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NUREG-1911, Rev. 5

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

Report for Calendar Years 2012 and 2013

Office of Nuclear Material Safety and Safeguards

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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 Years 2012 and 2013, in accordance with Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (the NDAA). Section 3116 of the NDAA requires: (1) that DOE consult with the NRC on its non-high-level waste determinations and plans, and (2) 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,* 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," dated 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 the U.S. Department of Energy (DOE) non-high-level waste disposal actions in Calendar Year (CY) 2012 and 2013. The NRC monitors DOE disposal actions in covered States in accordance with Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA). Section 3116 of the NDAA has two main subsections—subsection (a) requires DOE to consult with the NRC on its non-high-level waste determinations and plans and subsection (b) requires the NRC, in coordination with the covered States of South Carolina and Idaho, to 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." This report is concerned exclusively with subsection (b) of Section 3116. Appendix A to this report provides the complete text of Section 3116 of the NDAA. This is the sixth report of what the NRC anticipates will be a periodic report during its NDAA monitoring activities. 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 (NRC, 2007a).

DOE has issued three waste determinations (WDs) under Section 3116 of the NDAA. In January 2006, DOE completed the WD for salt waste disposal at the Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) in South Carolina (DOE, 2006). In November 2006, DOE issued a WD for the Tank Farm Facility (TFF) at Idaho National Laboratory (INL) Idaho Nuclear Technology and Engineering Center (INTEC) (DOE-Idaho, 2006). In March 2012, DOE issued a WD for the F-Tank Farm (FTF) at SRS (DOE, 2012). The NRC staff reviewed the draft basis documents for these WDs, along with their associated performance assessments (PAs) and other documents, and documented its review in technical evaluation reports (TERs) for the SDF, INL, and FTF sites (NRC, 2005a; NRC, 2006; NRC, 2011). In 2009, DOE revised the SDF PA (SRR, 2009). The 2009 SDF PA replaced the 2005 PA that supported the January 2006 WD; however, the January 2006 WD, itself, was not revised and still remains valid. The NRC staff reviewed the 2009 SDF PA and documented its evaluation in a TER for the SDF in April 2012 (NRC, 2012a).

Based on the risk-significant monitoring areas (MAs) identified in these TERs, the NRC completed its initial monitoring plans for the SDF, INL, and FTF sites (NRC, 2007b, NRC 2007c, NRC 2013a). The NRC staff issued a revision to the SDF monitoring plan in 2013, based on its evaluation in the 2012 TER (NRC, 2012a; NRC, 2013b). In each monitoring plan, the NRC staff identified a hierarchy of elements defining the overall scope of monitoring at each site. The scope of monitoring was defined by those technical subject matter areas identified in the TERs that were most uncertain or significant in the DOE analysis of whether the disposal of these incidental wastes can: (1) meet the NRC performance objectives and (2) be considered non-high-level wastes.

The NRC staff identified risk-significant modeling assumptions or disposal facility features important to compliance with the performance objectives in 10 CFR Part 61, Subpart C, in its 2005 SDF TER (NRC, 2005a) and 2006 INTEC TFF TER (NRC, 2006). These risk-significant assumptions and disposal facility features became the focus of the NRC staff's monitoring and are listed as "factors" or "key monitoring areas" in the monitoring plans for the SDF and INTEC TFF, respectively (NRC, 2007b; NRC, 2007c). In 2012, the NRC staff re-evaluated its monitoring program during the development of the FTF monitoring plan (NRC, 2013a) and the revised SDF monitoring plan (NRC, 2013b). Most notably, changes were made to some

monitoring program terminology and the manner in which monitoring activities would be tracked. Most significantly, the term "monitoring factors (MFs)" replaced what were called "factors" in the original 2007 SDF monitoring plan. In general, "monitoring factors" are more focused than "factors." However, "monitoring activities" that constitute very specific technical review or onsite observation visit actions were not developed in the updated monitoring system and are no longer being tracked in the 2013 FTF and 2013 SDF monitoring plans. MFs can be evaluated in an onsite observation visit, or in a technical review activity, or both, and are simply tracked as open or closed. The INL INTEC TFF monitoring plan issued in 2007 has not yet been updated; therefore, the previous monitoring program terminology (i.e., key monitoring areas and monitoring activities) is still being used in this report to discuss monitoring at INL INTEC TFF.

In the 2013 monitoring plans for the FTF and SDF, the NRC staff defines an MA to be a general feature or aspect of the disposal action that is important to DOE's ability to meet the performance objectives of 10 CFR Part 61, Subpart C (e.g., infiltration and erosion control) (NRC, 2013a; NRC, 2013b). Each MA is further divided into one or more MFs. Each MF is a specific feature of the disposal action (e.g., conceptual model assumption, mathematical modeling assumption, parameter value) that DOE uses in its analyses that the NRC staff has determined to be important to demonstrating compliance with the performance objectives of 10 CFR Part 61. The NRC staff identifies MFs for each site through its review of (1) the basis documents for the WDs for each site, (2) the site's PA, (3) information that DOE generated during monitoring (e.g., technical report on a laboratory or field experiment), or (4) other information collected during monitoring. The identification, description, and status (i.e., open or closed) of each MF will evolve as monitoring continues. New MFs may be added to the monitoring plan as more information is known about future DOE disposal actions and experiments. The status of the monitoring programs at each of the three sites is summarized below.

Savannah River Site Saltstone Disposal Facility

The NRC has been performing monitoring activities at the SDF since 2006. While monitoring under the 2007 SDF monitoring plan (NRC, 2007b), the NRC staff identified three open issues (Open Issues 2007-1, 2007-2, and 2009-1) that had not been closed as of the issuance of the 2012 SDF TER (NRC, 2012a). As such, the NRC staff identified technical concerns in the 2012 SDF TER that included these open issues, which were then incorporated into the MFs identified for the SDF in the 2013 SDF monitoring plan (NRC, 2013b). In total, the 2013 SDF monitoring plan includes 11 MAs and 40 MFs to assess the site's compliance with the performance objectives in 10 CFR Part 61.

In CY 2012 and 2013, in accordance with the monitoring plans described above, the NRC staff completed three onsite observation visits (OOVs) at SDF (NRC, 2012b; NRC, 2013c; NRC 2013d). In August 2012, the NRC staff toured the SDF and lysimeter experiment apparatus. Technical discussions covered (1) salt waste processing, disposal structure construction, and quality assurance, (2) technetium-99 (Tc-99) inventory and new inventory quantification methods, and (3) PA maintenance and path forward for SDF monitoring. In December 2012, discussions included (1) followup on action items from the August 2012 OOV, (2) salt waste processing, and (3) research results from experiments conducted in accordance with the DOE PA maintenance program. In June 2013, discussions included (1) the recent saltstone production run into SDS 2B, (2) an update on the DOE Fiscal Year 2013 SDF Special Analysis document (DOE, 2013a), including a revised conceptual model, and (3) research results from experiments conducted in accordance with the DOE PA maintenance program.

No new open issues were determined for the SDF from these OOVs. Several followup action items were identified, all of which were completed.

The NRC staff performed two technical reviews related to the SDF in CY 2012 and 2013. The first major effort was a review of the revised PA for the SDF that DOE submitted to the NRC for review in 2009 (SRR, 2009). The NRC staff reviewed the revised SDF PA, held public meetings, sent DOE requests for additional information, and reviewed DOE's responses. The NRC staff's review of the revised SDF PA was performed in accordance with the NRC monitoring plan (NRC, 2007b), Section 3.1.9—Performance Assessment Process Review. On April 30, 2012, the NRC issued the "Technical Evaluation Report for the Revised Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site, South Carolina" (NRC, 2012a). On the same date that NRC issued the SDF TER, it also issued a Type IV Letter of Concern (NRC, 2012c), because the TER concluded that the NRC did not have reasonable assurance that salt waste disposal at the SDF could meet the performance objectives in 10 CFR Part 61; specifically, 10 CFR 61.41, "Protection of the General Population from Releases of Radioactivity." The Type IV Letter of Concern formally communicated the NRC staff's concerns to both DOE and the South Carolina Department of Health and Environmental Control (SCDHEC). Given this background, the August 2012 OOV (NRC, 2012b) focused on an important subset of the technical concerns articulated in its 2012 SDF TER (NRC, 2012a). Subsequently, the NRC issued a letter of acknowledgement, dated August 31, 2012 (NRC, 2012d), stating that a Type II Letter to the U.S. Congress (see Table 1-2 for types of notification letters) was not needed at that time. This conclusion was based on information DOE had provided about its newly revised Tc-99 inventory, which, if correct, suggested that Tc-99 is unlikely to cause an offsite peak dose exceeding the requirements of 10 CFR 61.41 [i.e., 0.25 millisieverts/year (mSv/yr) (25 millirem (mrem)/yr)].

The second technical review effort for SDF was completed in CY 2013. The NRC staff completed a Technical Review Report (TRR)[1] that documents its review of the Li and Kaplan (2013) report on the *Solubility of Technetium Dioxides in Reducing Cementitious Material Leachates* (NRC, 2013e).

Also in CY 2012, the SDF received a revised authorization, per the addition of a disposal structure design, and began saltstone disposal under the new authorization. Section 2.0 contains the MAs and MFs for SDF, summaries of the OOVs and TRRs completed in CY 2012 and 2013, and a list of followup actions for SDF (all completed).

Savannah River Site F-Area Tank Farm Facility

As mentioned above, the NRC staff completed the FTF monitoring plan in January 2013 (NRC, 2013a). In this monitoring plan, the NRC staff identified 8 MAs and 26 MFs to assess compliance with the performance objectives in 10 CFR Part 61. In CY 2012 and 2013, the NRC staff completed four OOVs at FTF (NRC, 2012e; NRC, 2012f; NRC, 2013f; NRC, 2013g). In June 2012, the NRC staff focused on observing the grouting of Tank 18, given technical concerns related to the potential for future cracking and/or shrinkage of emplaced grout material. In September 2012, the NRC staff followed up on action items related to Tank 18 and 19 grouting operations; DOE staff conducted presentations related to the completion of closure of Tanks 18 and 19 and to the sampling and analysis of Tanks 5 and 6; and the NRC staff took a tour of FTF and the facilities used for sample handling, processing, and analysis at

[1] Typically, the NRC staff documents its reviews of large, comprehensive documents, such as a facility PA, in a TER and its reviews of smaller, more specific issues in a TRR.

the Savannah River National Laboratory. In March 2013, discussions included the environmental monitoring program, radiation protection program, FTF Tanks 18 and 19 final closure documentation, PA maintenance plan, and FTF Tanks 5 and 6 final inventory reports. In August 2013, discussions included: (1) FTF Tank 5 and 6 closures and related concerns raised during the NRC staff's technical review of the Tanks 5 and 6 final inventory development (NRC, 2013h) and Special Analysis (NRC, 2013i), and (2) grout formula, development, and testing documentation for Tanks 5 and 6. No new open issues were determined for the FTF from these OOVs.

The NRC staff performed seven technical review efforts and issued seven TRRs related to FTF in CY 2012–2013:

1. Tanks 18 and 19 Cost Benefit Analysis TRR (NRC, 2013j) reviews DOE's updated cost-benefit analysis for removal of additional radionuclides from Tank 18 (SRR, 2012a).

2. Tanks 18 and 19 Special Analysis TRR (NRC, 2013k) reviews DOE's Tank 18 and 19 Special Analysis (SRR, 2012b).

3. Waste Release Documentation TRR (NRC, 2013l) reviews waste release and solubility documents prepared by DOE (see the TRR for a list of DOE documents).

4. Tanks 5 and 6 Inventory TRR (NRC, 2013h) reviews DOE's final inventory documentation for Tanks 5 and 6 and other documentation (see the TRR for a list of DOE documents).

5. Tanks 5 and 6 Special Analysis TRR (NRC, 2013i) reviews DOE's Tank 5 and 6 Special Analysis (SRR, 2013a).

6. Tanks 18 and 19 Grout Documentation TRR (NRC, 2013m) reviews DOE's Tanks 18 and 19 final configuration report and other grout documentation (see the TRR for a list of DOE documents).

7. Tank 5/6 Closure Module contains the NRC staff's comments to SCDHEC (NRC, 2013n).

In CY 2012 and 2013, DOE completed grouting of FTF Tanks 18 and 19 and Tanks 5 and 6, respectively. Section 3.0 contains the MAs and MFs for FTF, summaries of the OOVs and TRRs completed in CY 2012 and 2013, and a list of followup actions from the OOVs at FTF (all completed).

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

The INL INTEC TFF monitoring plan (NRC, 2007c), identifies five risk-significant monitoring areas or key monitoring areas (KMAs) from its INL TER (NRC, 2006) that are subdivided into 31 separate monitoring activities (see Appendix B). Monitoring activities can be either onsite observations of disposal activities or technical reviews of documents performed in the office.

There were no significant disposal actions or operations during CY 2012–2013 at INL INTEC TFF; however, the NRC staff completed one OOV at the site in June 2012 (NRC, 2012g).

During this OOV, the NRC staff participated in discussions with DOE and its contractor staff regarding the completed and planned INTEC TFF closure activities, obtained information regarding radiological controls during washing and grouting operations, and received a briefing about schedule delays for closure of the four large tanks remaining to be cleaned and grouted. The NRC staff also inquired about DOE's PA maintenance plan and annual checklist used to facilitate decisionmaking regarding the need for supplementary analyses or modifications to key closure documents. The NRC staff concluded that DOE's annual checklist is an adequate tool to ensure that new and significant information that may impact the conclusions in DOE's WD (DOE-Idaho, 2006) or supporting PA (DOE-Idaho, 2003) is evaluated to ensure that INTEC TFF disposal actions comply with the performance objectives in 10 CFR Part 61, Subpart C.

In early CY 2014, the NRC staff conducted technical reviews for KMA 3, "Hydrological Uncertainties," and KMA 4 related to the evaluation of 10 CFR 61.43, "Protection of Individuals During Operations." The reviews included data collected during CY 2012–2013 and were documented in two separate TRRs (NRC, 2014a; NRC, 2014c).

Key Monitoring Area 3

On May 19, 2014, the NRC staff issued a TRR entitled, "Technical Review of Hydrological Studies and Data for Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center, Tank Farm Facility" (NRC, 2014a). In this TRR, the NRC staff summarized its review of hydrological studies and environmental monitoring reports since it began monitoring the INTEC TFF in 2007. The NRC staff concluded that, while review of this additional information has increased the NRC staff's understanding of the hydrological system at the INTEC TFF, the information has not fundamentally changed the NRC staff's understanding of the technical uncertainties nor has it changed the NRC staff's TER conclusions (NRC, 2006). Therefore, the NRC staff decided to close KMA 3 in May 2014, which is notably the first time a KMA has been closed under the NDAA (NRC, 2014b).

Key Monitoring Area 4

On April 15, 2014, the NRC staff issued a TRR entitled, "Environmental Monitoring Programs at Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center" (NRC, 2014c). This TRR documents the NRC staff's review of the environmental monitoring program reports prepared by (1) Gonzales Stoller Surveillance, LLC, a contractor for DOE INL, and (2) the Idaho Department of Environmental Quality. This technical review considered environmental monitoring activities conducted at INTEC and INL, in general, from January 2011 through September 2013. The NRC staff concluded that it continues to have reasonable assurance that DOE can meet the 10 CFR 61.43 performance objective at INL INTEC TFF. The NRC staff also determined that it is no longer necessary to perform a separate annual review of the environmental monitoring programs and exposure assessment calculations associated with INL and will instead include environmental monitoring and exposure assessments as part of future OOVs.

Conclusion

In CY 2012 and 2013, the NRC staff's monitoring activities resulted in no findings of noncompliance and no identification of new open issues for all three sites: the SDF, FTF, and INL INTEC TFF. For the Saltstone facility, the three open issues that were previously identified

during CY 2007 and CY 2009 were administratively closed and folded into newly defined MFs (NRC, 2013b).

This periodic compliance monitoring report presents information about the NRC staff's observations, including several followup action items that were identified for the facilities during the OOVs and technical reviews. All followup actions identified for the SDF and the FTF during the OOVs in this reporting period were completed. Several followup actions that were identified for the FTF in the NRC staff's TRRs will continue to be discussed.

New monitoring plans were developed for both FTF and the SDF during this monitoring period (NRC, 2013a; NRC, 2013b). Monitoring for the INL INTEC TFF continues to be conducted pursuant to the 2007 monitoring plan (NRC, 2007c). However, because KMA 3 was closed in May 2014, only 4 KMAs and 28 monitoring activities remain for the INL INTEC TFF.

INL INTEC TFF: Based on its observations and technical review activities for CY 2012 and CY 2013, the NRC staff concludes that it continues to have reasonable assurance that the applicable criteria of the NDAA can be met for INL INTEC TFF, if key assumptions made in DOE's WD prove to be correct.

SDF: During the CY 2012–2013 reporting period, the NRC staff was encouraged by DOE's progress in research on technetium solubility in saltstone and saltstone core testing methodologies for the SDF. However, based on the results of the OOVs conducted during this reporting period, there was no change to the conclusions in the 2012 SDF TER (NRC, 2012a)—the NRC continues to conclude that it does not have reasonable assurance that salt waste disposal at the SDF meets the performance objectives in 10 CFR Part 61; specifically, 10 CFR 61.41. The NRC staff is encouraged by the progress made since publication of the 2012 SDF TER. DOE and the NRC continue to work via the monitoring process to resolve all outstanding issues that led to the issuance of the Type IV Letter of Concern.

FTF: During the CY 2012–2013 reporting period, the NRC staff was encouraged by DOE's progress in addressing technical issues raised in the 2011 FTF TER and 2013 FTF monitoring plan (NRC, 2011; NRC, 2013a). The NRC staff continues to conclude that additional information is needed to have reasonable assurance that disposal actions at the FTF meet the performance objectives in 10 CFR Part 61, Subpart C. DOE and the NRC continue to work via the monitoring process to resolve higher priority MFs identified in the monitoring plan, as well as more risk-significant followup actions identified in the NRC staff's TRRs.

In accordance with the requirements of the NDAA and consistent with the NRC monitoring plans, the NRC staff will continue to monitor DOE disposal actions at SDF, FTF, and INL INTEC TFF. The staff expects the monitoring activities to be an iterative process, and several OOVs and technical reviews of various reports, studies, and other documents may be necessary to obtain the information needed to ensure that the applicable criteria of the NDAA can be met.

A historical summary for each site is presented in Table ES-1.

Table ES-1 Summary of Monitoring at Sites Pursuant to Section 3116 of NDAA

Saltstone Disposal Facility (SDF):

- *Consultation*
  - DOE submitted 2005 draft WD and PA.
  - NRC reviewed 2005 DOE draft WD and PA.
  - NRC issued 2005 TER—DOE could meet performance objectives (POs).
  - DOE issued Final WD in January 2006.
- *Monitoring*
  - NRC issued 2007 SDF Monitoring Plan (MP), Rev. 0.
  - NRC performed technical reviews, issued TRRs, performed OOVs, and issued OOV Reports.
  - NRC reviewed 2009 DOE PA, which replaced 2005 PA.
  - NRC issued 2012 Type IV Letter and 2012 TER—lack of reasonable assurance that DOE will meet the PO in 10 CFR 61.41.
  - NRC issued 2013 SDF MP, Rev. 1—three Open Issues administratively closed and folded into newly defined MFs.
  - DOE reply to Type IV Letter included the Fiscal Year 2013 SDF Special Analysis, supplementing the 2009 PA.
  - NRC prepared Questions in Requests for Additional Information for the DOE Fiscal Year 2013 SDF Special Analysis.
  - DOE issued the 2014 Saltstone Special Analysis in December 2014 (DOE, 2014).
  - NRC plans to issue a revised TER after reviewing the 2014 DOE Saltstone Special Analysis.

F-Tank Farm (FTF):

- *Consultation*
  - From 2007 to 2008: DOE held nine scoping meetings to assist with development of FTF performance assessment.
  - DOE submitted 2010 draft WD and PA for entire FTF.
  - NRC reviewed 2010 DOE draft WD and PA.
  - NRC issued 2011 TER—did not have conclusions on POs but had recommendations about Tank 18.
  - DOE issued March 2012 Final WD, which attempted to address many of the more risk-significant NRC recommendations from TER.
- *Monitoring*
  - Early monitoring efforts focused on closure of Tanks 5, 6, 18, and 19.
  - NRC issued 2013 FTF MP, Rev. 0.
  - NRC performed technical reviews, issued TRRs, performed OOVs, and issued OOV Reports.

Table ES-1 (cont'd) Summary of Monitoring at Sites Pursuant to Section 3116 of NDAA

Idaho Nuclear Technology and Engineering Center Tank Farm Facility (INTEC TFF):

- *Consultation*
  - DOE submitted September 2005 draft WD and PA for the INTEC TFF.
  - NRC reviewed 2005 DOE draft WD and PA.
  - NRC issued October 2006 TER—conclusion that DOE could meet POs.
  - DOE issued November 2006 Final WD.
- *Monitoring*
  - NRC issued April 2007 INL MP, Rev. 0.
  - Early monitoring efforts focused on closure of 7 of 11 large 1,000 m^3 (300,000 gallon) tanks.
  - NRC performed technical reviews, issued TRRs, performed OOVs, and issued OOV Reports.
  - In May 2014, NRC closed KMA 3—the first time a key monitoring area (or factor) has been closed under the NDAA.

ACRONYMS AND ABBREVIATIONS

ADAMS	Agencywide Documents Access and Management System
ALARA	as low as is reasonably achievable
ASR	alkali–silica reaction
CFR	*Code of Federal Regulations*
CNWRA	Center for Nuclear Waste Regulatory Analyses
CY	calendar year
DOE	U.S. Department of Energy
E_h	measure of reduction (or oxidation) potential
EM	environmental monitoring
EPA	U.S. Environmental Protection Agency
FFA	Federal Facilities Agreement
FTF	F-Tank Farm at SRS
FY	fiscal year
GCL	geosynthetic clay liner
GIS	geographic information system
GSA	General Separations Area
HDPE	high-density polyethylene
HLW	high-level waste
HRR	highly radioactive radionuclide
HTF	H-Tank Farm at SRS
I-129	iodine-129
IDEQ	Idaho Department of Environmental Quality
INL	Idaho National Laboratory
INTEC	Idaho Nuclear Technology and Engineering Center
ICRP	International Commission on Radiological Protection
IWTU	Integrated Waste Treatment Unit at INL
K	potassium
K_d	distribution or partition coefficient
KMA	key monitoring area
MA	monitoring area
MCC	moisture characteristic curve
MF	monitoring factor

MP	monitoring plan (only in tables)
mrem	millirem
mrem/yr	millirem per year
mSv	millisievert
N/A	not applicable
NDAA	Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005
NRC	U.S. Nuclear Regulatory Commission
OOV	onsite observation visit
PA	performance assessment
PO	performance objective (only in tables)
Pu	plutonium
QA	quality assurance
SBW	sodium-bearing waste at INL
SCDHEC	South Carolina Department of Health and Environmental Control
SDF	Saltstone Disposal Facility
SDS	Saltstone Disposal Structure
SNF	Spent Nuclear Fuel
SPF	Saltstone Production Facility
SRNL	Savannah River National Laboratory
SRNS	Savannah River Nuclear Solutions, LLC
SRR	Savannah River Remediation
SRS	Savannah River Site
TER	technical evaluation report
TFF	Tank Farm Facility
Tc-99	technetium-99
TRR	technical review report
WD	waste determination

1.0 PURPOSE OF THIS REPORT

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

The purpose of this report is to aggregate all monitoring activities performed at each site specified by Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year [FY] 2005 (the NDAA). While not required by law, this report is intended to be consistent with the U.S. Nuclear Regulatory Commission (NRC) policy on openness. The NRC seeks to keep the public informed about its monitoring of the U.S. Department of Energy's (DOE's) radioactive waste disposal process at these sites. The NRC also seeks to keep the covered States informed by documenting monitoring activities in coordination with the covered States.

1.1 Background

In October 2004, the U.S. Congress passed legislation that allows the Secretary of Energy to determine, in consultation with the NRC, whether radioactive waste resulting from the reprocessing of spent nuclear fuel is not high-level radioactive waste (HLW). The legislation in Section 3116 of the NDAA requires that (1) DOE consult with the NRC on its non-HLW determinations and plans, and (2) 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, as part of DOE's consultation with the NRC, DOE will identify specific inventories of radioactive waste and associated facilities and equipment (e.g., tanks, piping, disposal cells) 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* (HRRs) 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 basis document for the waste at each site, describing its basis for a *waste determination* (WD) under Section 3116 of the NDAA. This basis document describes DOE's analysis to determine whether a particular type of waste meets the NDAA criteria. In addition to the basis document for the WD, DOE prepares a *performance assessment* (PA) to predict long-term disposal site performance (see Section 1.3). As described in NUREG-1854, "NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations," issued August 2007 (NRC, 2007a), the NRC staff (1) consults with DOE on the draft basis document for the WD, (2) reviews the assumptions and parameters included in DOE's PA and other documents, and (3) 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 WD.

After the Secretary's determination, and based on the conclusions in NRC's TER, the NRC staff will, in coordination with the covered State and as described in NUREG–1854 (NRC, 2007a), 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. Table 1-1 presents these performance objectives.

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

Section	Title	Text
§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 10 CFR 61.41 through 10 CFR 61.44.
§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 groundwater, surface water, air, soil, plants, or animals must not result in an annual dose exceeding an equivalent of 25 millirems to the whole body, 75 millirems to the thyroid, and 25 millirems to any other organ of any member of the public. Reasonable effort should be made to maintain releases of radioactivity in effluents to the general environment as low as is reasonably achievable.
§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.
§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 10 CFR Part 20 of this chapter, except for releases of radioactivity in effluents from the land disposal facility, which shall be governed by 10 CFR 61.41. Every reasonable effort shall be made to maintain radiation exposures as low as is reasonably achievable.
§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 determine 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 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.

[2] As stated in the staff requirements memorandum for SECY-05-0073, "Implementation of New U.S. NRC Responsibilities under the National Defense Authorization Act of 2005 in Reviewing Waste Determinations for the U.S. DOE," dated June 30, 2005 (NRC, 2005b), the dose standard is 25 millirem (mrem) total effective dose equivalent using the methodology of the International Commission on Radiological Protection (ICRP), Publication 26, "Recommendations of the International Commission on Radiological Protection" (ICRP, 1977).

Because NRC monitoring is risk informed and performance based, it focuses on assumptions, parameters, and features that are expected to have either a large influence on the performance demonstration or relatively large uncertainties, or both.

As of the end of Calendar Year (CY) 2013, DOE has completed three WDs in consultation with the NRC since the NDAA was enacted in 2004. In January 2006, DOE completed the WD for salt waste disposal at the Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) in South Carolina (DOE, 2006). DOE issued a second WD under Section 3116 on the Tank Farm Facility (TFF) at the Idaho Nuclear Technology and Engineering Center (INTEC) at the Idaho National Laboratory (INL) in November 2006 (DOE-Idaho, 2006). In March 2012, DOE issued a third WD for the F-Tank Farm (FTF) at SRS (DOE, 2012). The NRC staff reviewed the draft basis documents for these WDs, along with their associated *performance assessments* (PAs) and other reports. The NRC staff documented its reviews in TERs for the SDF, INL, and FTF sites (NRC, 2005a; NRC, 2006; NRC, 2011).

In 2009, DOE revised the SDF PA (SRR, 2009). The 2009 SDF PA replaced the 2005 PA that supported the January 2006 WD; however, the January 2006 WD, itself, was not revised and still remains valid. The NRC staff reviewed the 2009 SDF PA and documented its evaluation in a TER for the SDF in April 2012 (NRC, 2012a).

Based on the risk-significant modeling assumptions and disposal facility features identified in these TERs, the NRC completed its initial monitoring plans for the SDF, INL, and FTF sites (NRC, 2007b; NRC, 2007c; NRC, 2013a). The NRC staff issued a revision to the SDF monitoring plan in 2013, based on its evaluation in the 2012 TER (NRC, 2012a; NRC, 2013b) and the monitoring experience at SDF. In each monitoring plan, the NRC staff identifies a hierarchy of elements defining the overall scope of monitoring at each site.

Section 1.2 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 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.

1.2 The NRC's National Defense Authorization Act Monitoring Approach

Section 3116(b)(1) of the NDAA states 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.

As mentioned previously, the basis for the monitoring plan for each facility is the NRC staff's TER that documents its review of DOE's basis for the site's WD, PA, and other supporting documents. The NRC has adopted a risk-informed and performance-based approach to monitoring DOE disposal activities under Section 3116 of the NDAA. In the 2013 SDF and FTF monitoring plans (NRC, 2013b; NRC, 2013a), the NRC identified *monitoring areas* (MAs), or programmatic or technical subject matter areas important to DOE's compliance demonstration with the performance objectives in 10 CFR Part 61, Subpart C. The MAs are broad areas (e.g., MA 1: Inventory); therefore, the facility-specific monitoring plans subdivide these MAs

into one or more *monitoring factors* (MFs) at SRS sites (e.g., MF 1.01: Inventory in Disposal Structures). The performance objectives, MAs, and MFs form a hierarchy of plan elements that serve as the structure of the SRS monitoring program. Sections 2.0 and 3.0 contain the MAs and associated MFs identified for the two SRS sites (SDF and FTF), respectively.

Figure 1-1 illustrates the hierarchy of elements in the 2013 NRC monitoring plans (i.e., for SDF and FTF) by illustrating a hypothetical example of the relationship among 10 CFR Part 61 performance objectives, MAs, and MFs. Section 1.3 summarizes the staff's process for developing these elements. Figure 1-2 presents the flow of the monitoring and consultation process.

