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NUREG-1911, Rev. 1

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

Annual Report for Calendar Year 2008

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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 2008, pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (the NDAA). Section 3116 of 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 of the *Code of Federal Regulations* (10 CFR) Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart C, "Performance Objectives." 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) 2008. 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 (the NDAA). Section 3116 of the NDAA has two main subsections, one that requires DOE to consult with the NRC on its non-high-level waste determinations and plans, and a second that requires the NRC, in coordination with the covered States of South Carolina and Idaho, to monitor the disposal actions that DOE takes to assess compliance with NRC regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart C, "Performance Objectives." 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 second 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 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 2008, 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 followed up on open issues that were identified during CY 2007 monitoring activities. Open issues require additional followup by the NRC staff or additional information from DOE to address questions that the NRC staff raised regarding the DOE disposal actions. For CY 2008, the NRC staff has no additional recommendations beyond those offered in CY 2007, which offered 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 in DOE disposal actions.

In CY 2008, the staff's monitoring activities resulted in no findings of noncompliance. However, the staff closed one open issue that it had identified in CY 2007 at the Saltstone Facility and continued to follow up on two open issues. Staff will continue to monitor DOE progress on closing open issues in CY 2009. Tables 3 and 4 in the body of this report summarize the NRC staff's open issues and recommendations. The body of this report presents more information about the staff's observations. Appendix C contains the onsite 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; the facility; the primary applicable 10 CFR Part 61, Subpart C, performance objective; the monitoring area;, and the type of monitoring performed (i.e., 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[1] etc.	01- 02- 03- etc.	T or O

For example, the fifth monitoring activity listed in the NRC monitoring plan for the SRS Saltstone Facility (and thus the fifth 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

In October 2007, the NRC staff observed that DOE had not generated hydraulic and chemical properties of saltstone grout over the range of compositions actually produced at the Saltstone Production Facility (SPF). The 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). The 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. These issues were identified as Open Issue 2007-1 and 2007-2, respectively, in last year's NUREG-1911, "NRC Periodic Compliance Monitoring Report for U.S. Department of Energy Non-High-Level Waste Disposal Actions," issued August 2008. In 2008, the staff observed that DOE is making progress in obtaining data that will provide additional support for assumptions that were used in DOE's performance assessment in support of the SDF waste determination. However, because this information was still under review as of the end of CY 2008, both Open Issue 2007-1 and 2007-2 remain open.

[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.

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

The NRC staff identified no new recommendations or open issues in CY 2008.

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
ARP	actinide removal process
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
DQA	data quality assessment
EM	environmental monitoring
HLW	high-level waste
HRR	highly radioactive radionuclides
ICRP	International Commission on Radiological Protection
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
KMA	key monitoring area
L	liter
MCU	modular caustic side solvent extraction
MDIFF	mesoscale diffusion air dispersion model
MEI	maximally exposed individual
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
SCDHEC	South Carolina Department of Health and Environmental Control

SDF	Saltstone Disposal Facility
SPF	Saltstone Production Facility
Sr	strontium
SRNL	Savannah River National Laboratory
SRS	Savannah River Site
Sv	sievert
Tc	technetium
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 (the 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 DOE disposal actions to assess compliance with NRC regulations in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," Subpart C, "Performance Objectives." 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* (HRR) 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, the 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* established in 10 CFR Part 61, Subpart C. Because NRC monitoring is risk-informed and performance-based, it focuses on assumptions, parameters, and features that are expected to have a large influence on the performance demonstration and/or have relatively large uncertainties. Table 1 presents the performance objectives from 10 CFR Part 61, Subpart C.

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[1]	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[2]	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.

[1] In general, to assess compliance with the requirements of 10 CFR 61.40, the NRC will rely on its assessment of DOE's compliance with 10 CFR 61.41 through 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.

[2] As stated in the Staff Requirements Memorandum for SECY-05-0073 (NRC, 2005a), the dose standard is 25 millirem (mrem) total effective dose equivalent using the methodology of International Commission on Radiological Protection (ICRP)-26. (ICRP, 1977)

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 the 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* (KMAs) 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 KMA in facility-specific monitoring plans. The performance objectives, KMAs, 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, 10 CFR 61.42, and 10 CFR 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

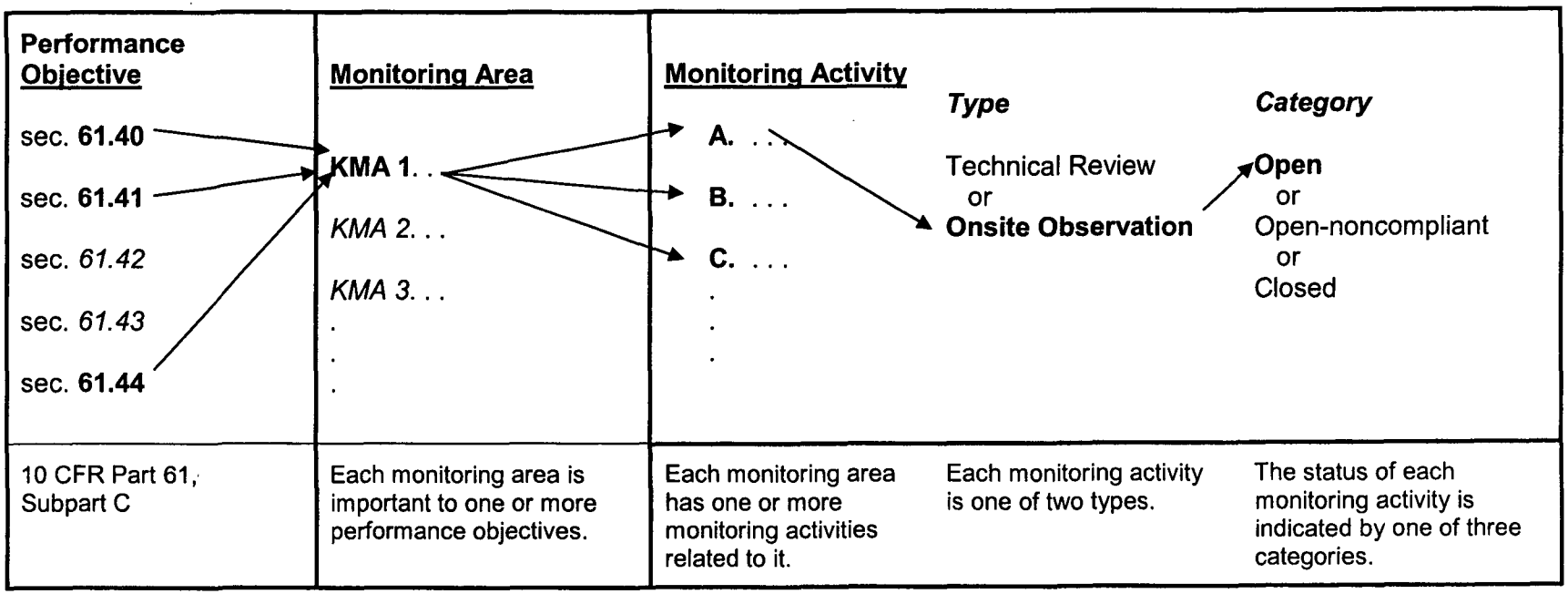

Figure 1 A hypothetical example of the relationship among 10 CFR Part 61 performance objectives, a single monitoring area, and the different types and categories of monitoring activities

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 designated as 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 the requirements in 10 CFR 61.41, 10 CFR 61.42, and 10 CFR 61.44, in recognition 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, 10 CFR 61.42, and 10 CFR 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 the NRC and/or covered States will close soon after the completion of the DOE disposal action. Other monitoring activities are long term and the NRC and/or the affected covered State staff may conduct them 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 in Appendix B to this report 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 PAs. 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 finds that the draft waste determination provides insufficient technical bases 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, reopen 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 (SCDHEC) 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 (DEQ) 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 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 and 2007b)

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 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 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 2008 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 the following:
  - 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 reopened 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 reopening 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 2008. Appendix C to this report contains the staff's observation reports, which more completely describe the site visits, including the staff's activities for which no open issues were raised, no recommendations were provided, and no findings of noncompliance were made. There were no previous reports on the staff's technical reviews in CY 2008. Therefore, this report presents a complete discussion of the staff's technical reviews.

2. MONITORING AT THE SAVANNAH RIVER SITE SALTSTONE FACILITY IN 2008

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 lists the current NRC monitoring plans. In the salt waste disposal monitoring plan, the NRC staff identified 8 KMAs, or *factors*, an additional monitoring area for EM and radiation protection during facility operations, and a total of 39 monitoring activities. Table B-1 in Appendix B to this report describes all monitoring areas and related monitoring activities for salt waste disposal.

In 2008, the NRC staff conducted two observation visits, on March 24–28 and July 31. The monitoring activities conducted during these visits are shaded grey in Table B-1.

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. Nuclear Regulatory Commission Plan for Monitoring the U.S. Department of Energy Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005" (NRC, 2007b)	May 3, 2007	ML070730363
INL INTEC Tank Farm Facility	"U.S. Nuclear Regulatory Commission Plan for Monitoring Disposal Actions Taken by the U.S. Department of Energy at the Idaho National Laboratory Idaho Nuclear Technology and Engineering Center Tank Farm Facility in Accordance with the National Defense Authorization Act for Fiscal Year 2005" (NRC, 2007a)	April 13, 2007	ML070650222

2.1 Onsite Observations

The staff's March 24–28, 2008, onsite observation visit focused primarily on the two performance objectives found in 10 CFR 61.41 and 10 CFR 61.43. Specifically, the staff observed operations at the DOE SPF and SDF and the DOE radiation protection measures associated with those operations. Appendix C to this report contains the observation report dated June 5, 2008 (NRC, 2008c). 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.

The staff's July 31, 2008, onsite observation visit focused primarily on the performance objective in 10 CFR 61.41. Specifically, the staff observed ongoing laboratory experiments that were expected to provide information to address open issues identified by the NRC during an observation visit in October 2007 and to provide additional support for models used in the PA for

the SDF (DOE, 2005). Appendix C contains the observation report dated September 24, 2008 (NRC, 2008e).

2.1.1 March 24–28, 2008 Onsite Observation—Monitoring Areas

As discussed more fully in the observation report (Appendix C), the NRC staff evaluated saltstone grout characterization, operation and characterization of the 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). Much of the staff's focus during this observation was on open issues that had been identified during an onsite observation in October 2007 (NRC, 2008a)

Saltstone Characterization

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 produced is of sufficient quality such that there is reasonable assurance that the performance 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 onsite observation was to assess the quality of saltstone grout, as compared to the design specifications assumed in the final waste determination (DOE, 2006a), and to assess whether significant deviations from design specifications have negatively impacted 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 and Factor 2, identified in the NRC monitoring plan for the SRS SPF and SDF (NRC, 2007b). In the waste determination, DOE assumed that the reinforced concrete vaults of the SDF would provide secondary containment for the radioactivity contained in saltstone grout and would 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 assess whether 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 assess DOE's methodology 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 assessing the DOE methodology for waste sampling and analysis. The staff achieved this by interviewing site personnel, reviewing relevant documents, and observing operations at the Savannah River National Laboratory (SRNL), where samples from the tank farms are analyzed.

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. The staff toured the SPF and the vicinity of Vault 4 to develop an understanding of the facility layout.

2.1.2 Results of the March 24–28, 2008, Observation Visit

Saltstone Characterization

As described in the 2007 Periodic Compliance Monitoring Report (NRC, 2008d), at the conclusion of the October 2007 onsite observation, the NRC staff identified two open issues pertaining to its assessment of the quality of saltstone grout. Open Issue 2007-1 relates to the staff's observation that the amounts of dry bulk material supplied for successive batches of saltstone grout at the SPF vary, but DOE had no information on the hydraulic and chemical properties of the saltstone grout over the range of compositions actually produced. Open Issue 2007-2 pertains to the staff's assessment that DOE has not assessed the impact on saltstone grout quality of adding up to 4,500 liters (1,200 gallons) of transfer line flush water at the end of each production run to the top of each day's poured grout.

During the March 24–28, 2008, onsite observation, DOE presented a quality assurance strategy for the saltstone grout. The strategy includes measurements of the physical and chemical properties of both laboratory-prepared grout simulant and the actual grout emplaced in Vault 4. DOE also described specific planned experiments, including batch Kd experiments of radionuclides in contact with crushed cement and oxygenated ground water, oxidation/reduction experiments with technetium and saltstone, and hydraulic conductivity measurements. At the close of this observation, the NRC staff planned to assess during subsequent observations DOE's progress in implementing its quality assurance strategy. Both Open Issues 2007-1 and 2007-2 remained open at the close of this observation.

Vault Construction

During an onsite observation in October 2007, the NRC staff observed that bleed water associated with the pouring of saltstone grout into SDF Vault 4 was seeping from cracks in the exterior wall of the disposal vault. The bleed water seeps occur as a result of water that accumulates in the shrinkage gap between the saltstone grout monolith and the vault wall. As a result, Open Issue 2007-3 pertains to the NRC staff's assessment that DOE had not assessed the risk significance of the seeps.

During the March 24–28, 2008, onsite observation, the NRC staff observed that DOE had applied concrete sealant to the area where the vault wall meets the floor up to a height of 1 meter (3 feet). DOE had also changed its operational procedures, so that bleed water is now returned to the SPF at the end of the day, rather than at the beginning of the next day. DOE had also begun using rain shields, huts, and drip pans on the exterior walls of cells that are being filled to further mitigate the release of radionuclides to the environment.

Immediately following the onsite observation, the NRC staff reviewed an April 2008 Unreviewed Disposal Question Evaluation prepared by DOE that addressed the risk significance of waste inventory contained in the vault walls at the time of SDF closure. The NRC staff concluded that the performance requirements of 10 CFR Part 61, Subpart C, are likely to be met, and closed Open Issue 2007-3.

