U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Summary of NRC Staff Recommendations to Modify 2013 NRC Saltstone Disposal Facility Monitoring Plan Based on NRC Staff Technical Review Reports

July 10, 2018

Saltstone Disposal Facility Onsite Observation Visit

Division of Decommissioning, Uranium Recovery and Waste Programs

U.S. Nuclear Regulatory Commission

Framework for Modifying Monitoring Plan

- NRC staff may recommend modifications to monitoring plan in technical review report (TRR)
  - See NRC staff recommendations to modify 2013 NRC Saltstone Disposal Facility (SDF) Monitoring Plan on Slides #6 though #28
  - If NRC implements all those recommendations, then see Slide #29 for the Status and Prioritization of SDF Monitoring Factors
- NRC may send letter to U.S. Department of Energy (DOE) that supplements monitoring plan
  - NRC letters to DOE supplementing 2013 SDF Monitoring Plan
    - June 5, 2017 – ML17097A351: Closed Monitoring Factors (MF) 3.01, MF 3.02, and MF 3.04 under both 10 CFR 61.41 and 10 CFR 61.42 performance objectives
    - March 1, 2018 – ML18033A071: Clarified Number of Monitoring Factors in DOE Savannah River Site Monitoring Plans
    - June 29, 2018 – ML18107A161: Increased Priority of MF 2.01 to Medium and Added New MF 10.14 (Medium Priority)
    - Future NRC letter(s) to DOE expected based on other NRC staff TRRs

Technical Review Reports Related to the Saltstone Disposal Facility (1 of 3)

Title	Date	Accession No.
Solubility of Technetium Dioxides in Reducing Cementitious Material Leachates, a Thermodynamic Calculation	11/7/2013	ML13304B159
Oxidation of Reducing Cementitious Waste Forms	6/4/2015	ML15098A031
Quality Assurance Documentation for the Cementitious Barriers Partnership Toolbox	8/1/2016	ML16196A179
Dose Calculation Methodology for Liquid Waste Performance Assessments at the Savannah River Site	12/23/2016	ML16277A060
Iodine Sorption Coefficients for Use in Performance Assessments for the Saltstone Disposal Facility	1/5/2017	ML16342C575
Saltstone Waste Form Hydraulic Performance	3/23/2017	ML17018A137

Technical Review Reports Related to the Saltstone Disposal Facility (2 of 3)

Title	Date	Accession No.
Performance of the High Density Polyethylene, High Density Polyethylene/Geosynthetic Clay Liner, and the Lower Lateral Drainage Layer	4/12/2017	ML17081A187
Hydraulic Performance and Erosion Control of the Planned Saltstone Disposal Facility Closure Cap and Adjacent Area	1/31/2018	ML18002A545
Groundwater Monitoring at and Near the Planned Saltstone Disposal Facility	5/17/2018	ML18117A494
Update on Projected Technetium Release from Saltstone	5/22/2018	ML18095A122
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	6/29/2018	ML18158A172

Technical Review Reports Related to the Saltstone Disposal Facility (3 of 3)

Title	Date	Accession No.
Selenium Sorption	TBD	TBD
Saltstone Degradation	TBD	TBD
Disposal Structure Concrete Degradation	TBD	TBD
Revised General Separations Area (GSA) (Groundwater) Model	TBD	TBD
Subsurface Flow and Transport	TBD	TBD

MF 2.01: Hydraulic Performance of Closure Cap

- Change: increase priority from low to medium
  - Recent DOE Tc-99 and I-129 research results indicate greater risk-significance than previously assumed
- More information needed to support assumptions related to
  - Hydrologic Evaluation of Landfill Performance (HELP) code
  - Hydraulic conductivity of the High Density Polyethylene/Geosynthetic Clay Liner composite layer
  - “As built” cover properties
  - Infiltration calculations associated with recent larger disposal structures