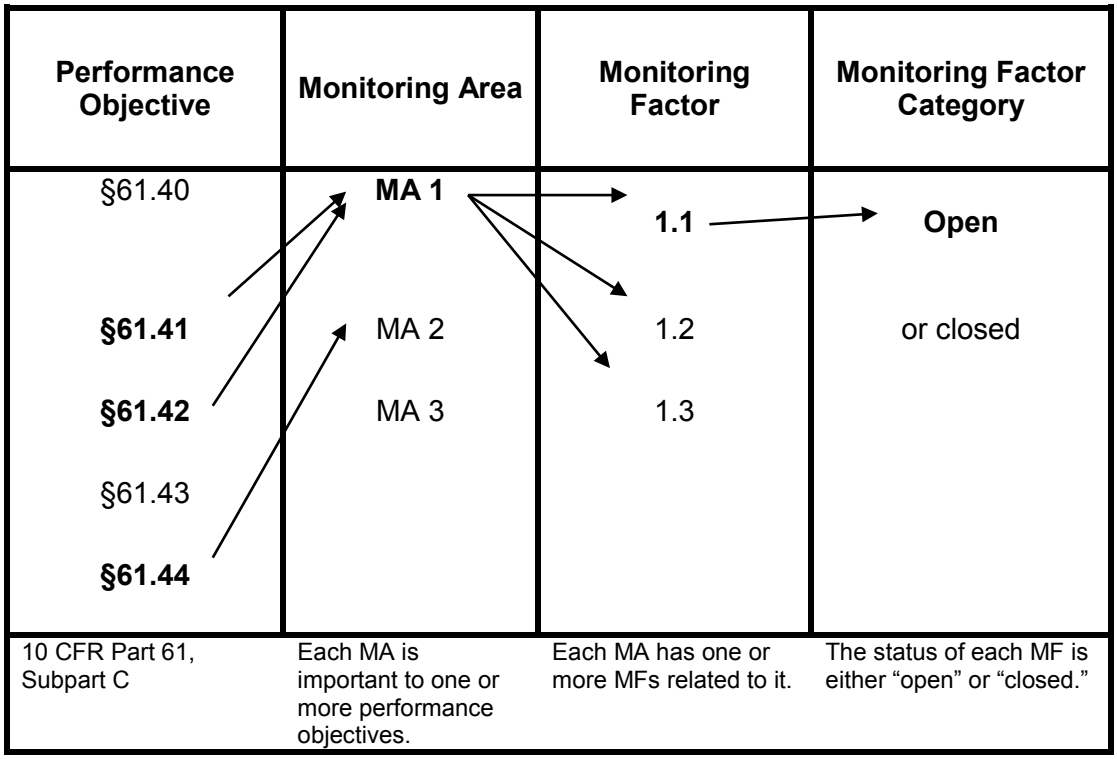

Figure 1-1 Hypothetical example of relationships between monitoring elements for the SDF and FTF sites

Because the INTEC TFF monitoring plan has not yet been revised, the previous monitoring program terminology that the NRC developed in the 2007 INL monitoring plan continues to be used in this report for the INTEC TFF. The *key monitoring areas* (KMAs) that are subdivided into *monitoring activities*, as originally developed in the 2007 monitoring plan (NRC, 2007c), are retained and listed in Appendix B.

1.3 Monitoring Areas and Monitoring Factors (SDF and FTF)

As the first step in the preparation of a monitoring plan for a specific site, the NRC staff identifies broad areas of review called MAs, and more importantly, specific MFs important to disposal facility performance. These MFs focus the NRC staff's efforts in areas that are important to DOE's ability to demonstrate compliance with the performance objectives of 10 CFR Part 61,

Subpart C (see Table 1-1). The NRC staff typically identifies the MFs during its review of DOE's basis for the WDs, PAs, and supporting documents and subsequently records them in the related TERs.
The NRC staff determines whether the requirements of 10 CFR 61.41, "Protection of the General Population from Releases of Radioactivity"; 10 CFR 61.42, "Protection of Individuals from Inadvertent Intrusion"; and 10 CFR 61.44, "Stability of the Disposal Site after Closure"; will be met on the basis of DOE predictions of long-term disposal site performance. As described further below, DOE uses a PA to predict disposal site performance, which most often involves calculations performed with the aid of computer-based models. Each site's PA makes certain assumptions about physical and chemical parameter values that DOE believes are appropriate for the disposal action. As such, the NRC staff identified MFs to monitor over time, to build confidence in DOE's selection of parameters and models.

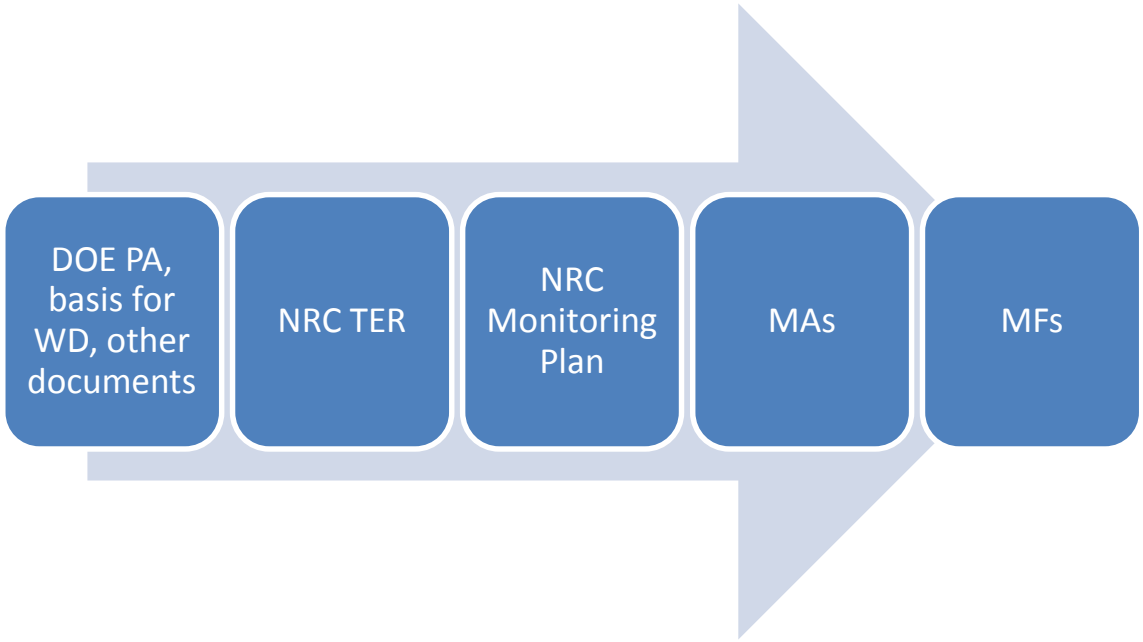

Figure 1-2 Diagram of NDAA consultation and SDF and FTF monitoring process

A PA is an important tool used by both DOE and the NRC to identify facility attributes that are important to demonstrating compliance with the performance objectives in 10 CFR Part 61, Subpart C. 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, recognizing that long-term modeling evaluations are needed to demonstrate compliance with performance objectives. A PA is a type of systematic risk analysis that addresses (i) what can happen, (ii) how likely it is to happen, (iii) what the resulting impacts are, and (iv) how these impacts compare to specifically defined standards.

Considering the long time period over which long-lived radionuclides pose a hazard to human health, a robust PA is needed to establish that the performance objectives will be met for releases from DOE facilities that may occur hundreds to thousands of years in the future. The NRC staff believes that sufficient PA model support, coupled with NRC observations of DOE disposal actions that are carried out in conformance with detailed closure plans are necessary for the NRC staff to assess whether these performance objectives can be met in the future. Therefore, the designation of MFs 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 basis documents (i.e., basis for WD and PA).

The NRC staff identified additional MFs related to 10 CFR 61.43, "Protection of Individuals during Operations," which are not typically derived from the NRC staff's review of a DOE PA. 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 for the disposal facility, which is used to demonstrate compliance with 10 CFR 61.41, 10 CFR 61.42, and 10 CFR 61.44.

As noted in Table 1-1, there are generally no specific MFs tied to 10 CFR 61.40, "General Requirements." 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.

1.4 Key Monitoring Areas and Monitoring Activities (INL)

Similar to MFs developed in the 2013 SDF and FTF monitoring plans, KMAs (and monitoring activities) were developed in the 2007 INTEC TFF monitoring plan (NRC, 2007c). The INL monitoring activities are listed as detailed technical reviews or onsite observation visits that support evaluation of the INL KMAs. Examples of NRC and covered State monitoring activities include: (1) reviewing the results of DOE measurements of residual radioactivity in tanks before tank closure, (2) observing periodic maintenance of disposal facility closure caps, (3) observing onsite radiation safety procedures during waste-handling operations, and (4) reviewing EM data. These examples demonstrate that some monitoring activities are near-term, short-duration activities that the NRC or covered States will close soon after the completion of the DOE disposal action, while others are long-term activities that NRC or covered State staff may conduct in perpetuity.

In a few instances for INL INTEC TFF, the NRC staff identified monitoring activities during preparation of the monitoring plan that the corresponding TER did not previously identify. As a result, these activities are not related to any particular KMA but are tied directly to a performance objective. Examples include reviewing any revisions and updates to DOE's PA and reviewing environmental and sampling data. See Appendix B for the complete list of KMAs and monitoring activities for INL INTEC TFF.

1.5 Technical Reviews and Onsite Observation Visits

Evaluations of MFs are supported by technical reviews and/or onsite observation visits (OOVs). Similarly, specific monitoring activities for INTEC TFF are designated as either technical review or OOV activities. Both activities are important tools for the NRC staff to use to conduct and document important monitoring reviews and evaluations.

- Technical reviews include the NRC staff's review and evaluation of DOE analyses or other information that addresses various aspects of site performance. These technical reviews are used to assess the model support for the assumptions and parameter

values DOE uses in its PA that are considered important to demonstrating compliance with the 10 CFR Part 61 performance objectives. Data reviews are a subset of technical reviews and focus on real-time monitoring data that may indicate future system performance (e.g., sampling and analysis of perched water underneath grouted vaults for changes in chemical conditions) or a review of records or reports that can be used to directly assess compliance with performance objectives (e.g., review of radiation records).

- The NRC coordinates OOVs with the affected covered State and the DOE site to ensure that the staff has an opportunity to observe specific DOE disposal actions. Typically, OOVs are first-hand observations by the NRC staff of a specific activity that could be used to assess an aspect of current or future site performance. An OOV is generally conducted (1) to observe data collection and ensure that data collected for a technical review are of sufficient quality and consistent with assumptions made in the basis for the WD, the PA, or related documents, or (2) to observe key disposal or closure actions that are important to DOE's compliance demonstration (e.g., operations, waste characterization).

  The NRC staff conducts OOVs in accordance with detailed plans for observation scope and related monitoring activities; observation guidance memoranda are prepared in advance of each visit to document these observation plans. Following the visit, the NRC staff issues an OOV report that includes a summary of specific activities observed during the visit, discussion summaries, the status of any resulting *followup action* items or *open issues*, and any NRC conclusions. The report is typically issued within 2 months of an OOV, unless DOE provides additional information following the OOV. In those cases, the NRC staff typically finishes the report within 60 days of completing its review of the additional information.

Followup action items may result during discussions held between the NRC and DOE, whether during an OOV, a teleconference, or a meeting. Generally, followup action items are specific, short-term actions to be performed by the NRC or DOE and are typically addressed either before the next OOV, teleconference, or meeting, although some followup actions may take more effort and time to address than others. As the NRC staff completes technical reviews and OOVs, it may identify particularly risk-significant open issues that require additional followup by the NRC staff or additional information from DOE to address questions the NRC staff has raised regarding DOE disposal actions. Typically, open issues are more risk significant and take longer to address than followup actions, although followup actions may become open issues if they increase in risk and are not adequately addressed in a reasonable timeframe.

The NRC staff tracks MFs based on their status as either open or closed. Monitoring activities (used in the INL program only) are tracked as either an *open activity*, an *open-noncompliant activity*, or a *closed activity*. The NRC staff may, upon evaluation of new information, reopen a closed activity or open a new MF/monitoring activity. Any DOE revisions to its PAs will also trigger an NRC staff review and possibly a revision to an NRC monitoring plan.

1.6 Notification Letters

At times during NRC's compliance monitoring, the staff may decide to prepare notification letters concerning a site's noncompliance or the potential for a site's noncompliance with the 10 CFR Part 61 performance objectives. There are five types of notification letters, as shown in

Table 1-2. Three of the letters are noncompliance letters (i.e., Type I, Type II, and Type III) that the NRC developed to implement the authority it has inferred from the statutory language in Section 3116 of the NDAA. The NRC may issue the other two letters (i.e., Type IV and Type V) as an interim step, based on the NRC guidance in NUREG–1854 (NRC, 2007a).

Ideally, the NRC would issue a Letter of Concern (i.e., Type IV) to allow DOE sufficient time to respond to the NRC staff's concerns before issuance of one of the three noncompliant notification letters. However, that may not be possible or appropriate in all situations. For example, if a worker were overexposed in an accident (i.e., received greater than 5 rem exposure) and a Type I Letter of Noncompliance were to be issued, the NRC may decide to immediately send that Type I notification letter to Congress, DOE, and the covered State, rather than first sending a Type IV Letter of Concern to DOE and the covered State. The NRC would use other means of notification (e.g., telephone conferences or meetings) with both DOE and the covered State before sending the Type I letter. Table 1-2 describes each type of notification letter, the NRC basis for issuing the letter, the NRC signing authority, and the addressees.

1.7 Coordination with Covered States

The NRC staff consulted with (1) the State of South Carolina during the preparation of the monitoring plans for the SDF and FTF at the SRS and (2) with the State of Idaho during the preparation of the monitoring plan for the INL INTEC TFF. For the SDF and FTF, the staff had early interactions with the South Carolina Department of Health and Environmental Control (SCDHEC) during its review of DOE's basis for the WD and later sought comments on the draft monitoring plans. Because of the combined roles of SCDHEC and the NRC under NDAA Section 3116(b), the NRC staff operates so as to leverage South Carolina's activities pertaining to these permits and to avoid duplication of effort. In CY 2012 and 2013, the NRC staff coordinated each OOV at SRS (i.e., for both the SDF and FTF) with the State of South Carolina. SCDHEC representatives accompanied the NRC staff at the OOVs when possible. Following the OOVs, the NRC staff communicated the results of the OOVs to SCDHEC.

Similarly, for the INL INTEC TFF, the NRC staff engaged the Idaho Department of Environmental Quality (IDEQ) early in the consultation process during its review of DOE's basis for the WD for the site. 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 regulatory activities associated with historical releases from the ancillary equipment associated with the TFF that resulted in soil and groundwater contamination. In its monitoring plan and in practice, the NRC considered these and other nonregulatory environmental surveillance activities and has leveraged IDEQ's activities to avoid duplication of effort. For example, the NRC staff routinely relies on EM program reports published by IDEQ for independent surveillance (see Section 4.4.2). In CY 2012, the NRC staff coordinated its one OOV at INL INTEC TFF with the State of Idaho, as is standard practice for all OOVs at the site.

Table 1-2 Types of Notification Letters

Type	Notification	Signature	Distribution
Noncompliant Performance Objective (PO) Notification Letters			
I	Evidence PO Is Not Met: NRC staff concludes that direct evidence (e.g., environmental sampling data) exists that indicates DOE disposal actions do not meet one or more POs in 10 CFR Part 61, Subpart C. Notification: NRC will issue a Type I letter of noncompliance, if DOE cannot demonstrate that executed disposal actions currently meet the requirements specified in the POs.	NRC Chairman	DOE, covered State, Congress
II	Lack of Compliance Demonstration: NRC staff concludes that indirect evidence (e.g., data regarding key modeling assumptions) exists that indicates DOE disposal actions do not meet one or more POs in 10 CFR Part 61, Subpart C. Notification: NRC will issue a Type II letter of noncompliance, if DOE cannot adequately address NRC technical concerns.	NRC Chairman	DOE, covered State, Congress
III	Insufficient Information: NRC staff concludes that insufficient information is available to assess whether DOE disposal actions meet POs in 10 CFR Part 61, Subpart C. It is not clear to NRC staff that either DOE: (i) has plans to, or (ii) is able to provide the information in a reasonable timeframe to allow NRC staff to assess compliance. Notification: NRC will issue a Type III letter of noncompliance, if DOE cannot adequately address NRC technical concerns.	NRC Chairman	DOE, covered State, Congress
"Other" Notification Letters			
IV	Concern: NRC staff concludes that there are concerns with DOE's demonstration of meeting the POs in 10 CFR Part 61, Subpart C. Notification: NRC will issue a Type IV letter of concern if DOE cannot adequately address NRC concerns.	NRC staff or Management	DOE and Covered State

Table 1-2 (cont'd) Types of Notification Letters

Type	Notification	Signature	Distribution
V	Resolution: NRC staff concludes that DOE has provided sufficient information to resolve the concerns in the Type IV letter of concern regarding DOE's demonstration of meeting the POs in 10 CFR Part 61, Subpart C. Notification: NRC will issue a Type V letter of resolution, if DOE adequately addresses the NRC concerns in a Type IV letter of concern.	NRC staff or Management	DOE and Covered State

1.8 Document Organization

This periodic compliance monitoring report covers three sites: the SDF at SRS, the FTF at SRS, and the INL INTEC TFF. Sections 2.0, 3.0, and 4.0 summarize the compliance monitoring at each of these sites for CY 2012 and 2013, respectively. Section 5.0 provides the references cited in this document, including Agencywide Documents Access and Management System (ADAMS) numbers where available. Section 6.0 contains a glossary of technical terms included in this document. Appendix A provides the text of Section 3116(a) of the NDAA for FY 2005. In Appendix B, Section 1 summarizes the KMAs, monitoring activities, and categorization of monitoring activities for the INL INTEC TFF, while Sections 2.0 and 3.0 present the MAs and MFs for the SDF and FTF, respectively. Appendix C contains timelines for the various monitoring activities conducted from 2007 to 2013 at each site.

2.0 MONITORING AT THE SAVANNAH RIVER SITE SALTSTONE FACILITY IN CALENDAR YEARS 2012 AND 2013

2.1 Introduction

The SRS is a 780-square-kilometer (km) (310-square-mile (mi)) facility located in south-central South Carolina, which began operation in 1951 to produce nuclear materials for national defense, research, medical, and space programs. Waste produced at the site from spent nuclear fuel (SNF) reprocessing for defense purposes has been commingled with nonreprocessing waste resulting from the production of targets for nuclear weapons and material for space missions. Significant quantities of radioactive waste are currently stored on site in large underground waste storage tanks, which were placed into service between 1954 and 1986. The tank waste is a mixture of insoluble metal hydroxide solids, referred to as sludge, and soluble salt supernate. The supernate volume has been reduced by evaporation, which also concentrates the soluble salts to their solubility limits. The resultant solution crystallizes as salts, and the resulting solid is referred to as saltcake. The saltcake and supernate combined are referred to as salt waste. DOE removes the salt waste, treats it to remove HRRs to the maximum extent practical, and disposes of the low-activity fraction on site in the SDF. The SDF is located in the Z-Area of the General Separations Area at SRS, which is approximately 10 km (6.2 mi) from the nearest SRS site boundary on a well-drained local topographic high.

As noted in Section 10.1, "Overall Approach and Scope," of the NRC staff guidance document, NUREG-1854 (NRC, 2007a), the NRC staff's approach to assessing compliance with the 10 CFR Part 61 performance objectives consists of two primary activities: (1) conducting technical reviews of DOE data and analyses and (2) physically observing DOE's disposal actions through OOVs. Since monitoring activities began at the SDF in 2007, the NRC has completed 14 OOVs, 13 formal technical reviews, and various data reviews. Each monitoring activity is associated with a public document describing the details of the activity. Each OOV is preceded by an onsite observation guidance document, which includes the objectives of the OOV and the relationship between each observation objective and its respective 10 CFR Part 61 performance objective. Following the OOV, the NRC staff report documents the activities that took place during the observation, assesses how the NRC staff's monitoring activities relate to their respective 10 CFR Part 61 performance objective, and describes the conclusions that the NRC staff drew from the OOV activities.

2.2 Background

On March 31, 2005, DOE submitted to the NRC the document, "Draft Basis for Section 3116 Determination Salt Waste Disposal at the Savannah River Site" (DOE, 2005), to demonstrate compliance with the Section 3116 criteria, including demonstration of compliance with the 10 CFR Part 61 performance objectives. In its consultation role, the NRC staff reviewed the draft basis for the WD, the PA, and related documents. The main NRC findings for long-term performance of the SDF were that to contain the major risk driver, technetium-99 (Tc-99), over the long term, (1) the as-placed wasteform would need to chemically reduce Tc-99 sufficiently to make it immobile, and (2) the wasteform and other engineered features would need to limit water flow into the wasteform. The NRC staff concluded, in the 2005 SDF TER (NRC, 2005a), that there was reasonable assurance that the applicable criteria of Section 3116 could be met, provided certain assumptions made in DOE's analyses were verified through monitoring. DOE

issued a final WD (DOE, 2006) in January 2006, taking into consideration the assumptions, conclusions, and recommendations documented in the NRC's SDF TER.

On May 3, 2007, the NRC completed its monitoring plan for DOE disposal actions at the SRS Saltstone facility, in accordance with the guidance in NUREG-1854 (NRC, 2007a). The 2007 monitoring plan identified eight "factors" that are important DOE model assumptions or parameter values used to demonstrate compliance with NDAA criteria. These factors are presented in Section 2.4.1. For each factor, the NRC staff identified one or more planned monitoring activities (i.e., specific tasks or actions). In the 2007 monitoring plan, 39 distinct monitoring activities were developed for the SDF to assess compliance with the performance objectives in 10 CFR Part 61. NRC monitoring of the SDF followed the 2007 SDF monitoring plan (NRC, 2007b) during a majority of the CY 2012 and CY 2013 compliance period documented in this report.

After issuing the WD in January 2006, DOE gathered additional information regarding its assumptions for long-term performance while producing saltstone operationally. Following short-term performance issues with the existing vault design, DOE redesigned the disposal structures. DOE developed revised analyses for the existing vaults and the newly designed disposal structures to address the results of new experiments and the new disposal structure designs, as well as performance issues (such as cracking in the walls of Vault 4). In October 2009, DOE submitted to the NRC an updated "2009 Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site" (SRR, 2009). DOE's updated PA included new information about model assumptions and parameters, and its purpose was to demonstrate that its updated waste disposal strategy remained in compliance with the 10 CFR Part 61 performance objectives.

In accordance with its monitoring role, the NRC began its review of the updated SDF PA and associated documentation. The NRC staff completed its review and issued the "Technical Evaluation Report for the Revised Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site, South Carolina" (NRC, 2012a) on April 30, 2012, along with a Type IV Letter of Concern (NRC, 2012c; see Table 1-2). This 2012 SDF TER (see Section 2.4.3.1) concluded that the NRC did not have reasonable assurance that salt waste disposal at the SDF could meet the 10 CFR Part 61 performance objectives, specifically 10 CFR 61.41. The Type IV Letter of Concern formally communicated NRC's concern to both DOE and SCDHEC. In response to the Type IV letter, DOE provided additional information to the NRC about its newly revised Tc-99 inventory, which, if correct, suggested that Tc-99 is unlikely to cause an offsite peak dose exceeding the requirements of 10 CFR 61.41 [i.e., 0.25 mSv/yr (25 mrem/yr)]. Upon review of this additional information, the NRC issued a letter of acknowledgement, dated August 31, 2012, stating that a Type II Letter to the U.S. Congress was not needed at that time, based on this additional information (NRC, 2012d).

Following issuance of the 2012 SDF TER (NRC, 2012a), the NRC staff issued a new SDF monitoring plan in September 2013 (NRC, 2013b). This new monitoring plan is discussed in detail in Section 2.4.1. All future OOVs at the SDF will be conducted in accordance with the 2013 SDF monitoring plan.

2.3 Disposal Actions in CY 2012 and 2013

DOE received a revised authorization, per the addition of the new disposal structure design presented in the 2009 PA update (SRR, 2009), and began disposal under the new authorization during September and October 2012. Approximately 4.2 million liters (L) (1.1 million gallons (gal)) of salt waste was discharged from Tank 50 into Saltstone Disposal Structure 2B. This is the first saltstone disposal using the new disposal design.

2.4 NRC Monitoring Activities in CY 2012 and 2013

To fulfill its monitoring responsibility under NDAA Section 3116, the NRC performs three types of monitoring activities: (1) technical reviews, (2) data reviews, and (3) OOVs, in coordination with the State of South Carolina site regulator, SCDHEC. During CY 2012 and 2013, these activities focused on key assumptions identified in the original 2007 NRC monitoring plan for salt waste disposal at SRS (NRC, 2007b). Appendix C provides a visual depiction of the timeline of NRC monitoring of the Saltstone facility under NDAA from CY 2007 through CY 2013. During CY 2012 and CY 2013, the NRC staff issued the 2013 SDF monitoring plan and completed three OOVs and two technical reviews, as discussed in the following sections.

2.4.1 Summary of 2013 SDF Monitoring Plan

On August 30, 2013, the NRC issued the revised SDF monitoring plan, "U.S. Nuclear Regulatory Commission Plan for Monitoring Disposal Actions Taken by the U.S. Department of Energy at the Savannah River Site Saltstone Disposal Facility in Accordance With the National Defense Authorization Act for Fiscal Year 2005, Rev. 1" (NRC, 2013b). Until this date, the NRC had monitored the Saltstone facility in accordance with the 2007 SDF monitoring plan (NRC, 2007b). The revised monitoring plan details NRC's path forward in assessing DOE compliance with the performance objectives at the SDF.

In the 2013 SDF monitoring plan, the NRC staff developed a new list of 11 MAs that address the complete scope of SDF monitoring (NRC, 2013b). These 11 MAs are presented in Table 2-1.

Table 2-1 SDF Monitoring Areas in the 2013 Monitoring Plan

MA#	Description of Monitoring Area	Performance Objective			
		§61.41	§61.42	§61.43	§61.44
1	Inventory	X	X		
2	Infiltration and Erosion Control	X	X		
3	Waste Form Hydraulic Performance	X	X		
4	Waste Form Physical Degradation	X	X		
5	Waste Form Chemical Degradation	X	X		
6	Disposal Structure Performance	X	X		
7	Subsurface Transport	X	X		
8	Environmental Monitoring	X	X		
9	Site Stability	X	X		X
10	Performance Assessment Model Revisions	X	X		
11	Radiation Protection Program			X	

The NRC staff will use the 2013 SDF monitoring plan to continue to assess DOE compliance with the 10 CFR Part 61 performance objectives in fulfillment of the NRC monitoring responsibilities under the NDAA. MAs are either key uncertain or significant model assumptions or parameter values in DOE's PA. For each MA, the NRC identified one or more MFs, as shown in Table 2-2.

Table 2-2 SDF Monitoring Factors in the 2013 Monitoring Plan

Monitoring Factors
MF 1.01—Inventory in Disposal Structures MF 1.02—Methods Used to Assess Inventory
MF 2.01—Hydraulic Performance of Closure Cap MF 2.02—Erosion Protection
MF 3.01—Hydraulic Conductivity of Field-Emplaced Saltstone MF 3.02—Variability of Field-Emplaced Saltstone MF 3.03—Applicability of Laboratory Data to Field-Emplaced Saltstone MF 3.04—Effect of Curing Temperature on Saltstone Hydraulic Properties
MF 4.01—Waste Form Matrix Degradation MF 4.02—Waste Form Macroscopic Fracturing
MF 5.01—Radionuclide Release from Field-Emplaced Saltstone MF 5.02—Chemical Reduction of Tc by Saltstone MF 5.03—Reducing Capacity of Saltstone MF 5.04—Certain Risk-Significant K_d Values for Saltstone MF 5.05—Potential for Short-Term Rinse-Release from Saltstone
MF 6.01—Certain Risk-Significant K_d Values in Disposal Structure Concrete MF 6.02—Tc Sorption in Disposal Structure Concrete MF 6.03—Performance of Disposal Structure Roofs and HDPE/GCL Layers MF 6.04—Disposal Structure Concrete Fracturing MF 6.05—Integrity of Non-cementitious Materials
MF 7.01—Certain Risk-Significant K_d Values in Site Sand and Clay
MF 8.01—Leak Detection MF 8.02—Groundwater Monitoring
MF 9.01—Settlement Due to Increased Overburden MF 9.02—Settlement Due to Dissolution of Calcareous Sediment
MF 10.01—Implementation of Conceptual Models MF 10.02—Defensibility of Conceptual Models MF 10.03—Diffusivity in Degraded Saltstone MF 10.04—K_d Values for Saltstone MF 10.05—Moisture Characteristic Curves MF 10.06—K_d Values for Disposal Structure Concrete MF 10.07—Calculation of Build-Up in Biosphere Soil MF 10.08—Consumption Factors and Uncertainty Distributions for Transfer Factors MF 10.09—K_d Values for SRS Soil MF 10.10—Far-Field Model Calibration MF 10.11—Far-Field Model Source Loading Approach MF 10.12—Far-Field Model Dispersion MF 10.13—Impact of Calcareous Zones on Contaminant Flow and Transport
MF 11.01—Dose to Individuals During Operations MF 11.02—Air Monitoring

Each MF is a specific item that the NRC staff will monitor and will track as "Open" or "Closed." If NRC staff concerns arise related to an MF, then the staff may develop an "Open Issue" to document these concerns. Thus, the NRC will have a mechanism to communicate to DOE early about the need for corrective action, before issuance of a Notification Letter.

The 2013 SDF monitoring plan is organized by performance objective, with a chapter devoted to each one. Each chapter provides the MAs and the associated MF(s) for each performance objective. Each MA supports one or more performance objectives. For each MF, the 2013 SDF monitoring plan provides the NRC staff's current expectations of how and when the MF will be closed.

The original eight MFs in the 2007 monitoring plan were updated and combined with the three open issues that the NRC staff had identified in 2007 and 2009 and mapped to the new MAs and MFs in the 2013 SDF monitoring plan. The three open issues were administratively closed. Based on its monitoring experience since the release of the 2007 SDF monitoring plan (NRC, 2007b), the NRC staff determined that making individual MFs more specific (i.e., smaller in scope), although leading to a slightly larger number of MFs, would facilitate monitoring. In the 2013 SDF monitoring plan (NRC, 2013b), MAs and MFs were clearly defined and made consistent with technical concerns described by the NRC in the 2012 SDF TER (NRC, 2012a). Table 2-3 shows a correlation of the factors in the 2007 SDF monitoring plan and the previously identified open issues to the MAs and MFs in the 2013 SDF monitoring plan.

2.4.2 Onsite Observations

The NRC conducted two OOVs at the SDF during CY 2011 (NRC, 2012i), and many of the topics covered during those OOVs were also discussed in CY 2012 and CY 2013. The NRC staff conducted three OOVs in August 2012, December 2012, and June 2013, as discussed below.

As discussed in Section 2.2, the NRC issued the 2012 SDF TER and a Type IV Letter of Concern (NRC, 2012a; NRC, 2012c) to DOE and SCDHEC on April 30, 2012. On June 13, 2012, DOE provided the NRC with the research results of Tc-99 inventory projections for SRS Saltstone Disposal Structure (SDS) 2A, 2B, 3A, 3B, 5A, and 5B, which DOE had been developing since August 2011. Subsequently, on July 12 and 26, 2012, DOE provided the NRC with two separate responses to the Type IV Letter of Concern. The July 12 response included information about updated Tc-99 inventory projections and about DOE Case K and K1 uncertainty and sensitivity analyses. The information DOE provided in the June 13, 2012, and July 12, 2012, submittals was discussed during the August 2012 OOV (NRC, 2012b).

Shortly before the December 2012 OOV, DOE requested that a public meeting be held during January 2013, so that it could present its revised model with updated parameterization and hold further discussions about the progress in research related to NRC concerns identified in the 2012 SDF TER. Some of the technical documents discussed during the December 2012 OOV were discussed further during this January 17, 2013, public meeting. A public meeting summary (NRC, 2013o) provides discussion details.

