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

June 29, 2018

MEMORANDUM TO: Richard Chang, Acting Chief
Low-Level Waste Branch
Division of Decommissioning, Uranium Recovery,
and Waste Programs
Office of Nuclear Materials Safety and Safeguards

THRU: Christepher A. McKenney, Chief /RA/
Performance Assessment Branch
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Office of Nuclear Materials Safety and Safeguards

FROM: A. Christianne Ridge, Sr. Risk Analyst /RA/
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Office of Nuclear Materials Safety and Safeguards

SUBJECT: TECHNICAL REVIEW: SUMMARY OF ACTIVITIES RELATED TO THE REVIEW OF THE U.S. DEPARTMENT OF ENERGY SAVANNAH RIVER SITE FISCAL YEAR 2013 AND FISCAL YEAR 2014 SPECIAL ANALYSIS DOCUMENTS FOR THE SALTSTONE DISPOSAL FACILITY (DOCKET NO. PROJ0734)

The U.S. Nuclear Regulatory Commission (NRC) staff performed a technical review of the U.S. Department of Energy (DOE) Savannah River Site (SRS) Fiscal Year (FY) 2013 and FY 2014 Special Analysis Documents for the Saltstone Disposal Facility (SDF) as part of the NRC monitoring of the DOE disposal actions to determine compliance with the performance objectives (POs) set forth in Subpart C of Title 10, Part 61, of the *Code of Federal Regulations* (10 CFR Part 61) at the SRS SDF pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA).

The NRC review was performed in accordance with monitoring activities described in the NRC 2013 SDF Monitoring Plan, Rev. 1 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13100A113). The NRC 2013 SDF Monitoring Plan contains monitoring areas and each monitoring area contains one or more monitoring factors. This NRC technical review report (TRR) is a summary of the NRC activities related to the review of the DOE FY 2013 and FY 2014 SDF Special Analysis Documents. This NRC TRR is related to all 11 of the monitoring areas and all the monitoring factors in the NRC 2013 SDF Monitoring Plan.

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When the NRC began reviewing both the FY 2013 and FY 2014 SDF Special Analysis Documents, the NRC expected to issue the next SDF technical evaluation report (TER) based on those two DOE documents. However, in 2018, the NRC decided to issue the next SDF TER after the DOE issues the next SDF Performance Assessment (PA), which is expected to replace the information in the DOE 2009 SDF PA as well as in both the FY 2013 and FY 2014 SDF Special Analysis Documents. As such, the NRC is issuing this TRR to provide a summary of the activities related to the NRC review of both the FY 2013 and FY 2014 SDF Special Analysis Documents, as supplemented by other documents and communications.

The NRC review of both the FY 2013 and FY 2014 SDF Special Analysis Documents, as supplemented by other documents and communications, resulted in the following NRC staff recommendations in previously issued TRRs:

- Increase the priority of Monitoring Factor (MF) 2.01 (Hydraulic Performance of Closure Cap) from Low to Medium to reflect the risk-significance of the NRC staff concerns about potential flow through the closure cap

- Change the name and scope of MF 2.02 (Erosion Protection) to include areas adjacent to the closure cap

- Close MF 3.01 (Hydraulic Conductivity of Field-Emplaced Saltstone), MF 3.02 (Variability of Field-Emplaced Saltstone), and MF 3.04 (Effect of Curing Temperature on Saltstone Hydraulic Properties) to reflect resolution of the NRC staff concerns about the initial hydraulic conductivity and variability of field-emplaced saltstone

- Narrow the scope of MF 3.03 (Applicability of Laboratory Data to Field-Emplaced Saltstone) to understanding of the short term (i.e., within the first several pore volumes) changes in the hydraulic conductivity between laboratory-prepared and field-emplaced saltstone samples

- Expand the scope of MF 5.04 (Certain Risk-Significant K_d Values for Saltstone), MF 6.01 (Certain Risk-Significant K_d Values in Disposal Structure Concrete), and MF 7.01 (Certain Risk-Significant K_d Values in Site Sand and Clay) to now include iodine sorption in saltstone, disposal structure concrete, and soils, respectively

- Decrease the priority of MF 5.02 (Chemical Reduction of Technetium by Saltstone) from High to Medium to reflect the NRC staff reduced concern about technetium (Tc) oxidation by trace concentrations of oxygen

- Decrease the priority of MF 5.03 (Reducing Capacity of Saltstone) from Medium to Low to reflect the NRC staff reduced concern about the reducing capacity of saltstone

- Close MF 5.05 (Potential for Short-Term Rinse-Release from Saltstone) to reflect the resolution of the NRC staff concerns about risk-significant rinse-release

- Close MF 6.02 (Technetium Sorption in Disposal Structure Concrete) to reflect the reduction in the DOE projected reliance on the disposal structure concrete as a chemical barrier to Tc release

- Add the new MF 8.03 (Identification and Monitoring of Groundwater Plumes in the

Z-Area) as High priority to reflect the new NRC staff concern about the saltstone groundwater monitoring well network

- Add the new MF 10.14 (Scenario Development and Defensibility) as Medium priority to reflect the NRC staff distinguishing conceptual model uncertainty from scenario uncertainty