Waste Sampling

During the onsite observation, the NRC staff reviewed documents and procedures used by DOE to determine the inventory of radionuclides in the SPF feed tank. As noted in further detail in the observation report (Appendix C), these documents and procedures describe the process for characterizing waste transferred from the tank farms to the SPF. The NRC concluded that the processes for waste characterization are adequate. In subsequent monitoring activities, the staff will review sampling plans for the ARP/MCU process and the sample data from both laboratory experiments and the full-scale ARP/MCU process that was used to support the development of the sampling plans.

During the October 2007 onsite observation, the NRC staff observed that DOE planned to begin operating agitation pumps in Tank 50 before making liquid transfers to the feed tank at the SPF. This would increase the transfer of particulate solids from Tank 50 to the SPF feed tank. Since the SPF feed tank was configured so that it could not be stirred while its contents were transferred to the blending system, the staff recommended (Recommendation 2007-2) that DOE either ensure that the accumulation of solids in the SPF feed tank is monitored during processing or mitigate the potential for solids accumulation in the SPF feed tank. During this onsite observation, the staff assessed that DOE had made certain modifications to the transfer system to mitigate the potential for solids accumulation.

As more fully described in the observation report (Appendix C), NRC and DOE staff also discussed the potential impacts of a new aluminum dissolution process that DOE is using to reduce the amount of aluminum transferred from the tank farm to the Defense Waste Processing Facility. The NRC staff did not open issues or make recommendations related to higher aluminum inventories at SDF. However, the staff will continue to evaluate the inventory of key radionuclides at the SDF as DOE proceeds with tank closure operations.

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.

2.1.3 July 31, 2008, Onsite Observation—Monitoring Areas

As discussed more fully in the observation report (Appendix C), the NRC staff observed saltstone characterization experiments at the SRNL and discussed ongoing experiments with key DOE and DOE contractor personnel. These experiments will provide DOE additional data to support assumptions in the PA that supports its salt waste determination (DOE, 2006a). The lack of information was the root of the open issues that had been identified during an onsite observation in October 2007 (NRC, 2008a). The staff also received information on interim salt waste processing operations.

Physical and Chemical Properties of Saltstone Grout

The experiments that the staff observed were (1) batch studies of adsorption and desorption rates of key radionuclides from a pulverized simulated concrete and grout and (2) studies of technetium-99 oxidation and release rates from crushed samples of laboratory-prepared saltstone grout. Studies on the reduction capacity of saltstone grout were complete at the time of the staff's onsite observation. Preliminary results of the experiments were not available for review.

Soil Sampling and Analysis in the Vicinity of Vault 4

At the time of the March 2008 onsite observation, the staff requested soil sampling analysis results for samples taken in the vicinity of the SDF. Data were available, but a data assessment had not been completed. On November 21, 2008, the NRC staff followed up on this request by letter (NRC, 2008f). The staff received a response in January 2009 (DOE, 2009) and will review this information in CY 2009.

Salt Waste Processing Information

As discussed more fully in the observation report (Appendix C), DOE and DOE contractor staff described some of the challenges involved in starting the MCU process, including unexpected rapid loading of solids on a decontaminated salt solution coalescer. In future onsite observations and technical reviews, the NRC staff will focus on the performance of interim salt waste processing, insofar as it affects the inventory of key radionuclides in the SDF.

2.1.4 Results of the July 31, 2008, Observation Visit

The purpose of this onsite observation was to observe ongoing experiments, the results of which will assist DOE in addressing Open Issues 2007-1 and 2007-2, as described above. Because no analytical results (data) or data assessment were yet available for review, the NRC staff did not close either open issue.

2.2 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 12 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.

On May 15, 2008, the NRC staff met with DOE and SCDHEC and shared with SCDHEC its insights and perspectives on the design for Vault 2 at the SDF. The staff described its observations regarding the new design in an NRC meeting summary (NRC, 2008b).

2.3 Summary of Open Issues and Recommendations

A summary of the recommendations and open issues from the NRC staff's monitoring activities of DOE salt waste disposal activities in CY 2008 that the staff will continue to monitor in CY 2009 is provided in Tables 3 and 4 (see Section 4).

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 2008

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 61.43, and a total of 31 monitoring activities in this plan. Table B-2 in Appendix B to this report summarizes the monitoring areas and related monitoring activities.

3.1 Monitoring Areas at the Idaho Nuclear Technical and Engineering Center Tank Farm Facility

In 2008, the NRC staff conducted one observation visit on August 12–13. 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 in Appendix B to this report)

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). In the TER, the staff concludes that several uncertainties are associated with DOE's ground water model. The DOE ground water model is 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. The uncertainties identified by the NRC staff include (1) hydrogeologic conceptual model uncertainty that broadly affects how subsurface flow and transport of radiological constituents are modeled, (2) uncertainty in infiltration rates that affect travel times and flux of contaminants to the Snake River Plain Aquifer, and (3) uncertainty in Big Lost River seepage impacts, which influence travel paths and dilution of radiological constituents in the unsaturated zone. However, the NRC staff concluded in the TER that natural system uncertainty could be managed using conservative assumptions, provided that the engineered barrier system performs as well as DOE assumed in its PA. For example, minimal credit for dilution from Snake River Plain Aquifer flow alone for the key radionuclides technetium-99 and iodine-129 and minimal credit for dilution, sorption and decay for key radionuclide strontium-90 is 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 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, 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., should the NRC staff identify concerns over whether the tank grout will provide reducing conditions or whether 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. KMA 2 and KMA 3 are, therefore, expected to be closed in tandem.

As part of KMA 3 monitoring activities, the NRC staff reviewed ground water monitoring reports for perched and saturated ground water at INTEC conducted under the CERCLA program. Review of data from historical releases collected under the CERCLA program provides the NRC staff with a basis for evaluating hydrogeological system uncertainties at the INTEC TFF. The historical releases studied by the NRC staff are not releases directly attributable to disposal actions taken by DOE pursuant to Section 3116 of the NDAA.

The NRC staff reviewed a monitoring and decision summary report for perched water at INTEC (Forbes, 2007). This report describes recent investigations and modeling of ground water contamination at the INTEC TFF, including the investigation of elevated levels of technetium-99 found in saturated ground water north of the TFF. Elevated levels of technetium at this location are linked to piping leaks and other releases from the facility. Forbes (2007) also summarizes updated CERCLA modeling efforts that address issues associated with previous modeling results. Previous modeling results appear to be invalidated by recent monitoring data, which show elevated technetium-99 concentrations in the aquifer. Similarly, recent data show that relocation of INTEC percolation ponds will have little impact on the presence of northern shallow perched water, which is contrary to previous modeling predictions. The infiltration rate estimates used in the hydrogeological conceptual model were also updated using data obtained from downhole neutron moisture logs. Forbes (2007) also cites an analysis of perched water levels in northern INTEC monitoring wells that show a strong positive correlation with precipitation (rain and snowmelt) infiltration, rather than Big Lost River seepage. Furthermore, updated modeling indicates that any efforts by DOE to add a liner to the Big Lost River will have no significant effect on reducing the migration of strontium-90 from shallow perched water beneath the tank farm to the Snake River Plain Aquifer. The data and analysis presented in Forbes (2007) are consistent with information available to the NRC staff when it prepared its TER in October 2006 and adequately summarize the revised hydrogeological conceptual model for the INTEC TFF.

The NRC staff also reviewed the 2007 annual ground water monitoring report for INTEC (Forbes, 2008). Concentrations of strontium-90 and technetium-99 from historical releases exceeded their respective drinking water standards in one or more of the aquifer monitoring wells at or near INTEC.[5] At least one aquifer well located southeast of INTEC showed an increase in strontium-90 from the previous year. Consistent with previous data, technetium-99

[5] 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 are not intended to demonstrate compliance with NRC low-level waste performance objectives. DOE's PA shows that drinking water concentration standards are generally more limiting than radionuclide concentrations that would be derived from the 10 CFR 61.41 performance objective for HRRs.

was detected at concentrations above drinking water standards in two aquifer wells. The highest technetium-99 concentration of 61 becquerels per liter (Bq/L) (1,650 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 46 Bq/L (1,230 pCi/L) was observed at an aquifer well located just southeast of the tank farm. 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, 2008). 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 2007 was 5,880 Bq/L (159,000 pCi/L). Although cesium-137 was detected in one shallow perched water well located at the INTEC TFF the previous 2 years (2005 and 2006), this perched well was dry in CY 2007 and could not be sampled. Cesium-137 is less mobile than technetium-99, iodine-129, and strontium-90. Thus, cesium-137 was not detected in INTEC ground water until 2005, long after the detection of technetium-99, iodine-129, and strontium-90 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's 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 but at levels lower than drinking water standards. Iodine-129 was not detected in any perched water well in CY 2007. This result is consistent with earlier observations that iodine-129 concentration trends are generally either relatively constant or slowly declining.

The information provided in the monitoring reports for INTEC (Forbes, 2007 and 2008) is reasonably consistent with information reviewed by the NRC staff during development of its TER (NRC, 2006). The NRC staff will continue to assess the mobility of radiological constituents such as cesium-137 and neptunium-237 through ongoing 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.

The NRC staff identified no new and significant information that would invalidate its TER conclusions. It appears that Big Lost River seepage near the INTEC TFF, while significant, infiltrates quickly to depth and has little to no impact on perched water located significant distances from the river near the INTEC TFF. Data reviewed on Big Lost River seepage, 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 under the CERCLA monitoring program to support each technical review activity for KMA 3.

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. (description of KMA 4; see Table B-2 of Appendix B to this report)

KMA 4 in the NRC's TER for the INTEC TFF addresses DOE compliance with the performance objective found in 10 CFR 61.43, which pertains to protection of individuals during operations. Grouting operations conducted in 2007 (and 2008[6]) could cause airborne releases of radioactive material. The NRC staff expects that releases of radioactive material from the INTEC TFF as a result of these waste disposal actions will continue to be indistinguishable from other INL sources. Also, releases from the TFF are not distinguishable from background radioactive material levels at the site boundary. The nearest site boundary is 16 kilometers (10 miles) away from the TFF. Previous environmental surveillance reports show that airborne radionuclide releases from current operations cannot be distinguished from worldwide fallout and natural radioactive materials in the region surrounding INL. The NRC staff plans to evaluate this performance objective through evaluation of DOE's bounding analysis for all INL operations at the facility boundary.

To assess compliance with the 10 CFR 61.43 performance objective, the INL monitoring plan provides that NRC staff will review DOE worker radiation records, including DOE's program to maintain worker doses as low as reasonably achievable (ALARA), and offsite dose assessment methods. The NRC staff observed DOE's worker protection program and reviewed worker radiation records during grouting operations conducted in 2008, as discussed in Section 3.1.2 of this report. In addition to an onsite observation, the NRC staff also conducted technical reviews of environmental surveillance data and analysis performed by Stoller Corporation and the Idaho DEQ, as discussed below.

The NRC staff reviewed DOE environmental surveillance reports of measurements of radionuclide concentrations in various media located at INL (DOE, 2008). DOE's environmental monitoring 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, 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. Two different computer programs were used to estimate doses. The Clean Air Act Assessment Package, 1988 (CAP-88) computer code was used to calculate the dose to the hypothetical, maximally exposed individual (MEI) and the mesoscale diffusion (MDIFF) air dispersion model was used to estimate the dose to the population within 80 kilometers (50 miles) of the INL site facilities. The maximum dose to the MEI was calculated to be 0.93 microsieverts (μSv) (0.093 mrem), well below the applicable radiation protection standard of 0.10 millisievert (mSv) per year (10 mrem/year). For comparison, the dose from natural background radiation was estimated to be 3.6 mSv (360 mrem). The maximum

[6] Only the first 2008 INL DEQ quarterly report was available for review.

potential population dose to 295,793 people residing within an 80-kilometer (50-mile) radius of any INL site facility was calculated as 3.2×10^{-3} person-Sv (0.32 person-rem), below that expected from exposure to background radiation (1,060 person-Sv or 106,000 person-rem). A maximum effective dose equivalent of 3 μSv/year (0.3 mrem/year) was calculated for workers at the Central Facilities Area. The U.S. Environmental Protection Agency (EPA) standard for public drinking water systems is 40 μSv/year (4 mrem/year).

The maximum potential individual doses from consumption of waterfowl and big game animals at the INL were estimated from the highest concentrations of radionuclides measured in samples collected at the site. Current trends show that this dose is lower than the maximum dose estimates from previous periods. The maximum potential dose of 0.15 μSv (0.015 mrem) for waterfowl samples is substantially below the 8.9 μSv (0.89 mrem) estimated from the most contaminated ducks collected between 1993 and 1998 and the 0.54 mSv (54 mrem) estimated from eating a duck collected on the site during the late 1970s. Only one game animal collected in 2007 contained detectable levels of radioactivity in the edible portions, resulting in an estimated dose from consumption of approximately 0.1 μSv (0.01 mrem). Based on the graded approach used to evaluate nonhuman biota, Stoller concluded that there is no evidence that INL site-related radioactivity associated with the soil or water is harming the resident plant and animal populations.

The NRC staff also reviewed environmental data collected by the State of Idaho. The Idaho DEQ 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 DOE's monitoring program and assess environmental impacts from INL facilities. The Idaho DEQ publishes quarterly and annual reports that provide monitoring data for analysis. The NRC staff concluded that the Idaho DEQ's independent environmental surveillance program is sufficient to address this technical review area. Therefore, the 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 Idaho DEQ posts the latest quarterly and annual reports on its INL Oversight Web site (see http://www.deq.idaho.gov/inl_oversight). The NRC staff reviewed the annual report as well as the quarterly reports for CY 2007 and the first quarter of 2008 to determine the 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 2007 annual report (Idaho DEQ, 2008), data collected in 2007 show that measurements were generally consistent with historic trends. Concentrations of radioactivity in air, soil, and milk samples were consistent with background levels. Radiation levels were also consistent with historic background measurements. In general, there appears to be good agreement between the environmental monitoring data reported by the Idaho DEQ and data collected by DOE and its contractors.