Table 2-3 Correlation of 2007 Factors/Open Issues to MAs/MFs in the 2013 SDF MP

2007 Monitoring Plan Factors and Subsequent Open Issues	2013 Revised SDF Monitoring Plan
Factor 1: Oxidation of Saltstone	MF 5.01: Radionuclide release from field-emplaced saltstone MF 5.02: Chemical reduction of Tc by saltstone MF 5.03: Reducing capacity of saltstone
Factor 2: Hydraulic Isolation of Saltstone	MA 3: Waste Form Hydraulic Performance MA 4: Waste Form Physical Degradation MA 6: Disposal Structure Performance
Factor 3: Model Support	MF 2.01: Hydraulic performance of the closure cap MF 4.02: Waste form macroscopic fracturing MF 5.01: Radionuclide release from field-emplaced saltstone MF 5.02: Chemical reduction of Tc by saltstone MF 5.03: Reducing capacity of saltstone MF 6.04: Disposal Structure concrete fracturing MF 10.05: Moisture Characteristic Curves (MCCs)
Factor 4: Erosion Control Design	MF 2.02: Erosion protection
Factor 5: Infiltration Control Design and Performance	MF 2.01: Hydraulic performance of the closure cap
Factor 6: Feed Tank Sampling	MF 1.02: Methods used to assess inventory
Factor 7: Tank 48 Wasteform	N/A, DOE no longer plans to send untreated Tank 48 waste to the SDF
Factor 8: Removal Efficiencies	MF 1.01: Inventory in Disposal Structure at SDF
Open Issue 2007-1: As-emplaced Saltstone Properties	MF 3.01: Hydraulic conductivity of field-emplaced saltstone MF 3.02: Variability of field-emplaced saltstone MF 3.03: Applicability of laboratory data to field-emplaced saltstone MF 3.04: Effect of curing temperature on saltstone hydraulic properties MF 5.01: Radionuclide release from field-emplaced saltstone
Open Issue 2007-2: Intra-Batch Variability of Saltstone Properties	MF 3.02: Variability of field-emplaced saltstone MF 5.01: Radionuclide release from field-emplaced saltstone
Open Issue 2009-1: Reduction and Retention of Tc-99 in Saltstone	MF 5.01: Radionuclide release from field-emplaced saltstone MF 5.02: Chemical reduction of Tc by saltstone MF 5.03: Reducing capacity of saltstone

2.4.2.1 August 2012 Onsite Observation Visit

The NRC staff's August 7–8, 2012, OOV (Saltstone Observation 2012-01; NRC, 2012b) focused on a subset of the technical concerns articulated in its 2012 SDF TER (NRC, 2012a) and associated Type IV Letter of Concern (NRC, 2012c), as well as on assessing compliance with the performance objectives in 10 CFR Part 61. To accomplish these goals, the NRC staff and DOE (including DOE contractors) participated in tours and technical discussions during the OOV. The NRC staff toured the SDF and lysimeter experiment apparatus. Technical discussions covered (1) salt waste processing, disposal structure construction, and quality

assurance (QA), (2) Tc-99 inventory and new inventory quantification methods, and (3) PA maintenance and path forward for SDF monitoring.

Saltstone Observation 2012-01 began with a short briefing on the observation agenda and review of standard site safety procedures, presented by DOE contractor Savannah River Remediation (SRR) and attended by representatives from DOE, the NRC, Savannah River National Laboratory (SRNL), and SCDHEC. After the briefing, the NRC staff toured the SDF with DOE, who provided a facility overview and closer views of Vault 4 and SDS 2A, 2B, 3A, 3B, 5A, and 5B. Also, the NRC staff toured the new lysimeter radionuclide leaching and sorption experiment apparatus with DOE. The following report sections contain summaries of those discussions and tours.

2.4.2.1.1 Tour of the SDF

The NRC staff monitored construction of new disposal structures to ensure the integrity of the structures and to identify potential mechanisms of contaminant release from the facility. Section 3.1.3, "Hydraulic Isolation of Saltstone," of the 2007 SDF monitoring plan (NRC, 2007b) provides details of the basis for the NRC staff review areas.

Results

After viewing the SDF, the NRC staff visited Vault 4, observed patched cracks on Vault 4 Cell A, and discussed whether DOE had observed any infiltration in the Vault 4 drain system. Next, the NRC staff visited SDS 2A and SDS 2B, around which soil had been backfilled; however, the tanks were not filled, and the tops of the disposal structures were easily accessible for observation. The NRC staff discussed with DOE (1) the plan for sealing penetrations in the disposal structure roofs before site closure and (2) the plan for maintaining the neoprene seals used to ensure that any roof penetrations do not allow infiltration into the tanks. DOE informed the NRC staff that seals would be chosen with service lives exceeding the time elapsed between tank closure and SDF closure to minimize the potential need for replacement. The NRC staff observed small pools of water collected on the roofs of SDS 2A and SDS 2B, apparently attributable to recent rainfall. Finally, the NRC staff visited the SDS 3A/SDS 3B and SDS 5A/SDS 5B construction sites. The NRC staff observed the external high-density polyethylene (HDPE) liner in different stages of installation on each of the disposal structures. In response to NRC questions about leak-checking the HDPE liner, DOE explained that each joint was welded along two vertical lines with the resulting vertical pocket between the welds tested through pressurization.

Conclusions and Followup Actions

The NRC staff will continue to monitor construction of the new disposal structures as well as their potential future operation. The staff identified several followup actions related to this topic (2012-01-1, 2012-01-9, and 2012-01-10), as presented in Table 2-4.

Table 2-4 Status of Followup Actions from CY 2012 and 2013 OOVs at SDF

ID	From	Followup Action	Status
2012-01-1	8/12 OOV	DOE will provide hydration temperature profiles for field-emplaced saltstone.	Completed
2012-01-2	8/12 OOV	DOE will provide analytical documents to NRC (see NRC, 2012b).	Completed
2012-01-3	8/12 OOV	DOE will clarify the interpretation of lysimeter concentration data as they relate to evaporation from collection vessels.	Completed
2012-01-4	8/12 OOV	DOE will clarify the interpretation of data related to water that flows around the lysimeter cementitious samples.	Completed
2012-01-5	8/12 OOV	NRC will provide a draft priority list of monitoring factors to DOE.	Completed
2012-01-6	8/12 OOV	DOE will provide a document list of certain original and updated documents that are relevant to the NRC in performing its NDAA monitoring responsibilities.	Completed
2012-01-7	8/12 OOV	DOE will provide SRR documents to NRC for review (see NRC, 2012b).	Completed
2012-01-8	Other	DOE will provide SDS 3A leachate collection construction details.	Completed
2012-01-9	8/12 OOV	DOE will provide documentation of lateral distances between groundwater monitoring wells and SDS 2A and SDS 2B.	Completed
2012-01-10	8/12 OOV	DOE will define which aquifers the wells near SDS 2A and SDS 2B are screened in.	Completed
2012-01-11	8/12 OOV	DOE to provide information related to Tc-99 concentrations beyond Batch 7 and anticipated through 2015. During Saltstone Observation 2012-02, this action was rewritten as two new followup actions (2012-02-4 and 2012-02-5).	Completed
2012-02-1	12/12 OOV	DOE to provide an estimate of the volume of water from environmental sources, if any, intruding into SDS 4.	Completed
2012-02-2	12/12 OOV	DOE to describe the expected surveillance and maintenance program for disposal structure penetrations after operations and prior to final site closure.	Completed
2012-02-3	12/12 OOV	DOE to describe the plans to maintain or close the drain water removal system after operations and prior to final closure (e.g., maintenance of instrumentation for liquid detection).	Completed
2012-02-4	12/12 OOV	As needed, NRC and DOE to discuss the Salt Macro-batch 6 qualification sample report and any additional sampling reports related to Salt Batch 7 at January public meeting.	Completed

Table 2-4 (cont'd) Status of Followup Actions from CY 2012 and 2013 OOVs at SDF

ID	From	Followup Action	Status
2012-02-5	12/12 OOV	NRC and DOE to add Salt Batch qualification sample reports to the routine document list in the revised NRC monitoring plan.	Completed
2012-02-6	12/12 OOV	DOE to provide additional thermocouple data for SDSs 2B and 4, including an elevation measurement and a plan view of the location of the thermocouples corresponding to each data series.	Completed
2012-02-7	12/12 OOV	DOE to provide revision 1 of SRNL-STI-2010-00668 when it becomes available. *NRC Note: That referenced document was replaced by SRNL-STI-2011-00716, Rev. 1, "Technetium Sorption by Cementitious Materials Under Reducing Conditions."*	Completed
2012-02-8	12/12 OOV	DOE to provide the FY 2013 Special Analysis modeling inputs change matrix to NRC.	Completed
2013-01-1	6/13 OOV	DOE to provide to NRC information on all current admixtures in use.	Completed
2013-01-2	6/13 OOV	DOE to evaluate information available regarding blast furnace slag properties and provide to NRC: • crystalline vs. glass • proportion of slag oxide types • age of slag from time of grinding • temperature during storage	Completed
2013-01-3	6/13 OOV	DOE to evaluate previously provided information regarding QA for dry feeds. Provide updated information, if any, to NRC.	Completed

2.4.2.1.2 Tour of Lysimeter Experiment Apparatus

DOE expects that the lysimeter experiment will evaluate radionuclide sorption in SRS soils and radionuclide leaching from simulated saltstone samples. The NRC staff monitors radionuclide sorption in saltstone, because it is a key chemical barrier to radionuclide release from the SDF. Section 3.1.2, "Oxidation of Saltstone," and Section 3.2.4, "Grout Formulation and Placement," of the 2007 SDF monitoring plan (NRC, 2007b) provide details of the basis for the NRC staff review areas.

Results

The NRC staff toured DOE's lysimeter experiment apparatus, which is being used to test radionuclide sorption in SRS soils and radionuclide leaching for simulated saltstone samples. DOE provided an overview of the experiment, including plans for data collection and a brief description of the construction of the apparatus. The radionuclide concentrations and chemical parameters (e.g., nitrate concentration, pH) will be measured quarterly in water collected from the lysimeters. The lysimeters will be sacrificed periodically (e.g., 2, 6, 10 years after initiation) so that DOE can measure the radionuclide movement that had occurred in the soil inside the lysimeters. DOE will evaluate the radionuclide mass that could be accounted for in the aqueous and solid samples (i.e., DOE will attempt to close the radionuclide mass balance).

Conclusions and Followup Actions
The NRC staff found the lysimeter experiment to have the potential to supply useful information about radionuclide release from saltstone and migration in SRS soils, if appropriate data are collected. The NRC staff informed DOE that the plan to evaluate evidence of rinse-release in the early data from the simulated saltstone samples could provide useful information about the DOE conceptual model used in the PA. Two followup actions were identified related to this topic (2012-01-3 and 2012-01-4), as presented in Table 2-4.

2.4.2.1.3 Technical Discussion—Salt Waste Processing, Disposal Structure Construction, and Quality Assurance

The NRC staff monitors salt waste processing, including qualification of salt batches. Salt waste processing and QA are critical to grout quality. Disposal structure construction directly relates to its performance. Worker doses during salt waste processing and disposal structure construction and operation are directly related to the performance objective for the protection of individuals during operations (i.e., 10 CFR 61.43). Section 3.2.2, "Waste Sampling"; Section 3.2.3, "Vault Construction"; Section 3.2.4, "Grout Formulation and Placement"; and Section 5, "Monitoring to Assess Compliance with 10 CFR 61.43, 'Protection During Operations'; of the 2007 SDF monitoring plan (NRC, 2007b) provide details of the basis for the NRC staff review areas.

DOE's formed-core sampling method was directly related to former Open Issues 2007-1 and 2007-2, because DOE was developing formed-core sampling to obtain representative measurements of samples of field-emplaced saltstone. Salt waste processing is also related to those open issues. Open Issues 2007-1 and 2007-2 were rolled into the technical concerns identified by the NRC in its 2012 SDF TER (NRC, 2012a); subsequently, those open issues were administratively closed after they were folded into a detailed series of MFs in the 2013 SDF monitoring plan (NRC, 2013b).

Results
DOE provided an update about salt waste processing and the status of disposal structure construction. DOE provided dose information for the 10 individuals with the greatest dose attributable to the SDF and informed the NRC staff that all exposures were within regulatory limits. DOE described an ongoing operating outage, which began on December 1, 2011, and was scheduled to end in late August 2012. The operating outage enabled the completion of grout transfer lines from the Saltstone Production Facility (SPF) to SDS 2A and SDS 2B.

DOE discussed the FY 2013 production goals and how those goals related to the formation of individual salt batches. Specifically, DOE planned to process approximately 4,500 cubic meters (m^3) (1.2 million gal) of treated salt waste during FY 2013. DOE informed the NRC staff of the upcoming readiness assessment for SDS 2A/SDS 2B and the expected introduction of grout into those disposal structures in September 2012. DOE informed the NRC staff that SDS 3A, SDS 3B, SDS 5A, and SDS 5B were expected to undergo a readiness assessment in late 2013 or early 2014 and were expected to receive saltstone grout from July 2014 to July 2015.

In response to the NRC staff's questions, DOE provided a detailed discussion of the formed-core sampling method (used to verify the characteristics of as-emplaced saltstone) and the status of its development.

Conclusions and Followup Actions
There were no resulting followup action items from this topic. The NRC staff will continue to monitor SPF activities, including any changes in the SPF QA program, as DOE transfers saltstone grout to Vault 4 cells and to SDS 2A, 2B, 3A, 3B, 5A, and 5B.

2.4.2.1.4 Technical Discussion—Tc-99 Inventory and New Inventory Quantification Methods

The expected dose from saltstone is directly correlated to the inventory disposed of at the SDF. The NRC staff monitors both the inventory and the DOE methodology to quantify that inventory. Section 3.1.1.1, "Radioactive Inventory"; Section 3.1.6, "Feed Tank Sampling"; and Section 3.2.2, "Waste Sampling"; of the 2007 SDF monitoring plan (NRC, 2007b) provide details of the basis for the NRC staff review areas.

Results
DOE provided both an overview of the revised methodology for calculating inventory and a demonstration of the new inventory calculator software tool.

The NRC staff and DOE discussed the methodology used to generate the revised Tc-99 inventory for SDS 2A, 2B, 3A, 3B, 5A, and 5B. DOE agreed to provide additional references and analytical measurements to the NRC staff. In response to questions from the NRC staff about the uncertainty in the inventory of the Salt Waste Processing Facility Batches B1, B2, B3, and B4, given that those batches had not been created or sampled yet, DOE agreed to provide the NRC with additional information on the Tc-99 concentrations in the salt waste that is anticipated to comprise those batches.

Conclusions and Followup Actions
The NRC staff will continue to monitor the Tc-99 inventory in the disposal structures. Three followup action items were identified related to this topic (2012-01-2, 2012-01-7 and 2012-01-11), as presented in Table 2-4.

2.4.2.1.5 Technical Discussion—PA Maintenance and Path Forward for SDF Monitoring

DOE uses its PA maintenance program both to satisfy DOE internal requirements and to address technical topics in NRC's SDF monitoring plans (NRC, 2007b; NRC, 2013b). As part of monitoring under Section 3116 of the NDAA, the NRC is responsible for reviewing updates to the DOE PA. Section 3.1.2, "Oxidation of Saltstone"; Section 3.1.3, "Hydraulic Isolation of Saltstone"; and Section 3.1.4, "Model Support"; of the 2007 SDF monitoring plan (NRC, 2007b) provide details of the basis for the NRC staff review areas.

Results
DOE provided the NRC staff with an overview of the FY 2012 PA maintenance program and discussed funding decisions for various projects. DOE described current research related to the effects of saltstone grout hydration temperature profiles on grout properties and measurements of hydration temperatures in field-emplaced saltstone. DOE described the long-term experiment where saltstone samples would be exposed to representative environmental conditions for several years, during which time their physical properties would be monitored. DOE described a current literature review related to the long-term fracturing of cementitious materials.

The NRC staff led a discussion of the path forward for SDF monitoring. The NRC staff told DOE that, based on the 2012 SDF TER (NRC, 2012a), it was drafting a revised SDF monitoring plan

(NRC, 2013b) in coordination with SCDHEC. DOE told the NRC staff that knowledge of NRC's prioritization of MFs was important to DOE, as it determined its future research plans.

Conclusions and Followup Actions
Two followup action items resulted this topic (2012-01-5, 2012-01-6), as presented in Table 2-4.

2.4.2.2 December 2012 Onsite Observation Visit

The NRC staff's December 6, 2012, OOV (Saltstone Observation 2012-02; NRC, 2013c) also focused on a subset of the technical concerns articulated in its 2012 SDF TER (NRC, 2012a) and associated Type IV Letter of Concern (NRC, 2012c) and on assessing compliance with the performance objectives in 10 CFR Part 61. Discussions during the December 2012 OOV included (1) followup on action items from the August 2012 OOV, (2) salt waste processing, and (3) research results from experiments conducted in accordance with DOE's PA maintenance program. The individual monitoring activities are discussed in the following subsections, along with the onsite observation results for each topical area.

2.4.2.2.1 Followup on Items from the Previous Onsite Observation Visit

DOE provided a status update for 14 followup action items stemming from the August 2012 OOV. Eleven of fourteen action items were completed (2012-01-1 through 2012-01-11) and three were carried forward and assigned an estimated completion date (2012-02-1 through 2012-02-3). Two new followup action items resulted from a discussion between DOE and the NRC about Salt Batch 7 Tc-99 concentrations (2012-02-4 and 2012-02-5). See Table 2-4 for these five followup action items.

2.4.2.2.2 Technical Discussion—Salt Waste Processing

The discussion of salt waste processing continued in December 2012, as mentioned in Section 2.4.2.1.3. A discussion of grout quality includes the qualification of salt batches and grout production at SPF. Batch qualification ensures that feed material is within tolerances acceptable to production, and evaluates production variables, such as water-to-cement ratio, dry feeds variability, and environmental conditions, that may impact the performance of the waste form.

Results
DOE provided an update of salt waste grout processing, including details of recent saltstone processing in SDS 2B. Approximately 4.2 million L (1.1 million gal) of salt waste were discharged into SDS 2B from Tank 50 in September and October, 2012. DOE informed the NRC that the SPF had operated for 19 days in October, completely processing all of the available feed in SPF feed Tank 50.

DOE noted that it planned to process more saltstone at the SPF in March 2013 but that this date may slip, depending on the resolution of an operational issue at the Defense Waste Processing Facility. DOE noted an upward trend in cesium content in the Z-Area storm water runoff basin. The NRC staff will continue to monitor radionuclide concentrations in this basin and evaluate the implications for site performance.

Conclusions and Followup Actions
No followup actions resulted from this technical discussion. The NRC staff will continue to monitor SPF activities, including any changes in the SPF production schedule, as DOE transfers saltstone grout to SDS 2A, 2B, 3A, 3B, 5A, and 5B.

2.4.2.2.3 Technical Discussion—PA Maintenance Research Activities

As mentioned in Section 2.4.2.1.5, the NRC and DOE staffs continued to discuss DOE's updates to the SDF PA during Saltstone Observation 2012-02.

Results
Before Saltstone Observation 2012-02, DOE provided the NRC staff with a group of documents covering research related to issues identified in the 2012 SDF TER (NRC, 2012a). The NRC staff discussed its limited review of each document with DOE during the December 2012 OOV. See the OOV report for specific details of these discussions (NRC, 2012c).

Conclusions and Followup Actions
Three followup actions resulted from these discussions (2012-02-6 through 2012-02-8):

2.4.2.3 June 2013 Onsite Observation Visit

The NRC staff conducted a third OOV during the CY 2012–2013 reporting period on June 26-27, 2013 (Saltstone Observation 2013-01; NRC, 2013d). Discussions during the Saltstone Observation 2013-01 visit included (1) the recent saltstone production run into SDS 2B, (2) an update on DOE's Special Analysis for Saltstone (DOE, 2013a), including a revised conceptual model, and (3) research results from experiments conducted in accordance with DOE's PA maintenance program.

2.4.2.3.1 Saltstone Production Facility Operations and Discussion of Processing Cycle

The NRC staff's interest in discussing operations at the SPF is to ensure that production of saltstone grout is consistent with the assumptions of the 2009 PA (SRR, 2009). As discussed previously, the NRC staff monitors salt waste processing, which is critical to grout quality.

Results
DOE provided an update about salt waste processing, including details of the recent saltstone processing in SDS 2B. DOE described new monitoring capabilities, such as video monitoring in the grout hopper and a humidity sensor in the vapor space of SDS 2A, to reduce uncertainty in curing conditions. DOE discussed the physical and chemical characteristics of the slag as it is received and when it is used in saltstone. DOE confirmed that the QA program is based on vendor analysis to show the product meets the DOE product specification.

Conclusions and Followup Actions
The NRC staff will continue to monitor SPF activities, including any changes in the SPF production schedule, as DOE transfers saltstone grout to newly constructed SDSs.
Three followup action items resulted from these discussions (2013-01-1 through 2013-01-3), as shown in Table 2-4.

2.4.2.3.2 Technical Discussion—Update on DOE's Special Analysis for Saltstone and the DOE PA Maintenance Plan

The objective of this monitoring activity was for DOE staff to provide the NRC staff with an update on recent activities related to the DOE Special Analysis and the implementation of DOE's PA maintenance plan. The Special Analysis would incorporate newly available technical data and modeling lessons learned from other activities to resolve uncertainties and address problematic issues identified by the NRC in the 2012 SDF TER (NRC, 2012a). DOE uses its PA maintenance program both to satisfy DOE internal requirements and to address technical topics in SDF monitoring plans (NRC, 2007b; NRC, 2013b).

Results
DOE provided an overview of the PA maintenance plan elements related to saltstone, divided into critical property testing, degradation studies, and emplaced saltstone testing. DOE also presented details on the FY 2014 update (DOE, 2014) on the FY 2013 Special Analysis (DOE, 2013a).

Conclusions and Followup Actions
No open issues or followup actions resulted from this discussion. The NRC will continue to monitor DOE's PA maintenance program as it applies to NRC's monitoring responsibilities under the NDAA. In particular, the NRC staff will review DOE's FY 2013 and FY 2014 Special Analysis reports.

2.4.2.3.3 Technical Discussion—Recent Research Activities

The discussion of recent DOE research focused primarily on experimental results documented in the following two technical reports:

Li and Kaplan (2013), "Solubility of Technetium Dioxides in Reducing Cementitious Material Leachate," Rev. 1 (SRNL-STI-2012-00769)	ADAMS No. ML13070A135
Flach and Smith (2013), "Degradation of Cementitious Materials Associated with Saltstone Disposal Units" (SRNL-STI-2013-00118)	ADAMS No. ML13189A205

As noted in Section 3.1.2, "Factor 1—Oxidation of Saltstone," of the 2007 SDF monitoring plan (NRC, 2007b), saltstone oxidation is considered to be important in demonstrating compliance with the 10 CFR Part 61 performance objectives, because oxidation can lead to increased releases of Tc-99 from the wasteform. As noted in Section 3.1.3, "Factor 2—Hydraulic Isolation of Saltstone," of the 2007 SDF monitoring plan, performance of the wasteform and concrete vault barriers is also important in demonstrating compliance with the performance objectives. The methods used to analyze the long-term performance of the SDF must account for potential mechanisms for contaminant release from the facility and the potential mechanisms for loss of integrity of the SDF engineered barriers.

Results
DOE presented the topic of each technical report, and the authors of each report were present. The NRC staff documented its full conclusions about Li and Kaplan (2013) in a TRR (NRC, 2013e) and summarized them in Section 2.4.3.2 of this report.

Conclusions and Followup Actions
No open issues or followup actions resulted from this discussion. The NRC staff found these discussions very helpful and will continue to monitor the progress of this research and its application in DOE's Special Analysis reports and future revisions to the PA.

2.4.3 Technical Reviews

2.4.3.1 Technical Evaluation Report for Revised Performance Assessment for Saltstone Disposal Facility

During this reporting period, the NRC staff reviewed DOE's revised Saltstone PA (SRR, 2009) and documented its review in the Saltstone TER (NRC, 2012a), which it issued on April 30, 2012. At the time that the NRC issued the December 2005 TER, it had concluded that it had reasonable assurance that salt waste disposal at the SDF would meet the performance objectives of 10 CFR Part 61, provided certain DOE assumptions were verified during monitoring. During the more recent review of the updated 2009 PA, the NRC staff carefully evaluated information related to these assumptions (i.e., information regarding saltstone oxidation, saltstone and disposal unit hydraulic conductivity, field-scale properties of as-emplaced saltstone, saltstone fracturing, numerical modeling of flow-through fractures, radionuclide concentrations, moisture characteristic curves, and erosion control), as well as new factors of importance to the modified disposal plans and revised conceptual model.

Findings and Conclusions
The NRC staff concluded, in the 2012 SDF TER, that it had reasonable assurance that waste disposal at the SDF meets the 10 CFR Part 61 performance objectives for protection of individuals against intrusion (10 CFR 61.42), protection of individuals during operations (10 CFR 61.43), and site stability (10 CFR 61.44). However, based on the NRC staff's evaluation of DOE's results and independent sensitivity analyses conducted with DOE's models, the NRC no longer had reasonable assurance that DOE's disposal activities at the SDF met the performance objective for protection of the general population from releases of radioactivity (10 CFR 61.41).

The NRC staff questioned the support for several of DOE's assumptions in its base case analysis, including (1) an absence of cracks in the saltstone, given that saltstone cracking had been observed, (2) the performance provided by the roof and lower drainage layer in shedding greater than 99 percent of the water around the disposal units throughout a 10,000-yr performance period; and (3) the basis for a number of parameters (e.g., hydraulic conductivity, Tc-99 sorption coefficients), because recent research did not support DOE assumptions. Although the NRC staff could not conclude that 10 CFR 61.41 had been met, based on DOE's results and NRC's own independent analyses, the potential dose to an offsite member of the public from DOE's disposal actions was still expected to be relatively low (i.e., approximately 1 mSv/yr (100 mrem/yr), the public dose limit in 10 CFR 20.1301) (NRC, 2012a).

DOE's 2009 PA (SRR, 2009) concluded that any dose greater than 0.25 mSv/yr (25 mrem/yr) would occur more than 10,000 years after site closure; however, as mentioned above, the NRC staff disagreed with many of the assumptions in DOE's model. The NRC staff expects that any exceedance of the 10 CFR 61.41 limit would occur many years after site closure but found that DOE had not provided a sufficient basis for its conclusion that any exceedances would occur beyond 10,000 years. Therefore, the NRC staff believed that DOE could provide additional information or take mitigative actions in the short term that would provide reasonable assurance

that salt waste disposal at the SDF meets all the performance objectives in 10 CFR Part 61. The NRC staff identified such information or mitigative actions as MFs in the 2012 SDF TER (NRC, 2012a).

2.4.3.2 Technical Review of "Solubility of Technetium Dioxides (TcO_2-c, $TcO_2 \cdot 1.6H_2O$ and $TcO_2 \cdot 2H_2O$) in Reducing Cementitious Material Leachates, a Thermodynamic Calculation" by Li and Kaplan (2013)

The NRC staff's technical review (NRC, 2013e) of the report, "Solubility of Technetium Dioxides in Reducing Cementitious Material Leachates, a Thermodynamic Calculation" (Li and Kaplan, 2013), and associated references support MFs 5.02, "Chemical Reduction of Technetium by Saltstone," and 5.05, "Potential for Short-Term Rinse-Release from Saltstone," in the 2013 SDF monitoring plan (NRC, 2013b).

In the 2013 SDF monitoring plan, the NRC staff notes that the studies undertaken to demonstrate technetium retention in saltstone included experimental artifacts that made the results difficult to interpret. As described under MF 5.02, the NRC staff needed to determine whether DOE has robust model support for the chemical reduction of Tc(VII) to Tc(IV) and whether this reduced state is maintained under field conditions. Additionally, under MF 5.05, the NRC staff concluded that additional support was needed to demonstrate that the short-term rinse-release from saltstone during the first few pore volumes will not significantly affect peak doses. The report by Li and Kaplan (2013) and its associated references provided additional information about the chemical reduction of technetium by saltstone and about the release of technetium, including the initial release of technetium during the first few pore volumes.

Findings and Conclusions

Several of the NRC staff's conclusions in this TRR (NRC, 2013e) are as follows:

- The NRC staff agrees with the approach in Li and Kaplan (2013) of using measured values to support the input parameters used in a PA, along with using geochemical modeling to better understand the system and the uncertainty.
- The NRC staff agrees with DOE's conclusion that the release of technetium from saltstone under young and moderately aged saltstone reducing conditions is more realistically represented as being solubility controlled rather than controlled by sorption (K_d values).
- The NRC staff agrees with DOE's conclusion that the solubility of technetium in the saltstone leachates appears to be controlled by a $TcO_2 \cdot xH_2O$ phase, which is likely to be $TcO_2 \cdot 1.6H_2O$.
- It is important to capture the uncertainty in technetium solubility, especially for moderately aged cementitious materials, because this may be one of the most risk-significant parameters in the model.
- It is only appropriate to exclude the early stage cement from PA modeling, if this assumption does not lead to an underestimation of the dose.
- Neglecting the potential for leaching of the phases responsible for the reducing capacity of blast furnace slag may be nonconservative, based on observations of reduced sulfur species in leachates from saltstone simulant experiments. The slag is likely to contain several different reduced sulfur species with different solubilities.

For MF 5.02, the additional information is needed: (1) the fraction, if any, of the technetium in saltstone that initially remains oxidized, (2) additional model support on the ability of saltstone to maintain technetium in the reduced form over time, (3) an estimate of the potential impact of leaching of reduced sulfur phases on the evolution of saltstone's reducing capacity and a list of the dominant reduced sulfur species expected to be in the slag, and (4) a PA model that adequately considers the uncertainty in technetium solubility or additional experimental data to reduce this uncertainty.

For MF 5.05, the additional information is needed: (1) experimental measurements of the early rinse-release of technetium, and (2) an analysis that this fraction released would not significantly affect the projected dose. Alternatively, an analysis based on existing measurements should demonstrate that an early rinse release would not significantly affect projected peak doses. The analysis should consider the fraction, if any, of technetium that is either not fully incorporated into saltstone or not fully reduced by saltstone, as well as the potential effects of high ionic strength.

The NRC staff is reviewing these technical areas during its review of the FY 2013 Saltstone Special Analysis. The NRC staff will continue monitoring MFs 5.02 and 5.05, as described in the 2013 SDF monitoring plan (NRC, 2013b).

2.4.4 Summary of Open Issues and Followup Actions

No new open issues resulted from Saltstone Observation 2012 01, 2012-02, or 2013-01. Previous open issues were folded into the technical concerns identified by the NRC staff in the 2012 SDF TER (NRC, 2012a) and into the MFs in the revised 2013 SDF monitoring plan (NRC, 2013b). During the CY 2012 and CY 2013 reporting period, the NRC staff was encouraged by DOE's progress in research on technetium solubility in saltstone and saltstone core testing methodologies. Results from these research activities will provide useful information about risk-significant aspects related to SDF performance. Based on the results of the OOVs conducted during this reporting period, there was no change to the conclusions in the 2012 SDF TER (NRC, 2012a). The NRC continued to conclude that it does not have reasonable assurance that salt waste disposal at the SDF meets the performance objectives in 10 CFR Part 61, specifically 10 CFR 61.41. However, the NRC is encouraged by the progress made since publication of the 2012 SDF TER. DOE and the NRC continue to use the monitoring process to resolve all outstanding issues that led to issuance of the Type IV Letter of Concern. In accordance with the requirements of NDAA, the NRC will continue to monitor DOE disposal actions at the SDF.