Enclosure:
Technical Review: Summary of Activities Related to the Review of the U.S. Department of Energy Savannah River Site Fiscal Year 2013 and Fiscal Year 2014 Special Analysis Documents for the Saltstone Disposal Facility

cc: (w/ Enclosure):
WIR Service List
WIR ListServ

SUBJECT: TECHNICAL REVIEW: SUMMARY OF ACTIVITIES RELATED TO THE REVIEW OF THE U.S. DEPARTMENT OF ENERGY SAVANNAH RIVER SITE FISCAL YEAR 2013 AND FISCAL YEAR 2014 SPECIAL ANALYSIS DOCUMENTS FOR THE SALTSTONE DISPOSAL FACILITY (DOCKET NO. PROJ0734) DATED **JUNE 29, 2018**

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ADAMS Accession No. ML18158A172 ***via email**

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Technical Review: Summary of Activities Related to the Review of the U.S. Department of Energy Savannah River Site Fiscal Year 2013 and Fiscal Year 2014 Special Analysis Documents for the Saltstone Disposal Facility

Date:

June 29, 2018

Reviewers:

A. Christianne Ridge, Sr. Risk Analyst, U.S. Nuclear Regulatory Commission (NRC)
Harry Felsher, Sr. Project Manager, NRC

Purpose:

The purpose of this NRC staff Technical Review Report (TRR) is to provide a summary of the activities related to the NRC review of the of the U.S. Department of Energy (DOE) Savannah River Site (SRS) Fiscal Year (FY) 2013 and FY 2014 Special Analysis Documents for the SRS Saltstone Disposal Facility (SDF) as part of the NRC monitoring of the DOE disposal actions to determine compliance with the performance objectives (POs) set forth in Subpart C of Title 10, Part 61, of the *Code of Federal Regulations* (10 CFR Part 61) at the SRS SDF pursuant to Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA).

When the NRC began reviewing both the FY 2013 and FY 2014 SDF Special Analysis Documents, the NRC expected to issue the next SDF technical evaluation report (TER) based on those two DOE documents. However, in 2018, the NRC decided to issue the next SDF TER after the DOE issues the next SDF Performance Assessment (PA), which is expected to replace the information in the DOE 2009 SDF PA as well as both the FY 2013 and FY 2014 SDF Special Analysis Documents. As such, the NRC is issuing this TRR to provide a summary of the NRC review of both the FY 2013 and FY 2014 SDF Special Analysis Documents, as supplemented by other documents and communications.

Background:

The NRC review was performed in accordance with monitoring activities described in the NRC 2013 SDF Monitoring Plan (Agencywide Documents Access and Management System (ADAMS) Accession No. ML13100A113). The 2013 SDF Monitoring Plan contains monitoring areas and each monitoring area contains one or more monitoring factors.

In October 2009, the DOE issued the 2009 SDF PA (SRR-CWDA-2009-0017, Rev. 0) (ADAMS Accession No. ML101590008) to update the DOE 2005 SDF PA. The NRC reviewed the DOE 2009 SDF PA. In April 2012, the NRC issued the TER (ADAMS Accession No. ML121170309) based on the information in the DOE 2009 SDF PA, as supplemented by other documents and communications. In the April 2012 NRC SDF TER, the NRC concluded that it did not have reasonable assurance that the PO in §61.41 was met, which also meant that the NRC did not have reasonable assurance that the PO in §61.40 was met. At the same time, the NRC issued a Type-IV Letter of Concern (ADAMS Accession No. ML120650576) to both the DOE and the South Carolina Department of Health and Environmental Control, which formally communicated those NRC concerns.

In October 2013, the DOE issued the FY 2013 SDF Special Analysis Document (SRR-CWDA-2013-00062, Rev. 2) (ADAMS Accession No. ML14002A069). The DOE FY 2013 SDF Special Analysis Document supplemented the DOE 2009 SDF PA. At that time, the NRC was planning on issuing the next SDF TER based on the NRC review of the DOE FY 2013 SDF Special Analysis Document. In June 2014, the NRC issued Request for Additional Information (RAI) Comments (ADAMS Accession No. ML14148A153) to the DOE on the FY 2013 SDF Special Analysis Document. In January 2015, the DOE issued a response to the NRC RAI Comments (SRR-CWDA-2014-00099, Rev. 1) (ADAMS Accession No. ML15020A672).

In September 2014, the DOE issued the FY 2014 SDF Special Analysis Document (SRR-CWDA-2014-00006, Rev. 2) (ADAMS Accession No. ML14316A586). The DOE FY 2014 SDF Special Analysis Document supplemented both the DOE FY 2013 SDF Special Analysis Document and the DOE 2009 SDF PA. At that time, the NRC was planning on issuing the next SDF TER based on the NRC review of both the DOE FY 2013 SDF Special Analysis Document and the DOE FY 2014 SDF Special Analysis Document. In June 2015, the NRC issued RAI Questions (ADAMS Accession No. ML15161A541) to the DOE on the FY 2014 SDF Special Analysis Document. In March 2016, the DOE issued a response to the NRC RAI Questions (SRR-CWDA-2016-00004, Rev. 1) (ADAMS Accession No. ML16105A043).