MF 2.02: Erosion Control of the SDF Engineered Surface Cover and Adjacent Area

- No change to priority (low) or status
- Change title and description to clarify that areas adjacent to the future SDF closure cap are covered under the NRC monitoring activities at the SDF because of risk-significance of controlling erosion in those areas
- More information is needed to address previous concerns from the NRC 2012 SDF TER, support assumptions related to the closure cap and silting-in of cover layers, and calculations associated with the soil loss equation

MF 3.01: Hydraulic Conductivity of Field-Emplaced Saltstone

- Change: close under both 10 CFR 61.41 and §61.42
- Research is adequate to support the assumed initial hydraulic conductivity of field-emplaced saltstone
  - Testing on cores of field-emplaced saltstone from Saltstone Disposal Structure (SDS) 2A supports DOE assumptions about the initial hydraulic conductivity of saltstone
  - Additional laboratory studies and analyses provided explanations for previously-observed results that did not support modeling assumptions

MF 3.02: Variability of Field-Emplaced Saltstone

- Change: close under both §61.41 and §61.42
  - Properties of saltstone core samples provided significant insight into variability in field-emplaced saltstone
  - The production, placement, and curing conditions that could cause significant variability in saltstone performance are well-controlled by the DOE
  - The DOE process to evaluate variability due to potential future changes is an adequate basis for the DOE to use to assess and control saltstone variability

MF 3.03: Applicability of Laboratory Data to Field-Emplaced Saltstone

- No change to priority (high) or status
- Narrow scope to understanding differences between the short-term changes in hydraulic conductivity in laboratory-prepared and field-emplaced saltstone
  - Results of physical and hydraulic properties of core samples provide support for use of laboratory data in representing the initial properties of field-emplaced saltstone
  - Differences in the evolution of observed leaching behavior between laboratory-prepared and field-emplaced samples may be due to differences in the evolution of hydraulic properties

MF 3.04: Effect of Curing Temperature on Saltstone Hydraulic Properties

- Change: close under both §61.41 and §61.42
  - Measurements of cores from SDS 2A demonstrated that the effects of curing conditions were adequately accounted for in the assumed initial hydraulic conductivity and effective diffusivity values
  - Additional laboratory studies and analyses provided explanations for previously-observed results that did not support modeling assumptions

MF 5.01: Radionuclide Release from Field-Emplaced Saltstone

- No change to priority (high) or status
  - Tc solubility limits the DOE used to model Tc release from chemically reduced saltstone in the 2014 Evaluation Case are not supported by recent data from dynamic leaching of cores of field-emplaced saltstone
  - Projected SDF performance is sensitive to Tc solubility in reduced saltstone
- Models of SDF performance should account for data from SDS 2A cores, including a technical justification for the projected duration of “young” cementitious material conditions

MF 5.02: Chemical Reduction of Tc by Saltstone

- Change: reduce priority from high to medium
  - NRC staff reinterpretation of three studies that led to concern
  - Observed insensitivity of Tc release to leachate dissolved oxygen
  - Greater-than-assumed Tc concentration in releases from cores of field-emplaced saltstone expected to be reducing
  - Results of DOE sensitivity analyses
- More information needed to support assumptions about re-reduction and projected duration of reducing conditions

MF 5.03: Reducing Capacity of Saltstone

- Change: reduce priority from medium to low
  - Greater than expected Tc releases from reduced saltstone reduce gap between releases from oxidized and reduced saltstone
  - NRC review of sensitivity analyses that the DOE provided in response to Questions SP-2 and SP-8 of the NRC Request for Additional Information on the FY14 Special Analysis Document confirmed low risk-significance of reducing capacity of saltstone
- More information needed to address sulfur dissolution and the applicability of the Ce (i.e., Angus-Glasser) method

MF 5.04: Certain Risk-Significant Kd Values for Saltstone
MF 10.04: Kd Values for Saltstone

- Change: Move monitoring of sorption of iodine on saltstone from MF 10.04 to MF 5.04
  - Kd value of iodine for saltstone appears to be risk-significant based on recent data and analyses
  - Preliminary leaching data from saltstone cores indicate that iodine is not significantly retained by field-emplaced saltstone
  - Kd values assumed for iodine for saltstone in the FY14 Special Analysis Document appear to be higher than is justified based on available data
- More information is needed to support assumed iodine Kd values for saltstone. Alternatively, an analysis with more justified Kd values for iodine in saltstone could be provided.