During CY 2012 and 2013, the NRC staff's monitoring of the Saltstone facility resulted in no findings of *noncompliance*. The followup action items that were identified during the three OOVs have all been completed, as summarized in Table 2-4. All the MFs identified in Table 2-2 remain open.

3.0 MONITORING AT THE SAVANNAH RIVER SITE F-AREA TANK FARM IN CALENDAR YEARS 2012 AND 2013

3.1 Introduction

The SRS is a 780-square-km (310-square-mi) facility located in south-central South Carolina, which began operation in 1951 to produce nuclear materials for national defense, research, medical, and space programs. Waste produced at the site from SNF reprocessing for defense purposes has been commingled with nonreprocessing waste resulting from the production of targets for nuclear weapons and material for space missions. Significant quantities of radioactive waste are currently stored on site in large underground waste storage tanks, including the 22 tanks within the FTF, which were placed into service between 1954 and 1986. The tank waste is a mixture of insoluble metal hydroxide solids, referred to as sludge, and soluble salt supernate. The supernate volume has been reduced by evaporation, which also concentrates the soluble salts to their solubility limits. The resultant solution crystallizes as salts and the resulting solid is referred to as saltcake. The saltcake and supernate combined are referred to as salt waste. DOE removes the salt waste, treats it to remove HRRs to the maximum extent practical, and disposes of the low activity fraction on site in the SDF (see Section 2.0). The subject tank farm is located in the F-Area of the General Separations Area, which is located approximately 10 km (6.2 mi) from the nearest SRS site boundary on a well-drained local topographic high.

The FTF contains 22 below grade, carbon steel and reinforced concrete tanks that store or previously stored liquid radioactive waste generated from the chemical separations facility in the F-Canyon. The waste tanks consist of three basic types (I, III, and IV). Type I is the original waste tank type and it is also the smallest. These tanks are 23 meters (m) (75 feet (ft)) in diameter and 7.5 m (24.5 ft) in height, with a storage capacity of 2,850 m^3 (750,000 gal). Type IV waste tanks were designed and sited in the late 1950s; these tanks are 26 m (85 ft) in diameter and 11 m (34.5 ft) in height, with a storage capacity of 4,940 m^3 (1,300,000 gal). Type III tanks are the most recent tank type placed into service; they were added to the FTF during the 11-year period spanning from 1969 to 1980. Type III tanks are 26 m (85 ft) in diameter and 11 m (34.5 ft) in height, with a storage capacity of 4,940 m^3 (1,300,000 gal).

To date, six waste tanks have been cleaned and grouted. This includes Tanks 17 and 20, which were closed with approval from SCDHEC before the implementation of the NDAA; Tanks 18 and 19, which were grouted and closed in 2012; and Tanks 5 and 6, which were grouted and closed in 2013. In addition to removing waste from the tanks, FTF closure includes cleaning and stabilizing the tank system components (including tanks, vaults, piping, structures, and ancillary equipment).

In CY 2012 and CY 2013, the NRC staff completed four OOVs (NRC, 2012e; NRC, 2012f; NRC, 2013f; NRC, 2013g) and seven TRRs (NRC, 2013h–2013n) for the FTF site. Publicly available OOV reports and TRRs provide details of the NRC staff's evaluations. Each OOV is preceded by an onsite observation guidance document, which states the objectives of the OOV and the relationship between each OOV objective and its respective 10 CFR Part 61 performance objective. Following the OOV, the NRC staff report documents the activities that took place, assesses how the NRC staff's monitoring activities relate to their respective 10 CFR Part 61 performance objective, and describes the conclusions the NRC staff drew from the OOV activities.

3.2 Background

On September 30, 2010, DOE submitted to the NRC the document, "Draft Basis for Section 3116 Determination for Closure of F-Tank Farm (FTF) at the Savannah River Site" (DOE, 2010), to demonstrate compliance with the Section 3116 criteria as well as with the performance objectives in 10 CFR Part 61. DOE concluded, in the draft basis for the WD for FTF, that the stabilized waste residuals in the FTF tanks and auxiliary components, as well as the tanks and auxiliary components themselves, are not HLW and, therefore, meet the criteria in NDAA Section 3116.

In its consultation role, the NRC staff reviewed the draft basis for the WD, the FTF PA (SRR, 2010), and related documents. The NRC staff identified a number of technical concerns and recommendations for DOE to consider that, if implemented, could benefit or enhance DOE's demonstration of compliance with the performance objectives in 10 CFR Part 61. The NRC documented the results of its technical review in the FTF TER (NRC, 2011), which was issued in October 2011. In the 2011 FTF TER, the NRC staff did not draw a conclusion on the ability of the waste at FTF to meet the requirements of the performance objectives in 10 CFR Part 61, due to uncertainty in the final inventories for the remaining 20 tanks.

The NRC staff's primary recommendation in the 2011 FTF TER (related to Criterion 3 of the NDAA; see Appendix A) was that DOE conduct waste release experiments to increase support for key modeling assumptions related to the (1) evolution of pH and Eh in the grouted tank system over time, (2) identification of HRR association with solid phases comprising the residual wastes, and (3) expected solubility of HRRs under a range of environmental or service conditions to which the residual wastes in the contaminated zone are expected to be exposed over time. Implementation of this recommendation was deemed crucial, so that the NRC staff may have reasonable assurance that the performance objectives in 10 CFR Part 61 could be met.

Considering longer performance periods beyond 10,000 years, DOE models predicted that Tank 18 would produce overall peak doses significantly above the dose limits in 10 CFR 61.41 and 10 CFR 61.42. Given the magnitude of the dose predictions and uncertainty in the timing of the peak dose, the NRC staff recommended that technical issues associated with Tank 18 (e.g., support for release and natural attenuation assumptions) should be resolved *prior to tank grouting* to inform its closure, as well as that of future FTF tank closures. Given the risk significance of Tank 18 to the overall PA and the scheduled closure per the SRS Federal Facilities Agreement (FFA)[1] by December 2012, the NRC advised DOE in the 2011 FTF TER to initiate discussions with the NRC staff regarding implementation of this primary recommendation as soon as practical for Tank 18. The NRC staff believed that experiments to address this recommendation should be conducted before final closure of Tank 18, so that the NRC could evaluate the results of the residual waste experiments to determine the need for additional data collection, experiments, and modeling for Tank 18 and other FTF tanks.

DOE issued a final WD for FTF in March 2012 (DOE, 2012) and began the grouting of Tanks 18 and 19 in April 2012. DOE indicated that it predicated the final WD on extensive analyses and scientific rationale, including the FTF PA (SRR, 2010), as supplemented by the Special Analysis

[1] The FFA is a formal agreement between DOE, the U.S. Environmental Protection Agency (EPA), and SCDHEC. One purpose of the agreement is to establish a schedule by which SRS waste tanks that do not meet secondary containment standards are removed from service. The SRS FFA schedule called for the closure of two HLW tanks by 2012.

for Tanks 18 and 19 (SRR, 2012b). DOE indicated, in its final WD, that it had considered the assumptions, conclusions, and recommendations documented in NRC's FTF TER and had conducted a number of studies to address the NRC staff's technical concerns. In fact, DOE conducted significant work to reduce the technical uncertainties associated with Tank 18 before issuance of the final WD, which the NRC staff has since reviewed in its monitoring role, as detailed below. Following issuance of DOE's final WD in March 2012 (DOE, 2012), the NRC staff issued an FTF monitoring plan in January 2013 (NRC, 2013a). This new monitoring plan is discussed in detail in Section 3.4.1.

3.3 Disposal Actions in CY 2012 and 2013

During CY 2012, DOE grouted Tanks 18 and 19 and developed the final inventory for Tanks 5 and 6, after waste retrieval operations and sampling were complete. During CY 2013, DOE grouted Tanks 5 and 6.

3.4 NRC Monitoring Activities in CY 2012 and 2013

3.4.1 Summary of 2013 FTF Monitoring Plan

The NRC staff issued the FTF monitoring plan, "U.S. Nuclear Regulatory Commission Plan for Monitoring Disposal Actions Taken by the U.S. Department of Energy at the Savannah River Site F-Area Tank Farm Facility in Accordance With the National Defense Authorization Act for Fiscal Year 2005," in January 2013 (NRC, 2013a). The monitoring plan was issued in time to inform the third OOV at the site in March 2013 (see Section 3.4.2.3). The FTF monitoring plan details NRC's path forward in assessing DOE's compliance with the performance objectives in 10 CFR Part 61, in fulfillment of the NRC monitoring responsibilities under the NDAA.

In the 2013 FTF monitoring plan, the NRC staff developed a new list of eight risk-significant MAs that address the complete scope of FTF monitoring (NRC, 2013a). These eight MAs are presented in Table 3-1.

Table 3-1 FTF Monitoring Areas in the 2013 Monitoring Plan

MA	Monitoring Areas	Performance Objective			
		§61.41	§61.42	§61.43	§61.44
1	Residual Waste Inventory	X	X		
2	Waste Release	X	X		
3	Cementitious Material Performance	X	X		
4	Natural System Performance	X	X		
5	Closure Cap Performance	X	X		
6	Performance Assessment Maintenance	X	X		
7	Protection of Individuals During Operations			X	
8	Site Stability				X

The NRC will monitor and evaluate DOE compliance with 10 CFR 61.41 and 10 CFR 61.42 by conducting risk-informed reviews, including onsite observations, technical reviews, and data reviews of MFs associated with MA 1 through MA 6. The NRC staff developed MA 1, "Residual Waste Inventory," to ensure that the final postcleaning inventory that is developed for each cleaned tank is consistent with assumptions made in DOE's final WD and PA regarding the final waste inventory at closure. The NRC will perform monitoring activities related to

engineered and natural features of the disposal facility that are also found to be important to meeting the performance objectives. The NRC staff developed MA 2, "Waste Release," to ensure that releases of *key radionuclides* remain low for long periods of time. The NRC staff developed MA 3, "Cementitious Material Performance," to ensure that cementitious materials act as effective barriers to fluid flow, mitigate or attenuate releases of radioactivity from the tanks, and otherwise perform in a manner consistent with DOE FTF PA assumptions. The NRC staff developed MA 4, "Natural System Performance," to ensure the hydrogeological system acts as an effective natural barrier to attenuate key radionuclide releases. Additionally, under MA 4, the NRC staff will review environmental data collected by DOE as an additional assurance that the FTF is operating as predicted by DOE models. The NRC staff developed MA 5, "Closure Cap Performance," to evaluate key features of the closure cap identified in the NRC staff's review. All of these MAs are directly related to the facilities' long-term ability to limit or mitigate releases of contaminants from the FTF that could result in adverse human health impacts. Items of lower risk significance or longer term activities are addressed in MA 6, "PA Maintenance." PA maintenance is also necessary to ensure that a mechanism is in place to consider new and significant information that may be collected in the future that might significantly alter results presented in DOE's FTF PA. The NRC staff will review radiation records and environmental data, and reports and may conduct interviews to assess compliance with 10 CFR 61.43 under MA 7, "Protection of Individuals During Operations." Finally, under MA 8, "Site Stability," the NRC staff considers unique aspects affecting the stability of the disposal site after closure that are not already considered under 10 CFR 61.41 and 10 CFR 61.42.

For each MA, the NRC identified one or more MFs, as shown in Table 3-2. Each MF is a specific item that the NRC staff will monitor and track as "Open" or "Closed." If NRC concerns arise related to an MF, then the NRC staff may develop an "Open Issue" to document such concerns. Thus, the NRC will have a mechanism to communicate to DOE early about the need for corrective action, before the issuance of a Notification Letter.

The FTF monitoring plan is organized by performance objective, with a chapter devoted to each one. Each chapter provides the MAs and its associated MF(s) for each performance objective. Each MA supports one or more performance objectives. The FTF monitoring plan provides the NRC staff's current estimates of how and when the NRC expects that each MF will be closed.

3.4.2 Onsite Observations

The NRC staff conducted two FTF OOVs in CY 2012, before the issuance of the FTF monitoring plan, and another two in CY 2013, following issuance of the FTF monitoring plan (NRC, 2013a).

Table 3-2 FTF Monitoring Factors in the 2013 Monitoring Plan

Monitoring Factors
MF 1.1—Final Inventory and Risk Estimates
MF 1.2—Residual Waste Sampling
MF 1.3—Residual Waste Volume
MF 1.4—Ancillary Equipment Inventory
MF 1.5—Waste Removal (as it Pertains to ALARA)
MF 2.1—Solubility-Limiting Phases/Limits and Validation
MF 2.2—Chemical Transition Times and Validation
MF 3.1—Concrete Vault Performance (as it Relates to Steel Liner Corrosion)
MF 3.2—Groundwater Conditioning
MF 3.3—Shrinking and Cracking
MF 3.4—Grout Performance
MF 3.5—Basemat Performance
MF 3.6—Use of Stabilizing Grout (as it Pertains to ALARA)
MF 4.1—Natural Attenuation of Plutonium (Pu)
MF 4.2—Calcareous Zone Characterization
MF 4.3—Environmental Monitoring (EM)
MF 5.1—Long-Term Hydraulic Performance of the Closure Cap
MF 5.2—Long-Term Erosion Protection Design
MF 5.3—Closure Cap Functions that Maintain Doses ALARA
MF 6.1—Scenario Analysis
MF 6.2—Model and Parameter Support
MF 6.3—F-Tank Farm PA Revisions
MF 7.1—Protection of Workers During Operations
MF 7.2—Air Monitoring
MF 7.3—As Low As (Is) Reasonably Achievable (ALARA)
MF 8.1—Settlement

3.4.2.1 June 2012

The NRC staff conducted its first OOV (NRC, 2012e) at the FTF (FTF Observation 2012-01) on June 12, 2012, before issuing the FTF monitoring plan (see Section 3.4.1). During this OOV, the NRC staff focused on observing the grouting of Tank 18, given technical concerns related to the potential for future cracking, shrinkage, or both, of emplaced grout material. Such shrinkage and cracking has the potential to create preferential fast flow pathways for water through the bulk grout to the residual waste and lead to early release of HRRs from the disposal system. As such, the NRC staff focused on the potential impact of these phenomena on DOE's ability to meet 10 CFR 61.41 and 10 CFR 61.42. The NRC staff also focused on Tank 18 and 19 grouting operations as they relate to compliance with 10 CFR 61.43, protection of workers during operations. The DOE contractor staff indicated that, as of June 7, 2012, Tank 18 was approximately 67-percent full and had received a total of 699 truckloads of grout, while Tank 19 was approximately 83-percent full and had received a total of 866 truckloads of grout. No risers in either tank had been capped. The following subsections discuss individual monitoring activities, along with the OOV results and conclusions for each topical area.

3.4.2.1.1 Tank 18 Grouting Operations

The objective of the observation of the Tank 18 grouting operations was to ensure that production of waste-tank-stabilizing grout is consistent with the assumptions of the FTF PA (SRR, 2010). The NRC staff monitors grouting operations, which are critical to grout quality, grout performance, and worker protection. Section 3.3, "Cementitious Material Performance," and Section 5, "Protection of Individuals during Operations," of the 2013 FTF monitoring plan (NRC, 2013a) provide details of the basis for the NRC staff review areas for these topics.

Results

The NRC staff was able to observe arrival and verification of grout trucks, delivery of grout to aboveground hoppers, pumping of grout into a slick line, and an example of periodic testing for grout acceptability.

The DOE contractor staff presented an overview of grouting operations for Tank 18, supplemented by real-time video, using a camera and light array to monitor grout placement. The DOE contractor staff described the internal grouting of in-tank equipment, such as slurry pumps and transfer jets, and the procedure to be used for grouting tank risers.

The NRC staff noted grout mounding up in the center of Tank 18 beneath the tremie pipe, due to placement of the grout through the center riser and due to an inability of the placed grout to self-level. The NRC staff was concerned that filling the tank vaults may be difficult, because DOE may be unable to deliver grout to the periphery of the tank due to premature filling of the grout access point in the center of the vault. DOE indicated that the domed roofs of the Type IV tank vaults will make it easier to fill all void space above the spring line of the tanks. However, DOE indicated that, if necessary, it would create additional access points in peripheral risers to ensure that void space within the tank is minimized.

Conclusions and Followup Actions

This topic was evaluated in more detail in the NRC TRR entitled, "DOE Documentation Related to Tanks 18 and 19 Final Configurations with an Emphasis on Grouting from Recommendations and Testing to Final Specifications and Procedures" (NRC, 2013m), as summarized in Section 3.4.3.6. Three followup action items resulted from these observation activities (Items 1 through 3), as shown in Table 3-3. SCDHEC indicated that it would continue to monitor grouting activities as part of its inspection process and that it would share the resulting information with the NRC.

3.4.2.1.2 Technical Discussion—Measures to Prevent Grout Shrinkage

The objective of the discussion on measures that could be used to prevent grout shrinkage was to ensure that production of waste-tank-stabilizing grout is consistent with the assumptions of the FTF PA (SRR, 2010).

Results

The NRC staff communicated to DOE its grout-shrinkage concerns, specifically the potential formation of preferential fast flow pathways along sidewalls, at interfaces of residual equipment, and between grout flow lobes. The NRC staff noted that Stefanko and Langton (2011) recommended developing and testing a shrinkage-compensating all-in-one grout mix and described special test forms that were designed and instrumented to evaluate dimensional changes as a function of time, temperature, and humidity.

Conclusions and Followup Actions

The NRC staff will continue to monitor DOE activities related to the potential for shrinkage and cracking of FTF tank grout. This topic was evaluated in more detail in a TRR (NRC, 2013m). One followup action resulted from this discussion (Item 4), as shown on Table 3-3.

Table 3-3 Status of Followup Actions from CY 2012 and 2013 OOVs at FTF

Item	From	Followup Action Item	Status
1	6/2012 OOV	DOE to provide sample videos of Tank 18 grout pours that include at least 4 hours of continuous video for one operating day per week. Sample videos should include those acquired on different week days. The NRC staff's request included two examples of "end-of-day/beginning-of-next-day" video and two examples of "end-of-week/beginning-of-next-week" video.	**Completed**
2	6/2012 OOV	DOE to provide a copy of an in-tank daily inspection video from grout pouring operations.	**Completed**
3	6/2012 OOV	DOE to provide grout batch tickets from four accepted and four rejected loads.	**Completed**
4	6/2012 OOV	NRC to provide DOE with its most recent contractor reports on grout monolith characteristics (draft report) and saltstone experiments.	**Completed**
5	6/2012 OOV	NRC to provide DOE with documentation on ASR occurring in concrete at the Seabrook Station.	**Completed**
6	9/2012 OOV	NRC to provide DOE and SCDHEC with a copy of a final report by CNWRA® staff that documented the results of meso- and intermediate-scale grout monolith experiments.	**Completed**
7	9/2012 OOV	DOE to provide GSA GIS data, water table elevation data, and well construction data to NRC.	**Completed**
001	03/2013 OOV	DOE to provide *2012 Annual Groundwater Monitoring Report for the F- and H-Area Radioactive Liquid Waste Tank Farms (SRNS-RP-2013-00118, Rev. 0)*	**Completed**
002	03/2013 OOV	DOE to provide General Separations Area Eastern & Western GW reports *Scoping Summary for the General Separations Area Eastern Groundwater Operable Unit (WSRC-RP-2000-4134, August 2012)* and *Scoping Summary for the General Separations Area Western Groundwater Operable Unit (ERD-EN-2005-0127, August 2012)*	**Completed**
003	03/2013 OOV	NRC to arrange Clarification Telecon on Tank 8 Plume	**Not needed**
004	03/2013 OOV	DOE to provide radiological dose reports for FTF Tanks 5/6 Final Sampling and Characterization *Post-Job ALARA Review – Tank 5 Riser 8 to Tank 6 Riser 7 Crawler Relocation (11-FTF-131A)* and *Post-Job ALARA Review – Tank 5 Crawler Riser 8 Sampling (11-FTF-147)*	**Completed**
005	03/2013 OOV	DOE to provide information on air doses within FTF and the annual environmental monitoring report *Fifth Annual Review of Monitoring Systems (FARMS) F-Tank Farm Facility (SRR-FSH-2012-00036)*	**Completed**

Table 3-3 (cont'd) Status of Followup Actions from CY 2012 and 2013 OOVs at FTF

Item	From	Followup Action Item	Status
006	03/2013 OOV	DOE to provide FTF Tanks 18/19 Pre-Job ALARA Reviews *Pre-Job ALARA Checklist — Tank 18 Grout Pour (12-FTF-123_Pre-Job)* & *Pre-Job ALARA Checklist—Tank 19 Grout Pour (12-FTF-124_Pre-Job)*	**Completed**
007	03/2013 OOV	DOE to provide Industrial Hygiene Monitoring Plan for FTF Tanks 18/19 as well as associated results of monitoring *Tank 18/19 Grout Addition RadCon Plan (LWO-FSH-2012-00003, Rev. 1)*	**Completed**
008	03/2013 OOV	DOE to provide *Tanks 18 and 19 Final Configuration Report for F-Tank Farm at the Savannah River Site (SRR-CWDA-2012-00170, Rev. 0)* *Tanks 18 and 19 Final Configuration Report Inputs (SRR-LWE-2012-00217, Rev. 1)*	**Completed**
009	03/2013 OOV	NRC to arrange Clarification Telecon on FTF Tank 18 Grouting Operation Videos	**Held 05/01/13**
010	03/2013 OOV	DOE to provide *Savannah River Site Liquid Waste Facilities Performance Assessment Maintenance Program, FY 2013 Implementation Plan (SRR-CWDA-2013-00049, Rev. 1)*	**Completed**
011	03/2013 OOV	DOE to provide *Characterization of Additional Tank 18F Samples (SRNL-STI-2010-00386, Rev. 0)*	**Completed**
012	03/2013 OOV	DOE to provide *Liquid Waste Tank Residuals Sampling - Quality Assurance Program Plan (SRR-CWDA-2011-00117, Rev. 0)*	**Completed**
013	03/2013 OOV	DOE to provide *Tank 5 Composite Samples Volumetric Proportions (SRR-CWDA-2011-00067, Rev. 1)*	**Completed**
014	03/2013 OOV	DOE to provide *Estimated Thickness of Tank 5 Floor Residue Scrape Samples (SRNL-L3100-2011-00066, Rev. 0)*	**Completed**
015	03/2013 OOV	DOE to provide Calculation document, *M-CLC-F-01256*	**DOE not using now**
016	03/2013 OOV	DOE to provide *Tank Mapping Methodology (SRR-LWE-2010-00240, Rev. 1)*	**Completed**
017	03/2013 OOV	DOE to provide *Technical Task Request for Tanks 5 and 6 Final Sample Analysis (HLE-TTR-2010-004, Rev. 2)*	**Completed**
018	03/2013 OOV	DOE provide *Technical Task Request for Tanks 5 and 6 Final Sample Analysis and Data Validation Support (HLE-TTR-2010-004, Rev. 7)*	**Completed**
019	03/2013 OOV	DOE to provide *Tank 6 Composite Samples Volumetric Proportions (SRR-CWDA-2011-00172, Rev. 0)*	**Completed**
020	03/2013 OOV	DOE to provide *Task Technical and Quality Assurance Plan for Analysis of the Tank 5F and Tank 6F Final Characterization Samples – 2011 (SRNL-RP-2010-01695, Rev. 1)*	**Completed**
021	03/2013 OOV	NRC to arrange Clarification Telecon on FTF Volume Mapping Methodology	**Held 05/15/13**
022	03/2013 OOV	DOE to consider to provide FTF Tank 5 Crawler Video	**Completed**
023	03/2013 OOV	DOE to consider to provide FTF Tanks 5/6 Annulus Inspection Videos	**Completed**
024	03/2013 OOV	NRC to arrange Clarification Telecon on FTF Tanks 5/6 Special Analysis	**Held 05/08/13**

Table 3-3 (cont'd) Status of Followup Actions from CY 2012 and 2013 OOVs at FTF

Item	From	Followup Action Item	Status
037	08/2013 OOV	DOE to provide *Followup in Support of U.S. Nuclear Regulatory Commission Monitoring Activities in F-Tank Farm (SRR-CWDA-2013-00103, Rev. 0)*	**Completed**
038	08/2013 OOV	NRC to provide hard drive for FTF Tanks 5/6 SA PORFLOW files	**Completed**
039	08/2013 OOV	DOE to provide FTF Tanks 5/6 SA PORFLOW files	**Completed**
040	08/2013 OOV	DOE to provide *Liquid Waste Tank Residuals Sampling and Analysis Program Plan (SRR-CWDA-2011-00050, Rev. 2)* and *Liquid Waste Tanks Residual Sampling-Quality Assurance Program Plan, (SRR-CWDA-2011-00117, Rev. 1)*	**Completed**
041	08/2013 OOV	DOE to provide *Task Technical and Quality Assurance Plan for Determining the Radionuclide Release from Tank Waste Residual Solids (SRNL-STI-2013-00203, Rev. 0)*	**Completed**
042	08/2013 OOV	DOE to provide Idaho grout drop report, *Grout/CLSM Testing and Selection for the INTEC Tank Farm Closure (EDF-6715, Rev. 0)*	**Completed**
043	08/2013 OOV	DOE to provide basis for the 10-foot grout drop height	**Completed**

3.4.2.1.3 Technical Discussion—Alkali–Silica Reaction Cracking

The objective of the technical discussion on measures that could be used to prevent alkali-silica reaction cracking was to ensure that production of waste-tank-stabilizing grout is consistent with the assumptions of the FTF PA (SRR, 2010).

Results

The NRC staff communicated to DOE its concern with the potential formation of cracks in tank grout due to alkali–silica reaction (ASR). ASR is a slow process whereby reactive aggregates break down under exposure to the highly alkaline pore solution in concrete, which can result in significant expansion and, in some cases, can cause the cracking of concrete. This concern arose because (1) the grout used to fill Tanks 18 and 19 included 1-cm (⅜-in.) granite pea gravel as aggregate, rather than the sand-only aggregate described in the FTF PA (SRR, 2010), and (2) concrete cracking was recently observed at the Seabrook nuclear power plant in Seabrook, NH. In that facility, granite aggregates also were used in the concrete mix. The occurrence of ASR concrete cracking at Seabrook became evident only decades after the plant was constructed. The Tank 18 and 19 grout fill mix contains less Portland cement than the Seabrook concrete mix and likely would be less susceptible to ASR. Nevertheless, the NRC staff is concerned that DOE's criterion for acceptance of vendor-supplied granite aggregate relies on short-term alkali reactivity tests, which are unlikely to predict the occurrence of ASR over a long-term period of performance (i.e., 10,000 years).

Conclusions and Followup Actions

This topic was evaluated in more detail in a TRR (NRC, 2013m). One followup action item (Item 5) on Table 3-3 resulted from this discussion.

3.4.2.1.4 Technical Discussion—pH Buffering Capacity of Grout

The objective of the technical discussion on the pH buffering capacity of grout was to ensure that production of waste-tank-stabilizing grout is consistent with the assumptions of the FTF PA (SRR, 2010).

Results
The NRC staff noted that Stefanko and Langton (2011) indicated that currently available Portland cements contain up to 5-weight-percent limestone. The NRC staff communicated its concern that a reduction in the amount of Portland cement in the grout mix would lower the pH buffering capacity of the grout and could affect the timing of release of HRRs.

Conclusions and Followup Actions
No followup actions resulted from this discussion. This topic was evaluated in more detail in the TRR discussed in Section 3.4.3.6 (NRC, 2013m).

3.4.2.1.5 Technical Discussion—Worker Protection

The objective of the discussion of worker protection was to ensure compliance with 10 CFR 61.43 during waste disposal activities. Section 5, "Protection of Individuals During Operations," of the 2013 FTF monitoring plan (NRC, 2013a) provides details of the basis for the NRC staff review of this topic.

Results
DOE provided an overview of its radiation protection protocols specific to the grouting project during the briefing, as well as information on radiological controls and its radiation worker protection program. DOE created a project-specific radiation work permit to track worker doses associated with grout placement into Tanks 18 and 19.

Conclusions and Followup Actions
No followup actions resulted from this discussion. The NRC and DOE agreed that a detailed discussion regarding specific aspects of DOE's radiation protection program would be conducted during a future OOV when subject matter experts could be included as participants.

3.4.2.2 September 2012

The NRC staff conducted its second OOV (NRC, 2012f) at the FTF (FTF Observation 2012-02) on September 26–27, 2012, before issuance of the FTF monitoring plan (see Section 3.4.1). The purpose of this visit was to follow up on action items related to Tank 18 and 19 grouting operations that resulted from FTF Observation 2012-01(NRC, 2012e), including tank and vault grouting, waste retrieval and closure, and environmental data (groundwater). In addition, the NRC staff began reviewing aspects of the preparation of Tanks 5 and 6 for closure and grouting, discussed with DOE its reviews of several DOE technical reports, and obtained information related to historic, current, and planned groundwater monitoring activities in the vicinity of the FTF. All issues are related to compliance with 10 CFR 61.41 through 10 CFR 61.43.

During FTF Observation 2012-02, the DOE staff conducted presentations related to completion of closure of Tanks 18 and 19 and to sampling and analysis of Tanks 5 and 6. DOE also provided an overview of groundwater monitoring in the vicinity of FTF. The NRC staff took a tour of FTF near Tanks 18, 19, 5, and 6. The NRC staff also toured SRNL, where residual tank

waste is characterized, and observed a field lysimeter test in A-Area that may yield information related to radionuclide movement in the natural environment.

3.4.2.2.1 Technical Discussion—Recently Completed DOE Grouting Activities for Tanks 18 and 19

The objective of this technical discussion on grouting operations was to ensure that the production of waste-tank-stabilizing grout is consistent with the assumptions of the FTF PA (SRR, 2010).

Results
DOE provided a status update about recently grouted and closed Tanks 18 and 19, which included discussions of the verification of void filling in tanks and internal equipment, riser completion, and test data about the mechanical characteristics of the grout. DOE provided a schedule for completion of the activities, including a Final Configuration Report and a Liquid Waste Maintenance Plan.

Conclusions and Followup Actions
One followup action item resulted from this discussion (Item 6), as shown on Table 3-3.

3.4.2.2.2 Technical Discussion—Waste Retrieval and Closure

The objective of this technical discussion on waste retrieval and tank closure was to ensure that waste tank cleaning is consistent with the assumptions of the FTF PA (SRR, 2010). The NRC staff monitors tank cleaning, residual waste sampling, and waste retrieval, which are critical to residual waste inventory. Section 3.1, "Inventory," of the 2013 FTF monitoring plan (NRC, 2013a) provides details of the basis for NRC staff review areas for this topic.