Important NDAA-Monitoring Activities at the DOE SRS SDF since April 2012:

Important NDAA-Monitoring activities at the DOE SRS SDF since the NRC issued the 2012 SDF TER are documented in Meeting Summaries, Onsite Observation Visit (OOV) Reports, TRRs, and Letters to DOE Changing the NRC 2013 SDF Monitoring Plan:

Summaries for Meetings and Teleconference Calls on:

- August 6, 2012 (ADAMS Accession No. ML12233A206)
- January 17, 2013 (ADAMS Accession No. ML13025A038)
- April 30, 2013 (ADAMS Accession No. ML13171A127)
- October 3, 2013 (ADAMS Accession No. ML13337A204)
- February 10, 2014 (ADAMS Accession No. ML14057A578)
- November 14, 2016 (ADAMS Accession No. ML16354A116)
- December 13, 2016 (ADAMS Accession No. ML17023A287)
- February 28, 2017 (ADAMS Accession No. ML17072A500)

OOV Reports for OOVs on:

- August 7-8, 2012 (ADAMS Accession No. ML12286A191)
- December 6, 2012 (ADAMS Accession No. ML13010A499)
- June 26-27, 2013 (ADAMS Accession No. ML13199A434)
- May 27-29, 2014 (ADAMS Accession No. ML14199A219)
- February 4-5, 2015 (ADAMS Accession No. ML15041A562)
- July 7-8, 2015, (ADAMS Accession No. ML15236A299)
- April 19-21, 2016, (ADAMS Accession No. ML16147A197)
- January 25, 2017 (ADAMS Accession No. ML17054C453)

TRRs Issued on:

- November 7, 2013 – Technical Review: Solubility of Technetium Dioxides in Reducing Cementitious Material Leachates, a Thermodynamic Calculation (ADAMS Accession No. ML13304B159)

- June 4, 2015 – Technical Review: Oxidation of Reducing Cementitious Waste Forms (ADAMS Accession No. ML15098A031)

- August 1, 2016 – Technical Review: Quality Assurance Documentation for the Cementitious Barriers Partnership Toolbox (ADAMS Accession No. ML16196A179)

- December 23, 2016 – Technical Review: Dose Calculation Methodology for Liquid Waste Performance Assessments at the Savannah River Site (ADAMS Accession No. ML16277A060)

- January 5, 2017 - Technical Review: Iodine Sorption Coefficients for Use in Performance Assessments for the Saltstone Disposal Facility (ADAMS Accession No. ML16342C575)

- March 23, 2017 – Technical Review: Saltstone Waste Form Hydraulic Performance (ADAMS Accession No. ML17018A137)

- April 12, 2017 – Technical Review: Performance of the High Density Polyethylene, High Density Polyethylene/Geosynthetic Clay Liner, and the Lower Lateral Drainage Layer (ADAMS Accession No. ML17081A187)

- January 31, 2018 – Technical Review: Hydraulic Performance and Erosion Control of the Planned Saltstone Disposal Facility Closure Cap and Adjacent Area (ADAMS Accession No. ML18002A545)

- May 17, 2018 – Technical Review: Groundwater Monitoring at and Near the Planned Saltstone Disposal Facility (ADAMS Accession No. ML18117A494)

- May 22, 2018 – Technical Review: Update on Projected Technetium Release from Saltstone (ADAMS Accession No. ML18095A122)

<u>Letters to the DOE Changing the NRC 2013 SDF Monitoring Plan:</u>

- June 5, 2017 – Supplemented the NRC 2013 SDF Monitoring Plan by Closing Monitoring Factor (MF) 3.01 (Hydraulic Conductivity of Field-Emplaced Saltstone), MF 3.02 (Variability of Field-Emplaced Saltstone), and MF 3.04 (Effect of Curing Temperature on Saltstone Hydraulic Properties) (ADAMS Accession No. ML17097A351)

- March 1, 2018 – Clarified the number of monitoring factors in both the NRC 2013 SDF Monitoring Plan and the NRC 2015 Tank Farms Monitoring Plan (ADAMS Accession No. ML18033A071)

- June 29, 2018 – Supplemented the NRC 2013 SDF Monitoring Plan by: (1) Increasing the priority of MF 2.01 (Hydraulic Performance of Closure Cap); and (2) Adding a new MF 10.14 (Scenario Development and Defensibility) (ADAMS Accession No. ML18107A161)

- After this NRC TRR is issued, the NRC plans to issue one or more letters to the DOE supplementing the NRC 2013 SDF Monitoring Plan by making the following changes that were recommended by the NRC staff in previously issued TRRs and in this TRR:

- From NRC TRR issued in May 2018 (ADAMS Accession No. ML18117A494):
  - Adding a new MF 8.03 (Identification and Monitoring of Groundwater Plumes in the Z-Area)

- From NRC TRR issued in May 2018 (ADAMS Accession No. ML18095A122):
  - Lowering the priority of MF 5.02 (Chemical Reduction of Technetium by Saltstone);
  - Lowering the priority of MF 5.03 (Reducing Capacity of Saltstone);
  - Closing MF 5.05 (Potential for Short-Term Rinse-Release from Saltstone); and
  - Closing MF 6.02 (Technetium Sorption in Disposal Structure Concrete)

- From this NRC TRR (ADAMS Accession No. ML18158A172):
  - Replacing the three tables of NRC prioritization of monitoring factors (i.e., Table 1-6, Table 1-7, Table 1-8) with two new tables (i.e., table covering monitoring factors in MA 1 through MA 6, table covering monitoring factors in MA 7 through MA 11)