The NRC staff concludes 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 review of 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.

3.1.2 Onsite Observation

The staff's August 12–13, 2008, onsite observation visits focused primarily on two performance objectives, 10 CFR 61.41 and 10 CFR 61.43. The staff observed DOE tank grouting operations and verified DOE radiation protection measures associated with those operations (Appendix C to this report contains the onsite observation report). Since wasteform production operations could affect the long-term stability of the disposal facility after its closure, this observation also partially assessed the performance objective in 10 CFR 61.44.

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).

Ground Water Monitoring

During this onsite observation visit, the NRC staff observed routine ground water monitoring activities, reviewed pertinent procedures, and interviewed site personnel to gather information about the ongoing ground water monitoring program at the INTEC TFF.

Radiation Protection Program

During this onsite observation visit, the NRC staff interviewed DOE and contractor radiation protection personnel, reviewed radiological control documents associated with INTEC TFF grouting operations, and reviewed associated worker dose records.

3.1.2.2 Results of the Observation Visits

Grout Formulation and Performance

As noted in more detail in the observation report in Appendix C, the NRC staff did not observe any problems with the grouting of the ancillary equipment at the INTEC TFF, and the staff determined that this program is being conducted in a manner that ensures the grout specifications meet those that were assumed in DOE's final waste determination, issued in November 2006.

The NRC staff plans to review the outcome of the grouting operations for the remaining ancillary equipment. In addition, on future site visits, the staff plans to observe the grouting of the remaining four large tanks once the waste has been removed and the tanks have been cleaned.

Ground Water Monitoring

As noted in more detail in the observation report in Appendix C, the NRC staff found that DOE has an adequate program for monitoring ground water quality.

Radiation Protection Program

As noted in more detail in the observation report 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

No recommendations or open issues resulted from the NRC staff's monitoring activities of the DOE INTEC TFF activities in CY 2008. During technical reviews performed in 2008, 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 intends to return to INL in 2009 to follow up on the activities described above.

The NRC staff opened no new monitoring activities (see Table B-2 in Appendix B). The staff identified no open activities as open-noncompliant. Therefore, the NRC plans no revisions to the monitoring plan in response to monitoring activities in CY 2008.

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.

4. OPEN ISSUES AND RECOMMENDATIONS

Tables 3 and 4 summarize the open issues and recommendations, respectively, that the NRC staff identified during its ongoing monitoring of DOE waste disposal actions from January 1, 2007, through December 31, 2008.

Table 3 Summary Description of Open Issues in the NRC Section 3116(b) Monitoring Program

Open Issues		
Number	**Description**	**Status**
2007-1	At the SRS Saltstone Facility, as a result of variations in the composition of saltstone grout actually produced at the SRS SPF, DOE should determine the hydraulic and chemical properties of as-emplaced saltstone grout. Inadequate saltstone grout quality could result in disposal actions that are not compliant with the 10 CFR 61.41 performance objective.	Open
2007-2	At the SRS Saltstone Facility, DOE should demonstrate that intra-batch variability, flush water additions to freshly poured saltstone grout at the end of each production run, and additives used to ensure processability are not adversely affecting the hydraulic and chemical properties of the final saltstone grout. DOE should show that hydraulic and chemical properties 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.	Open
2007-3	At the SRS Saltstone Facility, DOE should reassess the risk significance of the as-built conditions of Vault 4 in light of the presence of contaminated seeps on the exterior wall of Vault 4.	Closed

Table 4 Summary Staff Recommendations under the NRC Section 3116(b) Monitoring Program

Recommendations	
Number	**Description**
2007-1	At the SRS Saltstone Facility, the NRC staff recommends independent verification of the material characteristics of blast furnace slag to provide additional assurance of the quality of saltstone grout.
2007-2	At the SRS Saltstone Facility, 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.
2007-3	At the INL INTEC TFF, 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.
2007-4	At the INL INTEC TFF, 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.
2007-5	At the INL INTEC TFF, 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.
2007-6	At the INL INTEC TFF, 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.
2007-7	In general, 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.

5. REFERENCES

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6. 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 has determined to be important through the review of a 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, through the review of a DOE waste determination that describes its waste disposal actions, to be important to demonstrating 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 (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.
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 in 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 Part 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 ground water 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=onsite observation activities.
3 The activities are tracked as open, open-noncompliant, or closed. Definitions of these terms are in the glossary.

10 CFR Part 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.41 (cont.)	Factor 1, Oxidation of Saltstone (cont.)		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 Part 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: (1) moisture flow through fractures in the concrete and saltstone located in the vadose zone, (2) realistic modeling of waste oxidation and release of technetium, (3) the extent and frequency of fractures in saltstone and vaults that will form over time, (4) the plugging rate of the lower drainage layer of the engineered cap, and (5) 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 Part 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 Part 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 Part 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 Part 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 SAPs and DQAs for tanks WM-187 through WM-190. (INL-TFF-41-01-01-T)	T	Open
			Compare post-cleaning WM-182 tank inventory to post-cleaning 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 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=onsite observation activities.
6 The activities are tracked as open, open-noncompliant, or closed. Definitions of these terms are in the glossary.

10 CFR Part 61 Perf. Obj.	Monitoring Area	Description	Activities (Monitoring Activity Code)	Activity Type	Activity Status
61.42	KMA 1, Residual Waste Sampling (cont.)		Compare post-cleaning WM-182 tank inventory to the post-cleaning 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 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 PA release modeling, or significant deviations should be evaluated to determine their significance with respect to the conclusions in the PA and TER. The short-term performance of the grouted vault is especially important to mitigate the release of short-lived radionuclides such as Sr-90 from the contaminated sand pads that could potentially dominate the predicted doses from the TFF within the first few hundred years.	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 Part 61 Perf. Obj.	Monitoring Area	Description	Activities (Monitoring Activity Code)	Activity Type	Activity Status
61.41 (cont.)	KMA 2, Grout Formulation and Perf. (cont.)		Evaluate the 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 INTEC 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 Part 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 CERCLA 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, the NRC relies on the Idaho Department of Environmental Quality (DEQ) environmental surveillance program for this monitoring activity.

10 CFR Part 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.41	KMA 5, Engineered Surface Barrier/ Infiltration Reduction (cont.)		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 Part 61 Perf. Obj.	Monitoring Area	Description	Activities	Activity Type	Activity Status
61.41 and 61.43	Environmental Review and Environmental Sampling (cont.)		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, the NRC relies on the Idaho DEQ environmental surveillance program for this monitoring activity.

Appendix C

NRC Observation Reports for Calendar Year 2008

June 5, 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 report describes the U.S. Nuclear Regulatory Commission's (NRC's) onsite observation activities on March 24-28, 2008, at the Savannah River Site (SRS), Saltstone Production Facility (SPF) and Saltstone Disposal Facility (SDF). The report also incorporates supplemental information received from the U.S. Department of Energy (DOE) on April 10, 2008. 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 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).

Similar to NRC's previous visit in October, 2007 (NRC 2008), this 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.

A number of open issues resulted from the previous NRC onsite observation visit (NRC, 2008). During this March observation visit, NRC staff paid considerable attention to following up on these issues. One previously opened issue was closed as a result of discussions with DOE and DOE contractor personnel during this onsite observation visit and a technical review of supplemental information received from DOE on April 10, 2008. Specifically, NRC staff was able to conclude that the impact of the differences in the observed conditions of the disposal vaults compared to the assumptions in the performance assessment supporting the waste determination has been assessed by DOE [(Romanowski 2007), (Rosenberger 2008)]. That analysis demonstrated that there is reasonable assurance that Vault 4 can meet the performance objectives in spite of the observed vault conditions, if the system is emptied of liquids prior to closure.

DOE presented plans for additional studies (some of which are ongoing) that, when completed, should provide the information needed to address the remaining open issues from the October 2007 report. However, no additional quantitative information was available during this second monitoring visit sufficient to close the remaining previously open issues, therefore, they remain open. In addition to following up on the open issues from the October 2007 report, NRC staff conducted monitoring activities related to waste sampling and radionuclide inventory, vault operation and characterization, and radiation protection. No new open issues were identified.

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

On March 28, 2008, at the conclusion of the onsite observation activities, NRC staff members discussed the topics addressed in this report with you, other DOE representatives, and representatives from the State of South Carolina. If you have any questions or need additional information regarding this report, please contact Michael Fuller, at 301-415-0520, or David Brown at 301-415-6116.

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

cc: w encl:
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SAVANNAH RIVER SITE SALTSTONE PRODUCTION AND DISPOSAL FACILITIES
U. S. NUCLEAR REGULATORY COMMISSION ONSITE OBSERVATION REPORT

EXECUTIVE SUMMARY

NRC staff conducted its second onsite observation visit of the Saltstone Production Facility (SPF) and Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) on March 24-28, 2008. In addition NRC staff reviewed supplemental information received from DOE on April 10, 2008. 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 obtaining information on DOE saltstone wasteform production and saltstone disposal facility 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. Based on the results of the visit, the NRC continues to have reasonable assurance that the performance objectives of 10 CFR 61 can be met in the areas reviewed.

A number of open issues resulted from the previous NRC onsite observation visit on October 29-30, 2007 (NRC 2008). NRC staff paid particular attention to the follow up of these issues during this onsite observation visit. DOE provided two analyses, and a change to an operational requirement, demonstrating that the observed differences between the disposal system and the assumptions in the performance assessment supporting the waste determination would not result in non-compliance with the performance objectives. Therefore, the open issue described in Section 2.2.3 of NRC's onsite observation report dated January 31, 2007, has been closed. No additional quantitative information was available during this second monitoring visit to address the remaining issues. Therefore, these issues remain open. However, DOE presented plans for additional studies (some of which are ongoing) that when executed should provide the information needed to address the open issues. DOE outlined eleven projects and model support activities, such as, a reducing capacity of saltstone study and a degradation mechanism study that will likely be completed in FY 2008 and be incorporated into a revision of the saltstone performance assessment (PA). Eight additional future activities were outlined that will probably not be completed by the time of the PA revision in early FY 2009. Examples of additional future studies that were outlined by DOE included: long-term testing of saltstone and vault degradation, and their hydraulic properties; long-term testing of saltstone and vault cracking, and transport through cracks; and the study of the drainage layer plugging.

NRC staff evaluated the (i) saltstone characterization and testing program; (ii) environmental monitoring program for groundwater, soil, and air effluents; (iii) modifications to the saltstone disposal facility vaults; (iv) waste sampling and characterization program; and (v) radiation protection program. Staff interviewed key SRS and contractor personnel and also reviewed pertinent records. NRC staff toured the SPF and observed the SDF (Vault 4). NRC staff observed activities and reviewed data to assess consistency of the data with the assumptions DOE made in its waste determination (DOE, 2006).

Enclosure

Status of Open Issues from the October 29-30, 2007 visit and other conclusions:

Saltstone Characterization

- Since the previous monitoring visit, DOE stated that they did not have additional information to support the physical characteristics of the saltstone wasteform assumed in the waste determination. However, DOE provided plans to develop information throughout the remainder of fiscal year 2008 and into 2009 that will address assumed saltstone wasteform characteristics. Final product characteristics remains an open issue that will be followed up through future monitoring activities because inadequate quality of saltstone could result in the saltstone disposal facility being noncompliant with the 10 CFR 61.41 performance objective.

- No additional information was available to quantify the impact on final product properties of potential bulk component intrabatch variability, flush water additions, and additives used to ensure processability. DOE presented a saltstone product quality assurance strategy that would quantify the impact of these factors on the processability of the materials and on the wasteform properties that are important to performance assessment. Inadequate quality of saltstone could result in the disposal of saltstone being noncompliant with the 10 CFR 61.41 performance objective. Therefore, this issue remains open and will be followed up by NRC through future monitoring activities.

Vault Operation and Characterization

- The observation determined that DOE has acted to mitigate the impact on facility performance of previously identified vault construction defects (e.g., cracking). Recent DOE actions appeared to be more effective than earlier efforts to mitigate the release of radiologically contaminated water from the disposal cells during operations. However, the modifications do not, nor are they intended to, repair the defects in the vaults. The observation determined that DOE appropriately characterizes and manages the contamination. The measured level of contamination on the outside of the vault does not pose an immediate health and safety concern to workers or the public. DOE has sampled the soil at several locations around Vault 4 where liquid has leaked in order to characterize the soil contamination. The sampling results were not available at the time of the NRC monitoring visit but will be evaluated through future monitoring activities.

- During the monitoring visit, DOE provided an Unreviewed Disposal Question Evaluation (UDQE) to determine the significance of the liquid seeping from the saltstone Vault 4 exterior walls (Romanowski 2007). NRC reviewed a revised UDQE (Rosenberger 2008) DOE provided after the monitoring visit and determined that, combined with a requirement to flush the vault drain water system prior to closure, DOE has adequately assessed the risk significance of the differences between the observed vault conditions and the conditions assumed in the final waste determination and PA. DOE's assessment concluded that the performance objectives could be met even if small quantities of waste were released to the environment in the near-term, due to radioactive decay and dilution during transport. NRC's review verified this assessment. Therefore, the open issue described in Section 2.2.3 of NRC's onsite observation report dated January 31, 2007, is closed.

Waste Sampling and Inventory

- 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. Since the disposal of salt waste will be an ongoing activity for several years, NRC staff will continue to monitor the characterization of the waste and the radionuclide inventory for the foreseeable future.