MF 5.05: Potential for Short-Term Rinse-Release from Saltstone

- Change: close under both §61.41 and §61.42
  - NRC staff reinterpretation of two studies that led to concern
  - Surficial phenomena: Scaling of data from a study of intact laboratory samples led to projected peak fractional releases less than 1 mrem/yr
  - Volumetric phenomena: Release from core samples consistent with solubility of $TcO_2 \cdot 1.6\ H_2O$ or $TcO_2 \cdot 2\ H_2O$. Additional release mechanisms (e.g., "first flush" or release from "persistent oxidized fraction") not needed to represent initial Tc release
- The importance of chemical conditions to Tc release will be monitored under MF 5.01

MF 6.01: Certain Risk-Significant Kd Values in Disposal Structure Concrete

MF 10.06: Kd Values for Disposal Structure Concrete

- Change: Move monitoring of sorption of iodine on disposal structure concrete from MF 10.06 to MF 6.01
  - Kd values assumed for iodine for disposal structure concrete in the FY14 Special Analysis Document may be higher than is justified based on available data
  - Recent research results indicate less sorption of iodine in saltstone than represented in the 2014 Evaluation Case, increasing its risk-significance
- More information is needed to support assumptions about sorption of iodine on disposal structure concrete. Alternatively, an analysis with more justified Kd values for iodine for disposal structure concrete could be provided.

MF 6.02: Tc Sorption in Disposal Structure Concrete

- Change: close under both §61.41 and §61.42
  - Major changes in DOE model of Tc migration through disposal structure concrete resolved NRC staff concern
    - Discontinued "average-K_d" approach
    - Included fast pathways through disposal structure concrete in Evaluation Case
  - DOE sensitivity analyses show assumed oxidation state of disposal structure concrete had little impact on magnitude or timing of projected peak dose

MF 6.03: Performance of Disposal Structure Roofs and HDPE/GCL Layers

- No Change to priority (medium) or status
  - NRC staff recognizes the importance of the Lower Lateral Drainage Layer (LLDL), the HDPE geomembrane also in combination with a GCL
  - Contrast between the high hydraulic conductivity of the LLDL and the low hydraulic conductivity of the HDPE/GCL composite layer has a significant impact on projected performance
  - Clarification on potential revisions to DOE's conceptual model of bottom-up deposition of clay particles in the LLDL is needed
  - Clarification of potential revisions to DOE's technical basis for HDPE performance due to the potential breach of the SDS 3A HDPE is needed
  - Additional support is needed for assumptions relating to the initial parameters used to develop the sampling set of flow cases

MF 7.01: Certain Risk-Significant Kd Values in Site Sand and Clay
MF 10.09: Kd Values for SRS Soil

- Change: Move monitoring of sorption of iodine in SRS subsurface soil from MF 10.09 to MF 7.01, including the sorption on both leachate impacted and non-leachate impacted soils
  - Kd values for subsurface soil not adequately supported
  - Basis for the leachate impact factors was not provided
  - Recent research results indicate less sorption of iodine in saltstone than represented in the 2014 Evaluation Case, increasing its risk-significance
- More information is needed to support assumptions about subsurface Kd values for iodine, particularly the leachate-impacted Kd values. Alternatively, an analysis with more justified Kd values for iodine in subsurface soils could be provided.