The NRC does not issue letters supplementing the NRC 2013 SDF Monitoring Plan for changes to scope of monitoring factors in a monitoring plan. Below are monitoring factors in the NRC 2013 SDF Monitoring Plan where the NRC staff has recommended changes in scope since the NRC 2013 SDF Monitoring Plan was issued:

- Expand the scope and change the name of MF 2.02 from “Erosion Protection” to “Erosion Control of the SDF Engineered Surface Cover and Adjacent Area” to include areas adjacent to the closure cap – from NRC TRR issued in January 2018 (ADAMS Accession No. ML18002A545)

- Narrow the scope of MF 3.03 (Applicability of Laboratory Data to Field-Emplaced Saltstone) to understanding of the short term (i.e., within the first several pore volumes) changes in the hydraulic conductivity between laboratory-prepared and field-emplaced saltstone samples – from NRC TRR issued in March 2017 (ADAMS Accession No. ML17018A137)

- Expand the scope of MF 5.04 (Certain Risk-Significant K_d Values for Saltstone), MF 6.01 (Certain Risk-Significant K_d Values in Disposal Structure Concrete), and MF 7.01 (Certain Risk-Significant K_d Values in Site Sand and Clay) to include iodine sorption in saltstone, disposal structure concrete, and soils, respectively – from NRC TRR issued in January 2017 (ADAMS Accession No. ML16342C575)

In addition to those activities, the NRC staff has worked with the Center for Nuclear Waste Regulatory Analyses (CNWRA) to conduct hydraulic and chemical tests of laboratory-made simulated saltstone samples. Specific details of that research are in a CNWRA status report (ADAMS Accession No. ML17221A038).

The DOE Evaluation Cases:

One of the most important aspects of the NRC staff review was the review of models created by the DOE to project future SDF performance under different potential conditions. The DOE typically selects one case to use to demonstrate meeting the POs and supports that case with

sensitivity and uncertainty analyses. The terminology that is used in this TRR to indicate the case that the DOE used to demonstrate meeting the POs is the DOE Evaluation Case.

In this TRR:

- the DOE "2009 Evaluation Case" means the Base Case model that the DOE used to support the 2009 SDF PA;

- the DOE "2013 Evaluation Case" means the Evaluation Case model that the DOE used to support the FY 2013 SDF Special Analysis Document;

- the DOE "2014 Evaluation Case" means the Evaluation Case model that the DOE used to support the FY 2014 SDF Special Analysis Document; and

- the DOE "Evaluation Cases" means all three of the above DOE Evaluation Cases from 2009, 2013, and 2014.

In the DOE 2009 SDF PA, the DOE referred to Case A as the "Base Case," which was described as the scenario that the DOE most expected for the duration of the performance period. In both the DOE FY 2013 SDF Special Analysis Document and the FY 2014 SDF Special Analysis Document, the DOE did not use the term "Base Case;" but, instead the DOE developed an "Evaluation Case" by selecting parameter values that the DOE considered to be most probable and defensible. Although there were slight differences in how the DOE described the Base Case and Evaluation Case, the DOE used the Base Case results and Evaluation Case results for comparison to the 10 CFR Part 61 POs. Therefore, the NRC regards the DOE Base Case and the DOE Evaluation Case as serving the same purpose.

Some important technical areas in the NRC 2012 SDF TER were the following:

- PA Approach and Major Features
- Saltstone Waste Form
- Disposal Structure Concrete
- Degradation and Structural Modeling
- Far Field
- Biosphere

Table 1 below provides a summary of the major features of the DOE Evaluation Cases in those important technical areas from the NRC 2012 SDF TER as well as where the NRC staff reviews of those specific aspects of the DOE Evaluation Cases are located. Note that in Table 1, the constructed Saltstone Disposal Structure (SDS) 2A, SDS 2B, SDS 3A, SDS 3B, SDS 5A, and SDS 5B are referred to as "150-foot" disposal structures for consistency with the DOE terminology. One hundred fifty feet is equal to 45.7 meters. Similarly, SDS 6 (constructed), SDS 7 (under construction), and the planned for SDS 8, SDS 9, SDS 10, and SDS 11 are referred to as "375-foot" disposal structures for consistency with the DOE terminology. Three hundred seventy five feet is equal to 114 meters.

