEDE calculated by contractor personnel, and well below the 10 CFR Part 20.1101(d) constraint of 10 mrem TEDE per year.

2.4.1.3 Conclusions and Followup Actions

During this observation visit, NRC staff reviewed sampling results for both the groundwater and air effluent monitoring programs at the SPF. NRC staff found that there is no indication of groundwater contamination in the vicinity of Vault 4 resulting from salt waste disposal operations. NRC staff also found that the air effluent sampling results for Vault 4 during filling operations indicate that doses to nearby workers and members of the public from air effluents remain well below applicable limits of 10 CFR Part 20 (i.e., the 10 mrem per year constraint on TEDE to the public). NRC staff plans to continue monitoring DOE environmental monitoring and surveillance programs at the SPF and SDF, for the foreseeable future, as an open activity under the NRC monitoring plan.

2.4.2 Worker Dose Monitoring

2.4.2.1 Observation Scope

To verify that DOE's radiation protection program is in place for operations at the SPF and the SDF to assess compliance with 10 CFR Part 61.43, *protection of individuals during operations*, the onsite observation included (i) interviews with DOE, and contractor radiation protection personnel; (ii) reviews of radiological control documents associated with saltstone operations, e.g., the SRS Radiation Control, and (iii) reviews of associated worker dose records. NRC staff toured the SPF and the SDF to verify the adequacy of access controls.

2.4.2.2 Observation Results

Through interviews with the F Tank Farm Manager and former Facility Manager for Saltstone, as well as other key site radiation protection personnel, and through reviews of pertinent personnel dosimetry records, NRC staff determined that SRS has an adequate radiation protection program. The NRC staff determined that the SPF and the SDF operations are controlled by 10 CFR 835 and the SRS Radiation Control Manual (WSRC Manual 5Q, *Radiological Control*). There is no saltstone-specific radiation protection program.

NRC staff reviewed personnel dosimetry reports for the 2^{nd} and 3^{rd} quarters of 2007. For approximately 150 individuals, the total quarterly person-rem were 40 mrem and 22 mrem, respectively, and quarterly radiation doses to individuals were predominately in the 0-3 mrem range. These doses are well within the dose limits in 10 CFR Part 835. It was during this timeframe that limited operations were ongoing at the SPF and the SDF similar to the operations observed during this visit.

NRC staff also determined that there were no incidents involving personal contamination or loss of control of radioactive material during saltstone operations, year to date in 2007.

Through interviews with key facility and radiation protection personnel, it was determined that there are adequate training and emergency response programs in place at SRS.

2.4.2.3 Conclusions and Followup Actions

Through a review of the radiation protection program implemented by DOE at the SPF and the SDF, interviews with radiation protection personnel, and a tour of the facility, NRC staff determined that DOE has an adequate radiation protection program in place for SPF and SDF operations. No specific items were identified for followup, and there are currently no associated open items. NRC will continue monitoring activities related to radiation protection during future onsite observation visits to SRS.

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11. ABSTRACT *(200 words or less)*

This is the U.S. Nuclear Regulatory Commission (NRC) staff's report of its monitoring of U.S. Department of Energy (DOE) non-high-level waste disposal actions in calendar year 2007, pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, or the NDAA. The NDAA requires that DOE consult with the NRC on its non-high-level waste determinations and plans and that the NRC, in coordination with the covered States of South Carolina and Idaho, monitor disposal actions that DOE takes to assess compliance with NRC regulations in Title 10, Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart C, "Performance Objectives," of the Code of Federal Regulations (10 CFR Part 61). The NRC has prepared this report in accordance with NUREG 1854, "NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations," issued August 2007.

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