- The observation determined that DOE has made modifications to the salt feed tank that should mitigate the potential solids buildup in this tank. Since the SPF was not operating during the onsite observation visit, NRC staff did not have an opportunity to observe the effects of this modification. Therefore, this remains an open issue that NRC will continue to follow up on through future monitoring activities.

Radiation Protection Program

- The observation determined that DOE continues to have an adequate program for protecting its personnel and the public from radiation exposures during operations at the SPF and SDF.

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: (i) technical reviews, (ii) onsite observations, and (iii) data reviews. These activities will focus on key assumptions—called "factors"—identified in the NRC monitoring plan for saltwaste disposal at SRS (NRC, 2007). Technical reviews generally will focus on obtaining additional model support for assumptions DOE made in its performance assessment (PA) that are considered important to DOE's compliance demonstration. Onsite observations generally will be performed to (i) observe the collection of data (e.g., observation of waste sampling used to generate radionuclide inventory data) and review the data to assess consistency with assumptions made in the waste determination, 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 by focusing on real-time monitoring data that may also indicate future system performance or by reviewing records or reports that can be used to directly assess compliance with performance objectives.

The October 2007 and March 2008 NRC onsite observation visits at SRS 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 operations at the SPF and SDF, and verifying DOE radiation protection measures at those facilities. 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*. Future visits will assess the performance objective in 10 CFR 61.42, *protection of individuals against inadvertent intrusion*, and also continue to assess DOE compliance with the other performance objectives.

2.0 NRC ONSITE OBSERVATION ACTIVITIES

2.1 Saltstone Characterization

2.1.1 Observation Scope

The observation of DOE saltstone processing and disposal operations is related to two factors identified in the NRC monitoring plan for the SRS SPF and SDF (NRC, 2007): Factor 1–"Oxidation of Saltstone" and Factor 2–"Hydraulic Isolation of Saltstone." The general objectives of NRC monitoring activities related to Factors 1 and 2 are to ensure that the saltstone that is produced is of sufficient quality such that there is reasonable assurance 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 saltstone that has or will be produced is of sufficient quality. Staff also attempted to obtain information DOE has collected to further evaluate uncertainties (discussed in the NRC TER).

2.1.2 Observation Results

The SPF was not operating at the time of the NRC visit. However, NRC toured the SPF and had detailed discussions with DOE staff about facility operations, upgrades to the facility, and plans to better characterize the saltstone wasteform. DOE presented a saltstone product quality assurance strategy intended to ensure that adequate saltstone quality is achieved and that the process, underlying science, and PA are properly integrated. The strategy, when implemented, would conduct measurements of grout properties, including hydraulic properties, compressive strength, distribution coefficient (Kd), and reduction capacity (for saltstone) using laboratory prepared grout without radionuclides, laboratory prepared samples with radionuclides, and possibly in-process and emplaced grout. Five different grout mix types are planned: (i) saltstone from Deliquification, Dissolution, and Adjustment (DDA) waste, (ii) saltstone from Actinide Removal Process (ARP) and the Modular Caustic Side Solvent Extraction Unit (MCU) waste, (iii) saltstone from Salt Waste Processing Facility waste, (iv) Vault 1 concrete, and (v) Vault 4 concrete. Some of these tests have been initiated. NRC will evaluate information generated from these tests as it becomes available. The potential outputs of the strategy are revisions to the waste acceptance criteria, process parameters and controls, and inputs to the PA maintenance program. The strategy was beginning to be implemented at the time of the monitoring visit, with the availability of some products anticipated later in fiscal year 2008.

Modifications or upgrades to the facility and operations included, but were not limited to (i) replacement of the mechanical seal on the mixer, (ii) improvement in the hopper crossover flushing system to reduce the accumulation of material in the crossover piping (the crossover system is used to convey dry bulk materials to the SPF for blending with salt solution to form saltstone), (iii) installation of a new grout density meter, and (iv) installation of a new salt feed tank agitator motor. In the previous monitoring report, NRC discussed the potential for buildup of solids in the SPF feed tank. The DOE modification of the feed tank should mitigate this potential solids buildup (see Section 2.4.2 for

additional discussion). Facility modifications also were designed to improve operational efficiencies with higher equipment reliability and better instrumentation.

As discussed in the previous NRC monitoring report, a number of process variables could potentially impact saltstone quality. DOE did not have any measurement or test results available for NRC to review, but presented plans to assess the quality of the saltstone wasteform. The DOE saltstone product quality assurance strategy is expected to address variability in dry feeds, variability in salt solution composition, flush water additions, and the impact of additives.

The method to sample as-emplaced saltstone has not yet been determined, and DOE stated it would have to consider a variety of issues, such as radiological protection of workers, when deciding how to implement such activity. NRC previously indicated that sampling and measurement of the characteristics of as-emplaced saltstone is the most direct way to quantify the quality of the wasteform. Laboratory scale measurements of saltstone may not adequately reproduce the thermal, mechanical, and chemical conditions of emplaced material due to the difference in scale between laboratory specimens and emplaced materials. The saltstone product quality assurance strategy should provide the information needed to resolve the open issues, with the exception of the issue of scale noted above. NRC will follow up on the DOE plans to sample as-emplaced saltstone or the DOE strategy to address scale issues as those become available.

DOE discussed specific experiments that are currently ongoing that may provide information to address the key monitoring areas in the NRC's monitoring plan for the saltstone facility, including batch type Kd experiments of radionuclides in contact with crushed cement and oxygenated groundwater, oxidation/reduction experiments with technetium and saltstone, and hydraulic conductivity measurements. In addition, a variety of activities are planned to address factors from the NRC TER although most are not scheduled to start until FY2009 or after (NRC, 2005). DOE salt disposition activities are expected to be ongoing until 2020. NRC will observe DOE experiments that are ongoing during future monitoring visits, as practical.

During the monitoring visit, NRC observed videographic information of saltstone pouring operations. Resolution of surface features is limited by condensation that develops within the cell during curing of saltstone. The saltstone surface appeared to be relatively level, with localized pools of water. The significance of the water on product quality is not expected to be significant, because the water flows to the sheet drain system as the saltstone pour proceeds (i.e., the pooling water is transient). At the center of the monolith where the pour enters the vault, a depression formed on the surface that was large enough to hold roughly a few hundred liters of water. DOE performed a video analysis to look for potential saltstone cracking of the top of cell G in Vault 4. Frequent cracking was not observed, however two major cracks were observed in the cell. The depth of those cracks cannot be determined from the video analysis. A shrinkage gap of about 0.5 cm was observed between the wall and the sheet drain. As noted in section 2.3.2 below, DOE completed an analysis to demonstrate that, in spite of the differences between the observed vault conditions and performance assessment assumptions, the system could meet the performance objectives.

2.1.3 Conclusions and Followup Actions

DOE presented a strategy to ensure the quality of the saltstone product. The implementation of that strategy is in the early stages; however when it is implemented it should provide information to verify the quality of the saltstone product or to define conditions and controls that will ensure future product quality. NRC will follow up on the DOE strategy to address scale issues as those become available. Previous DOE effort had been focused on process implementation and control. Verifying the quality of the saltstone wasteform is important to assessing whether the 10 CFR 61.41 performance objective will be satisfied. Final product characterization remains an open issue that will be evaluated during future monitoring activities as the product quality assurance strategy is implemented. NRC staff intends to return to SRS to observe future saltstone production, characterization, associated experiments, and disposal operations, and follow up on open issues.

2.2 Vault Operation and Characterization

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," which were 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.

2.2.2 Observation Results

As discussed in the previous monitoring report, DOE observed a number of problems with the vault during the early operations of the SDF. Subsequent to the October 2007 monitoring visit, DOE completed a number of facility modifications to mitigate the occurrence and impact of liquid seeping from the vaults. NRC toured the SDF to observe the facility modifications, and discussed the modifications and operational changes with DOE staff.

As noted in the previous report, although mitigative actions were taken by DOE, the vaults continue to have contaminated seeps that appear on the exterior surface of the vaults as they are filled with saltstone. NRC staff did not observe active seeps during this visit as the facility was not in operation. A commercially available concrete sealant coating had been previously applied to the outside of the vaults to a height of approximately 1.8 m (5 ft). The purpose of the sealant coating was to mitigate the seepage of liquid to the exterior of the vault walls. The seeps occur at imperfections in the vault walls, primarily as a result of fluid buildup in the gap between the saltstone and vault wall. DOE changed operations to pump the built up liquid to the SPF at the end of an operation shift. Previously the liquid was not pumped back to the SPF until the next morning. This operational change has lessened, but not eliminated, the occurrence of seeps. The bottom joint where the vault wall meets the vault floor has been a primary

location of seeps. The sealant coating applied in this area has been ineffective at eliminating seeps, in part because the aperture of the joint changes significantly with temperature. DOE has applied a new sealant coating material to the bottom 1 m [3 ft] of the vault wall to mitigate seeps in that area. The new sealant coating provides an approximately 8 cm (3 in) layer over the joint area. This new sealant coating will likely reduce seepage of liquid to the environment, but will be unlikely to prevent seepage of liquid at the joint/sealant coating interface. In addition to applying the sealant coatings, DOE has installed a rain shield, certified huts, and a drip pan on the exterior walls of the vault cells that will be filled during current or future operations. These modifications should be effective at significantly reducing or eliminating contamination from the vault from reaching the environment in the short term.

DOE stated that the seeps dry relatively quickly as the vaults are filled and the saltstone sets. The drying of the seeps appears to be due to removal of the excess water (the driving force) from inside the vaults, and not due to sealing of the fractures in the walls. A large quantity of water in Cell E was pumped to Cell F, which reactivated the seep sites that had previously dried. Similar occurrences were observed at a different set of cells. DOE stated that rainwater enters Cell A relatively frequently and must be drained. This water is sampled, characterized, and released to the environment if the contaminant concentration is below release limits, which has always been the case, to date. Therefore, the future performance assessment for Vault 4 should include advective pathways through the vault wall as part of the base case analysis (see Section 2.3).

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. Since the last monitoring visit, DOE sampled soil adjacent to known leak sites in order to quantify the amount and extent of contamination (See Section 2.5).

DOE has an inspection program for Z-Area Vault 4 (Plummer, 2008). The inspection procedure provides the responsibilities, requirements and methods, frequency and extent, and records of the inspections. The inspections will use digital photography to record wet spots and monitor potential changes over time. Daily visual inspections will be performed of the Vault 4 exterior. NRC will evaluate results of the inspection program during future monitoring activities.

The previous observation report (NRC, 2008 Section 2.2) discussed the observed vault conditions and the differences between these conditions and the performance assessment assumptions. This issue is discussed further in Section 2.3 of this report.

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 problems previously identified by DOE have been a challenge to mitigate. It is likely that recent modifications (since the October monitoring visit) will significantly reduce releases during operations. However, the modifications do not, nor are they intended to, repair the

defects in the vaults. The vault defects should be included in future performance assessments of Vault 4.

2.3 Performance Assessment

2.3.1 Observation Scope

The observation of DOE performance assessment modifications and revisions is related to all factors identified in the NRC monitoring plan for the SPF and SDF (NRC, 2007). The general objective of NRC monitoring activities related to the DOE performance assessment is to assess whether there is reasonable assurance that the performance objectives of 10 CFR Part 61, Subpart C, will be achieved. A specific objective of the monitoring visit was to evaluate the consistency of observations of the current disposal facility and wasteform with the performance assessment assumptions. NRC staff also attempted to obtain information on future disposal facility designs and how those designs may be evaluated in a revision to the performance assessment.

2.3.2 Observation Results

As discussed in the previous monitoring report, the condition of Vault 4 is not consistent with the assumptions in the base case analysis supporting the waste determination (DOE, 2006). These differences include the (i) active advective hydraulic pathways in the vault walls, (ii) presence of waste inventory in the vault walls, and (iii) remaining liquid waste inventory in the drain water system of the vault cells. As discussed below, DOE, using its UDQE process, completed an analysis to demonstrate that, in spite of the differences between the observed vault conditions and performance assessment assumptions, the system could meet the performance objectives. The analysis stated that the drain water collection system would be flushed to remove liquid waste, and that the system will not contain liquid at the time of closure.

The waste determination and supporting performance objective demonstration document assumed the saturated hydraulic conductivity of the vault would be less than or equal to 1×10^{-12} cm/s [4×10^{-13} in/s] (which is representative of a very high quality concrete) for 100 years after facility closure. The saturated hydraulic conductivity of the saltstone was assumed to be 1×10^{-11} cm/s [4×10^{-12} in/s] over this time period. The performance assessment increased the hydraulic conductivity in a stepwise manner over the 10,000 year performance period. The observed seeps suggest that the vault is of insufficient quality to achieve a 1×10^{-12} cm/s [4×10^{-13} in/s] hydraulic conductivity. NRC previously documented the importance and relevance of the physical properties of the vault and saltstone in its TER (NRC, 2005). DOE performed sensitivity analysis to evaluate the impact of higher hydraulic conductivities of the vault and saltstone in response to NRC requests for additional information during the NRC review of the waste determination (NRC, 2005). Sensitivity cases evaluated in-filled saturated cracks scenarios. The analyses resulted in increases of the dose from 0.05 mrem/yr (base case) to 1.1 to 3.5 mrem/yr (sensitivity cases). The results are well within the 25 mrem/yr performance objective, but indicated the need to revise the performance assessment based on the observed facility condition. DOE plans to update the performance assessment supporting the saltstone waste determination, including the actual vault conditions in fiscal year 2009.