Table 1. Major Features of the Three DOE Evaluation Cases

Parameter or Process	2009 SDF PA	2013 Evaluation Case	2014 Evaluation Case	Location of NRC Staff Review
PA Approach and Major Features				
SDF Layout	rectangular Saltstone Disposal Structure (SDS) 1 and SDS 4 sixty-four 150-foot cylindrical disposal structures	rectangular SDS 1 and SDS 4 sixty-four 150-foot cylindrical disposal structures	rectangular SDS 1 and SDS 4 six 150-foot cylindrical disposal structures seven 375-foot disposal structures	NRC TRR – Groundwater Monitoring (ML18117A494)
Probabilistic Representation of Flow Variations	5 flow cases evaluated in PORFLOW with results used as input to GoldSim model	36 flow cases evaluated in PORFLOW with results used as input to GoldSim model	18 flow cases evaluated in PORFLOW with results used as input to GoldSim model	NRC TRR – Hydraulic Performance and Erosion Control of Cap (ML18002A545) Report for the April 19-21, 2016 NRC SDF OOV (ML16147A197)
Projected SDF Inventory at Closure: Key Radionuclides and Significant Changes (curies)*	Tc-99: 3.5×10^{4} I-129: 25 Cs-135: 5.4 Cs-137: 3.0×10^{5} Ra-226: 4.1 Th-230: 20	Tc-99: 3.5×10^{4} I-129: 25 Cs-135: 5.4 Cs-137: 3.0×10^{5} Ra-226: 1.8×10^{-3} Th-230: 0.84	Tc-99: 2.9×10^{4} I-129: 12 Cs-135: 3.8 Cs-137: 2.7×10^{6} Ra-226: 143 Th-230: 144	Not specifically reviewed by NRC staff in a TRR
Saltstone Waste Form				
Saturated Hydraulic Conductivity (centimeter/second (cm/s))	2×10^{-9} (constant for all disposal structures)	6.4×10^{-9} (initial for all disposal structures) values at 10,000 years: SDS 4: 1.1×10^{-6} 150-foot: 1.0×10^{-6}	6.4×10^{-9} (initial for all disposal structures) values at 10,000 years: SDS 4: 1.4×10^{-6} 150-foot: 1.7×10^{-6} 375-foot: 7.9×10^{-7}	NRC TRR – Saltstone Hydraulic Performance (ML17018A137)
Effective Diffusion Coefficient (cm^2/s)	1×10^{-7} (constant for all disposal structures)	1×10^{-8} (initial for all disposal structures) values at 10,000 years: SDS 4: 1.9×10^{-7} 150-foot: 1.6×10^{-7}	1×10^{-8} (initial for all disposal structures) values at 10,000 years: SDS 4: 1.9×10^{-7} 150-foot: 2.2×10^{-7} 375-foot: 1.1×10^{-7}	NRC TRR – Saltstone Hydraulic Performance (ML17018A137)
Initial Reducing Capacity (meq e^- /milliliter (mL) grout)	0.822	0.607	0.607	NRC TRR – Tc Release (ML18095A122)

Parameter or Process	2009 SDF PA	2013 Evaluation Case	2014 Evaluation Case	Location of NRC Staff Review
Iodine Sorption Coefficient (mL/gram) (mL/g)	middle-age reducing: 9 middle-age oxidizing: 15 old-age oxidizing: 4	middle-age reducing: 9 middle-age oxidizing: 15 old-age oxidizing: 4	middle-age reducing: 9 middle-age oxidizing: 15 old-age oxidizing: 4	NRC TRR – Iodine sorption (ML16342C575)
Solubility Limit for Technetium (Tc) Release from Chemically Reduced Saltstone (moles/liter)	not applicable (pseudo-sorption coefficient used instead)	1×10^{-8}	1×10^{-8}	NRC TRR – Technetium (Tc) Solubility (ML13304B159) NRC TRR – Tc Release (ML18095A122)
Disposal Structure Concrete				
Fast Pathways in the Disposal Structure Floor or at the Wall/Floor Joint	not included	SDS 4: floor construction joints 150-foot: wall-to-floor joints	SDS 4: floor construction joints 150-foot: wall-to-floor joints 375-foot: wall-to-floor joints	NRC TRR – Disposal Structure Degradation (to be issued)
Initial Reducing Capacity (meq e^-/g concrete)	0.240	0.178	0.178	NRC TRR – Tc Release (ML18095A122)
Degradation and Structural Modeling				
Saltstone Waste form Degradation	no change in hydraulic properties for 20,000 years	degradation of hydraulic properties controlled by decalcification	degradation of hydraulic properties controlled by decalcification delay before degradation begins in 150-foot structures decreased from 3,866 to 961 years	NRC TRR – Saltstone Degradation (to be issued)
Disposal Structure Concrete Degradation	considered sulfate attack	considered sulfate attack, carbonation, and decalcification	considered sulfate attack, carbonation, and decalcification roof degradation by sulfate attack begins earlier than in 2013 Evaluation Case because of lack of clean cap	NRC TRR – Disposal Structure Degradation (to be issued)

Parameter or Process	2009 SDF PA	2013 Evaluation Case	2014 Evaluation Case	Location of NRC Staff Review
Fast Pathways in the Disposal Structure Floor or at the Wall/Floor Joint	not included	SDS 4: floor construction joints 150-foot: wall-to-floor joints	SDS 4: floor construction joints 150-foot: wall-to-floor joints 375-foot: wall-to-floor joints	NRC TRR – Disposal Structure Degradation (to be issued)
Preferential Pathways through Saltstone Waste Form	no preferential pathways through saltstone	SDS 4 and 150-foot disposal structure roof support columns degrade in 2-foot segments	SDS 4, 150-foot disposal structure, and 375-foot disposal structure roof support columns degrade in 2-foot segments	NRC TRR – Saltstone Degradation (to be issued)
Far Field				
Iodine Sorption Coefficient (K_d) (mL/g)	clayey soil = 0.6 sandy soil = 0	introduced leachate-impacted (LI) values clayey soil = 0.9 LI clayey soil = 0.1 sandy soil = 0.3 LI sandy soil = 0.0	clayey soil = 3.0 LI clayey soil = 0.3 sandy soil = 1.0 LI sandy soil = 0.1	NRC TRR – Iodine sorption (ML16342C575)
Biosphere				
Biosphere Modeling	baseline	modified from 2009	same as FY 2013 SDF Special Analysis Document	NRC TRR – Dose Calculation Methodology (ML16277A060)

* To convert curies to Becquerel, multiply by 3.7×10^{10}

Table 2 below provides a summary of the major sensitivity and uncertainty analyses that the DOE developed since the NRC issued the 2012 SDF TER. Those DOE sensitivity and uncertainty analyses were reviewed by the NRC staff in other TRRs that were previously or are about to be issued.