Results
DOE provided a status update and schedule for closure of the Type I Tanks 5 and 6. Each tank contained more than 6,400 lineal m (21,000 lineal ft) of 5-cm (2-in.) inner diameter cooling coil, which presented significant obstacles to both cleaning and sampling equipment. DOE gave a detailed presentation related to its sampling strategy and implementation challenges for Tanks 5 and 6. Because infrastructure was different for each tanks, different approaches were needed. The NRC staff reviewed the references DOE shared and documented the results of its review in a TRR entitled, "Final Inventory Documentation for Tanks 5 and 6 at F-Area Tank Farm Facility" (NRC, 2013h; see Section 3.4.3.4).

The NRC staff took a walking tour of Tanks 5 and 6, during which they observed surface features associated with the tanks, including access risers. DOE discussed limitations regarding the use of some risers for waste removal and for providing access for the sampling of residual waste. DOE also gave a general overview of the schedule for closure of the entire FTF. DOE's timeline extends at least 10 years into the future.

Conclusions and Followup Actions
No followup actions were identified for this topic.

3.4.2.2.3 Technical Discussion—Environmental Data

The objective of the technical discussion on environmental and groundwater monitoring data was to ensure that the natural barrier system is consistent with the assumptions of the FTF PA (SRR, 2010). The NRC staff monitors environmental and groundwater data, which provide important information about natural system performance. Section 3.4, "Natural System Performance," of the 2013 FTF monitoring plan (NRC, 2013a) provides details of the basis for the NRC staff review areas for this topic.

Results

DOE presented information related to FTF groundwater monitoring, including the introduction and evolution of upgradient and downgradient wells. DOE discussed external features (in particular, a leaking process sewer line near FTF) that likely will affect groundwater monitoring results.

DOE also presented information related to the Tc-99 plume at the FTF that is now thought to be potentially sourced from the process sewer lines that feed the F-Area seepage basins. Previously, the Tc-99 plume was thought to be associated with a historical release from Tank 8 that occurred in 1961.

DOE provided the NRC with the FTF groundwater monitoring plan (SRNS, 2012) and groundwater monitoring data from the last 3 years, 2009 through 2011. The NRC staff plans to issue a TRR on these topics in CY 2014.

The NRC staff requested that DOE provide Geographic Information System (GIS) data for the General Separations Area (GSA), water level data from 1990 to the present, and well construction data for applicable FTF wells. The water table data will be used to determine the likelihood of water table rise above the bottom of FTF tanks, a potentially risk-significant alternative conceptual model for Type IV tanks at FTF. The GIS data will be used to better understand and analyze groundwater data collected for the FTF and SDF. DOE agreed to provide the NRC with GSA GIS water table elevation data and well construction data from the Environmental Restoration Data Management System that may aid in the interpretation of groundwater monitoring data.

Conclusions and Followup Actions

One followup action resulted from this topic (Item 7), as shown on Table 3-3.

3.4.2.2.4 Onsite Tours of Savannah River National Laboratory and Lysimeter Experiment

Two additional NRC staff tours took place at SRS in September 2012: (1) the SRNL facility that processes, characterizes, and analyzes samples of residual tank waste, and (2) a long-term field lysimeter experiment in which DOE has placed a number of test samples to try to determine long-term performance in natural conditions. Future results from this experiment may provide insight into expectations of residual tank waste performance as well as performance of saltstone. For more detailed information about a previous tour of this experiment by the NRC staff, refer to Section 2.4.2.1.2.

3.4.2.3 March 2013

The NRC staff conducted its third OOV (FTF Observation 2013-01) on March 27–28, 2013 (NRC, 2013f), after the issuance of the 2013 FTF monitoring plan (NRC, 2013a). During this OOV, discussions included the EM program, radiation protection program, final closure documentation for FTF Tanks 18 and 19, PA maintenance plan, and final inventory reports for FTF Tanks 5 and 6. Additionally, the NRC staff toured Tanks 18, 19, 5, and 6 at the FTF.

The role of the various regulatory authorities was clarified during FTF Observation 2013-01. The NRC performs monitoring activities in coordination with the SCDHEC staff, who typically participates in the OOVs. Starting with FTF Observation 2013-01, EPA Region 4 staff will also participate in FTF monitoring activities because, while SCDHEC will have the lead regulatory authority for closed FTF tanks, EPA will also have regulatory authority. After the entire FTF is closed, EPA and SCDHEC will share regulatory authority through the SRS FFA. DOE provided an overview of the joint regulatory responsibilities of EPA Region 4 and SCDHEC during the time of NRC's monitoring role under NDAA Section 3116(b) for the SRS tank farms.

In the future, DOE mentioned that it may want the NRC to perform joint monitoring activities for the two SRS tank farm sites (FTF and the H-Tank Farm (HTF)). DOE suggested this may mean replacing the individual tank farm WDs with a joint WD, or adding HTF information to the FTF monitoring plan and then issuing it as a combined monitoring plan for both tank farms. The NRC agreed with this approach, indicating that a single monitoring plan covering both SRS tank farms would be beneficial.

3.4.2.3.1 FTF Site Tour

During the FTF site tour, DOE provided an overview of the FTF disposal activities, with a special focus on Tanks 18, 19, 5, and 6.

Results
The NRC inquired about grout formulation changes and testing that may have occurred since the grouting of Tanks 18 and 19. DOE indicated that a better flowing grout would be used in Tanks 5 and 6, compared to that placed in Tanks 18 and 19, due to the presence of cooling coils in Tanks 5 and 6.

The NRC inquired about the effectiveness and efficiency of submersible mixer pumps for all stages of waste retrieval, including heel removal. DOE indicated that, ideally, it would be beneficial to use different pumps for different stages of waste removal but that it was impractical to do so. The NRC asked whether any of the wells near Tank 8, which were sampled following the release of HLW from Tank 8 during a historical overfill event, were still operable. DOE indicated it would provide a map of the wells that were in use at FTF.

Conclusions and Followup Actions
No followup action items resulted from this tour.

3.4.2.3.2 Technical Discussion—Environmental Monitoring Program

As stated in the FTF monitoring plan (NRC, 2013a), the NRC monitors DOE disposal actions to assess compliance with 10 CFR 61.41 for DOE's EM program through MA 4 ("Natural System

Performance") under MF 4.3 ("Environmental Monitoring"). Section 3.4.3 of the FTF monitoring plan provides details on the basis for the NRC staff monitoring reviews of the DOE EM program.

Results
The NRC was interested in historical releases from FTF Tank 8 (and HTF Tank 16) that might provide insight into potential vulnerabilities in the tank systems and information about contaminant flow and transport at the SRS GSA that might help validate the DOE far-field hydrology models.

The NRC was interested in elevated concentrations of Tc-99 observed at FTF Well 28, which is screened in the lower zone of the Upper Three Runs aquifer. Contamination observed in that well had been historically linked to a release from Tank 8 after an overfill event in the early 1960s. The NRC asked for clarification regarding the continued presence of Tc-99 in that well several decades after the event.

DOE indicated that sampling is done once a year for the Eastern Groundwater Operable Unit area and twice a year for the Western Groundwater Operable Unit area. DOE also described the characterization process for choosing groundwater monitoring well sites and indicated that the purpose of monitoring the wells is to meet EPA regulations for groundwater monitoring and to detect any releases from the tanks.

The NRC staff plans to issue a TRR on these topics in CY 2014 or 2015.

Conclusions and Followup Actions
Three followup actions resulted from this technical discussion (Items 001 through 003), as shown on Table 3-3.

3.4.2.3.3 Technical Discussion—Radiation Protection Program

As stated in the FTF monitoring plan (NRC, 2013a), the NRC monitors DOE disposal actions to assess compliance with 10 CFR 61.43 for the DOE radiation protection program through MA 7 ("Protection of Individuals During Operations") under MFs 7.1 ("Protection of Workers During Operations"), 7.2 ("Air Monitoring"), and 7.3 ("ALARA"). Sections 5.1 through 5.3 of the FTF monitoring plan provide the basis for the NRC staff's monitoring reviews of DOE's radiation protection program. The NRC staff monitors both the inventory of tanks in FTF and the DOE methodology to quantify that inventory.

Results
DOE presented (1) an overview of the radiation protection program, (2) challenges with the program (e.g., grouting with tremies, contamination, interference from risers), and (3) individual doses incurred, which were at Radiation Work Permit levels. The total Tank 18 dose was 202 mrem, with a maximum individual dose of 18 mrem; and the total Tank 19 dose was 146 mrem, with a maximum individual dose of 25 mrem. DOE indicated that the major disposal activities that would incur a dose include (1) the removal of riser port plugs to obtain access to a tank, (2) the installation of tremies, cameras, lighting, and early stages of grouting, and (3) waste sampling.

The NRC staff plans to issue a TRR on these topics in CY 2014 or 2015 (or in conjunction with a future OOV).

Conclusions and Followup Actions
Four followup action items resulted from this technical discussion (Items 004 through 007), as shown in Table 3-3.

3.4.2.3.4 Technical Discussion—FTF Tanks 18/19 Final Closure Documentation

As stated in the FTF monitoring plan (NRC, 2013a), the NRC monitors DOE disposal actions to assess compliance with 10 CFR 61.41 related to FTF Tanks 18 and 19 Final Closure Documentation through MA 3 ("Cementitous Material Performance") under MF 3.4 ("Grout Performance"). Section 3.3.4 of the FTF monitoring plan provides the basis for the NRC staff monitoring reviews of grout performance.

Results
The NRC and DOE discussed the Tank 18 and 19 grouting video that had previously been provided to the NRC. The NRC and contractor staffs had observed in the video that a significant amount of segregation or bleedwater was occurring as grout was placed into the tanks, which may lead to higher hydraulic conductivity grout at the edges of the tank, because the watery component of the grout was preferentially traveling to topographically low points along the tank walls.

The NRC and DOE discussed the upcoming DOE Tanks 18/19 Final Configuration Report. The NRC staff issued a TRR on these topics, as discussed in Section 3.4.3.6 (NRC, 2013m).

Conclusions and Followup Actions
Two followup action items resulted from this technical discussion (Items 008 and 009), as shown in Table 3-3.

3.4.2.3.5 Technical Discussion—PA Maintenance Plan

As stated in the FTF monitoring plan (NRC, 2013a), the NRC monitors DOE disposal actions to assess compliance with 10 CFR 61.41 related to the DOE Order 435.1 PA maintenance plan through MA 6 ("Performance Assessment Maintenance"). Section 3.6 of the FTF monitoring plan provides the basis for the NRC staff monitoring reviews of PA maintenance.

Results
The NRC inquired about the annual update to the PA maintenance plan. DOE indicated that the plan is actually an update covering all three SRS facilities (i.e., SDF, FTF, and HTF) that the NRC is currently monitoring or that are the subject of consultations with DOE. For FTF and HTF, the two important items were: (1) computational methods/method development for impact on higher pH leachates on soils and testing K_ds, and (2) waste release/solubility assumptions.

The NRC indicated a technical concern about DOE's K_d averaging approach used to model Pu at FTF. This is important because higher mobility forms of Pu are thought to exist, based on DOE lysimeter experiments. Model fits to data suggest that K_ds for the more mobile fraction are as low as approximately 3 L/kg (approximately 1 gal/lb). Therefore, given the relatively rapid potential rates of transport of more mobile forms of Pu, it will be important for DOE to demonstrate that an insignificant fraction of higher mobility Pu exists along flow paths from the FTF (and HTF) tanks or that Pu is immobilized along the flow path.

Conclusions and Followup Actions
One followup action item resulted from this technical discussion (Item 010), as shown in Table 3-3.

3.4.2.3.6 Technical Discussion—FTF Tanks 5 and 6 Final Inventory Reports

As stated in the FTF monitoring plan (NRC, 2013a), the NRC monitors DOE disposal actions to assess compliance with 10 CFR 61.41 related to the FTF Tanks 5 and 6 Final Inventory Reports through MA 1 ("Inventory") under MFs 1.2 ("Residual Waste Sampling") and 1.3 ("Residual Waste Volume"). Sections 3.1.2 and 3.1.3 of the FTF monitoring plan provide the basis for the NRC staff reviews for monitoring the residual waste sampling and residual waste volume for FTF tanks.

Results
This technical discussion was based on NRC questions in areas of technical concern, which the NRC transmitted to DOE after reviewing the documents previously provided by DOE. The discussion focused on topics such as sampling and analysis, volume estimation, and detection limits. The NRC issued a TRR on these topics, as discussed in Section 3.4.3.4 (NRC, 2013h).

Conclusions and Followup Actions
Fourteen followup action items resulted from this technical discussion (Items 011 through 024), as shown in Table 3-3.

3.4.2.4 August 2013

The NRC staff conducted its fourth OOV (FTF Observation 2013-02) on August 27–28, 2013 (NRC, 2013g). During Observation 2013-02, discussions included: (1) FTF Tank 5 and 6 closure, and related concerns raised during the NRC staff's technical review of the final inventory development for Tanks 5 and 6 (NRC, 2013h; see Section 3.4.3.4), and the Special Analysis for Tanks 5 and 6 (NRC, 2013i; see Section 3.4.3.5), and (2) grout formula, development, and testing documentation for Tanks 5 and 6 (NRC, 2013m; Section 3.4.3.6). Additionally, the NRC staff observed the grouting of Tanks 5 and 6.

3.4.2.4.1 Technical Discussion—Technical Reviews related to FTF Tanks 5/6 Closure

As stated in the FTF monitoring plan (NRC, 2013a), the NRC monitors DOE disposal actions to assess compliance with 10 CFR 61.41 and 10 CFR 61.42 for tank closure activities through MA 1 ("Inventory") under MF 1.1 ("Final Inventory and Risk Estimates"), MF 1.2 ("Residual Waste Sampling"), and MF 1.3 ("Residual Waste Volume").

Results
The NRC discussed with DOE the current development of NRC's TRRs related to Tank 5 and 6 closures; specifically, final inventory development (NRC, 2013h), the Special Analysis for Tanks 5 and 6 (NRC, 2013i), and the TRR related to the grouting of Tanks 18 and 19 (NRC, 2013m).

Three other topics covered during this technical discussion were: (1) NRC questions to DOE transmitted on August 21, 2013, regarding two DOE documents, (2) a review of followup action items since FTF Observation 2013-01, and (3) the NRC staff's major findings and conclusions in

the Tanks 18 and 19 Special Analysis TRR (NRC, 2013k; see also Section 3.4.3.2) and Waste Release TRR (NRC, 2013l; see also Section 3.4.3.3).

During FTF Observation 2013-02, DOE provided information in response to all but one followup action item from three clarifying teleconferences held with the NRC during May 2013. DOE led a discussion about its methodology for making inventory adjustments and provided examples of using the methodology, such as for iodine (I)-129 and Tc-99. The NRC staff questioned DOE on details of the methodology and examples as well as on the basis for assuming a volume of 6,435 L (1,700 gal) of residual waste for Type I tanks that have not been cleaned when Tanks 5 and 6 had higher final residual volumes. DOE indicated that the basis for the volume of 6,435 L (1,700 gal) was that it was a factor of 10× higher than the 1.6-mm (0.0625-in.) height assumed in the FTF PA.

Regarding the conclusions in the NRC TRRs, the NRC staff reiterated its expectation that DOE would perform waste release experiments to better understand Pu solubility. Such experiments are particularly important, given the NRC staff's observations of risk-significant Pu solubility observed in Tank 18 following its cleaning. The NRC staff discussed its expectations that DOE would perform additional analyses to address the performance impact of higher mobility forms of Pu that may exist in SRS subsurface environments.

Conclusions and Followup Actions
Five followup action items resulted from this technical discussion (Items 037 to 041), as shown in Table 3-3.

3.4.2.4.2 Technical Discussion—Grout Formula, Development, and Testing Documentation and Tank 5 and 6 Grouting Observations

As stated in the FTF monitoring plan (NRC, 2013a), the NRC monitors DOE disposal actions to assess compliance with 10 CFR 61.41 and 10 CFR 61.42 for grout performance through MA 3 ("Cementitious Material Performance") under MF 3.4 ("Grout Performance").

Results
The NRC staff and DOE observed the real-time grouting of Tanks 5 and 6 and participated in extensive technical discussions, including the Tanks 5 and 6 grouting strategy, equipment, grout testing protocol, annulus and riser grouting, and the status of tank closure progression.

The NRC staff inquired about the change in grout formulation from Tanks 18 and 19, which would allow the grout to flow more easily around cooling coils in Type I tanks, such as Tanks 5 and 6. The NRC staff inquired about the maximum water-to-cement ratio and asked if a higher water-to-cement ratio was used in Tanks 5 and 6 versus Tanks 18 and 19 to achieve greater flowability. DOE indicated that the maximum water-to-cement ratio used for Tanks 5 and 6 was 0.58, which is similar to the water-to-cement ratio for Tanks 18 and 19, and that admixtures alone were used to adjust the flowability of the grout.

The NRC staff indicated that, while more contact of infiltrating groundwater with reducing grout is expected for Type I tanks with cooling coils, the main technical concern is that the FTF PA reference case does not account for bypass flow for any tank type. The NRC staff and DOE agreed that a preferential pathway case may represent a bounding scenario and discussed different methods of adding realism to the PA calculations.

The NRC staff inquired about the basis for the maximum 3-m (10-ft) drop height of grout into the tanks. DOE indicated that the drop height that is actually used is less at (1.5 m) 5 ft and that the basis for the allowable drop height is found in an American Concrete Institute standard, which allows a drop height of up to 3 m (10 ft) without additional evaluation.

Conclusions and Followup Actions
Two followup action items resulted from the technical discussion (Items 042 and 043), as shown in Table 3-3.

3.4.3 Technical Reviews

3.4.3.1 Technical Review: Updated Cost–Benefit Analysis for Removal of Additional HRRs from Tank 18

On March 21, 2013, the NRC staff issued a TRR (NRC, 2013j) on DOE's "Cost–Benefit Analysis for Removal of Additional Highly Radioactive Radionuclides from Tank 18, F-Area Tank Farm Savannah River Site" (SRR, 2012a). In this document, DOE provided a new, more rigorous cost–benefit analysis, evaluating the benefits of additional waste removal from Tank 18 versus the costs and risks associated with additional removal and delay of operational closure of Tank 18 to address the NRC comments and recommendations in the FTF TER (NRC, 2011). The NRC staff's technical review of this document supports MF 1.5, "Waste Removal (as it impacts ALARA)," in the FTF monitoring plan (NRC, 2013a).

Findings and Conclusions
The NRC staff evaluated DOE's list of alternative technologies and considered it to be adequate for the purpose of performing the cost–benefit analysis. In the TRR, the NRC staff concludes that, while DOE presented satisfying arguments for why the costs of additional cleanup of Tank 18 at this time outweigh the benefits for the reference case, the NRC staff believes that the reference case should be the long-term sensitivity analysis. Furthermore, the NRC staff notes that many additional costs were due to the time elapsed between the decision to cease HRR removal activities and the time at which the cost–benefit analysis was performed. DOE does not expect this lapse in time for future cost–benefit analyses for other FTF tanks.

For future tanks, the NRC anticipates that DOE will provide the opportunity to comment on cost-benefit analyses early in the decisionmaking process, before DOE decides to cease cleaning activities, as part of NRC's monitoring efforts under the ALARA provisions of 10 CFR Part 61, Subpart C. This will help ensure a robust analysis before proceeding with disposal actions that could significantly affect the cost–benefit analysis. DOE may engage with the NRC either in coordination with the State of South Carolina during the public comment period or as a potential OOV activity.

Followup Actions or Open Issues
No followup actions or open issues were identified in this TRR.

3.4.3.2 Technical Review of "Tank 18 and 19 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site"

On April 10, 2013, the NRC staff issued a TRR (NRC, 2013k) on DOE's "Tank 18 and 19 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site*"* (SRR, 2012b). The Tanks 18 and 19 Special Analysis is DOE's evaluation of new

information obtained since its preparation of the FTF PA (SRR, 2010). The new information included final inventories for Tanks 18 and 19 and additional key radioelement sensitivity analyses (Pu solubility and K_d). This sensitivity analysis was performed because earlier analyses showed that, considering the final inventory for Tank 18 in the reference case FTF PA model, the peak dose from Tank 18 could be significant at approximately 5 mSv/yr (approximately 500 mrem/yr) over longer simulation times. However, DOE concluded, in this Tanks 18 and 19 Special Analysis, that the additional sensitivity analysis demonstrated that the FTF base case model incorporated conservative approaches and inputs and that the peak doses associated with Pu-239 would likely occur even later. The NRC staff's technical review of the SRR document (SRR, 2012b) supports MF 1.1 ("Final Inventory and Risk Estimates") in the FTF monitoring plan (NRC, 2013a).

Findings and Conclusions

In this TRR, the NRC staff concludes that DOE has made significant improvements to its initial FTF PA solubility modeling using the latest thermodynamic data available in the literature. However, the Tank 18 and 19 Special Analysis shows that the doses associated with Tank 18 could be above or below the 10 CFR 61.41 performance objectives considering longer periods of performance. Therefore, the timing of peak dose may still be important to the compliance demonstration.

The TRR concludes that the combined impact of *all* potential conservatisms and nonconservatisms in DOE's reference PA model (SRR, 2010) is not clear; additional information is needed to support the compliance demonstration for Tank 18 and the greater FTF facility. Therefore, contrary to DOE's conclusion in the Tank 18 and 19 Special Analysis, the NRC staff continues to recommend waste release experiments to better understand Pu solubility under a range of chemical conditions. The NRC staff concluded, in this TRR, that the Tanks 18 and 19 Special Analysis provides useful information regarding the sensitivity of predicted FTF peak doses to key modeling parameters, such as Tank 18 final inventory, Pu solubility, and natural system K_d. However, to support the compliance demonstration for Tank 18 and the greater FTF facility, and due to the limited nature of the analysis, additional information is needed to address the remaining technical issues identified by the NRC in the FTF TER (NRC, 2011) that DOE analyses have not yet addressed.

Followup Actions or Open Issues

There are currently no followup actions or open issues related to this technical review.

3.4.3.3 Technical Review: Waste Release and Solubility-Related Documents Prepared by DOE To Support Final Basis for Section 3116 Determination for the FTF

A primary recommendation in the FTF TER (NRC, 2011) was that DOE should conduct waste-release experiments to increase the support for several key modeling assumptions, including (1) the evolution of pH and E_h in the grouted tank system over time, (2) the identification of HRR association with solid phases comprising the residual wastes, and (3) the solubility of HRRs under a range of expected conditions. Following issuance of the FTF TER, DOE conducted a number of studies to provide additional support for several waste-release assumptions, including (1) spectroscopic analyses of residual waste samples from Tank 18, and (2) revision of related geochemical modeling. DOE also convened a Pu-solubility peer-review group to provide expert technical advice related to residual Pu in Tank 18.

On May 31, 2013, the NRC staff issued a TRR (NRC, 2013l) on the resulting waste-release and solubility-related reports listed below. The NRC staff's technical review of these DOE documents supports MF 2.1 ("Solubility Limiting Phases/Limits") and MF 2.2 ("Chemical Transition Times") (NRC, 2013a). See the TRR for the list of documents reviewed.

Findings and Conclusions

The NRC staff concludes, in this TRR, that experimental verification of modeled solubilities of key radionuclides and solid phase analysis are still needed to provide support for key modeling assumptions in DOE's FTF PA (SRR, 2010). DOE waste-release and solubility studies conducted to date have further illustrated the need for experimental support. Analyses of residual waste indicate that Pu exists in the residual waste with a solubility that is potentially risk significant and that is inconsistent with the solubility assumptions in the FTF PA (SRR, 2010). In addition, geochemical modeling indicated that the predicted E_h threshold for increased Pu solubility is within the range of observed E_h values. Given the risk significance of Pu solubility, and consistent with previous NRC recommendations, as well as recommendations made by DOE's Pu solubility peer review group and other DOE experts, the NRC continues to believe that DOE should undertake the experimental verification of modeled Pu solubility under a range of chemical conditions potentially relevant to the contaminated zone.

The NRC staff also finds that additional information is needed regarding (1) the assumed longevity of reducing conditions in the contaminated zone, and (2) the assumption that the E_h of infiltrating groundwater remains below a critical threshold above which Pu solubility increases to risk-significant levels. These additional studies, which were not specifically discussed in the FTF monitoring plan (NRC, 2013a) yet are pertinent to closure of MFs 2.1 and 2.2, are listed as followup action items.

Followup Actions or Open Issues

The NRC staff identified two followup action items related to the closure of MFs 2.1 and 2.2 (NRC, 2013a):

- DOE should provide additional information to support assumptions regarding longevity of reducing conditions in the contaminated zone. Uncertainty in the normative mineralogy assumed in geochemical modeling should be considered under this action.
- DOE should provide additional support for the assumption that the E_h of infiltrating water will remain below a critical threshold above which Pu solubility would increase to a risk-significant value. Uncertainty in the critical threshold and the E_h of infiltrating groundwater should be considered under this action.

3.4.3.4 Technical Review: Final Inventory Documentation for Tanks 5 and 6

On September 30, 2013, the NRC staff issued a TRR entitled, "Final Inventory Documentation for Tanks 5 and 6" (NRC, 2013h), on several DOE documents that provide details about the development of the final inventory for FTF Tanks 5 and 6. The NRC staff's technical review of these documents supports MF 1.2, ("Residual Waste Sampling") and MF 1.3 ("Residual Waste Volume"), as detailed in the FTF monitoring plan (NRC, 2013a). See the TRR for the list of documents reviewed.

Findings and Conclusions

The NRC staff concludes in this TRR that DOE has made several improvements to its tank sampling and volume estimation programs. DOE's sampling and analysis program plan generally provides a technically sound approach to developing tank inventories in the future.

Training and procedures have also been developed to help formalize the tank residual volume mapping program. All of these improvements have led to a more technically defensible program. The NRC staff has identified, in this TRR, several technical concerns related to MFs 1.2 and 1.3 (NRC, 2013a); therefore, these MFs will remain open. The NRC staff will monitor progress on these technical concerns as FTF closure progresses. When the NRC staff determines that the technical concerns have been addressed, it may decide to close these MFs. If MFs 1.2 and 1.3 are closed before the development of final inventories for all FTF tanks, the NRC staff will perform a more cursory review of final inventory development under MF 1.1 ("Final Inventory and Risk Estimates") (NRC, 2013a).

Followup Actions or Open Issues

There are no open issues or followup actions associated with DOE's program for estimating final tank inventories.

The NRC discussed key findings and conclusions related to this TRR with DOE during the August 2013 OOV (NRC, 2013g; see Section 3.4.2.4.1). The NRC staff expects DOE to address the technical concerns listed in this TRR when developing inventories for FTF tanks in the future, although they were not explicitly identified in the FTF monitoring plan (NRC, 2013a), In general, the NRC staff considers inventory to be of high risk significance. However, the technical concerns identified by the NRC staff in this TRR are collectively considered to be of moderate risk significance, based on their importance to the NRC staff's conclusions regarding FTF compliance with the performance objectives in 10 CFR Part 61, Subpart C.

3.4.3.5 Technical Review: "Tanks 5 and 6 Special Analysis"

On October 4, 2013, the NRC staff issued its TRR (NRC, 2013i) on DOE's "Tanks 5 and 6 Special Analysis for the Performance Assessment for the F-Tank Farm at the Savannah River Site" (SRR, 2013). The NRC staff's technical review of this document supports MF 1.1 (Final Inventory and Risk Estimates") in the FTF monitoring plan (NRC, 2013a).

The Tanks 5 and 6 Special Analysis (SRR, 2013) updates dose estimates for the FTF using the latest information available about tank inventories (i.e., final inventories for Type I Tanks 5–6 and Type IV Tanks 17–20, and updated projected inventories for other FTF tanks). The new information includes additional key radioelement sensitivity analyses (Pu solubility and K_d).

The results of the Tanks 5 and 6 SA indicate that: (1) the peak total effective dose equivalent for a member of the public is less than 0.25 mSv/yr (less than 25 mrem/yr) considering a 10,000-year compliance period, and (2) the relatively high overall peak dose of 6 mSv/yr (600 mrem/yr) associated with Tc-99 presented in the FTF PA (SRR, 2010a), is no longer a concern.

Findings and Conclusions

As a result of (1) the review of several DOE documents that support the Tanks 5 and 6 Special Analysis, (2) a followup teleconference with DOE on May 8, 2013, and (3) discussions with DOE during the August 2013 OOV (NRC, 2013g), the NRC staff concludes that the Tanks 5 and 6 Special Analysis presents useful information about the potential risks associated with cleaned Tank 5 and Tank 6, as well as risks associated with the greater FTF. The NRC staff also concludes that additional information related to the niobium *distribution coefficient*, or K_d, is necessary to have reasonable assurance that DOE disposal actions taken at the FTF will meet the performance objectives in 10 CFR Part 61, Subpart C. Finally, technical concerns identified

by the NRC staff's review of the Tanks 18 and 19 Special Analysis (NRC, 2013k; Section 3.4.3.2) are also applicable to the Tanks 5 and 6 Special Analysis. The FTF monitoring plan (NRC, 2013a) provides a path forward for DOE to address all of the technical concerns discussed in the Tanks 18 and 19 Special Analysis TRR (e.g., additional information is needed to better understand Pu solubility and mobility in the natural environment).

Followup Actions or Open Issues
There are no open issues associated with this TRR.

The NRC staff will review and evaluate DOE results of site-specific K_d studies that include information on the niobium K_d. If the K_d for niobium is lower than assumed in the Tanks 5 and 6 Special Analysis composite analysis, then the NRC staff will evaluate the impact of lower K_d on the dose projections. This activity is considered to be of moderate- to-high risk significance based on its importance to the NRC staff's conclusions regarding the ability of DOE disposal actions at FTF to meet the 10 CFR Part 61 performance objectives.

3.4.3.6 Technical Review: DOE Documentation Related to Tanks 18 and 19 Final Configurations with an Emphasis on Grouting from Recommendations and Testing to Final Specifications and Procedures

On October 30, 2013, the NRC staff issued its TRR (NRC, 2013m) regarding a number of DOE documents that provide information on the closure of Tanks 18 and 19. The NRC staff's technical review of these documents, with an emphasis on grout formulations, testing, placement procedures, and final configurations, supports MF 3.3 ("Shrinkage and Cracking") and MF 3.4 ("Grout Performance") (NRC, 2013a). See the TRR for the list of documents reviewed.

Findings and Conclusions
The NRC staff concludes, in this Tank 18 and 19 Closure TRR, that performance requirements for DOE grout formulations recommended and tested for Tanks 18 and 19 closure are generally consistent with bulk, initial chemical and hydraulic properties assumed in DOE's FTF PA (SRR, 2010). However, the NRC staff also concludes that DOE has not provided sufficient information and testing to adequately invalidate alternative conceptual models of preferential flow through or around the tank grout monolith that might result from grout shrinkage and cracking, thereby justifying the exclusion of such models from its reference case (Case A).

The NRC staff thinks that DOE's conclusion that the temperature rise was sufficiently low for bulk grouting of Tanks 18 and 19, based upon a 0.8-m^3 (1- yd^3) bulk scale-up test was unsubstantiated by this test; the NRC staff will continue to evaluate this technical issue in future OOVs. A more detailed thermal analysis that considers the specific grout pour sequence and geometry to determine the potential for thermal cracking of the tank grout would improve model support. The NRC staff expects DOE to provide additional information on the potential for thermal cracking of the grout monoliths for Tanks 18 and 19.