MF 8.02: Groundwater Monitoring

- No Change made to priority (periodic) or status
  - MF 8.02 is a periodic monitoring factor where the groundwater data will be monitored in perpetuity at the SDF
  - No changes have been made to MF 8.02; however, this monitoring factor is directly associated with the new MF 8.03

MF 8.03: Identification and Monitoring of Groundwater Plumes in the Z Area

- Change: add new MF 8.03 as a high-priority factor under §61.41 and §61.42
  - Periodic nature of MF 8.02 does not address newly identified NRC staff concerns, which will be monitored under MF 8.03
  - Monitoring wells should detect saltstone disposal structure leaks or any unintentional release to the subsurface relatively early
  - Monitoring wells should be able to delineate the plume within the Z-Area
  - Background concentration values from the Upper Three Runs Aquifer—Lower Aquifer Zone (UTRA-LAZ) are needed
  - Recommend simulating past and current SDS 4 plume concentrations in the Z-Area to obtain site-specific parameter values

MF 10.02: Defensibility of Conceptual Models (1 of 3)

- No Change to priority (high) or status
- Addresses the uncertainty of conceptual models and analysis of potential alternative conceptual models under the assumption that present natural and environmental processes will remain unchanged over time
- MF 10.02 is cross-cutting and certain aspects of the MF are discussed in three TRRs:
  - Tc release update (ML18095A122)
  - Groundwater monitoring (ML18117A494)
  - HDPE and Lower Lateral Drainage Layer Performance (ML17081A187)

MF 10.02: Defensibility of Conceptual Models (2 of 3)

- Tc release:
  - Shift from prioritizing potential exposure to trace quantities of oxygen to focusing on releases from reduced saltstone
- Far-field flow:
  - Lengthy flow and transport along the surface of the TCCZ as an alternative conceptual model

MF 10.02: Defensibility of Conceptual Models (3 of 3)

- Near field:
  - Unlike the PORFLOW model from the DOE 2009 SDF Performance Assessment, the DOE SDF FY 2014 Special Analysis Document represents a conceptual model involving sudden and complete failure of the HDPE layer and HDPE/GCL composite layer performance as evaluation case
  - NRC recommends that the evaluation case and the DOE expected or best estimate case both be carried forward; the latter as a possible sensitivity case
- DOE provided NRC the document "Conceptual Model Development for the Saltstone Disposal Facility Performance Assessment" in May 2018

MF 10.05: Moisture Characteristic Curves (MCCs)

- No Change to priority (low) or status
  - Evaluation Case in the FY 2013 and FY 2014 Special Analysis Documents relied on MCCs
  - Effect of the MCCs was limited in these cases due to the high assumed saturation of saltstone
  - Accordingly, the support was determined to be sufficient
- MCCs could become more risk-significant if future modeling projects lower saturation levels

MF 10.08: Consumption Factors and Uncertainty Distributions for Transfer Factors

- Change: Expand MF 10.08
  - Include items documented in "Technical Review of the Dose Calculation Methodology for Liquid Waste Performance Assessments at the Savannah River Site" (ML16277A060)
- Items identified by the NRC that should be addressed in future SRS Performance Assessment model revisions include:
  - Human receptor definition
  - Certain behavioral parameters (e.g., consumption rates of water and certain foods, breathing rate, fractions of foods produced locally, exposure and inhalation parameters, and crop and gardening parameters)
  - Transparency and traceability of assumed parameter values

MF 10.14: Scenario Development and Defensibility

- Change: add new MF 10.14 as a medium-priority factor under §61.41 and §61.42
  - MF added to distinguish more clearly between conceptual model uncertainty (MF 10.02) and future scenario uncertainty (MF 10.14)
- More information is needed about the potential importance of future plausible alternative scenarios to dose projections
- More information is needed about the development and defensibility of the central scenario

Expected Future Status and Prioritization of SDF Monitoring Factors

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*~~

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 Monitorin
			- 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*