Table 2. Major DOE Sensitivity and Uncertainty Analyses Since the DOE 2009 SDF PA

Topic of the DOE Sensitivity or Uncertainty Analysis	References to the DOE Sensitivity or Uncertainty Analyses	References to the NRC Evaluations of the DOE Sensitivity and Uncertainty Analyses
Infiltration Rate	FY 2013 SDF Special Analysis Document Section 5.6.6.1 and Section 5.6.6.7 FY 2014 SDF Special Analysis Document Section 5.6.7.3 DOE Response to NRC RAI Question FFT-1 on FY 2014 SDF Special Analysis Document	NRC TRR – Hydraulic Performance and Erosion Control of Cap (ML18002A545) Report for the April 19-21, 2016, NRC SDF OOV (ML16147A197)
Saturated Zone Thickness	Sensitivity Modeling to Address Concerns Related to Saturated Zone Transport (SRR-CWDA-2014-00095, Rev. 1)	NRC TRR – Hydraulic Performance and Erosion Control of Cap (ML18002A545)
Evaluation of “Best Estimate,” “Nominal,” and “Conservative” Projected Saltstone Degradation	FY 2014 SDF Special Analysis Document Section 5.6.7.3	NRC TRR – Saltstone Degradation (to be issued)
Initial Hydraulic Conductivity of Saltstone and Clean Cap (maximum, nominal, and best estimate)	FY 2013 SDF Special Analysis Document Section 4.4.4.1 and Section 4.4.4.3 FY 2014 SDF Special Analysis Document Section 5.6.7.3	NRC TRR – Saltstone Degradation (to be issued)
Iodine Sorption	DOE Response to NRC RAI Comment SP-11 on FY 2013 SDF Special Analysis Document FY 2014 SDF Special Analysis Document Section 5.6.6.4	NRC TRR – Iodine sorption (ML16342C575)
Selenium Sorption	DOE Response to NRC RAI Comment SP-11 on FY 2013 SDF Special Analysis Document FY 2014 SDF Special Analysis Document Section 5.6.6.4	NRC TRR – Selenium Sorption (to be issued)

Topic of the DOE Sensitivity or Uncertainty Analysis	References to the DOE Sensitivity or Uncertainty Analyses	References to the NRC Evaluations of the DOE Sensitivity and Uncertainty Analyses
Technetium Solubility	FY 2013 SDF Special Analysis Document Section 5.6.6.5 DOE Response to NRC RAI Question SP-2 on FY 2014 SDF Special Analysis Document	NRC TRR – Technetium (Tc) Solubility (ML13304B159) NRC TRR – Tc Release (ML18095A122)
Evaluation of a Range of Saltstone Chemical Reducing Capacities	DOE Response to NRC RAI Question SP-2 on FY 2014 SDF Special Analysis Document	NRC TRR – Tc Release (ML18095A122)
Non-Depleting Sources of Oxygen in Saltstone	FY 2013 SDF Special Analysis Document Section 5.6.6.4 and Section 5.6.6.6 DOE Response to NRC RAI Comment SP-1 on FY 2013 SDF Special Analysis Document FY 2014 SDF Special Analysis Document Section 5.6.7.4 DOE Response to NRC RAI Question SP-10 on FY 2014 SDF Special Analysis Document	NRC TRR – Tc Release (ML18095A122)
Bypass of Certain Fractions of Tc from Oxidized Cells of Saltstone to the Unsaturated Zone (i.e., evaluation of effects of re-reduction of Tc)	FY 2014 SDF Special Analysis Document Section 5.6.6.2 DOE Response to NRC RAI Question SP-2 on FY 2014 SDF Special Analysis Document	NRC TRR – Tc Release (ML18095A122)

DOE Saltstone Core Samples:

As documented in the DOE document SRR-CWDA-2015-00066 (ADAMS Accession No. ML15223B078), in April and May 2015, the DOE used a wet drilling technique to collect cores from three locations in Saltstone Disposal Structure (SDS) 2A. The initial DOE plan was to collect two separate cores from each of three camera ports. However, complications encountered in the first drilling attempt resulted in only one core being collected from camera Port B. Therefore, cores were collected from five drill holes. Upper and lower sections of the cores were transported and stored separately and given separate sample designations. Only one sample section could be retrieved from Port B, so a total of nine designated samples were collected (i.e., upper and lower sections from two drill holes in Port A, upper and lower sections from two drill holes in Port C, lower section from one drill hole in Port B).

After the cores were collected, they were immediately transferred to core holders and the atmosphere in the holders was made chemically inert in the field with 99.99% pure nitrogen gas for transportation back to the laboratory. The DOE subsequently used those cores in physical property measurements, as documented in the DOE document SRNL-STI-2016-00106 (ADAMS Accession No. ML16173A174), and in leaching experiments, as documented in the DOE documents SRNL-STI-2016-00106, SREL DOC No. R-16-0003 (ADAMS Accession No. ML16298A149), and SREL DOC No. R-17-0005 (ADAMS Accession No. ML18087A391).