The NRC staff is concerned that the use of commercially available Portland cement in Tanks 18 and 19 that differs from the grout mix considered in the FTF PA (SRR, 2010), because of the substitution of up to 5-percent limestone by weight, would lower the pH buffering capacity of the grout and could affect the timing of release of HRRs. Evaluating the effect of limestone substitution in Portland cement on the pH buffering capacity of the grout and the release of key

radionuclides improves model support for the modeling of chemical states and transitions of water contacting the residual waste.

Followup Actions or Open Issues
No open issues resulted from this technical review. The NRC staff will continue to monitor DOE's grout formulations under MF 3.3 ("Shrinkage and Cracking") and MF 3.4 ("Grout Performance") (NRC, 2013a), focusing on the technical concerns discussed in this TRR (NRC, 2013m).

3.4.3.7 Technical Review: Tanks 5 and 6 Closure Module

In February 2013, the NRC staff reviewed DOE's "Industrial Wastewater Closure Module for the Liquid Waste Tanks 5F and 6F F-Area Tank Farm, Savannah River Site" (DOE, 2013b), and supporting references, and provided comments to SCDHEC (NRC, 2013n). SCDHEC approves the Tanks 5 and 6 closure module as part of the overall process for closure of the FTF facility. The NRC conducted its review of the closure module in fulfillment of its monitoring responsibilities under the NDAA. More specifically, the NRC staff conducted the review of the Tanks 5 and 6 closure module to support MF 1.5 ("Waste Removal (As It Impacts ALARA)"), listed in the FTF monitoring plan.

In its final WD for FTF, DOE indicates that it complies with the ALARA criteria specified in 10 CFR 61.41 through its demonstration that HRRs have been removed to the maximum extent practical. The NRC staff also agrees that an evaluation of the practicality of additional key radionuclide removal, or a similar type of evaluation, is important to demonstrate that ALARA criteria can be met. Because, at the time of preparation of the FTF TER (NRC, 2011), many of the tanks at FTF had not undergone waste retrieval operations or had a final inventory developed (i.e., Tanks 5 and 6), the NRC staff added MF 1.5 to evaluate DOE's compliance with ALARA criteria for Tanks 5 and 6 and other FTF tanks that have not yet been cleaned.

Findings and Conclusions
In its comments, the NRC staff noted that the Tanks 5 and 6 closure module (DOE, 2013b) provides a well-documented and comprehensive summary of DOE efforts to retrieve waste from the Type I tanks, Tanks 5 and 6, at FTF. The NRC staff encouraged DOE to perform a comprehensive evaluation of (1) the effectiveness and limitations of various cleaning technologies employed during Tanks 5 and 6 waste retrieval campaigns, and (2) alternative technologies that could be developed to overcome these limitations to facilitate future tank closures.

The NRC staff indicated, in its comments on the Tanks 5 and 6 closure module, that it plans to complete evaluation of the costs and benefits of additional radionuclide removal from Tanks 5 and 6 following a review of other DOE documentation. For example, an assessment of the long-term risks associated with residual waste in Tanks 5 and 6 is important in determining the benefits of additional radionuclide removal from these tanks. Therefore, the NRC staff review of the Tanks 5 and 6 Special Analysis (SRR, 2013) and other documentation that evaluate the risks of residual waste in Tanks 5 and 6 is also important in determining the extent to which closure of Tanks 5 and 6 is consistent with ALARA requirements in 10 CFR 61.41. Section 3.4.3.5 discusses a separate TRR documenting the review of the Tanks 5 and 6 Special Analysis.

Followup Actions or Open Issues
There are currently no followup actions or open issues related to this technical review.

3.4.4 Summary of Open Issues and Followup Actions

There are no open issues resulting from FTF Observations 2012-01, 2012-02, 2013-01, or 2013-02. All the followup action items identified during the CY 2012 and 2013 OOVs have been completed, as shown in Table 3-3.

FTF Observation 2013-02 was the second OOV to occur following issuance of NRC's FTF monitoring plan (NRC, 2013a). During CY 2012 and 2013, the NRC staff did not close any MAs or MFs. Therefore, all 8 FTF MAs and all 26 MFs shown in Table 3-1 and Table 3-2 remain open. Based upon the results of the OOVs, there were no changes to the NRC staff's FTF TER conclusions (NRC, 2011) regarding compliance of DOE disposal actions with the 10 CFR Part 61 performance objectives.

4.0 MONITORING AT THE IDAHO NATIONAL LABORATORY IDAHO NUCLEAR TECHNICAL AND ENGINEERING CENTER IN CALENDAR YEARS 2012 AND 2013

4.1 Introduction

INL is a 2,305-square-km (890-square mi) U.S. Government facility located in southeastern Idaho. Established in 1953, the Idaho Chemical Processing Plant, now the INTEC, was chartered to recover fissile uranium by reprocessing SNF. The spent fuel was dissolved, producing an acidic aqueous solution that was processed through a first-cycle extraction system to separate uranium from the bulk of the fission products (or first-cycle extraction waste). The separated uranium was processed through a second- and third-cycle extraction system to remove carryover radioactive material, which included Pu and transuranic radionuclides. INTEC, located approximately 29 km (18 mi) from the nearest INL site boundary, is home to the TFF, which has been used to store various INTEC wastes, including those from SNF reprocessing (first-, second-, and third-cycle reprocessing wastes), decontamination waste, laboratory waste, and contaminated liquids from other INTEC operations. In 1992, DOE officially discontinued reprocessing SNF at INTEC, and by February 1998, the first-cycle extraction process wastes stored in the TFF were removed and solidified by calcination (i.e., a thermal process whereby liquids are converted to solid oxides). In general, because of significantly higher radioactivity levels, first-cycle reprocessing wastes were segregated from the other types of liquid waste. These other tank wastes, referred to as sodium-bearing waste (SBW) because of their high sodium levels, were lower activity wastes than first-cycle reprocessing wastes and had a significantly different chemical composition than first-cycle reprocessing wastes.

In total, there are 15 waste storage tanks at the TFF, including eleven 1,136-m^3 (300,000-gal) tanks and four 114-m^3 (30,000-gal) tanks, as well as interconnecting transfer piping, and secondary containment components for the transfer piping. Placed into service between 1953 and 1966, the 11 large tanks (WM-180 through WM-190) are approximately 15.2 m (50 ft) in diameter and 6.4 to 7.0 m (21 to 23 ft) in height. Nine of the eleven large tanks are constructed of Type 304L stainless steel, whereas the other two tanks (WM-180 and WM-181) are constructed of Type 347 stainless steel. The four inactive and relatively small, stainless steel, below-grade storage tanks (WM-103 through WM-106) were constructed on reinforced concrete pads in 1954 and removed from service in 1983. These tanks are horizontal cylinders approximately 3.5 m (11.5 ft) in diameter and 11.6 m (38 ft) in length. All 11 of the large tanks are housed in concrete vaults approximately 13.7 m (45 ft) below grade, whereas the 4 smaller tanks have no vaults.

Waste retrieval and grouting operations have been completed for 7 of the 11 large tanks (WM-180 to -186) and all 4 of the smaller tanks (VES-WM-103 to -106). Four large tanks (WM-187 to -190) have not yet been cleaned; however, DOE assumes, in the INTEC TFF PA, that these tanks will be cleaned as efficiently as the other large tanks. DOE is currently performing startup tests for the Integrated Waste Treatment Unit (IWTU) and plans to begin final SBW transfers from the four large tanks that remain to be cleaned to the IWTU in CY 2015. After the bulk SBW is transferred from each of these four tanks, DOE plans to initiate waste removal operations to reduce the residual tank waste heels to the maximum extent practical to satisfy NDAA criteria.

Since monitoring activities began at the INTEC TFF during CY 2007 through the end of CY 2013, the NRC has completed five OOVs (including one in CY 2012) and various data reviews. Each monitoring activity is associated with a public document describing the details of the activity. Each OOV is preceded by an onsite observation guidance document, which states the objectives of the observation and the relationship between each observation objective and its respective 10 CFR Part 61 performance objective. Following an OOV, the NRC staff documents the activities that took place during the observation in an OOV report, which assesses how the NRC staff's monitoring activities relate to their respective 10 CFR Part 61 performance objectives and what conclusions the NRC staff drew from the observation activities.

4.2 Background

On September 7, 2005, DOE submitted to the NRC a draft basis document for the WD for residual waste incidental to reprocessing stored in the INTEC TFF to demonstrate compliance with the NDAA criteria, including demonstration of compliance with the 10 CFR Part 61 performance objectives. In its consultation role, the NRC staff reviewed the draft basis for the WD, the associated PA (DOE-Idaho, 2003), and related documents and concluded that there was reasonable assurance that the applicable NDAA criteria could be met for residual waste stored in the INTEC TFF. The NRC staff documented the results of its review in a TER issued in October 2006 (NRC, 2006). DOE issued a final WD in November 2006 (DOE-Idaho, 2006), taking into consideration the assumptions, conclusions, and recommendations documented in NRC's TER.

To carry out its monitoring responsibilities under the NDAA, the NRC staff developed a monitoring plan for the INTEC TFF facility in April 2007 (NRC, 2007c), based on the risk-significant monitoring areas identified in the TER. Appendix B contains the complete list of KMAs and monitoring activities for INL INTEC TFF.

The NRC staff conducted two OOVs in 2007 to observe tank grouting operations (7 of 11 large tanks and 4 smaller tanks) at the INTEC TFF. All open items identified in the first OOV conducted in April 2007 were closed in the August 2007 OOV. The NRC documented the results of its technical reviews of KMA 3 and 4 in the Periodic Monitoring Compliance Report for CY 2007 (NRC, 2008).

In August 2008, the NRC staff participated in a third OOV to observe pipe grouting operations, radiation protection controls, and the environmental sampling program. No findings resulted from the three OOVs. The NRC documented the results of its technical reviews of KMA 3 and 4 in the Periodic Monitoring Compliance Report for CY 2008 (NRC, 2009). No tank farm closure activities occurred in CY 2009; therefore, the NRC staff elected to forego an onsite observation. Nonetheless, as was the case in previous years, the NRC documented the results of its technical reviews of KMA 3 and 4 in the Periodic Monitoring Compliance Report for CY 2009 (NRC, 2010).

Various activities, including the demolition of 31 structures previously associated with the grouted tanks occurred at the site during CY 2010. Given the time elapsed since the last onsite observation, the NRC staff decided to conduct a fourth OOV in August 2010 to conduct a tour of INL INTEC facilities. The NRC also documented the results of its technical reviews of KMA 3 and 4 in the Periodic Monitoring Compliance Report for CY 2010 (NRC, 2012h).

In CY 2011, the NRC staff did not make any observation visits to INTEC TFF, because there were no active operations on site during the year. The NRC staff again conducted its technical reviews of KMA 3 and 4 and documented the results in the Periodic Monitoring Compliance Report for CY 2011 (NRC, 2012i).

During CY 2012, the NRC conducted the fifth OOV at the site to obtain additional information and observe disposal actions related to closure of the remaining four large tanks. The results of this OOV on June 19, 2012, are summarized in Section 4.4.1. During CY 2013, the NRC staff did not visit the INTEC TFF, because there were no active operations at the site. In early CY 2014, the NRC staff conducted technical reviews for KMA 3 and KMA 4 related to the evaluation of 10 CFR 61.43. The reviews included data collected during CY 2012–2013 and were documented in two separate TRRs (NRC, 2014a; NRC, 2014c). These TRRs are summarized in Section 4.4.2. Appendix C provides a visual depiction of the timeline of NRC monitoring of the INTEC TFF facility under the NDAA from 2007 to 2013.

4.3 Disposal Actions in CY 2012 and 2013

There were no disposal actions at INTEC TFF in CY 2012 and 2013. There have been delays in the schedule for closure of the final four large tanks (including one spare tank) related to issues with the startup of the IWTU that will be used to treat the SBW remaining in the tanks. During testing in 2012, the IWTU, which is a steam reforming processing unit that will be used to process the remaining SBW to be removed from the HLW tanks, suffered damage during an over-pressurization event. Since the 2012 event, the IWTU had to be redesigned, thereby delaying waste removal for the remaining four large tanks, WM-187–190. Despite uncertainty in the startup of the IWTU, DOE has recently taken steps to prepare for bulk waste removal, heel retrieval, and grouting of the final four large tanks, including design modifications, refurbishment and testing of existing wash equipment; fabrication and installation of steam jets and aboveground transfer lines; activation of wash procedures; and preparation of liquid transfer sheets to support cleaning operations. DOE made modifications to wash and grout equipment based on lessons learned from prior campaigns (e.g., spare tank WM-190 was outfitted with a wash ball and steam jet to facilitate testing and readiness when the IWTU comes online).

4.4 NRC Monitoring Activities in CY 2012 and 2013

One OOV was conducted at INL INTEC TFF during CY 2012 (NRC, 2012g) to monitor disposal actions. Before this OOV, the NRC staff met with IDEQ to discuss its INL oversight program, specifically related to its independent environmental surveillance program for monitoring at INTEC. No OOVs were conducted during CY 2013, because there were no active operations at the site. During CY 2012 and 2013, the NRC staff's monitoring of the TFF resulted in no findings of noncompliance.

4.4.1 June 2012 Onsite Observation Visit

The NRC staff's June 19, 2012, OOV (INTEC TFF Observation 2012-01; NRC, 2012g) focused on compliance with respect to 10 CFR 61.43. In particular, the NRC staff focused on verifying DOE's radiation protection and EM programs at the INTEC TFF. Because EM data also provide information to assess PA models, this OOV partially addressed the 10 CFR 61.41 performance objective. Details from the OOV are summarized below.

4.4.1.1 Radiation Protection

During the OOV, the NRC staff participated in discussions with DOE and its contractor staff regarding the completed and planned INTEC TFF closure activities, to obtain a better understanding of the types of activities that may lead to the greatest risks to radiation workers and members of the public during tank farm closure. The NRC staff also obtained information regarding radiological controls during washing and grouting operations and received a briefing about schedule delays for closure of the four large tanks. DOE also discussed differences between the tanks that have been cleaned and the four remaining large tanks (e.g., differences in cooling coil supports). After the briefing, the NRC staff performed a walk-down of the INTEC TFF facilities, including a tour of the operations center where video surveillance equipment is used to facilitate tank washing and grouting, and direct observation of radiological controls used to minimize worker doses during tank closure activities.

Results
NRC staff identified no new open issues related to DOE's radiation protection program.

Conclusions and Follow-up Actions
The NRC staff identified no follow-up action items related to DOE's radiation protection program. The NRC staff concluded that it has reasonable assurance that 10 CFR 61.43 can be met at the INTEC TFF. The NRC staff will continue to monitor DOE's radiation protection program related to INTEC TFF closure during future OOVs or through a technical review of documentation, such as radiation work permits, worker dose records, and ALARA documentation, as INTEC TFF closure activities progress.

4.4.1.2 Environmental Monitoring

During INTEC TFF Observation 2012-01, the NRC staff listened to DOE presentations and participated in discussions with DOE and its contractor staff regarding ongoing remedial actions and groundwater monitoring activities performed under the Comprehensive Environmental Response, Compensation, and Liability Act program at the INTEC TFF. The NRC staff inquired about continued sampling of a groundwater well (ICPP-MON-A-230) located north of the INTEC TFF, which had elevated concentrations of Tc-99 over the past several years. The NRC staff obtained information regarding the latest groundwater monitoring results and recently issued groundwater monitoring reports. The NRC staff completed and documented its review of these documents, as discussed in Section 4.4.2.1.

The NRC staff also inquired about DOE's PA maintenance plan and annual checklist used to facilitate decision-making regarding the need for supplementary analyses or modifications to key closure documents. DOE gave the NRC staff the "Compliance and Monitoring Plan for Performing Grouting at the INTEC Tank Farm Facility Closure Project" (DOE-Idaho, 2010). Appendix D of this plan contains a checklist that indicates the types of triggers that might warrant further evaluation. DOE used this checklist for the site in CY 2010 and its evaluation triggered a supplementary analysis by DOE to evaluate the impact of more vertical (rather than lateral) flow of groundwater released from INTEC tanks to the Snake River Plain Aquifer. Based on the supplementary analysis, DOE concluded that the doses could be a factor of 2 higher than predicted by the PA (DOE-Idaho, 2003). However, the doses were still significantly below the 10 CFR Part 61 performance objectives. The NRC staff reviewed DOE's supplementary analysis and found it to be acceptable. The results of the NRC staff's review of the supplementary analysis were provided in the Periodic Compliance Monitoring Report for CY 2011 (NRC, 2012i).

Results
The NRC staff identified no open issues related to DOE's EM program. The NRC staff finds DOE's annual checklist to be an adequate tool to ensure that new and significant information that may impact the conclusions in DOE's WD (DOE-Idaho, 2006) or supporting PA (DOE-Idaho, 2003) to ensure that INTEC TFF disposal actions are compliant with the 10 CFR Part 61 performance objectives.

Conclusions and Followup Actions
The NRC staff identified no followup action items. The NRC staff continues to coordinate monitoring with the IDEQ and to rely on IDEQ's oversight of INTEC TFF activities through its independent environmental surveillance program. The NRC staff continues to have reasonable assurance that the 10 CFR Part 61 performance objectives can be met at the INTEC TFF.

4.4.2 Technical Reviews

The NRC staff conducted two technical reviews that included a review of CY 2012 and CY 2013 environmental data in early CY 2014 (NRC, 2014a; NRC, 2014c), as summarized below.

4.4.2.1 Technical Review for Key Monitoring Area 3

KMA 3 can be described as "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 and TER are addressed. If significant new information is found, this information should be evaluated against the PA and TER conclusions… (see Appendix B)

KMA 3 was developed as a result of the NRC staff's review of the INTEC TFF draft basis document for the WD and supporting PA, as documented in the NRC TER (NRC, 2006), which showed a number of uncertainties associated with DOE's groundwater model used to support its demonstration of compliance with 10 CFR 61.41 for protection of the general population from releases of radioactivity. Some of the largest hydrogeological uncertainties impacting facility performance were related to infiltration rates and the impact of Big Lost River seepage on contaminant releases from the tank farm. However, because a large safety margin exists between the performance standard of 0.25 mSv/yr (25 mrem/yr) and DOE's estimated peak dose of 0.005 mSv/yr (0.5 mrem/yr), the NRC staff was able to conclude with reasonable assurance that natural system uncertainty could be managed with conservative assumptions. For example, although the NRC staff believes there is uncertainty in the amount of dilution DOE assumes will occur in the natural system, the NRC staff concluded through independent analysis that, even with less dilution assumed for key radionuclides such as Tc-99 and I-129, the doses at the site would meet the 0.25 mSv/yr (25 mrem/yr) standard.

As stated in the monitoring plan for the INTEC TFF (NRC, 2007c), the NRC staff planned to continue to stay abreast of relevant monitoring and modeling activities conducted by DOE, other agencies, or independent researchers until such time that the NRC staff could confidently conclude that overall system performance was adequately studied and constrained.

In May 19, 2014, the NRC staff issued a TRR entitled, "Technical Review of Hydrological Studies and Data for Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center, Tank Farm Facility" (NRC, 2014a). The NRC staff reviewed several documents

prepared by DOE and its contractors that provide information on the hydrological system at the site.

Findings and Conclusions

The NRC staff reviewed a DOE supplemental groundwater analysis that addresses technical concerns identified by the NRC staff in its INTEC TFF TER (NRC, 2006). The NRC staff concluded that, while changes to uncertain parameter values (e.g., infiltration rates, aquifer Darcy velocity, dispersivity, and well screen thickness) that affect GWSCREEN modeled dilution could lead to higher projected doses, the NRC staff is confident that the safety margin is sufficient to ensure that 10 CFR 61.41 can be met with the selection of more conservative parameter values. Finally, the NRC staff's review of recent monitoring reports in 2012 and 2013 reveals no new and significant information that would alter the NRC staff's TER conclusions (NRC, 2006). Therefore, the NRC staff continues to have reasonable assurance that the 10 CFR Part 61 performance objectives can be met.

KMA 3 was developed by the NRC staff to manage technical uncertainties identified in the NRC staff's INTEC TFF TER. The NRC staff has reviewed a number of hydrological studies and EM reports since it began monitoring the INTEC TFF in 2007. While review of this additional information has increased the NRC staff's understanding of the hydrological system at the INTEC TFF, the information has not fundamentally changed the NRC staff's understanding of the technical uncertainties, nor has it changed its TER conclusions. Therefore, the NRC staff decided to close KMA 3 in May 2014, which is notably the first time a KMA has been closed under the NDAA (NRC, 2014b). This decision is based on (1) years of NRC review of DOE- and DOE contractor-prepared documents, including a supplemental groundwater analysis that addresses technical concerns documented in the NRC staff's TER, and (2) results of NRC OOVs related to INTEC TFF tank closure activities. If technical issues arise in the future, the NRC staff may reopen KMA 3 or create a new monitoring area. The NRC staff will also continue to review EM reports routinely under KMA 4 (see next section), in conjunction with future OOVs.

4.4.2.2 Technical Review for Key Monitoring Area *4*

KMA 4 can be described as "monitoring during operations":

> Closure and post-closure operations (until the end of active institutional controls, 100 years) will be monitored to ensure that the §61.43 performance objective (protection of individuals during operations) can be met. As part of this assessment radiation records, environmental monitoring, and exposure assessment calculations may be reviewed. (See Appendix B.)

On April 15, 2014, the NRC staff issued a TRR entitled, "Environmental Monitoring Programs at Idaho National Laboratory, Idaho Nuclear Technology and Engineering Center" (NRC, 2014c). The NRC staff performed a technical review of the EM program reports prepared by (1) Gonzales Stoller Surveillance, LLC, a contractor for INL, and (2) the IDEQ. This technical review considered EM activities conducted at INTEC and INL, in general, from January 2011 through September 2013.

Findings and Conclusions

As a result of this review, 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. Other than some increases in radioactivity levels detected during March and

April 2011, following the Fukushima accident, the NRC staff found the monitoring results to be consistent with monitoring reports reviewed in previous years. In general, radioactivity levels remained the same or continued to decrease.

Based on the findings from this review and those from previous years, the NRC staff thinks that it is no longer necessary to perform a separate annual review of the EM programs and exposure assessment calculations associated with INL. The NRC staff will continue to include EM and exposure assessments as part of the OOVs. DOE should also continue to provide information to the NRC on specific 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 well as other EM issues that may be of concern. This includes information regarding worker or public dose exceedances within a reasonable timeframe of their occurrence.

4.4.3 Summary of Open Issues and Followup Actions

There are no new open issues or followup actions for the INTEC TFF as a result of the Observation 2012-01 or the technical reviews of KMA 3 and KMA 4. Based on the analysis conducted by DOE and the NRC staff's review of documentation, the NRC staff is confident that the current radiation protection program at INTEC TFF can meet the 10 CFR 61.41 and 10 CFR 61.43 performance objectives. DOE provided proper documentation to demonstrate that activities were being conducted in a manner that is protective of individuals during operations.

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6.0 GLOSSARY

Note: Many of the terms listed below are defined in the 2013 Saltstone Disposal Facility (SDF) and the F-Tank Farm (FTF) monitoring plans and are consistent with the updated monitoring program. The terms listed below that are consistent with the 2007 Idaho National Laboratory (INL) Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) monitoring plan are specified to be INL-specific terms.

Followup Action	Items identified during monitoring that require additional effort by the U.S. Department of Energy (DOE) to resolve. Examples include DOE providing answers to questions generated during technical reviews or DOE providing the results of a particular experiment after it becomes available. A Followup Action is less risk significant than an Open Issue.
Highly Radioactive Radionuclides (also called Key Radionuclides)	Radionuclides that contribute most significantly to risk to the public, workers, and the environment. In the context of the National Defense Authorization Act (NDAA), the U.S. Nuclear Regulatory Commission (NRC) staff considers "Highly Radioactive Radionuclides," to be equivalent to "Key Radionuclides" used in the DOE Manual (DOE M 435.1-1) for DOE Order 435.1, the West Valley Policy Statement, and in some NRC reviews of DOE Waste Determinations (WDs). In the context of an NRC review of a DOE WD conducted under the NDAA, "Highly Radioactive Nuclides" are not (in general) limited to radionuclides with high specific activity.
K_d (Distribution Coefficient)	A measure of the partitioning of a substance between water and a solid (e.g., cement or sediment). It describes the ability of a porous material to retain chemical constituents.
Monitoring Area (MA)	A general feature or aspect of the disposal action identified by the NRC as being important to DOE's ability to meet the performance objectives of Title 10 of the *Code of Federal Regulations* (10 CFR) Part 61, Subpart C. An MA is further divided into one or more specific Monitoring Factors (MFs).

Monitoring factor (MF)	A specific feature of the disposal action (e.g., conceptual model assumption, mathematical modeling assumption, parameter value) that DOE used in its performance demonstration that the NRC has determined to be important to demonstrating compliance with the performance objectives of 10 CFR Part 61. The NRC typically identifies an MF through the review of a DOE WD, performance assessment (PA), information that DOE generated during monitoring (e.g., technical report on laboratory or field experiment), or other information collected during monitoring (e.g., during an NRC onsite observation visit). An MF is associated with an MA and tracked as either Open or Closed.
Open issue	A concern that NRC staff identifies during monitoring that requires additional information from DOE to address questions regarding DOE disposal actions. Examples include an MF that DOE has not taken sufficient action to address or an instance where data collected by DOE are not consistent with assumptions (e.g., conceptual model assumptions, mathematical assumptions, parameter values) that DOE made in the PA. An Open Issue is more risk significant than a Followup Action. An Open Issue could lead to a noncompliant performance objective.
Performance Assessment (PA)	A type of systematic risk analysis that addresses the following four questions: (i) what can happen, (ii) how likely is that to happen, (iii) what are the resulting impacts of that happening, and (iv) how do those impacts compare to specifically defined standards.
Performance Objective (PO)	One of five 10 CFR Part 61, Subpart C, requirements for low-level waste disposal facilities, which are: (i) general requirement (10 CFR 61.40), (ii) protection of the general population from releases of radioactivity (10 CFR 61.41), (iii) protection of individuals from inadvertent intrusion (10 CFR 61.42), (iv) protection of individuals during operations (10 CFR 61.43), and (v) stability of the disposal site after closure (10 CFR 61.44).

Waste Determination (or Non-High-Level Waste Determination)	DOE documentation required by Section 3116 of the NDAA, which demonstrates that a specific waste stream is not high-level waste.
Worker	DOE or contractor staffs who carry out operational activities at the land disposal facility.

INL-Specific Terms

Key monitoring area	An area 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.

APPENDIX A: NATIONAL DEFENSE AUTHORIZATION ACT

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: MONITORING SUMMARY TABLE FOR INL INTEC TFF

Table B-1: Monitoring at at INL INTEC TFF (NRC, 2007c)

10 CFR Part 61 Performance Objectives	Monitoring Area	Description	Monitoring Activity Code	Type[1]	Status[2]
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, 2005). After cleaning, DOE should review sampling data and analysis of tanks WM-187 through WM-190 to ensure that the inventory for these tanks is not significantly underestimated (i.e., similar or better waste retrieval will be achieved).	Review sampling and analysis plans (SAPs) and data quality assessments 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

[1] There are two main types of monitoring activities: T=technical review activities; O=onsite observation activities.

[2] The activities are tracked as open, open-noncompliant, or closed. The glossary defines these terms. Note that an open activity is different from an open issue.

Table B-1: Monitoring at at INL INTEC TFF (NRC, 2007c)

10 CFR Part 61 Performance Objectives	Monitoring Area	Description	Monitoring Activity Code	Type[1]	Status[2]
			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
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 WM-190. (INL-TFF-42-01-06-T)	T	Open
61.41	KMA 2, Grout Formulation and Perf.		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

Table B-1: Monitoring at at INL INTEC TFF (NRC, 2007c)

10 CFR Part 61 Performance Objectives	Monitoring Area	Description	Monitoring Activity Code	Type[1]	Status[2]
			Evaluate the final grout formulation for consistency with design specifications. (INL-TFF-41-02-04-O)	O	Open

		The final grout formulation used to stabilize the Idaho Nuclear Technology and Engineering Center (INTEC) Tank Farm Facility (TFF) waste should be consistent with design specifications, or significant deviations should be evaluated to ensure that they will not negatively impact the expected performance of the grout. The reducing capacity of the tank grout is important to mitigating the release of technetium-99. Short-term performance of as-emplaced grout should be similar to or better than that assumed in the Performance Assessment (PA) release modeling, or significant deviations should be evaluated to determine their significance with respect to the conclusions in the PA and technical evaluation report (TER). The short-term performance of the grouted vault is especially important to mitigate the release of short-lived radionuclides, such as strontium-90, from the contaminated sand pads that could potentially dominate the predicted doses from the TFF within the first few hundred years.	Evaluate the risk significance of any deviations in the final grout formulation from design specifications. (INL-TFF-41-02-05-O)	O	Open
61.41 (cont.)	KMA 2, Grout Formulation and Perf.		Evaluate the DOE program for sampling, testing, and accepting grout materials. (INL-TFF-41-02-06-O)	O	Closed

Table B-1: Monitoring at at INL INTEC TFF (NRC, 2007c)

10 CFR Part 61 Performance Objectives	Monitoring Area	Description	Monitoring Activity Code	Type[1]	Status[2]
	(cont.)		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 strontium-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 the DOE 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

Table B-1: Monitoring at at INL INTEC TFF (NRC, 2007c)

10 CFR Part 61 Performance Objectives	Monitoring Area	Description	Monitoring Activity Code	Type[1]	Status[2]
61.43	KMA 4[3], Monitoring during Operations	Closure and post closure operations (until the end of active institutional controls, which is 100 years) will be monitored to ensure that the performance objective in §61.43, "Protection of Individuals during Operations," can be met.	Review DOE Idaho radiation protection program to ensure that 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 IDEQ environmental surveillance program. (INL-TFF-43-04-04-O)	O	Open

[3] This KMA was closed in 2014. This is the first KMA to be closed in the monitoring program. .

Table B-1: Monitoring at at INL INTEC TFF (NRC, 2007c)

10 CFR Part 61 Performance Objectives	Monitoring Area	Description	Monitoring Activity Code	Type[1]	Status[2]
61.41	KMA 5, Engineered Surface Barrier/ Infiltration Reduction	INTEC infiltration controls and the construction and maintenance of an engineered cap over the TFF under the Comprehensive Environmental Response, Compensation, and Liability 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
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

Table B-1: Monitoring at at INL INTEC TFF (NRC, 2007c)

10 CFR Part 61 Performance Objectives	Monitoring Area	Description	Monitoring Activity Code	Type[1]	Status[2]
61.41	Update Perf. Assessment	DOE Order 435.1, "Radioactive Waste Management," requires that the DOE PA be reviewed and revised when there are changes in waste form 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	Routine review of environmental monitoring data (or studies), and associated 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
61.41 and 61.43	Environmental Review and		Observe the installation of monitoring wells and instrumentation. (INL-TFF-41-RE-03-O)	O	Open

Table B-1: Monitoring at at INL INTEC TFF (NRC, 2007c)

10 CFR Part 61 Performance Objectives	Monitoring Area	Description	Monitoring Activity Code	Type[1]	Status[2]
	Environmental Sampling (cont.)		Observe sampling activities. or Rely on IDEQ oversight program. (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

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DOE, 2001. U.S. Department of Energy, DOE Order 435.1, "Radioactive Waste Management." Washington, DC, August 2001.