At the time of the October monitoring visit, DOE had not performed an analysis to evaluate the effect of differences between the vault conditions and those assumed in the performance assessment. Subsequent to the October 2007 visit, DOE conducted an assessment called an Unreviewed Disposal Question Evaluation (UDQE) "Evaluation of Liquid Weeping from Saltstone Vault 4 Exterior Walls," which NRC reviewed during this onsite observation visit. DOE submitted a revised UDQE assessment to NRC after the March monitoring visit (Rosenberger, 2008). The assessment evaluated the impact of waste inventory located in the vault walls using the NCRP-123 screening methodology for groundwater and a water ingestion screening limit of 2.5 mrem/yr. DOE stated that the analysis used conservative assumptions, such as assuming the total inventory was instantaneously mixed in the aquifer and the inventory of material available for release would not be limited by transport through the vault walls. The volume of waste was assumed to be 1,000 L, which is likely conservative based on known fracture frequency and size. The infiltration rate was assumed to be 41.78 cm/yr [16.4 in/yr], also likely to be conservative considering that the facility will have an engineered cap over the vaults at closure. The initial screening identified three radionuclides (Cs-137, 16.9 mrem/yr; Sr-90, 0.66 mrem/yr; and Pu-238, 0.11 mrem/yr) for additional analysis. When radioactive decay during transport was included, the potential dose from those three radionuclides was reduced to less than 0.02 mrem/yr. The transport calculation used distribution coefficients (Kds) of 50, 5, and 270 mL/g for Cs-137, Sr-90, and Pu-238, respectively. Future analyses of this type should consider whether the ambient soil Kds could change by interacting with liquid waste or cement-modified pore water.

DOE is envisioning a new vault design based on commercial water storage tank technology. NRC discussed the new design with DOE and the State of South Carolina. The new design will use prefabricated concrete slabs that will be assembled onsite and joined together using cast-in-place concrete. A high-density polyethylene (HDPE) liner will be used to provide an additional barrier to water flow and all the vaults eventually will be located below grade.

2.3.3 Conclusions and Followup Actions

The impact of the differences in the observed conditions of the disposal vault compared to the assumptions in the performance assessment supporting the waste determination has been assessed by DOE [(Romanowski 2007), (Rosenberger 2008)]. That analysis demonstrated that Vault 4 can meet the performance objectives in spite of the observed vault conditions, if the system is emptied of liquids prior to closure. DOE stated the Saltstone Disposal Facility Closure Plan would be revised to include this requirement. Therefore, this open issue has been resolved and is closed.

NRC will continue to follow up on DOE's Saltstone Disposal Facility Closure Plan to verify that it includes the requirement to empty the liquids prior to the closure of Vault 4. In addition, NRC will review the updated PA to confirm actual vault conditions have been properly incorporated and will review the new vault design information as it becomes available and evaluate its potential impact on long-term SDF performance.

2.4 Waste Sampling and Inventory

2.4.1 Observation Scope

NRC staff conducted monitoring activities in the areas of waste sampling and tracking of the radionuclide inventory transferred to the SDF during this onsite observation visit to evaluate the methodology used to quantify the inventory of radionuclides that is transferred to the SDF. This review was performed as part of the evaluation of Factor 6, Feed Tank Sampling, identified in the NRC monitoring plan (NRC, 2007). Adequate sampling of the waste transferred to the SDF is important because the total inventory of radionuclides disposed of in the SDF affects whether the performance objectives of 10 CFR 61.41 can be met. The methodology used for waste sampling and tracking of the radionuclide inventory transferred to the SPF/SDF was previously reviewed during the October 2007 onsite observation visit. NRC staff reviewed this methodology in greater detail during the March 2008 onsite observation. In addition, during this onsite observation, NRC staff members reviewed: waste sampling data, the Waste Acceptance Criteria (WAC) and Waste Compliance Plans (WCPs) for the SDF and the tank farm, information about the expected radionuclide inventory and chemical properties of waste that will be disposed of at the SDF as a result of the new process to remove aluminum from tank sludge, and information related to the operational experience for the transfer of waste containing solids to the SDF. This was achieved by interviewing site personnel and reviewing relevant documents. NRC staff also toured the labs at Savannah River National Lab (SRNL) where the samples from the tank farm are analyzed and met with SRNL personnel to discuss their analytical methods and quality assurance (QA) procedures.

2.4.2 Observation Results

NRC staff reviewed documents related to the WACs and WCPs for saltstone and the tank farm. 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, PA, and operating permitted values. Transfers to Tank 50 from outside the tank farm, such as transfers from the Effluent Treatment Process (ETP), must also be done in accordance with the Waste Acceptance Criteria for Liquid Waste Transfers to the 241-F/H Tank Farms (Rogerson, 2007). Additionally, transfers to the SDF and to the tank farm must be done in accordance with other WCPs such as the Tank 50 Waste Compliance Plan for Transfers to Saltstone (Harrison, 2008a) and the Waste Compliance Program for Liquid Waste Transfers from H-Canyon to 241-H Tank Farm (Price, 2007). The purpose of the WCPs is to ensure that the waste streams generated and transferred comply with the applicable WACs. NRC staff reviewed documents demonstrating that the waste transferred to the SDF as part of the DDA batches met the saltstone WACs (Zeigler et al., 2007, Fowler, 2008). NRC staff also reviewed documents showing that the waste transferred into Tank 50 met the saltstone WACs prior to this transfer (Martino, 2005, Oji, 2005). These documents were prepared in support of the requirement on the Evaluated Transfer Approval Form (ETAF) that waste should be evaluated against the saltstone WAC prior to transfer into Tank 50. NRC staff found that the methodology used by DOE to estimate the inventory of the waste sent to the SDF during the DDA batches was adequate to ensure that the waste satisfied the saltstone WACs.

Based upon discussions with DOE and DOE contractor personnel and review of pertinent documentation, NRC staff determined that the Interim Salt Disposition Project (ISDP) process will begin as the DDA process is finishing. The ISDP process includes the ARP and the MCU. The ARP involves the addition of Monosodium Titanate (MST) to the salt solution followed by filtration of the salt solution. This process removes strontium and actinides from the salt solution. The clarified salt solution effluent from the ARP treatment is then transferred to the MCU. The MCU process involves a solvent extraction to remove cesium from the salt solution. The waste streams from the ARP/MCU process that will be sent to Tank 50 include the decontaminated salt solution from the solvent extraction process as well as the solids wash water from the ARP.

The ISDP sample plan (Duffey, 2008) describes the sampling strategy for this process during the initial non-radiological operations and also as the facility transitions to operations involving salt waste. Initially, samples will be taken frequently in order to develop a process history. Once enough information has been obtained to statistically model the process, samples will be taken less frequently. In addition, salt waste must be qualified prior to being transferred from Tank 49 to ARP/MCU. The qualification of ISDP Batch 1 is described in the Evaluation of ISDP Batch 1 Qualification Compliance to 512-S, DWPF, Tank Farm, and Saltstone Waste Acceptance Criteria (Campbell, 2008). The purpose of this qualification was to determine the acceptability of this batch, and to demonstrate compliance with the Tank Farm, Saltstone, and Defense Waste Processing Facility (DWPF) WACs. Variable depth samples were taken from Tank 49 in support of this evaluation, and chemical and radionuclide characterization was performed on these samples. In addition, laboratory tests were also performed on these samples to assess the decontamination factors that could be achieved for this waste with the ARP/MCU processes. NRC staff reviewed the qualification report (Campbell, 2008) and determined that the qualification process used for Batch 1 was adequate to meet its purpose.

NRC staff will review the sample data and the removal efficiencies observed in the lab scale experiments as well as in the actual treatment processes once this information becomes available. This information is necessary to evaluate Factor 8, Removal Efficiencies, identified in the NRC monitoring plan (NRC, 2007). In addition, variability in the removal efficiencies observed also affects the extent to which it is appropriate to rely on process knowledge for calculating the inventory that is transferred to Tank 50 and is ultimately disposed of at SDF. NRC staff will also review sampling plans developed for this treatment process and plans for how compliance of the waste streams from the ARP/MCU processes with the tank farm and saltstone WACs will be demonstrated. NRC staff will also review the methodology used to evaluate the radionuclide inventory sent to Tank 50 from ARP/MCU.

As described in the previous onsite observation report, a materials balance is maintained for Tank 50 to track the inventory of radionuclides located in the tank and to track the inventory that is sent to the SDF. Though the methodology used for the materials balance and for tracking the inventory that is sent to the SDF was reviewed during the previous monitoring trip, it was reviewed in more detail during the current onsite observation. As part of this review, NRC staff examined the Saltstone Run Worksheet, a spreadsheet that shows the transfers made from Tank 50 and the grout produced from this waste, and reviewed the materials balance spreadsheet calculated at the end of February 2008 (Harrison, 2008b). NRC staff and site personnel also discussed the

method used to update these calculations. The materials balance spreadsheet is updated monthly, and the radionuclide inventory in the waste that was sent to the SDF is removed from the materials balance spreadsheet and the inventories in material that was transferred into the tank are added. In addition, the materials balance spreadsheet is re-baselined to measured concentrations when new sample results are obtained. The concentration calculated in Tank 50 at the end of previous month is used to calculate the inventory that is sent to the SDF. However, site personnel stated that if a major transfer into Tank 50 were to occur during the month, the spreadsheet would be updated to reflect the new concentration for any transfers to saltstone during that same month. Site personnel stated that it would be unlikely for there to be both major transfers into Tank 50 and transfers out to SDF during the same month because of the time that it takes to complete all of these transfers. NRC staff found that this approach to maintaining a materials balance for Tank 50 and tracking the inventory sent to the SDF is appropriate, though NRC staff believe that it is important for the materials balance update spreadsheet to be updated to account for the new waste if a major transfer happens during the month.

NRC staff also reviewed relevant portions of the "CST Sample Manual," including the sections related to obtaining a 3 L sample, the sample data sheet, and instructions for receiving, closing and shipping the shielded sample cask. In addition, NRC staff visited the H-Tank Farm in order to see an example of a riser that is used for sample collection. The riser that NRC staff observed was located on Tank 51. This tank is identical to Tank 50, but the riser for it can be seen from outside of the Radiological Buffer Area, while the riser for Tank 50 cannot. While at the H-Tank Farm, site personnel described in detail the procedures used for collecting samples. NRC staff found that the procedure used to collect samples from the tanks was appropriate.

In the previous observation report, NRC staff noted that DOE planned to slurry Tank 50 during transfers of waste to the feed tank at the SDF, and that any settled particles in Tank 50 would be transferred to the salt feed tank. Because this feed tank could not be slurried while waste was being pumped from it, NRC staff expressed concern that solids could build up in this tank and recommended that DOE either confirm that the build up of solids would be readily identified during processing or take actions to mitigate such build up. As stated in Section 2.1.2 of this report, DOE has modified the salt feed tank, by adding a new agitator motor that should mitigate the potential solids buildup in this tank. NRC staff did not have an opportunity to observe the effects of this modification during this onsite monitoring visit. Therefore, staff will continue to follow up on this modification through future monitoring activities.

NRC and site personnel also discussed the potential impacts of waste generated from the new aluminum dissolution process on the total inventory disposed at SDF and whether the chemical properties of this waste would have any effect on the wasteform generated with this waste. The aluminum dissolution process was developed because some of the sludge has a high aluminum content, which affects the vitrification of this waste in DWPF. To reduce this problem, a method was devised to remove the aluminum from the sludge. This method involves adding caustic chemicals to raise the hydroxide concentration to approximately 3 molar and raising the temperature to 50-60°C for a period of 2 to 4 weeks. The supernate from this process is then decanted to another tank for storage. This waste will eventually be sent through the Salt Waste

Processing Facility (SWPF) and will be disposed of in the SDF. Staff at SRS stated that the waste generated as a result of this waste stream is chemically similar to the supernates present in other tanks. Site personnel also stated that the inventory of aluminum disposed of at SDF will be increased as a result of this waste. In addition, there will be an incremental increase in the inventory of radionuclides, such as actinides. It is expected that the treatment processes at SWPF will remove a significant fraction of these radionuclides from the waste prior to the disposal of it at SDF, though the SWPF processes do not effectively remove technetium. Site personnel stated that the additional amount of technetium expected to be transferred to the SDF from this waste stream is small compared to total inventory that will be disposed at the SDF. NRC staff will evaluate additional inventory sent to SDF as a result of the new aluminum dissolution process as part of the monitoring of the total inventory disposed of at SDF.

During the onsite observation, NRC staff visited SRNL and met with the staff that performs the analyses on the samples taken from the tank farm to measure the concentration of radionuclides as well as other chemical constituents. While at SRNL, NRC staff toured the labs and discussed the analytical methods used to quantify the radionuclides and chemical constituents, the sample handling procedures, and QA procedures with lab personnel. NRC staff also reviewed the Analytical Development Section Procedure Manual, the Task Technical and QA Plan, the Analytical Study Plan, lab notebooks related to the analyses of samples from Tank 50, and the sample results from third and fourth quarter sampling in 2007. NRC staff determined that the analytical procedures used and the sample handling and QA protocols were appropriate and adequate.

2.4.3 Conclusions and Followup Actions

NRC staff determined that the methodology used to track the inventory of radionuclides sent to the SDF and to demonstrate compliance with the saltstone WACs appears to be adequate. NRC staff has also determined that the procedures used for obtaining samples, and the analytical procedures used for quantifying the constituents in the samples are appropriate. NRC staff determined that it is unlikely that the waste stream from the aluminum dissolution process will have a significant effect on the inventory in the SDF or the performance of the wasteform made with this waste stream. In addition, NRC staff has found that DOE has taken steps to mitigate the potential build up of particles in the salt feed tank discussed in the previous monitoring report (NRC, 2008). NRC staff will evaluate the aluminum dissolution process and DOE's actions to mitigate the potential build up of particles in the salt feed tank through future monitoring activities.