The initial physical and hydraulic properties of those core samples were reviewed in the NRC TRR issued on March 23, 2017 (ADAMS Accession No. ML17018A137). The DOE core leaching studies were reviewed in both the NRC TRR issued on January 5, 2017 (ADAMS Accession No. ML16342C575) and the NRC TRR issued on May 22, 2018 (ADAMS Accession No. ML18095A122). Measurements reported in the DOE document SRNL-STI-2016-00106 were subsequently reported again in comparison to measurements of laboratory-made samples in the DOE document SRR-CWDA-2016-00051.

NRC Evaluation:

The NRC staff determined that the recent DOE research on cores of field-emplaced saltstone has provided strong model support for the initial physical and chemical properties of saltstone. In addition, changes that the DOE made to the model of SDF performance between the DOE 2009 SDF PA model and both the FY 2013 SDF Special Analysis Document and FY 2014 SDF Special Analysis Document models, as well as sensitivity and uncertainty analyses that the DOE conducted with those models, have resulted in changes to the NRC staff understanding of the risk-significance of several key aspects of SDF performance.

Based on those changes in the NRC staff understanding of how the SDF is projected to function, the NRC staff has recommended changes to several monitoring factors (e.g., open, close, change priority) in the NRC 2013 SDF Monitoring Plan in several of the NRC TRRs listed above in this TRR. Based on those NRC staff recommendations in those NRC TRRs, the NRC plans to send letters to the DOE supplementing the NRC 2013 Monitoring Plan to include those NRC staff recommendations. The NRC has issued some of those letters to the DOE; but, not all of them.

In summary, the following are the changes (i.e., open, close, change in priority) that the NRC staff recommended for the NRC 2013 SDF Monitoring Plan that are either in or will be in those NRC letters to the DOE:

- Increase the priority of MF 2.01 from Low to Medium to reflect the risk-significance of the NRC staff concerns about potential flow through the closure cap

- Close MF 3.01, MF 3.02, and MF 3.04 to reflect the resolution of the NRC staff concerns about the initial hydraulic conductivity and variability of field-emplaced saltstone

- Reduce the priority of MF 5.02 from High to Medium to reflect the reduced NRC staff concern about Tc oxidation by trace concentrations of oxygen

- Reduce the priority of MF 5.03 from Medium to Low to reflect the reduced NRC staff concern about the reducing capacity of saltstone

- Close MF 5.05 to reflect the resolution of the NRC staff concerns about risk-significant rinse-release

- Close MF 6.02 to reflect the reduction in the DOE projected reliance on the disposal structure concrete as a chemical barrier to Tc release

- Add the new MF 8.03 (Identification and Monitoring of Groundwater Plumes in the Z-Area) as High priority to reflect the new NRC staff concerns about the saltstone groundwater monitoring well network

- Add the new MF 10.14 (Scenario Development and Defensibility) as Medium priority to reflect the NRC staff distinguishing conceptual model uncertainty from scenario uncertainty

When the NRC letters to the DOE supplementing the NRC 2013 SDF Monitoring Plan are issued covering the changes to MF 2.01, MF 3.01, MF 3.02, MF 3.04, MF 5.02, MF 6.02, MF 8.03, and MF 10.14, then the priority and status of the monitoring factors for the SDF will be as listed below in Table 3 and Table 4. The NRC intends to send a letter to the DOE supplementing the NRC 2013 SDF Monitoring Plan by replacing Table 1-6, Table 1-7, and Table 1-8 in the NRC 2013 SDF Monitoring Plan with what will be at that time the information in Table 3 and Table 4 below. The information in those two new tables may change again prior to the NRC issuing the next SDF Monitoring Plan.

Table 3. Status of Monitoring Factors in Monitoring Areas 1-6 (after NRC letters are issued)

MA 1 Inventory	MA 2 Infiltration and Erosion Control	MA 3 Waste Form Hydraulic Performance	MA 4 Waste Form Physical Degradation	MA 5 Waste Form Chemical Degradation	MA 6 Disposal Structure Performance
- 1.01 - Inventory in Disposal Structures §	- 2.01 - Hydraulic Performance of Closure Cap ‡	~~- 3.01 - Hydraulic Conductivity of Field-Emplaced Saltstone ±~~	- 4.01 - Waste Form Matrix Degradation ±	- 5.01 - Radionuclide Release from Field-Emplaced Saltstone ±	- 6.01 - Certain Risk-Significant K_d Values in Disposal Structure Concrete ‡
- 1.02 - Methods Used to Assess Inventory ‡	- 2.02 - Erosion Control of the SDF Engineered Surface Cover and Adjacent Area.†	~~- 3.02 - Variability of Field-Emplaced Saltstone ±~~	- 4.02 - Waste Form Macroscopic Fracturing ±	- 5.02 - Chemical Reduction of Tc by Saltstone ±	~~- 6.02 - Tc Sorption in Disposal Structure Concrete ±~~
		- 3.03 - Applicability of Laboratory Data to Field-Emplaced Saltstone ±		- 5.03 - Reducing Capacity of Saltstone †	- 6.03 - Performance of Disposal Structure Roofs and HDPE/GCL Layers ‡
		~~- 3.04 - Effect of Curing Temperature on Saltstone Hydraulic Properties ±~~		- 5.04 - Certain Risk-Significant K_d Values for Saltstone ‡	- 6.04 - Disposal Structure Concrete Fracturing ‡
				~~- 5.05 - Potential for Short-Term Rinse-Release from Saltstone ‡~~	- 6.05 - Integrity of Non-cementitious Materials ‡