DOE, 2005. U.S. Department of Energy, "Draft Section 3116 Determination Idaho Nuclear Technology and Engineering Center Tank Farm Facility–Draft," DOE/NE–ID–11226, Rev. 0, Idaho Falls, ID, September 2005.

NRC, 2007b. U.S. Nuclear Regulatory Commission, "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," Washington, DC, May 3, 2007, ADAMS Accession No. ML070730363.

NRC, 2007c. U.S. Nuclear Regulatory Commission, "Nuclear Regulatory Commission Plan for Monitoring the 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," Washington, DC, April 13, 2007, ADAMS Accession No. ML070650222.

APPENDIX C: NRC MONITORING ACTIVITIES TIMELINE FOR SDF, FTF, AND INL INTEC TFF

Monitoring Activities at the Saltstone Disposal Facility at the Savannah River Site 2007 to 2013

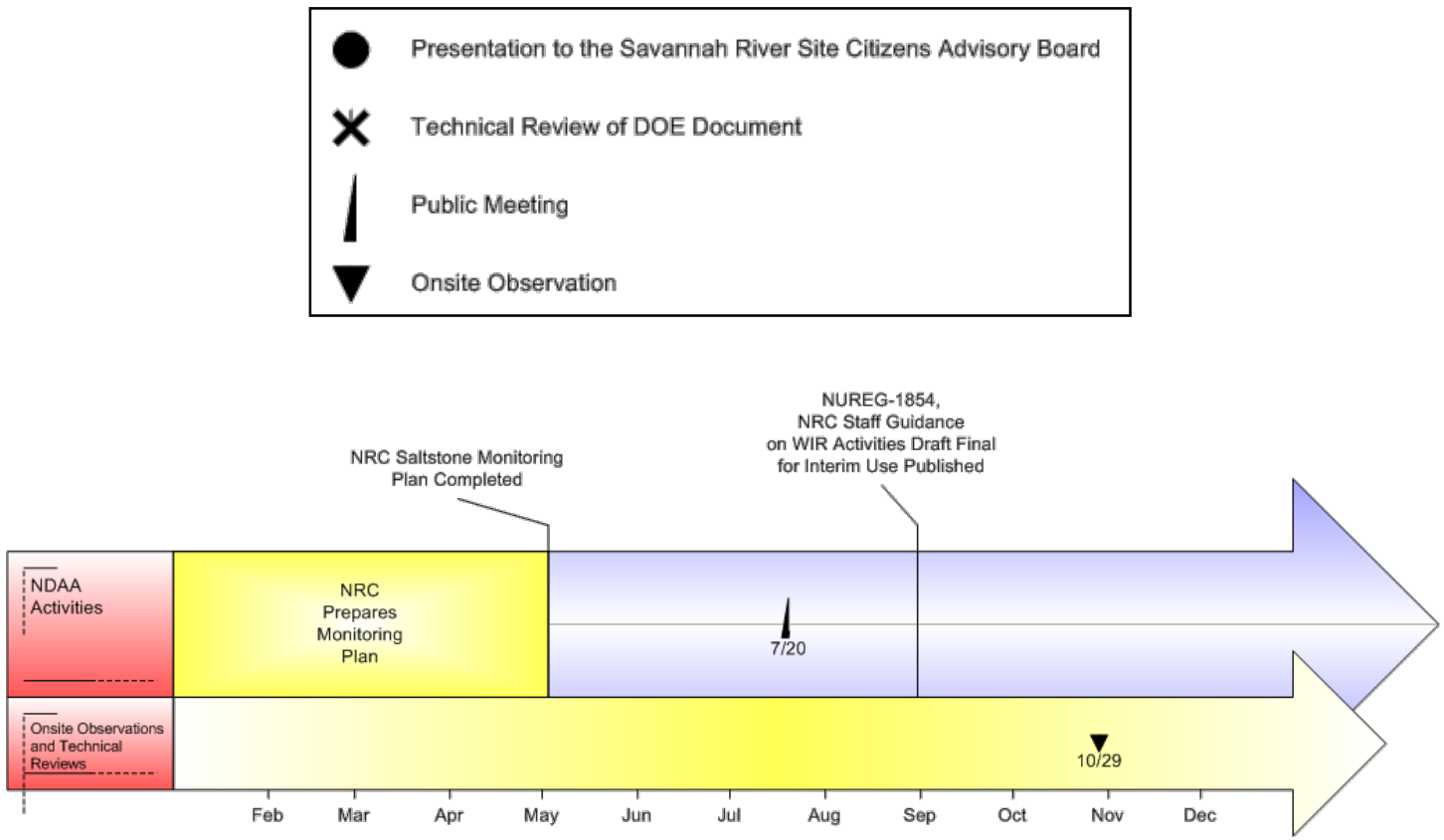

Figure C-1: NRC NDAA, Section 3116 Monitoring at SDF in 2007

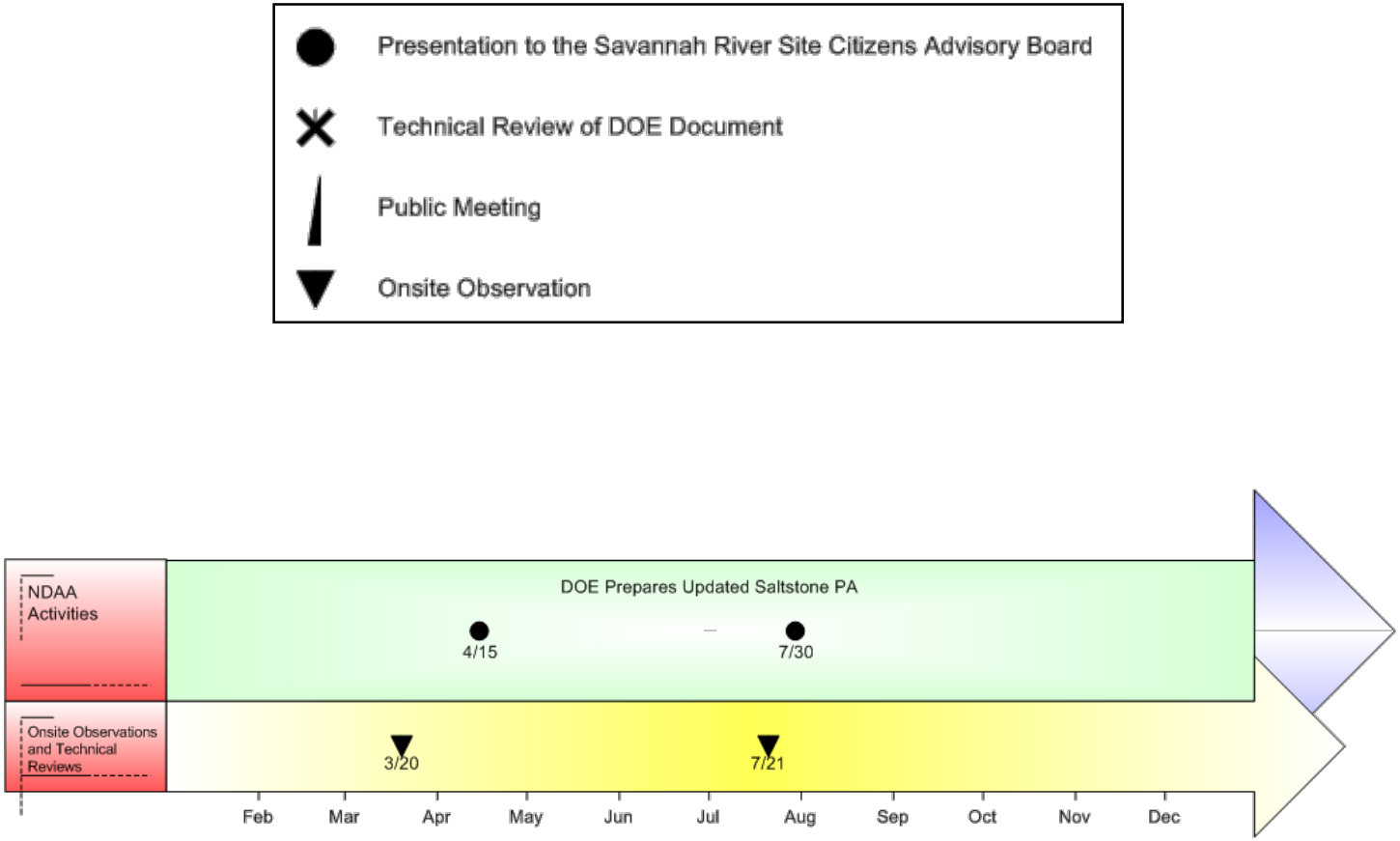

Figure C-2: NRC NDAA, Section 3116 Monitoring at SDF in 2008

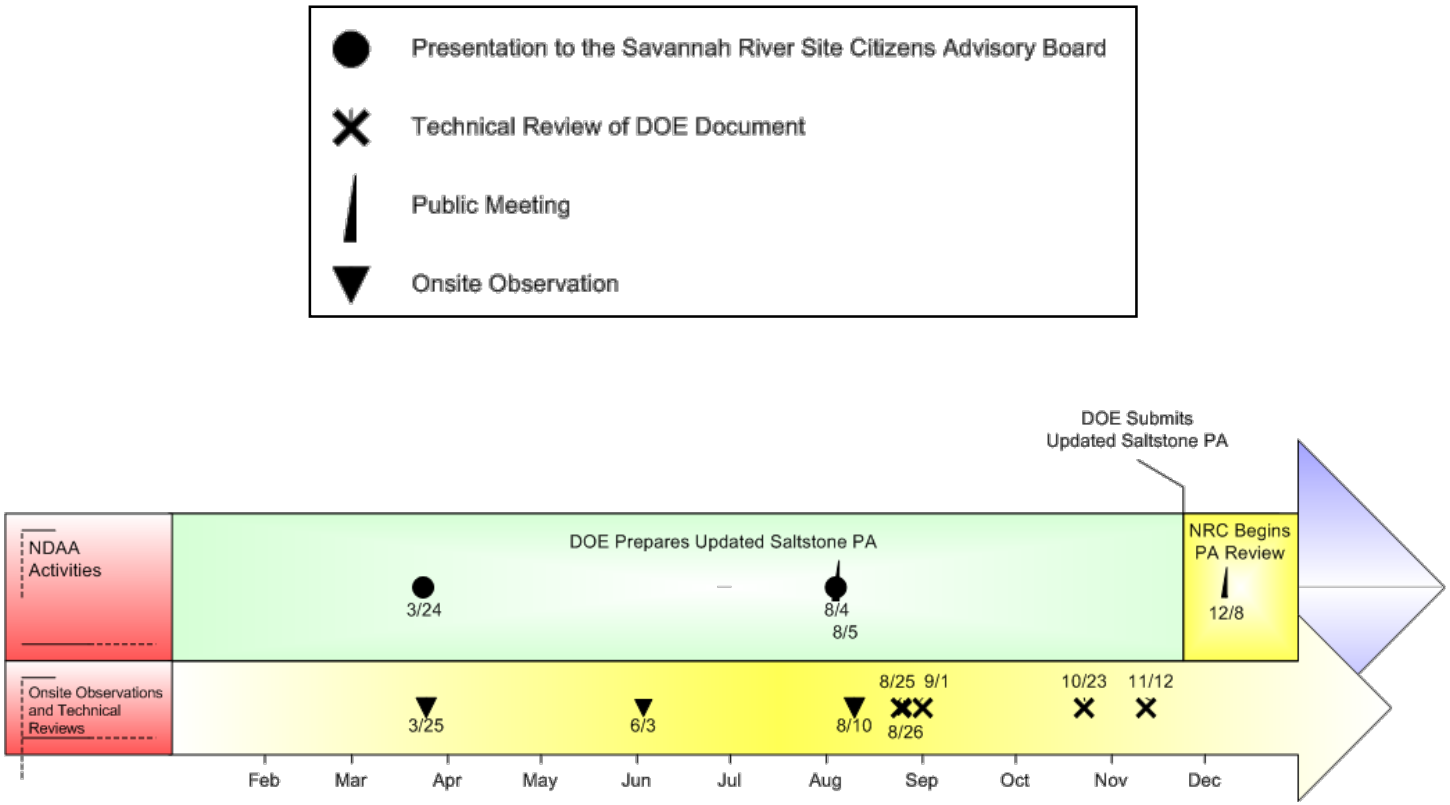

Figure C-3: NRC NDAA, Section 3116 Monitoring at SDF in 2009

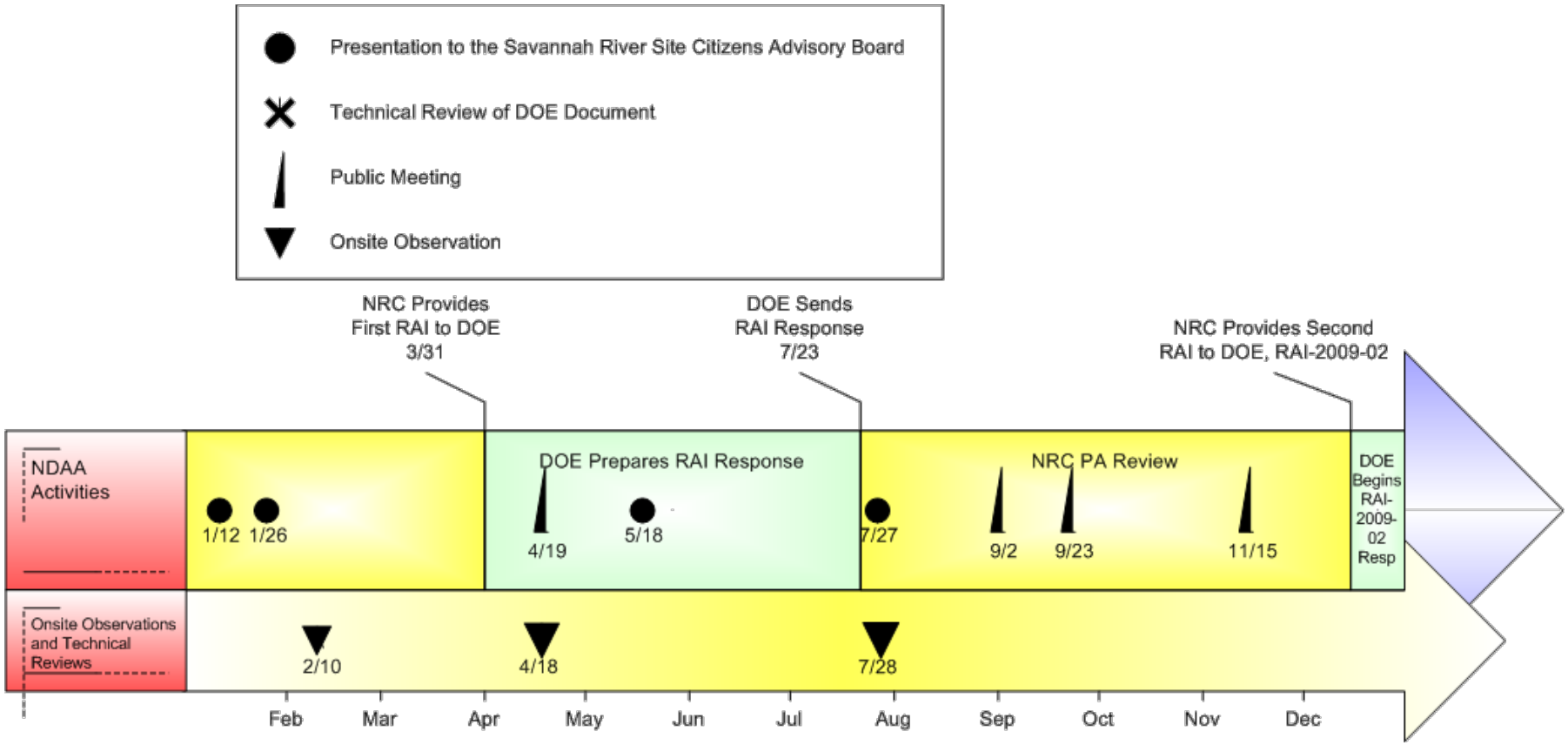

Figure C-4 : NRC NDAA, Section 3116 Monitoring at SDF in 2010

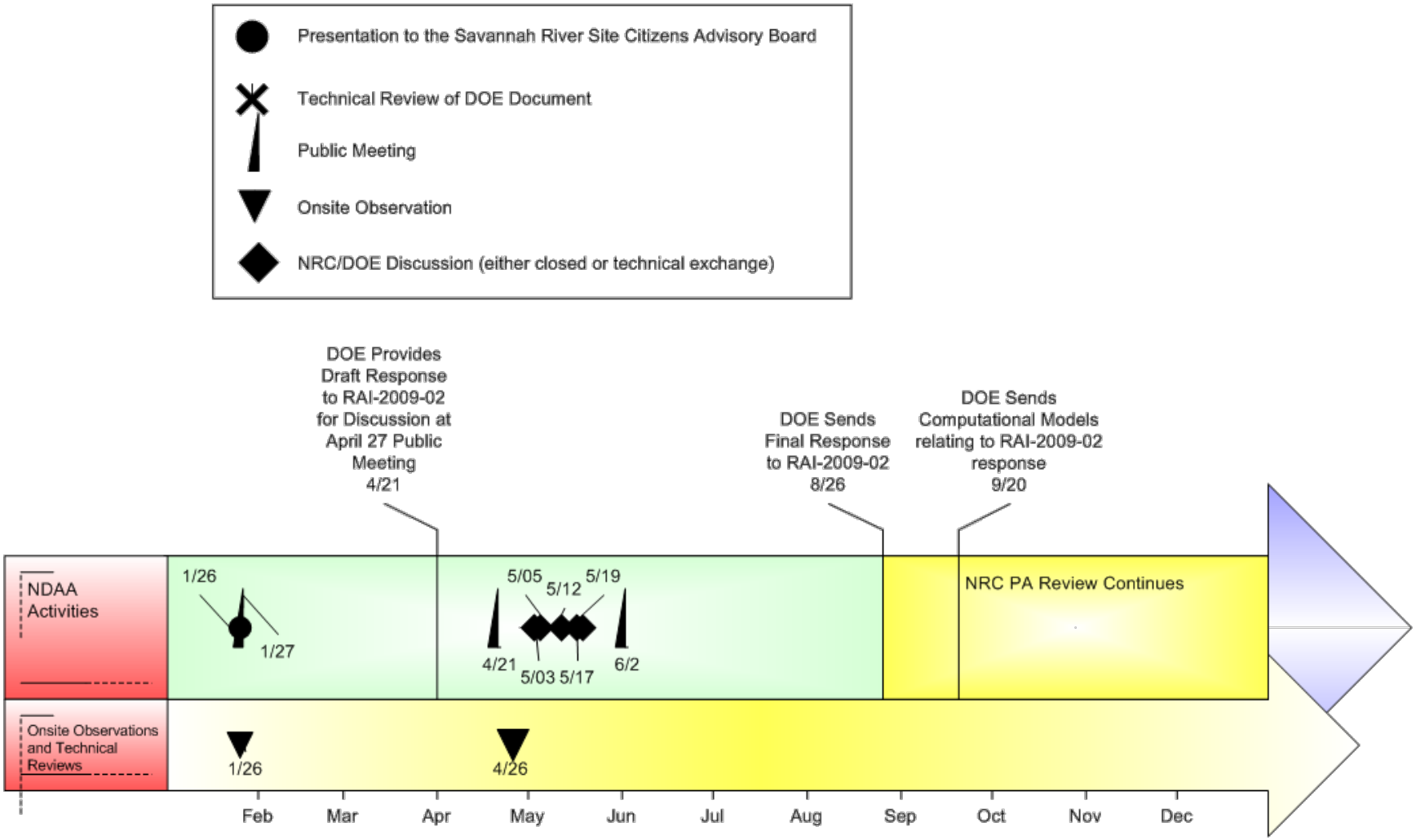

Figure C-5 : NRC NDAA, Section 3116 Monitoring at SDF in 2011

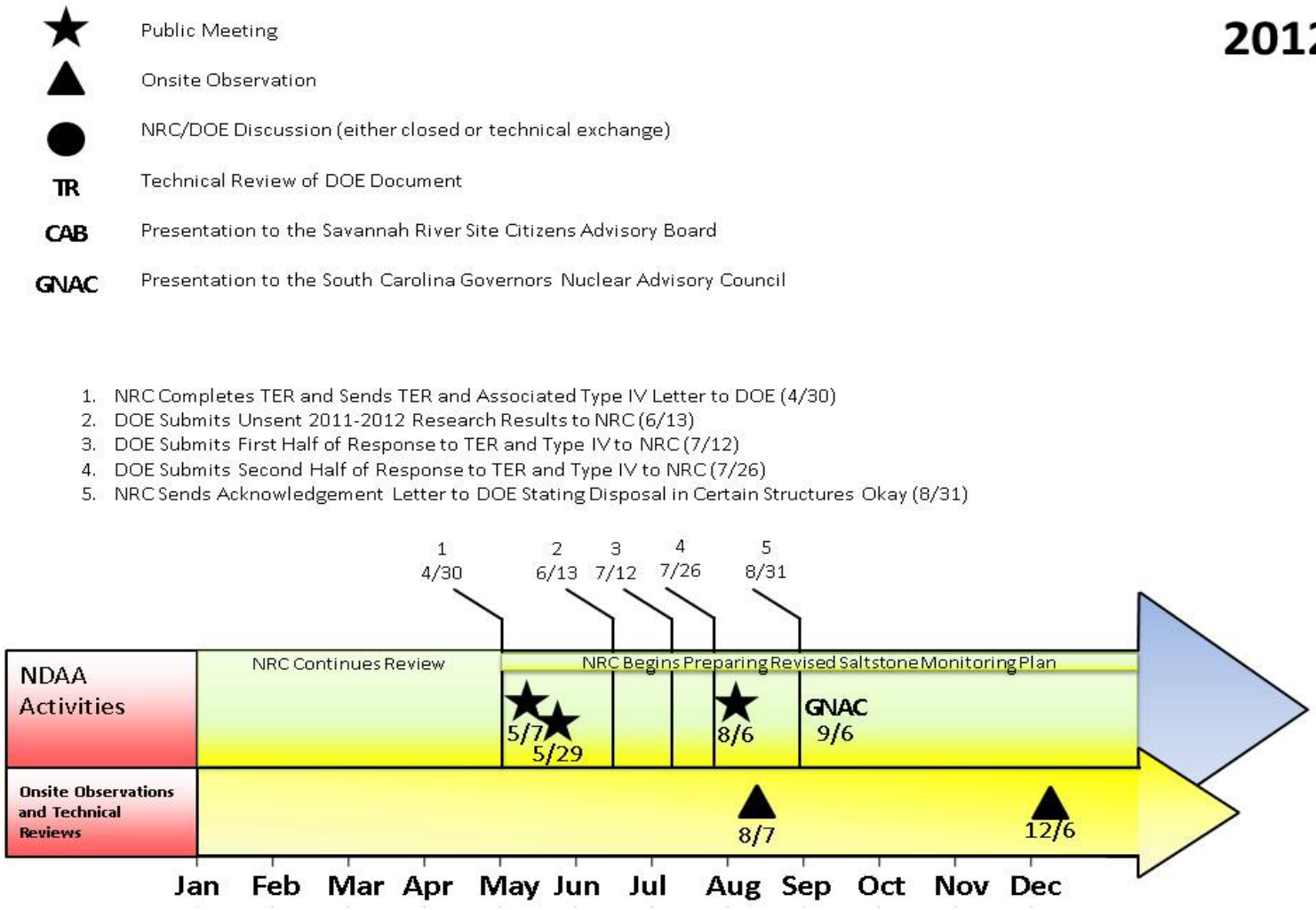

Figure C-6: NRC NDAA, Section 3116 Monitoring at SDF in 2012

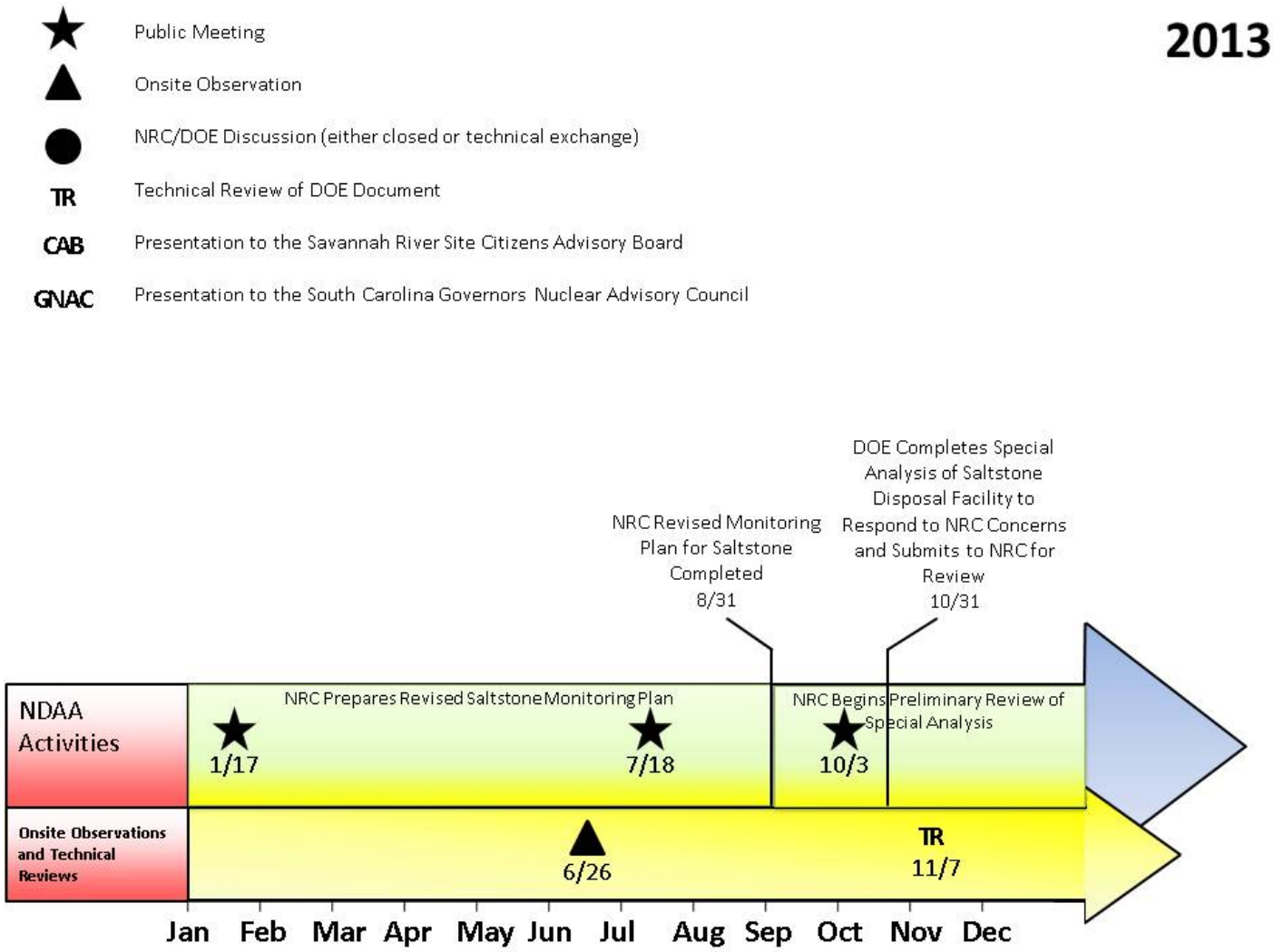

Figure C-7: NRC NDAA, Section 3116 Monitoring at SDF in 2013

Monitoring Activities at the F-Tank Farm at the Savannah River Site
2012 to 2013

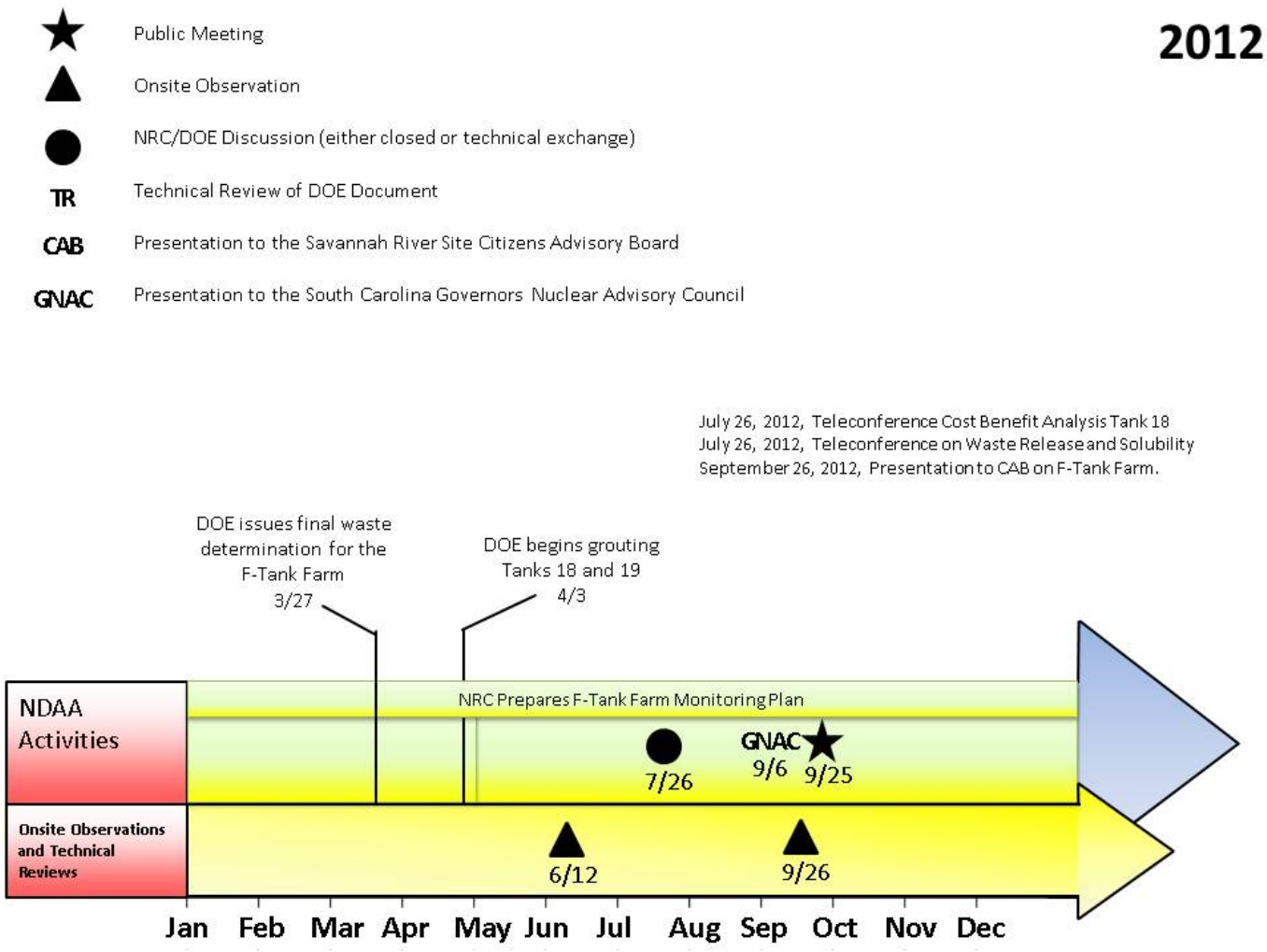

Figure C-8: NRC NDAA, Section 3116 Monitoring at FTF in 2012

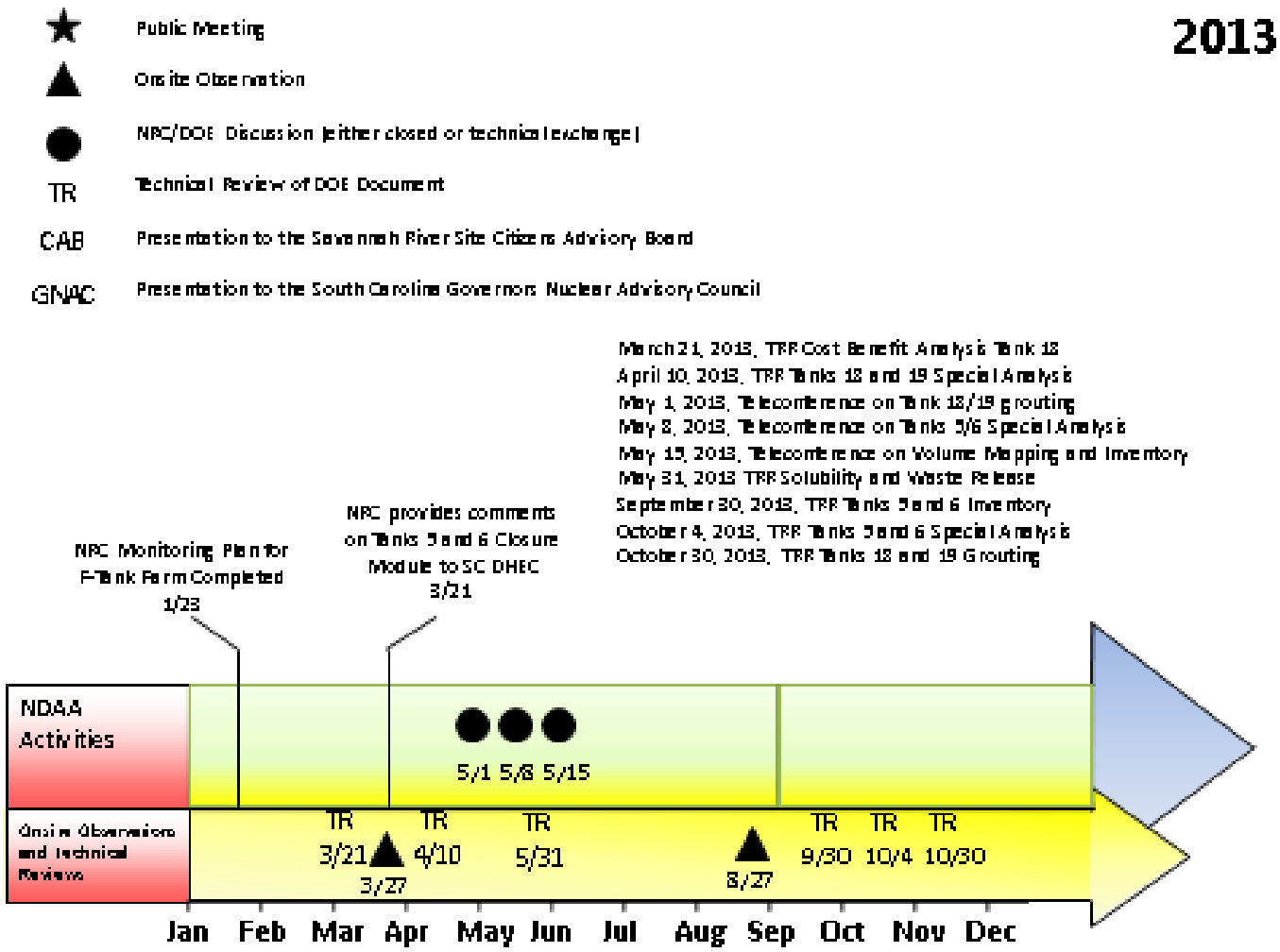

Figure C-9: NRC NDAA, Section 3116 Monitoring at FTF in 2013

Monitoring Activities at the Idaho National Laboratory INTEC TFF
2007 to 2013