2.5 Radiation Protection Program

2.5.1 Groundwater, Air Effluent and Worker Dose Monitoring

2.5.1.1 Observation Scope

NRC staff interviewed DOE and DOE 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: i) the 2007 groundwater

monitoring program results for eight groundwater monitoring wells installed in or near the salt waste disposal area; ii) 2007 air effluent monitoring program for the SPF stack and Vault 4; and iii) the soil sampling results in the vicinity of Vault 4. Staff toured the SPF and the vicinity of Vault 4 to develop an understanding of the facility layout. In addition, staff observed a groundwater sampling event from the up-gradient background monitoring well (designated "ZBG-1" in EM records). The staff's reviews were guided by the NRC monitoring plan (NRC, 2007).

2.5.1.2 Observation Results

With regard to groundwater monitoring, NRC staff and DOE contractor personnel discussed the location of up-and down-gradient monitoring wells, sample collection procedures, frequencies of sample collection, sample analysis, and recent sample results. NRC staff reviewed the following documents: (1) Revision 4 of the Groundwater Monitoring Plan for the Z-Area Saltstone Disposal Facility (WSRC, 2006); and (2) Z-Area Groundwater Monitoring Report for 2007 (WSRC, 2008a). NRC staff also observed that groundwater sampling by DOE contractor personnel was performed in accordance with appropriate sample collection procedures.

NRC staff noted that the groundwater monitoring report (WSRC, 2008a) indicates the existence of a groundwater divide and larger groundwater velocity between the up-gradient background monitoring well (ZBG-1) and Vault 4. This interpretation is reportedly the result of the steeper hydraulic gradient observed after the installation of new monitoring wells near Vault 1. NRC staff and DOE contractor personnel discussed how this information is being assessed for impacts in the performance assessment supporting the waste determination. DOE contractor staff indicated that the reporting of this groundwater divide is currently expected to have neither a significant impact on groundwater modeling supporting the waste determination nor negate the use of monitoring well ZBG-1 as an indicator of background groundwater quality for Vault 4. DOE plans to update the performance assessment supporting the saltstone waste determination in fiscal year 2009. NRC staff will evaluate the significance of any impacts of the groundwater divide and hydraulic gradient in the performance assessment update.

NRC staff also noted elevated observations in WSRC (2008a) of tritium in monitoring wells installed immediately down-gradient of Vault 1, which is located up-gradient of Vault 4. The release of tritium from Vault 1 could potentially be an indicator of the performance of Vault 4. DOE contractor staff indicated that the source of this tritium is inconclusive at this time. Of particular interest to NRC staff was the result for nitrate analysis which is a major soluble component of the grouted wastes. The observed nitrate concentration in these wells was similar to measurements from the up-gradient well, ZBG-1. NRC staff will continue to monitor groundwater monitoring data through future monitoring activities.

With regard to air effluent monitoring, NRC staff and DOE contractor personnel discussed airborne radioactivity levels measured during Vault 4 operations involving 0.2 curie (Ci) per gallon (nominal) waste at Cell D in February 2008 and resulting radiological controls. NRC staff reviewed the following documents: (1) Guidance for Determining the Need for Continuous Air Monitors (WSRC, 2004) and (2) Air Sampling Plan for Saltstone Vault 4 During 0.2 Low Curie Salt Processing (WSRC, 2008b). Based

on discussions with key DOE personnel, NRC staff determined that DOE had anticipated increases in the activity of the effluent released through the passive vent stacks (exhausts) atop Vault 4 when the higher activity waste stream processing was initiated in February 2008. DOE constructed temporary "huts" around the passive vent stacks in order to sample the air released during filling operations. Sample results were higher than anticipated, but within applicable regulatory limits (see discussion below).

The results from air samples collected during the initial filling of the 0.2 Ci/gal salt waste ranged from 20 to 33 derived air concentration (DAC)-hours (alpha) and from 16 to 19 DAC-hrs (beta/gamma) inside the huts. Airborne concentrations outside the huts ranged from 7 to 10 DAC-hrs (alpha) and from 0.4 to 0.6 DAC-hrs (beta/gamma). As a result of these measurements, DOE officials suspended saltstone filling operations and installed passive filters on the Vault 4 vent stacks. After the filters were installed, saltstone filling operations resumed. The resulting airborne concentrations for alpha emitters were non-detectable, and ranged from approximately 0.1 to 0.8 DAC-hrs for beta/gamma emitters, inside the huts. Airborne concentrations, after filtration, were non-detectable for both alpha and beta/gamma emitters outside the huts. According to DOE regulations (10 CFR 835.403), monitoring for airborne radioactivity is required when an individual is likely to receive an exposure of 40 or more DAC - hrs in a year.

For comparison purposes, NRC regulations limit occupational dose to 5,000 mrem, total effective dose equivalent (TEDE). TEDE is comprised of both external exposure (deep dose) and internal exposure to ionizing radiation. Committed effective dose equivalent (CEDE) refers to the dose from ionizing radiation that is deposited internally in the body. A dose of 5000 millirem (mrem), CEDE is equal to 2000 DAC-hrs of exposure to airborne radioactive material. Assuming that a particular worker replaced air filters inside a hut, or carried out some other operation there, every day for a year (200 days), the resulting exposure could potentially be as much as 200 DAC-hrs per year resulting in a dose of 500 mrem CEDE. This scenario does not provide for any respiratory protection factor. Based upon discussions with DOE and DOE contractor personnel, NRC staff determined that respiratory protection devices were used during the actual operations atop Vault 4.

With regard to soil sampling, NRC staff and DOE contractor personnel discussed the recent soil samples taken in the vicinity of Vault 4 below the observed wet spots. Results of this sampling program were not available at the time of the onsite observation visit to adequately characterize the extent of any soil contamination there. NRC staff plans to follow up on the results of this sampling through future monitoring activities.

In addition, NRC staff and DOE contractor personnel discussed actions taken to characterize and remediate the observed Cs-137 contamination in soils from the drainage ditch adjacent to Vault 4, Cell G, which was noted in the previous observation report (NRC, 2008). DOE contractor personnel performed radiological surveys and remedial activities along the drainage ditch adjacent to Vault 4 that discharges to a nearby onsite sedimentation basin. Review of the radiological survey results suggests that the soil removal actions taken by DOE contractor personnel remediated the contamination in the drainage ditch.

2.5.1.3 Conclusions and Followup Actions

Similar to the previous NRC onsite observation visit on October 29-30, 2007 (NRC 2008), NRC staff reviewed sampling results for both the groundwater and air effluent monitoring programs at the SPF. NRC staff found that there is no conclusive indication of groundwater contamination in the vicinity of Vault 4 resulting from salt waste disposal operations; however, NRC staff will continue to monitor groundwater data. 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 were well below DOE regulatory limits. NRC staff also learned that personnel from the State of South Carolina Department of Health and Environmental Control (SCDHEC) periodically collect sediment samples from a nearby sedimentation basin. NRC staff plans to include this independent data collected by SCDHEC as part of the ongoing monitoring activities at the SDF. NRC will continue to assess DOE's radiation protection program through future monitoring activities.

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SUBJECT: NUCLEAR REGULATORY COMMISSION ONSITE OBSERVATION REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE PRODUCTION AND DISPOSAL FACILITIES, JULY 31, 2008

Dear Ms. Ridley:

The enclosed report describes the U.S. Nuclear Regulatory Commission's (NRC's) onsite observation activities on July 31, 2008, at the Savannah River National Laboratory (SRNL) at the Savannah River Site (SRS). This onsite observation was conducted in accordance with the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), which requires NRC to monitor disposal actions taken by 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).

This onsite observation at SRS was primarily focused on the performance objective in 10 CFR 61.41, *protection of the general population from releases of radioactivity*. Since saltstone grout 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*.

During the previous onsite observation visit in March 2008, DOE presented plans for additional studies, including laboratory experiments. These experiments, when completed, are designed to provide information DOE needs to address open issues identified by NRC during an observation visit in October 2007 as well as to provide additional model support for the Saltstone Performance Assessment. The open issues identified by the NRC pertain to: (1) the need for additional information to support the physical characteristics of the saltstone grout assumed in the DOE waste determination; and (2) the need for additional information which quantifies the impact of grout component intrabatch variability, flush water additions, and additives, on final saltstone grout physical and chemical properties.

In July 2008, DOE-Savannah River (DOE-SR) informed NRC that DOE contractor staff at SRNL planned to complete three experiments on vault and saltstone grout materials by mid-August 2008. NRC staff visited SRNL on July 31, 2008 in order to observe ongoing experiments that will address the first open issue described above, before they were completed. No new open issues were identified relating to these observations, and no open issues were closed, as

the data from these experiments, data assessments, and updated performance assessments are not yet available.

Based on NRC staff observations, 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 DOE's waste determination analyses prove to be correct. In accordance with the requirements of the NDAA and consistent with NRC's monitoring plan for the salt waste disposal facility, NRC will continue to monitor DOE's disposal actions at SRS. The monitoring activities are expected to be an iterative process and several onsite observation visits, and technical reviews of various reports, studies, etc., may be necessary in order to obtain the information needed to close all of the current open issues, as well as issues that may be opened in the future.

If you have any questions or need additional information regarding this report, please contact David Brown at (301) 415-6116.

Sincerely,

/RA/

Patrice Bubar, Deputy Director
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Enclosure:
NRC Observation Report

cc: w encl:
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Federal Facilities Liaison
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SAVANNAH RIVER SITE SALTSTONE PRODUCTION AND DISPOSAL FACILITIES
U. S. NUCLEAR REGULATORY COMMISSION ONSITE OBSERVATION REPORT
JULY 31, 2008

1.0 INTRODUCTION

On July 31, 2008, NRC staff conducted its third onsite observation visit of the Savannah River Site (SRS) Saltstone Facilities. The purpose of this one-day visit was to observe ongoing experiments at the Savannah River National Laboratory (SRNL) at the Savannah River Site. This visit focused on the performance objective in 10 CFR 61.41, *"protection of the general population from releases of radioactivity,"* by reviewing ongoing laboratory experiments designed to collect data on the physical and chemical properties of the SRS Saltstone Disposal Facility (SDF) vault and saltstone grout materials. Because the saltstone grout 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. Based on the results of the visit, the NRC continues to have reasonable assurance that the performance objectives of 10 CFR 61 can be met in the areas reviewed.

2.0 NRC ONSITE OBSERVATION ACTIVITIES

At the beginning of the visit, DOE contractor staff provided briefings to staff from NRC and the South Carolina Department of Health and Environmental Control (SCDHEC) on: (1) the ongoing experiments at SRNL that are designed to collect data on physical and chemical parameters of the SDF vault and saltstone grout; and (2) the current status of salt waste processing. DOE briefing slides are included in Attachments 1 and 2. With regard to the experiments, DOE contractor staff explained that there are three main types of experiments at different stages of completion. These experiments include: (1) batch studies of absorption and desorption rates of key radionuclides from a pulverized simulated concrete and grout, which are 75% complete, and which DOE estimates will be complete in September 2008; (2) studies of technetium-99 oxidation and release rates from crushed samples of laboratory-prepared saltstone grout, which DOE estimates are about 50% complete; and (3) studies of the reduction capacity of saltstone, grout, which are complete.

With regard to the batch studies of absorption and desorption rates of key radionuclides from a pulverized simulated vault concrete and saltstone grout, DOE contractor staff explained that three saltstone grout mixtures are being studied that are representative of three liquid waste processing streams: (1) deliquification, dissolution, and adjustment (DDA); (2) actinide removal process / modular caustic side solvent extraction unit (ARP/MCU); and (3) the Salt Waste Processing Facility (SWPF). The data collected in these experiments is used to calculate distribution coefficients, or K_d values, which are key parameter values in the DOE performance assessment. DOE explained that the current experiments are not testing the effects of grout additives such as anti-foaming agents or set-retardant. However, DOE may conduct such experiments in the future, subject to prioritization of research needs and available funds.

Enclosure

The experiments to collect data on the reducing capacity of saltstone grout are using a colorimetric titration technique to oxidation endpoints measured using a spectrophotometer. The indicator is based on the reduction-oxidation couples of cerium and chromium .

The experiments on the oxidation of saltstone grout and desorption rates of technetium-99 in saltstone grout are batch experiments. In these experiments, crushed laboratory-prepared saltstone grout is added to small, sealed serum bottles with simulated, highly-buffered saltstone grout pore water. The grout and water mixture is equilibrated by tumbling or shaker table, which requires several days. Equilibrium is indicated by stable pH measurements, at which time the technetium-99 spike is added to the mixture. Aqueous technetium-99 concentrations are measured at regular time intervals throughout the experiment. Aqueous phase technetium-99 is determined after filtration of the leachate through 100 nanometer pore filters. Early results indicate that equilibrium technetium-99 adsorption is reached within 5 hours. After one week, air is sparged into the serum bottles, and technetium-99 aqueous phase concentrations continue to be measured at regular time intervals.

NRC staff did not review preliminary results for any of the experiments, as data validation and data assessment for all laboratory experiments is pending. As a result, the two open issues pertaining to saltstone characterization that are summarized in the NRC's observation report for the March 24-28, 2008, observation visit remain open. These open issues pertain to: (1) the need for additional information to support the physical characteristics of the saltstone grout assumed in the DOE waste determination; and (2) the need for additional information which quantifies the impact of grout component intrabatch variability, flush water additions, and additives, on final saltstone grout physical and chemical properties. In addition, NRC staff expects to review the results of these experiments as part of the monitoring of Factor 3: Model Support described in Section 3.1.4 of NRC's Monitoring Plan for Salt Waste Disposal at SRS.

NRC and DOE contractor staff also discussed whether soil sampling and analysis results for samples taken in the vicinity of the Saltstone Disposal Facility (SDF) were available for NRC technical review. These sample were taken in the vicinity of weep sites in Vault 4. DOE contactor staff stated that sample analysis results were available, but that additional time is needed to complete a data assessment. NRC staff will follow up on the availability of this information for NRC technical review.