§ Periodic Monitoring Factors (i.e., MFs related to data that NRC staff expects to review on a periodic basis)

† Low Priority

‡ Medium Priority

± High Priority

~~*Closed*~~

Table 4. Status of Monitoring Factors in Monitoring Areas 7-11 (after NRC letters are issued)

MA 7 Subsurface Transport	MA 8 Environmental Monitoring	MA 9 Site Stability	MA 10 Performance Assessment Model Revisions	MA 11 Radiation Protection Program
- 7.01 - Certain Risk-Significant K_d Values in Site Sand and Clay ‡	- 8.01 - Leak Detection §	- 9.01 - Settlement Due to Increased Overburden ‡	- 10.01 - Implementation of Conceptual Models ±	- 11.01 - Dose to Individuals During Operations §
	- 8.02 - Groundwater Monitoring §	- 9.02 - Settlement Due to Dissolution of Calcareous Sediment ‡	- 10.02 - Defensibility of Conceptual Models ±	- 11.02 - Air Monitoring §
			- 10.03 - Diffusivity in Degraded Saltstone ‡	
	- 8.03 - Identification and Monitoring of Groundwater Plumes in the Z Area ±		- 10.04 - K_d Values for Saltstone †	
			- 10.05 - Moisture Characteristic Curves †	
			- 10.06 - K_d Values for Disposal Structure Concrete †	
			- 10.07 - Calculation of Build-Up in Biosphere Soil †	
			- 10.08 - Consumption Factors and Uncertainty Distributions for Transfer Factors ‡	
			- 10.09 - K_d Values for SRS Soil †	
			- 10.10 - Far-Field Model Calibration ‡	
			- 10.11 - Far-Field Model Source Loading Approach ‡	
			- 10.12 - Far-Field Model Dispersion ‡	
			- 10.13 - Impact of Calcareous Zones on Contaminant Flow and Transport †	
			- 10.14 - Scenario Development and Defensibility ‡	

§ Periodic Monitoring Factors (i.e., MFs related to data that NRC staff expects to review on a periodic basis)
† Low Priority
‡ Medium Priority
± High Priority

The additional information developed by the DOE studies of cores of field-emplaced saltstone was developed after both the FY 2013 SDF Special Analysis Document and the FY 2014 SDF Special Analysis Document were issued. That additional information has not yet been incorporated into the latest DOE SDF PA. In response to an NRC RAI Question about the projected dose consequences of increased Tc release concentrations, the DOE provided additional sensitivity analyses (SRR-CWDA-2016-00134, in ADAMS Accession No. ML16356A127).

Those sensitivity analyses showed that, at a solubility limit of 5×10^{-7} mol/L, peak Tc releases within 10,000 years of closure could be limited to approximately the 10 CFR 61.41 dose limit (i.e., 25 millirem/year) if the DOE used its Best Estimate degradation rate to model saltstone hydraulic performance instead of the Nominal degradation rate used in the 2014 Evaluation Case. The NRC staff concerns about the DOE Best Estimate degradation rate will be described in a future TRR on Saltstone Degradation. The supplemental sensitivity analyses provided by the DOE (SRR-CWDA-2016-00134) does not alleviate the NRC staff concerns about the dose implications of the measured Tc release concentrations from cores of field-emplaced saltstone because the NRC staff still questions whether the DOE Best Estimate Degradation rate is adequately supported. Furthermore, the available data from cores of field-emplaced saltstone indicate Tc could potentially be released at concentrations greater than the observed concentration of 5×10^{-7} mol/L because of differences between field and laboratory flow rates.

The DOE PA maintenance process includes periodic revisions to the SDF PA. The DOE document "DOE Performance Assessment Maintenance FY 2018 Implementation Plan" (SRR-CWDA-2017-00096, in ADAMS Accession No. ML18067A594) indicates that:

- work has begun on a new revision to the DOE SDF PA;
- the completion date of the new DOE SDF PA depends on research results and the availability of funding; and
- the new DOE SDF PA is currently expected to be issued in FY 2019.

NRC Conclusion:

In 2018, the NRC decided to issue the next SDF TER after the DOE issues the next SDF PA, which is expected to replace the information in the DOE 2009 SDF PA as well as in both the FY 2013 and FY 2014 SDF Special Analysis Documents. As such, the NRC is issuing this TRR to provide a summary of the activities related to the NRC review of both the FY 2013 and FY 2014 SDF Special Analysis Documents, as supplemented by other documents and communications.

After the DOE issues the next SDF PA, the NRC will review it. The NRC expects to issue the next SDF TER, with conclusions regarding the DOE meeting the POs in 10 CFR Part 61, based on the next DOE SDF PA. After the NRC issues the next SDF TER, the NRC expects to issue the next SDF Monitoring Plan based on that TER, which will include the information from NDAA-Monitoring activities since the NRC 2013 SDF Monitoring Plan was issued.

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