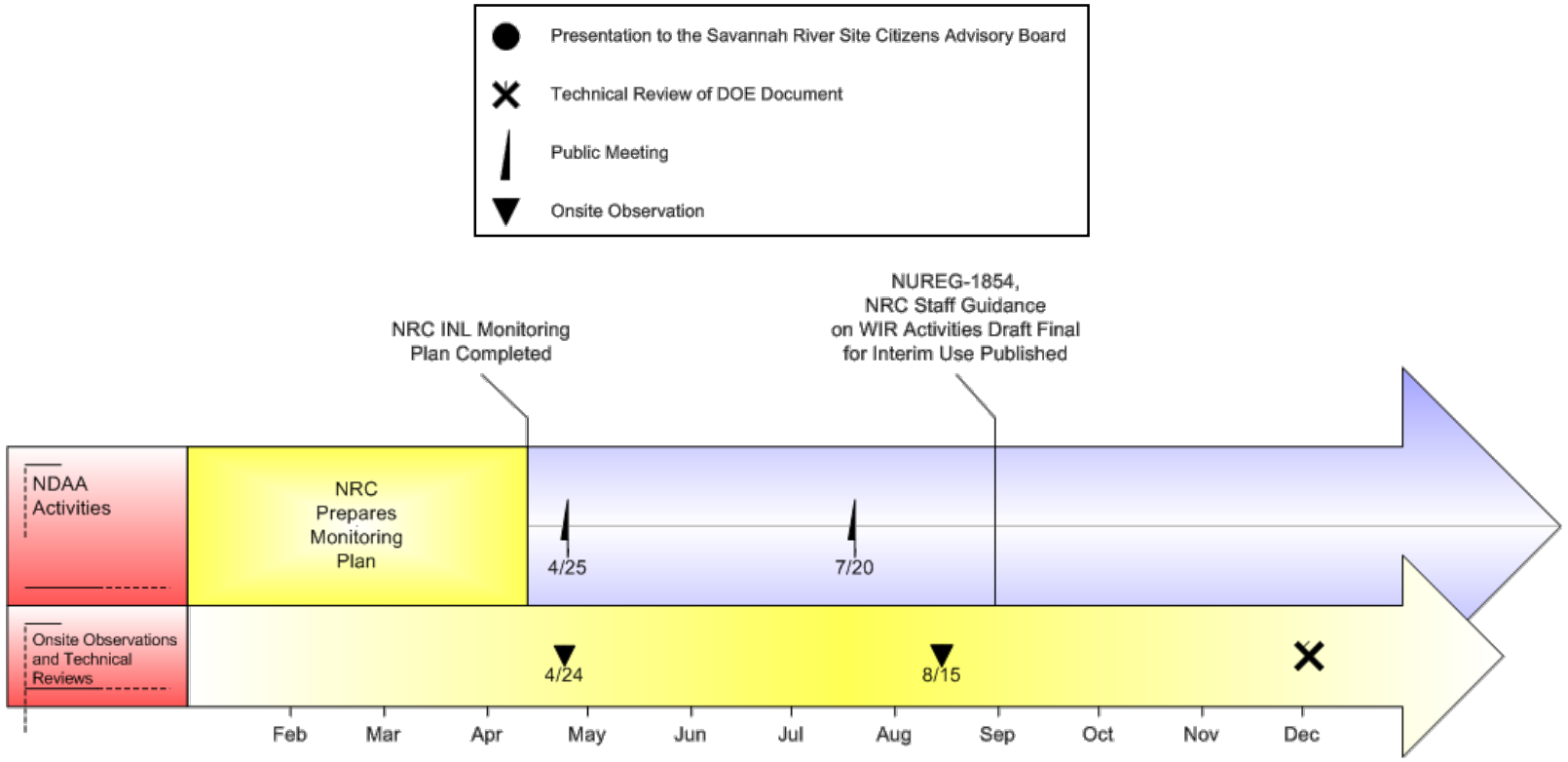

Figure C-10: NRC NDAA, Section 3116 Monitoring at INL in 2007

X Continued technical reviews for KMA 3 and KMA 4 (see NRC, 2008 for the list of technical documents reviewed)

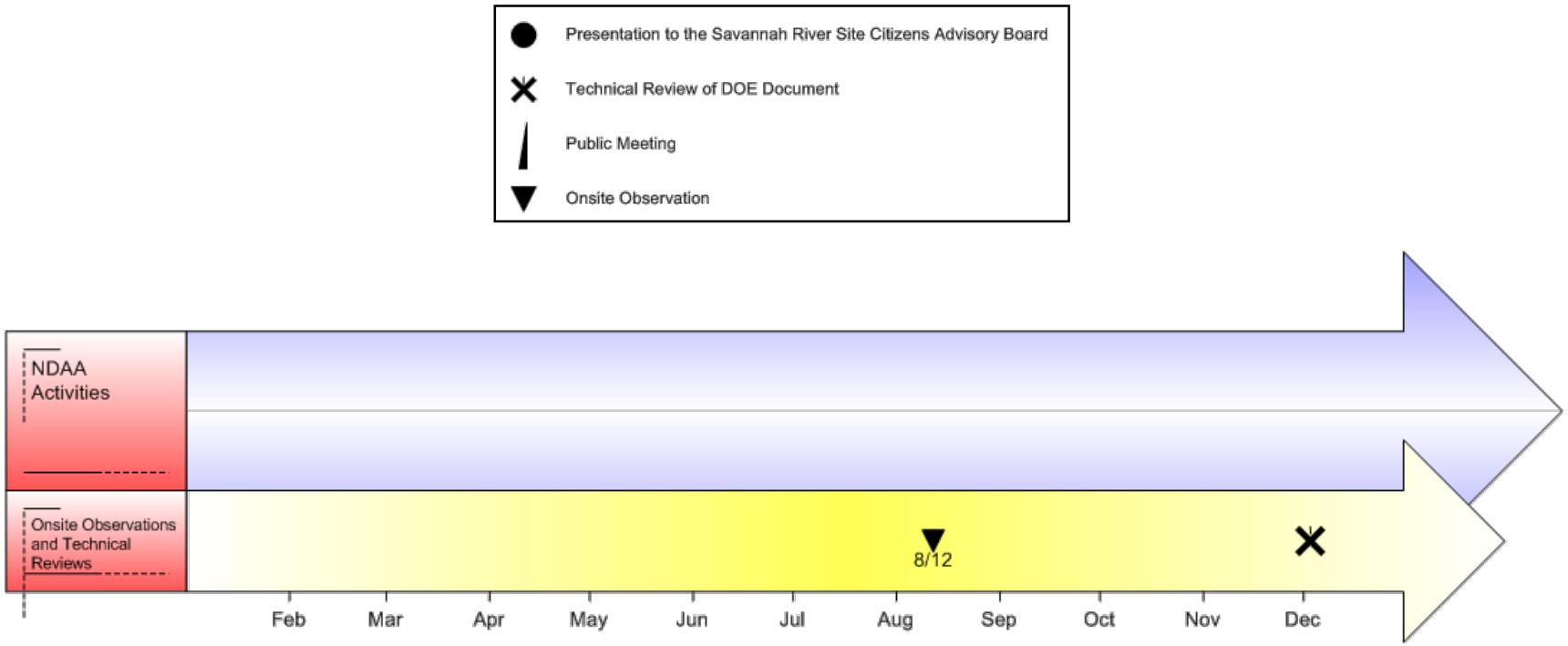

Figure C-11: NRC NDAA, Section 3116 Monitoring at INL in 2008

X Continued technical reviews for KMA 3 and KMA 4 (see NRC, 2009 for the list of technical documents reviewed)

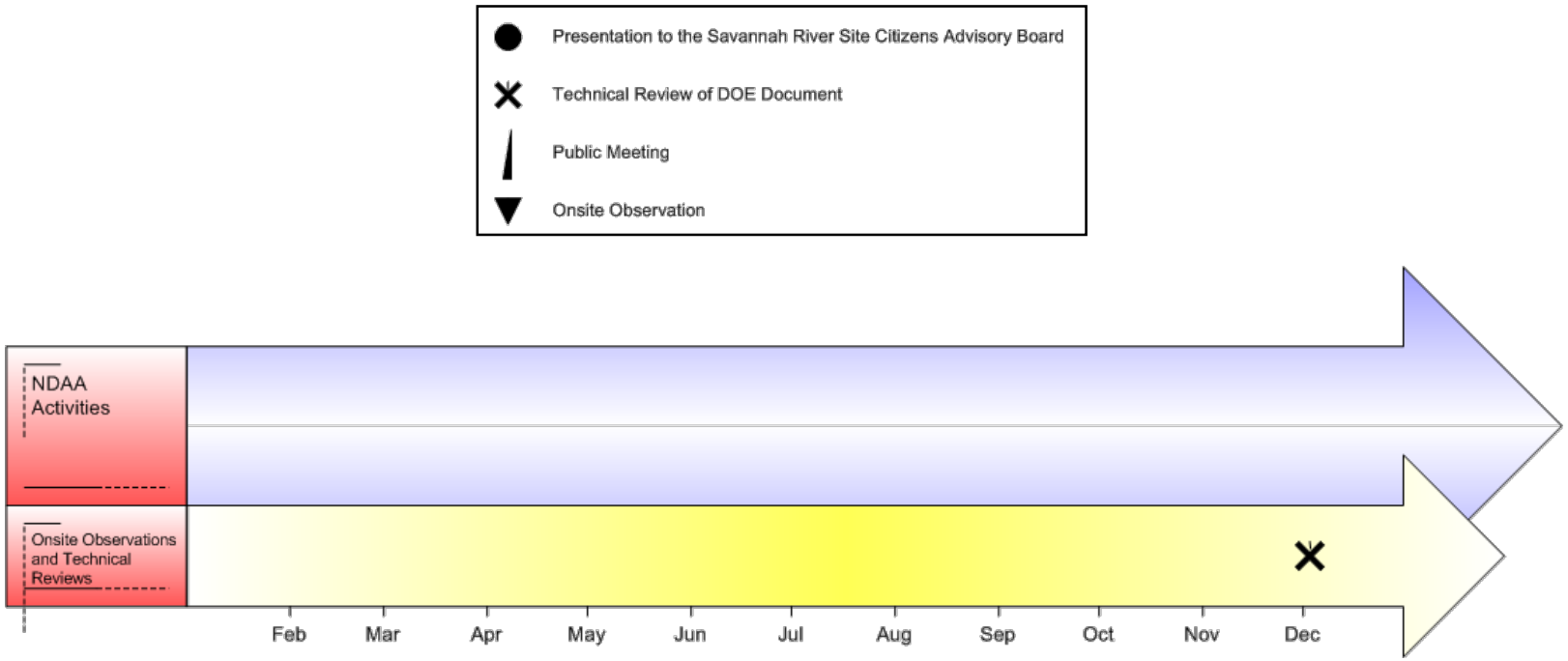

Figure C-12: NRC NDAA, Section 3116 Monitoring at INL in 2009

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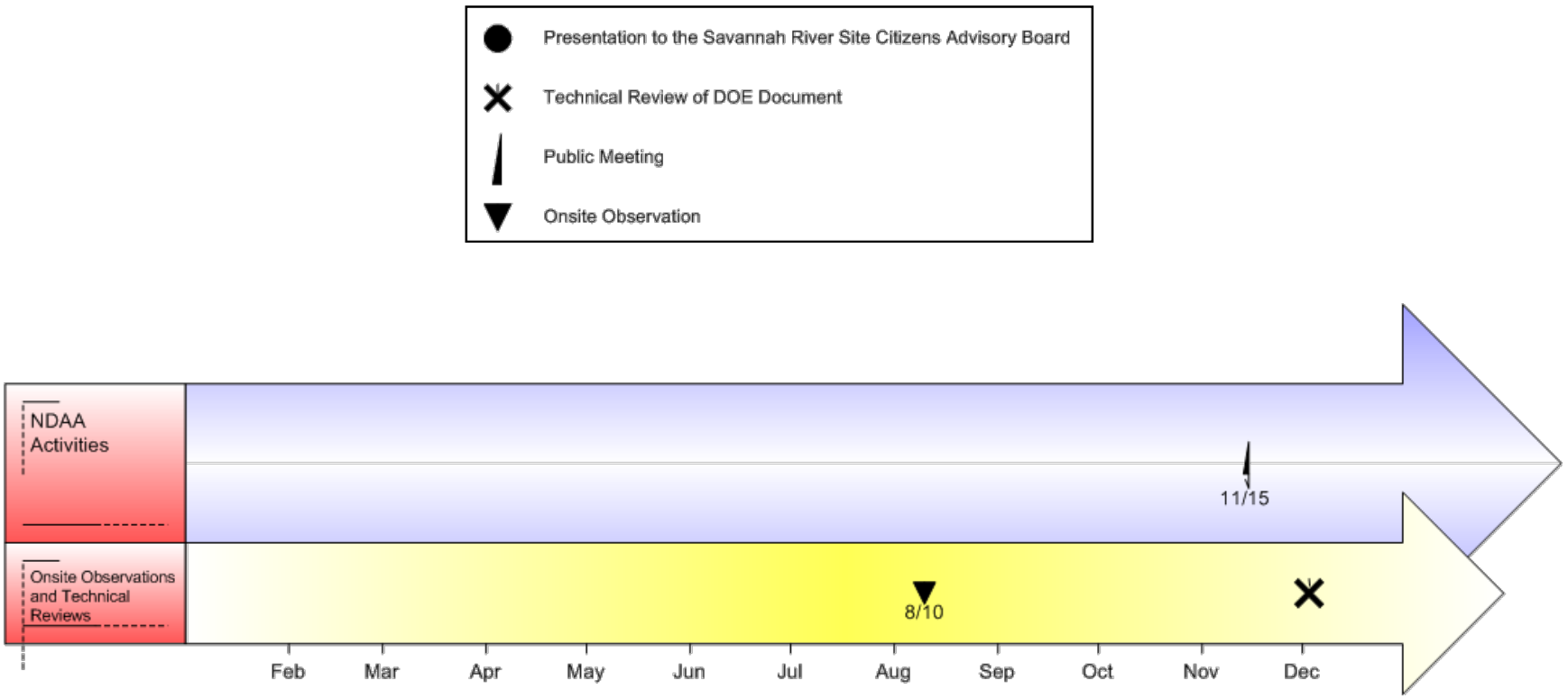

Figure C-13: NRC NDAA, Section 3116 Monitoring at INL in 2010

X Continued technical reviews for KMA 3 and KMA 4 (see NRC, 2012h for the list of technical documents reviewed)

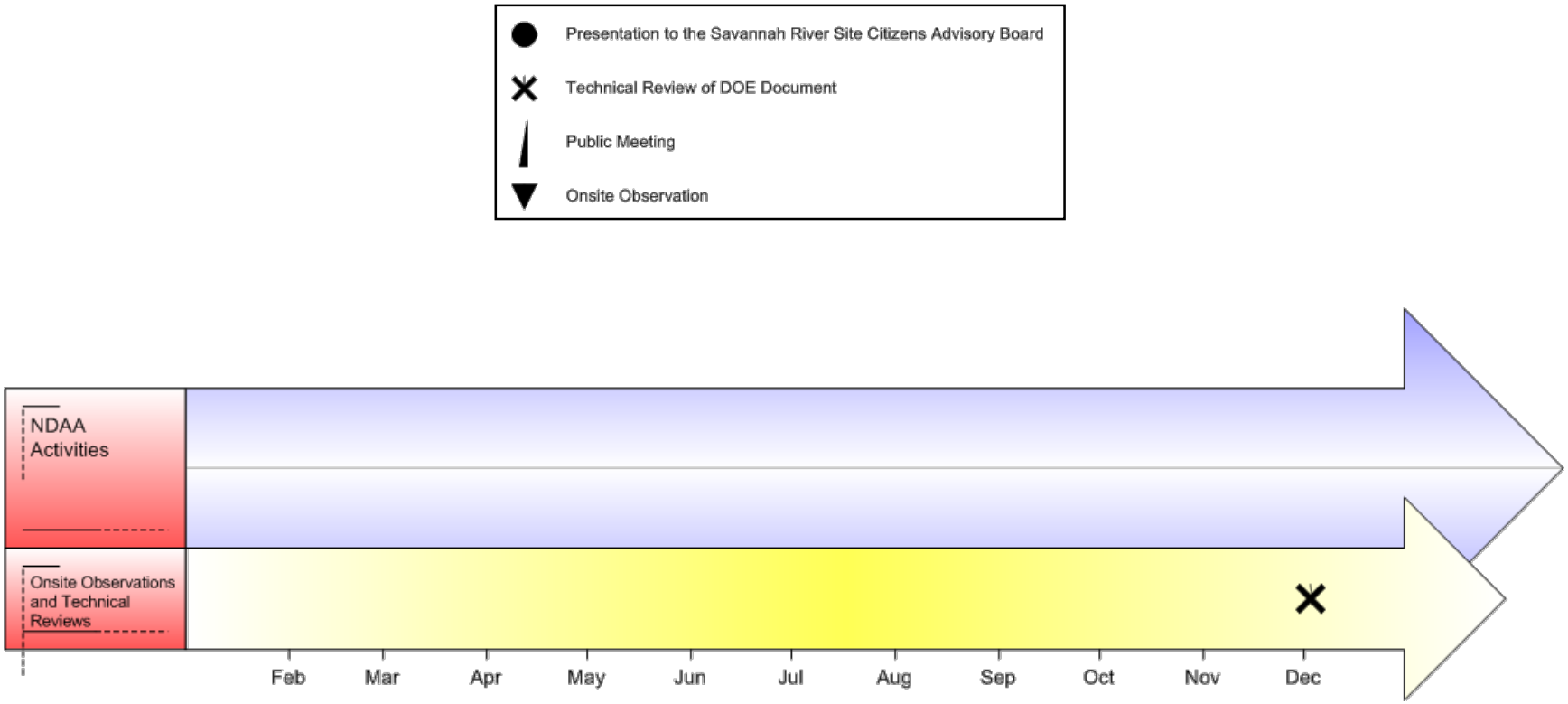

Figure C-14: NRC NDAA, Section 3116 Monitoring at INL in 2011

X Continued technical reviews for KMA 3 and KMA 4 (see NRC, 2012i for the list of technical documents reviewed)

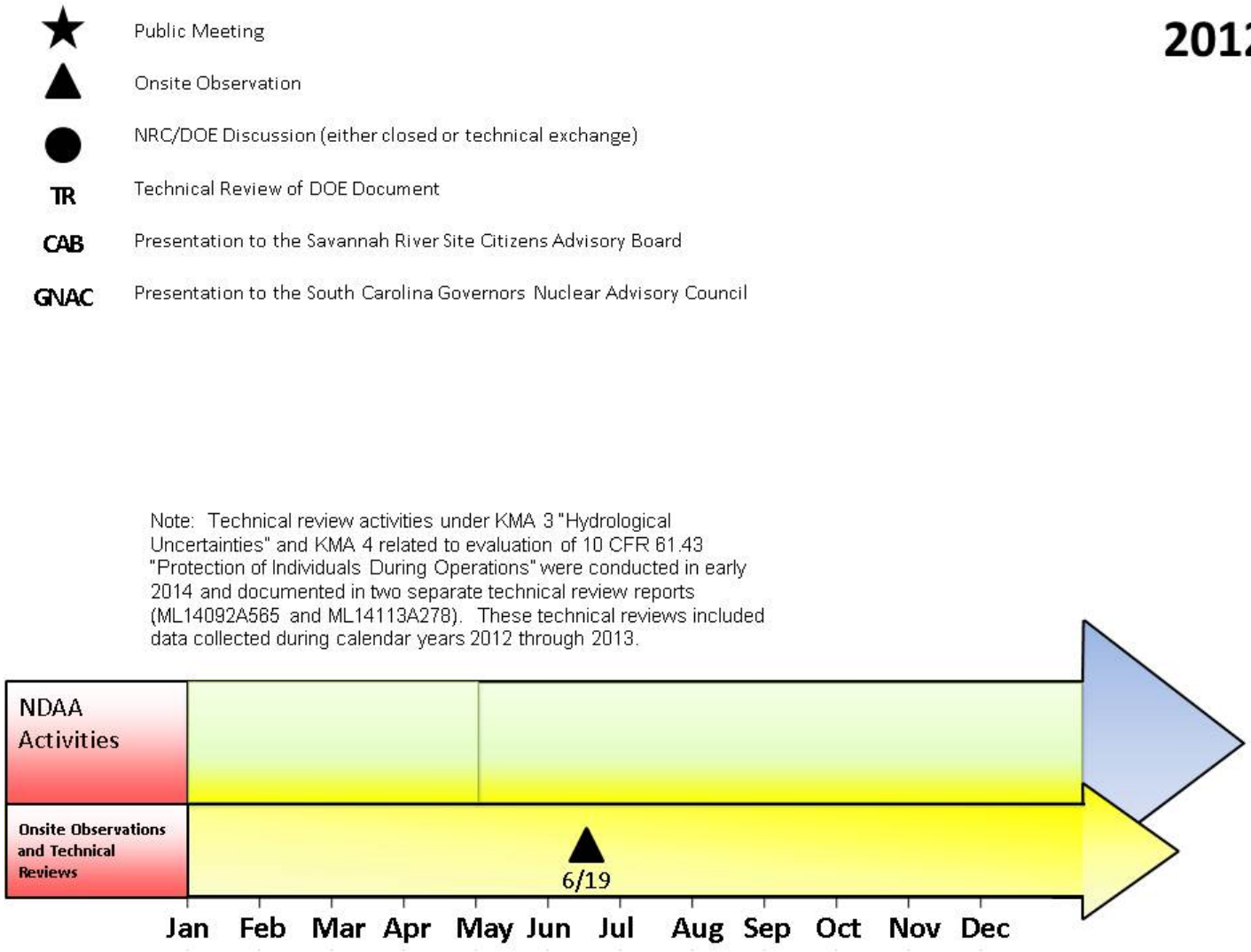

Figure C-15: NRC NDAA, Section 3116 Monitoring at INL in 2012

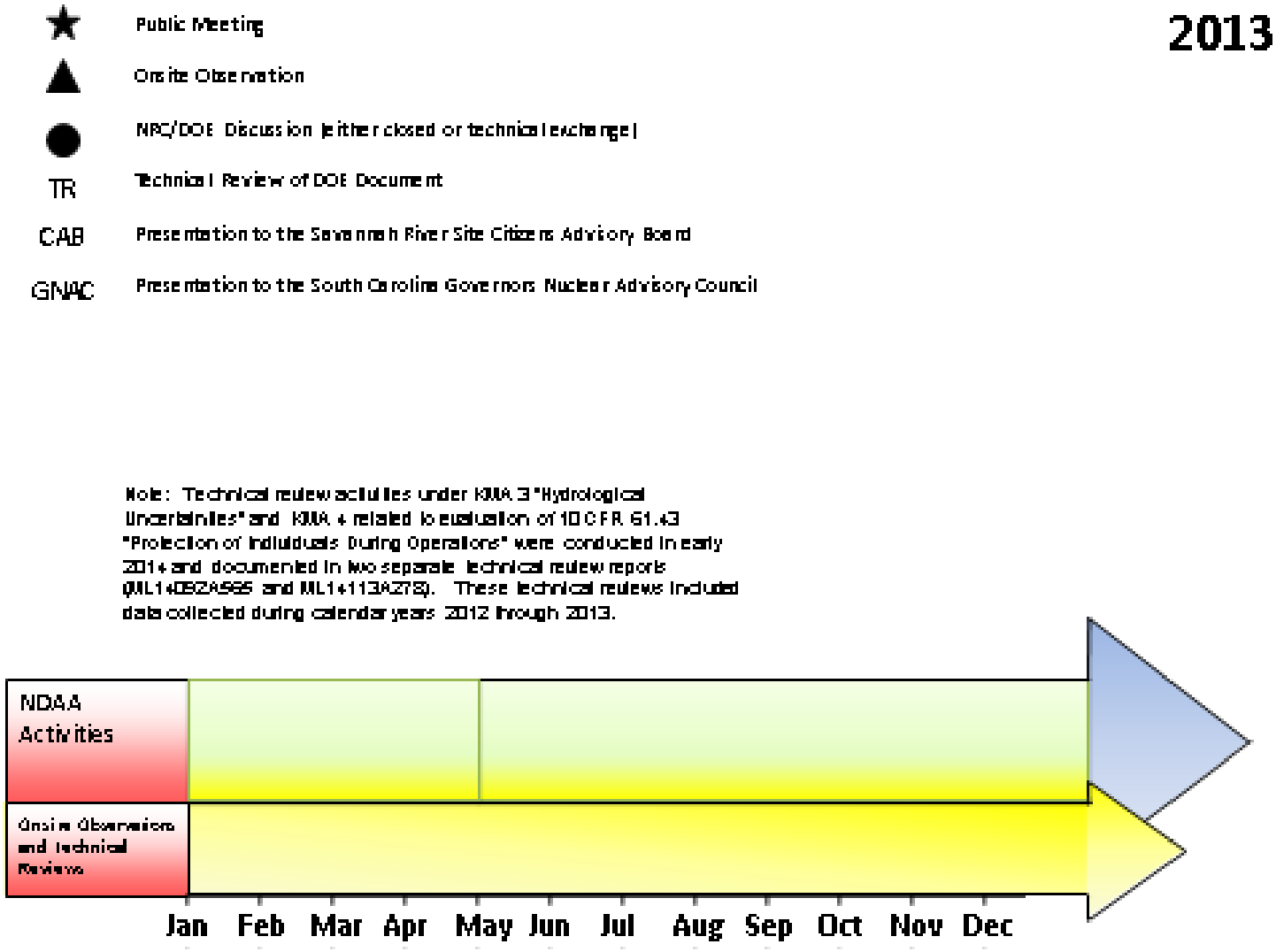

Figure C-16: NRC NDAA, Section 3116 Monitoring at INL in 2013

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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 Years 2012 and 2013, in accordance with Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (the NDAA). Section 3116 of the NDAA requires: (1) that DOE consult with the NRC on its non-high-level waste determinations and plans, and (2) 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, 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," dated August 2007.

12. KEY WORDS/DESCRIPTORS (List words or phrases that will assist researchers in locating the report.)

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