DOE contractor staff also provided an update to NRC and SCDHEC staff on salt processing. Of note, as described in the Attachment 2, DOE has started ARP/MCU processing under a Management Control Plan, which involves a heightened level of administrative controls on operations, including cross-checks, various process hold points for management review and approval, and higher sampling rates. The performance of the ARP/MCU processing is of interest to NRC staff because the amount of removal achieved during this process affects the inventory of radionuclides disposed of at the Saltstone Disposal Facility and consequently the dose that a receptor may receive.

DOE contractor staff explained that they have experienced some start-up challenges with MCU, including loading of a Decontaminated Salt Solution (DSS) coalescer. The accumulation of monosodium titanate solids on the coalescer media occurred more rapidly than anticipated, starting with the fifth of what was expected to be a series of 10 DSS batches under the Management Control Plan. The coalescer media in the crossflow filter protects contactors located downstream in the MCU process. DOE contractor staff explained that the rate of coalescer media loading does not present a process safety hazard. Lessons-learned on

equipment start-up are being shared with Parsons, which is designing the SWPF. DOE contractor staff explained that the ARP/MCU process is performing better than desired production goals. However, the process has been treating "startup simulant" from Tank 49, for which higher decontamination factors are expected. DOE will continue treating additional batches of ARP/MCU feed material, and expect that equilibrium processing rates and performance will be reached within ten batches following replacement of the coalescer media. DOE had processed a total of 13 batches at the time of the NRC observation visit. No radionuclide removal data was available for NRC technical review during the visit. However, DOE is preparing a technical report on the results of start-up operations under the Management Control Plan. In addition, the sampling protocol for the ARP/MCU process is being developed. NRC staff will follow up on the availability of these documents in the future.

Following discussion of the three types of experiments, and the update from DOE contractor staff on the status of salt processing, NRC and SC DHEC staff were provided a tour of ongoing experiments in the laboratory.

In the afternoon, NRC and DOE staff discussed which routine reports DOE and/or DOE contractor staff prepare for which NRC would like to be on distribution. NRC and DOE also discussed the schedule for the preparation of technical reports pertaining to the laboratory experiments observed during this visit, and other ongoing studies.

3.0 CONCLUSIONS

During this onsite observation visit, NRC and SC DHEC staff were afforded an opportunity to observe ongoing laboratory experiments, and ask clarifying questions on the design and scope of the experiments. NRC and SC DHEC staff also received a briefing on the status of salt waste processing operations, but did not request a tour of the Saltstone Facilities, or review onsite documentation pertaining to ongoing operations. Given the limited scope of the onsite observation, and the fact that experimental data and data assessments are not yet available, staff did not close open items that were described in the NRC's observation report for the March 24-28, 2008, observation visit.

Based on NRC staff observations, 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 DOE's waste determination analyses prove to be correct. In accordance with the requirements of the NDAA and consistent with NRC's monitoring plan for the salt waste disposal facility, NRC will continue to monitor DOE's disposal actions at SRS. The monitoring activities are expected to be an iterative process and several onsite observation visits, and technical reviews of various reports, studies, etc., may be necessary in order to obtain the information needed to close all of the current open issues, as well as issues that may be opened in the future.

4.0 PARTICIPANTS

NRC and State of South Carolina Observation Team

Anna Bradford, NRC
David Brown, NRC
Karen Pinkston, NRC
Jason Shirley, SC DHEC
Ted Millings, SC DHEC

U.S. DOE and Contractor Representatives

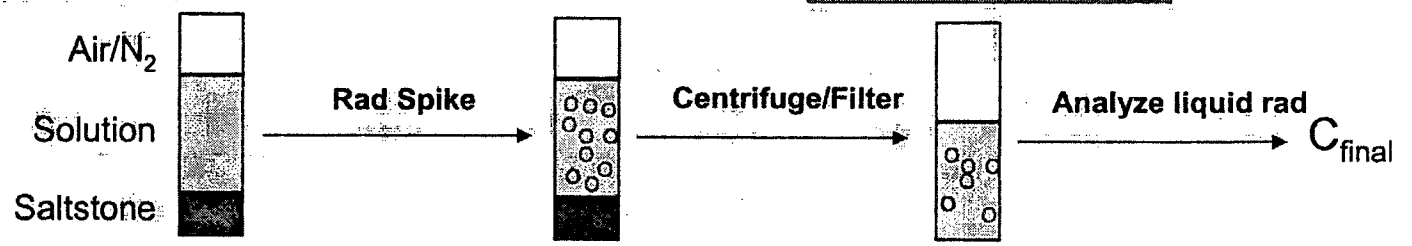
Seaward Middleton, DOE-SR
Howard Pope, DOE-SR
Sherri Ross, DOE-SR
Ginger Dickert, WSRC
Dan Kaplan, WSRC
David Little, WSRC
Jeff Newman, WSRC
Larry Romanowski, WSRC
Kent Rosenberger, WSRC
F. Malcolm Smith, WSRC

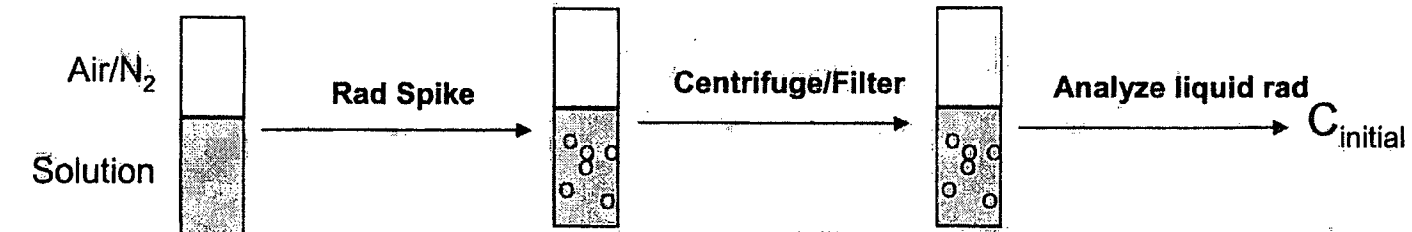
Attachments:

1. "Batch Kd Measurement," Dan Kaplan, WSRC, undated
2. "Salt Processing Update," David Little, WSRC, dated July 31, 2008.

Batch Kd Measurement

$$Kd = \frac{C_{solid}}{C_{liquid}}$$



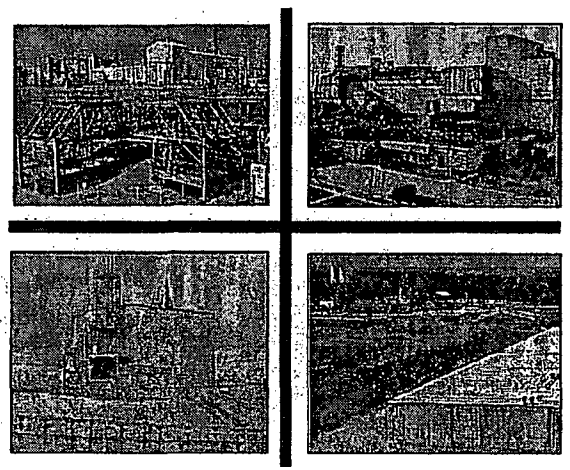


$$Kd = \frac{(C_{\cancel{final}\ initial} - C_{\cancel{initial}\ final}) \times V_{solution}}{C_{final} \times M_{saltstone}}$$

SRNL

SRS
savannah river site

Salt Processing Update



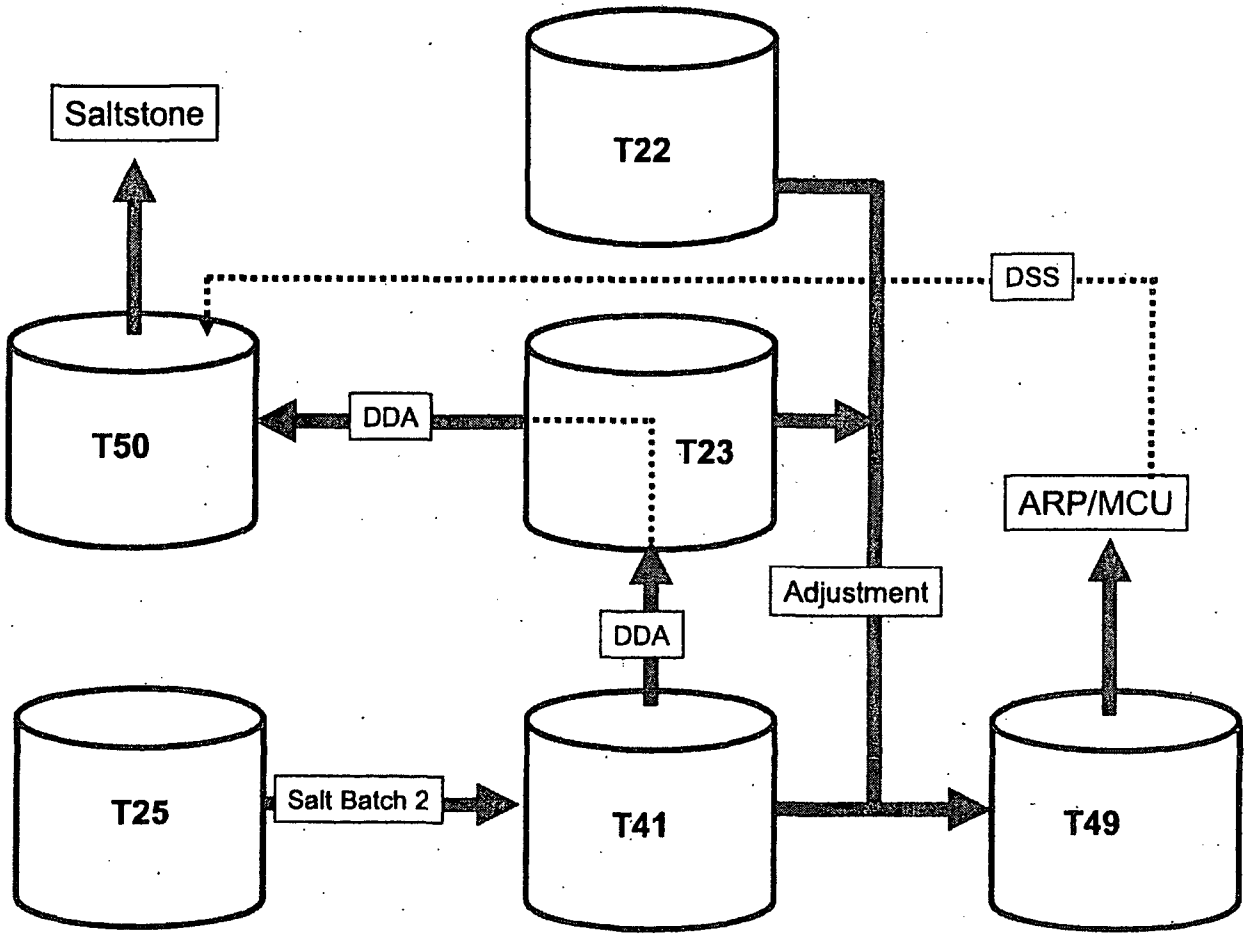
David Little
LWO Deputy Chief Engineer
Washington Savannah River Company

July 31, 2008

Areas of Discussion

1. Saltstone Feed Status
2. ARP/MCU Feed Status
3. Actinide Removal Process (ARP) and Modular Caustic Side Solvent Extraction Unit (MCU) Facilities Status
4. Saltstone Disposal Facility (SDF) Operations Status
5. Looking to the Near Future

Facility Overview



Tank Farm Background Information

- **Tank 22** contains low-activity waste from DWPF recycle waste
  - Used to adjust the waste for processing in the ARP/MCU Facilities
- **Tank 23** contains low-activity waste from historical site processes
  - Used to adjust the waste for processing in the Saltstone Facilities
- **Tank 25** contains salt waste that will be qualified for ARP/MCU feed as Salt Batch 2
- **Tank 41** contains salt waste that is permitted to be processed as "DDA" waste
  - Some of the saltcake in Tank 41 has been dissolved and transferred to Tank 49
  - Some of the saltcake in Tank 41 has been dissolved and transferred to Tank 23
- **Tank 49** was the settling tank for DDA Batches 1 through 3 processing and is currently the feed tank for the ARP/MCU process.
- **Tank 50** is the low-level waste feed tank for the Saltstone Production Facility & receipt tank for decontaminated salt solution from MCU

Saltstone Feed Status

- Processing of DDA Batch 3 Feed at SPF Was Completed in this Quarter (4/9/08)
- Preparation of Next Saltstone Feed Batch Completed
  - Dissolution of Tank 41 Saltcake (DDA) Was Completed (July 2008)
  - Tank 23 Status
    - TK41 > TK23 Transfers Completed (July 2008)
    - Waste Acceptance Criteria Sample Pulled (July 2008)
    - Tank isolated from remainder of Tank Farm

ARP/MCU Feed Status

- Preparation of Salt Batch 2 Underway
  - Dissolution of Tank 25 Saltcake (ARP/MCU feed) Was Initiated And Is In Progress (July 2008)
  - Tank 22 Status
    - Influent Transfers Completed (July 2008)
    - Waste Acceptance Criteria Sample Pulled (July 2008)
    - Tank isolated from remainder of the Tank Farm

ARP / MCU Facilities Status

- Start-up Activities Completed During this Quarter
  - Completed Final Facility Tie-ins
  - Completed Initial Tank 49 Transfer to ARP (4/21/08)
- ARP/MCU Operated Successfully under Management Control Plan
- Operating Results As Expected
  - DF's & CF's as Expected
  - Sr, Pu, & U Indicating Adequate ARP Performance
  - Cs Indicating Adequate MCU Performance
  - DSS and SE Organic Carryover Below Process Limit
- Typical Start-Up Equipment Lessons Learned
- 61K Gallons Processed Out of Tank 49 (thru July)

Saltstone Operations Status

- DDA Batch 3 Processing Was Completed in April 2008
- During the Quarter Saltstone Processed ~ 154 kgals of Salt Solution from Tank 50
  - Resulted in ~ 220 kgals of Saltstone
  - Disposal Occurred in Vault 4, Cell D
- 34 kCi Disposed in Saltstone Vaults in 2Q CY2008
- Total DDA Curies Disposed in Vaults is 134 kCi
- Modifications to the Saltstone Vaults Are in Progress to Handle Any Potential Solvent Carryover from the MCU Facility

Activities During the Current Quarter

- ARP / MCU Operations (Salt Batch 1) Will Continue Processing from Tank 49
- Dissolution of Tank 25 Saltcake (ARP/MCU feed) to Tank 41 Will Be Performed
- Salt Batch 2 (ARP/MCU) Qualification Planning in Progress
- Saltstone Outage to Install Modifications Necessary to Support Receipt of DSS Containing Low Levels of MCU Solvent Carry-over Will Complete
- Saltstone Will Initiate Processing of ISDP Batch 1 Material on 8/28/08 (DDA Material with Minimal Solvent Carryover from MCU)

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

September 24, 2008

R. Mark Shaw
Project Manager, Tank Farm Closure Project
U.S. Department of Energy, Idaho Operations Office
MS 1222
1955 Freemont Avenue
Idaho Falls, ID 83415

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

Dear Mr. Shaw:

The enclosed document describes the U.S. Nuclear Regulatory Commission's (NRC's) onsite observation activities on August 12-13, 2008, 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 April 13, 2007, for INTEC TFF.

NRC's onsite observation at INL was 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 ancillary components and equipment grouting operations, including the grouting of transfer lines, cooling coils and tank risers; by observing DOE's groundwater sampling program; and verifying DOE's radiation protection measures in its INTEC TFF grouting operations. Since the 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*.

Based on our observations, NRC continues to conclude that there is reasonable assurance that the applicable criteria of the NDAA can be met if key assumptions made in DOE's waste determination analyses prove to be correct. In accordance with the requirements of the NDAA and consistent with NRC's monitoring plan for the INTEC TFF, NRC will continue to monitor DOE's disposal actions at INL. The monitoring activities are expected to be an iterative process and several onsite observation visits, and technical reviews of various reports, studies, etc., may be necessary in order to obtain the information needed to fully assess compliance with all of the performance objectives set out in 10 CFR Part 61, Subpart C.

On August 13, 2008, at the conclusion of the onsite observation activities, members of my staff discussed the topics addressed in this report with you and other DOE INL staff members. If you have any questions or need additional information regarding this report, please contact Michael Fuller, Project Manager, at 301-415-7640

Sincerely,

Anna Bradford for

Patrice M. Bubar, Deputy Director
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Enclosure: NRC Observation Report

cc w encl: B. LaRue
Environmental Scientist/Impact Assessment
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900 North Skyline Drive, Suite C
Idaho Falls, ID 83402

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

EXECUTIVE SUMMARY

NRC staff conducted its third onsite observation visit of the Idaho Nuclear Technology and Engineering Center Tank Farm Facility (INTEC TFF) on August 12 to 13, 2008. 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's ancillary components and equipment grouting operations, including the grouting of transfer lines, cooling coils and tank risers; by observing DOE's groundwater sampling program; and verifying DOE's radiation protection measures in its INTEC TFF grouting operations. Because the 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.* This report provides a description of NRC onsite observation activities from the visit.

Grouting Operations

NRC staff monitored ongoing grouting operations of the tank and ancillary equipment at the INTEC TFF by interviewing site personnel, observing grouting operations, and reviewing videos of grouting operations.

- The observation determined that the grouting of ancillary components and equipment is being conducted in a manner that ensures the grout specifications meet those that were assumed in DOE's final waste determination, issued in November 2006.

Groundwater Sampling

NRC staff interviewed DOE and its contractors involved in groundwater monitoring and observed staff performing compliance sampling at a groundwater monitoring well.

- The observation determined that the sampling of groundwater was performed in accordance with the established procedures.

Radiation Protection Program

NRC staff interviewed DOE and its contractor's radiation protection personnel, reviewed the radiological control documents associated with TFF grouting 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 INTEC TFF grouting operations.

Enclosure

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 a demonstration of compliance with the performance objectives in 10 CFR Part 61, Subpart C (DOE, 2005). 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, assuming that certain key assumptions were shown to be correct. 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 (DOE, 2006).

To carry out its monitoring responsibility under the NDAA, NRC plans to perform three types of activities focusing on key monitoring areas 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 performance assessment 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 assumptions 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 August 2008 onsite observation at INL was the third such visit to INL. Additional visits will be conducted in the future to continue to assess the performance objectives in 10 CFR Part 61, Subpart C.

2.0 NRC ONSITE OBSERVATION ACTIVITIES

2.1 Grouting Operations

2.1.1. Observation Scope

During this onsite observation visit, NRC staff observed ongoing grouting operations at the INTEC TFF. NRC staff interviewed site personnel to gather information on: (i) the grouting operations that have taken place since the August 2007 onsite observation visit, (ii) the status of ongoing grouting operations, (iii) the procedures used to place grout into the various types of ancillary equipment, (iv) the grout mix used for grouting the ancillary

equipment, and (v) quality assurance procedures. In addition, NRC staff observed grouting operations and watched videos of various grouting operations.

2.1.2 Observation Results

In the time since the August 2007 NRC onsite observation visit to INL, site personnel completed the grouting of Tanks 180, 181, 182, 183, 184, 185, and 186, including the domes of the tanks as well as the upper portion of the tank vaults. In addition, ancillary equipment, such as the cooling coils in the tanks, transfer lines, and tank risers, were also grouted. At the time of this onsite observation visit, the remaining ancillary equipment, that had not yet been grouted, included approximately 300 ft (91 m) of transfer line, the risers for Tanks 182, 183, 184, 185, and some valve boxes and relief pits. On the day of the NRC onsite observation visit, relief valve pit RVP-5, which is affiliated with Tank 180, was being grouted. NRC staff observed the transfer of the grout to the pipe grout mixer and pump. NRC staff also reviewed videos showing the grouting of cooling coils, and vessel-off-gas (VOG) lines, as well as video showing the inside of the tank domes and the vaults at different stages in the grouting process. By watching these videos, NRC staff observed the processes used to grout the tank domes, vaults, and ancillary equipment and piping, including the changes made to the riser and piping configurations to provide access for grout. NRC staff observed that the grout flowed easily and appeared to fill the void spaces well.

NRC staff and site personnel discussed the procedures used to ensure that the ancillary equipment was fully grouted and that grout was not being placed into areas that were not intended to be grouted, such as, certain transfer lines still in use or potentially needed in the future. In those cases where it was possible to grout all the way through a piece of ancillary equipment (e.g. a pipe that had access on both ends) the grout was pumped until it came out on the other side. In addition, site personnel calculated the amount of grout needed to grout the equipment based on engineering drawings before grouting began. Grouting operations were stopped when the ancillary equipment was filled with a grout volume that was equal to 10% more than the volume calculated based on the engineered drawings. Site personnel stated that a few pours were stopped because this limit was reached. In these cases, it was determined that there was an error in the calculation rather than a problem with the grouting. An additional safety requirement for grouting operations involved the setting of a maximum pressure for the grout being pumped into the ancillary equipment, and grouting operations were stopped if this pressure was reached.

NRC staff and site personnel also discussed the processes used to access and grout the various ancillary equipment and piping, including the tank domes, the transfer lines, and the cooling coils. The domes for Tanks 180, 181, 182, 183, 184, 185, and 186 have been grouted. The grouting of these tank domes was done by emplacing grout through the outside risers until the grout level reached the height of these risers. The remaining portion of the tank dome was then grouted through the center riser, which is located at the highest point in the dome.

Grouting operations have also been completed for much of the ancillary equipment and piping on site. All but approximately 300 ft (91 m) of the more than 7 mi (11 km) of

transfer lines has been grouted. The transfer lines also had secondary containment, which has also been grouted. Because the transfer lines had contained contaminated material, any liquid that came out of the lines during grouting was managed as waste. The cooling coils were grouted from April 28 to May 13, 2008 using a total of 9 yd^3 (7 m^3) of grout. Three of the 300,000 gallon (1,000 m^3) tanks and all four of the 30,000 gallon (100 m^3) tanks have cooling coils with a 1.5 inch (3.8 cm) diameter. These lines never contained waste and were not internally contaminated. To ensure complete grouting of the entire cooling coil, the ends of the cooling coils were cut off and grout was pumped into one end of the coil until grout came out of the other end. Residual water pushed out of the coils by the grout was monitored for radioactivity and determined to be non-contaminated. Grouting operations were ceased on two of the cooling coils prior to grout coming out of the coil because the high pressure limit was reached. Both of these coils had longer lengths, so more pressure was required to push the grout all the way through these coils. Grouting of the remainder of these two coils was completed by emplacing grout into the other end of the coils. NRC staff found that the procedures used to grout the ancillary equipment are adequate and appropriate for ensuring that the ancillary equipment is properly grouted.

The grout mix used for grouting the ancillary equipment had a high water content comparable to that used for the upper portion of the tank to ensure that the grout was able to flow easily into all areas of the ancillary components. The design specifications for this mixture are described in Appendix C of DOE's final waste determination (DOE, 2006). NRC staff observed the grout consistency in the videos of grouting operations and confirmed that it was easily able to flow into piping. The grout components were typically measured out by the batch plant and mixed in a cement truck, but because of smaller volumes needed for some of the ancillary equipment, some of the grout mixing was done directly in the Pipe Grout Mixer. The consistency of the grout was verified using both the puddle test and compressive strength tests. NRC staff found that these procedures are appropriate for ensuring the consistency of the grout.

2.1.3 Conclusions and Follow-up Actions

NRC staff did not observe any problems with the grouting of the ancillary equipment at the INTEC TFF and the staff determined that this program is being conducted in a manner that ensures the grout specifications meet those that were assumed in DOE's final waste determination, issued in November 2006.

NRC staff plans to review the outcome of the grouting operations for the remaining ancillary equipment. In addition, on future site visits NRC staff plans to observe the grouting of the remaining four large tanks once the waste has been removed and they have been cleaned.

2.2 Groundwater Monitoring

2.2.1 Observation Scope

During this onsite observation visit, NRC staff observed routine groundwater monitoring activities, reviewed pertinent procedures, and interviewed site personnel to gather information about the ongoing groundwater monitoring program at the INTEC TFF.

2.2.2 Observation Results

Monitoring of underlying aquifers can be used to help in assessing whether the performance objective in 10 CFR 61.41, related to protection of the general public from releases of radioactivity, is being met and also to provide information to update modeling efforts to evaluate future performance. NRC staff observed DOE contractor site personnel conduct groundwater sampling at a groundwater monitoring well. No sampling was being performed in the INTEC TFF during the onsite observation visit; however, sampling was being performed at Test Area North (TAN). The sampling procedure is the same for the two areas. At TAN, the monitoring observed is part of the remediation efforts for a plume that resulted from a previous injection well. The plume contains trichloroethylene, perchloroethylene, and various radionuclides. The well that was sampled was TAN-1614. The INL staff sampled the well per the procedure, TPR-165, Revision 11, "Low-Flow Groundwater Sampling Procedure," (CWI, 2007). Analysis of the samples is done in house for TAN, while at INTEC TFF the samples are analyzed at offsite laboratories that comply with DOE protocols for quality assurance. NRC staff plans to review groundwater sample data during a future onsite observation visit.

2.2.3 Conclusions and Follow-up Actions

The NRC staff determined that the sampling of groundwater was performed in accordance with the established procedures. NRC will continue monitoring activities related to groundwater monitoring during future onsite observation visits to INL.

2.3 Radiation Protection Program

2.3.1 Observation Scope

During this onsite observation visit, NRC staff interviewed DOE, and contractor radiation protection personnel, reviewed radiological control documents associated with INTEC TFF grouting operations, and reviewed associated worker dose records.

2.3.2 Observation Results

DOE has contracted with CH2M-HILL and Washington Group, Idaho (CWI) to provide radiological protection for site personnel during INTEC TFF closure operations. Through interviews with key personnel and a review of pertinent records, NRC staff determined that radiation levels at the INTEC TFF are typically low during grouting operations. Furthermore, as low as is reasonably achievable (ALARA) reviews are required for all grouting activities. Because all INTEC TFF tank closure operations are project oriented,

a special personal electronic dosimeter (ED) monitoring device is required for each person conducting a specific project. While a thermoluminescence dosimeter (TLD) that is exchanged every quarter provides an individual's total external radiation dose received over that period, an ED can provide a specific dose associated with a specific activity, e.g., transfer line grouting. Through interviews with radiation protection personnel and observing the radiation protection computerized system operation, it was determined that the use of EDs can provide accurate information on worker dose associated with INTEC TFF grouting operations.

Through a review of INTEC TFF operation personnel dose records for 2008 (through August 1, 2008), including TLD and ED records, it was determined that there were no overexposure or overdose incidents involving INTEC TFF grouting operations. The maximum dose received by a worker during this period was 9 millirem (mrem). The maximum dose allowed to a worker under DOE regulations is 5,000 mrem per year (equivalent to 10 CFR Part 20 dose limits). CWI maintains an administrative limit of 700 mrem per year.

2.3.3 Conclusions and Follow-up Actions

Through a review of the radiation protection program implemented by DOE and CWI at the INTEC TFF, interviews with radiation protection personnel, and a tour of the facility, NRC staff determined that DOE took adequate steps to maintain radiation doses ALARA during INTEC TFF grouting operations. No specific items were identified for follow-up. NRC will continue monitoring activities related to radiation protection during future onsite observation visits to INL.

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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 2008, 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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