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

November 1, 2018

Mr. Daniel Ferguson
Waste Disposition Programs Division
U.S. Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, SC 29802

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION JULY 9 – 11, 2018, ONSITE OBSERVATION VISIT REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE DISPOSAL FACILITY

Dear Mr. Ferguson:

The enclosed Onsite Observation Visit (OOV) Report describes the OOV that the U.S. Nuclear Regulatory Commission (NRC) conducted on July 9 – 11, 2018, at the Savannah River Site (SRS) Saltstone Disposal Facility (SDF). The July 2018 SDF OOV was conducted in accordance with Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), which requires the NRC, in coordination with the NDAA-Covered State, to monitor certain disposal actions taken by the U.S. Department of Energy (DOE) for the purpose of assessing compliance with the five performance objectives set out in Title 10 of the *Code of Federal Regulations* (CFR) Part 61, Subpart C. The five 10 CFR Part 61 Subpart C performance objectives are: (1) §61.40 (General Requirements); (2) §61.41 (Protection of the General Population from Releases of Radioactivity); (3) §61.42 (Protection of Individuals from Inadvertent Intrusion); (4) §61.43 (Protection of Individuals during Operations); and (5) §61.44 (Stability of the Disposal Site after Closure). The July 2018 SDF OOV was the 20th SDF OOV conducted since the NRC began monitoring the DOE SDF disposal actions under NDAA Section 3116(b) in October 2007.

The main activities conducted during the July 2018 SDF OOV were: (1) discuss operating and disposal structure status; (2) tour the construction of the Saltstone Disposal Structure (SDS) 7 and the Z-Area perimeter; (3) discuss the recent DOE research involving samples of cores from SDS 2A; (4) discuss the recent DOE information about the closure cap; (5) discuss the recent DOE information about features, events, and processes as well as the conceptual model for the expected 2019 SDF performance assessment; (6) discuss the recent DOE reports about the inventory of iodine-129 and technetium-99 expected to be placed in the SDF; and (7) provide the opportunity for the DOE to ask questions about the NRC technical review reports issued since April 2016.

Those OOV activities were consistent with the activities described in the NRC Guidance Memorandum for the July 2018 SDF OOV dated June 6, 2018, [available via the NRC Agencywide Documents Access and Management System (ADAMS) at Accession No. ML18155A389]. That Guidance Memorandum was developed using the SDF Monitoring Plan, Rev. 1, dated September 2013 [ADAMS Accession No. ML13100A113] and two NRC letters to the DOE that supplemented the 2013 SDF Monitoring Plan [ADAMS Accession

Nos. ML17097A351 and ML18033A071]. The NRC issued a third letter to DOE supplementing the 2013 SDF Monitoring Plan after the Guidance Memorandum was issued and before this OOV [ADAMS Accession No. ML18107A161]. As supplemented by those NRC letters, the NRC 2013 SDF Monitoring Plan contains the monitoring areas and monitoring factors that describe how the NRC will monitor the DOE SDF disposal actions to assess compliance with the performance objectives, which will be performed through a risk-informed, performance-based process using technical reviews, data reviews, and OOVs. In addition, the NRC 2013 SDF Monitoring Plan states that, "[if] the NRC concludes with reasonable assurance that DOE complies with §61.41, §61.42, §61.43, and §61.44, then NRC will also conclude with reasonable assurance that DOE complies with §61.40, 'General Requirement'".

The July 2018 SDF OOV was part of the overall NDAA monitoring approach used by the NRC, in coordination with South Carolina, to assess the DOE compliance with the performance objectives. If there is a significant concern that the NRC staff identifies during NDAA monitoring, then the NRC may establish an "Open Issue" to document that concern. Early communication of a concern to the DOE will allow the DOE to perform corrective actions before the NRC issues a Notification Letter. There were no SDF Open Issues before the July 2018 SDF OOV and there were no SDF Open Issues identified during the July 2018 SDF OOV.

Based on the July 2018 SDF OOV, the NRC did not: (1) close any of the SDF monitoring areas; (2) close any of the SDF monitoring factors; or (3) change the overall conclusions from the NRC 2012 Technical Evaluation Report (TER) for the SDF.

During the NDAA monitoring process, the NRC does expect to open and close Follow-Up Action Items during OOVs, meetings, clarification teleconference calls, or technical teleconference calls. Most of those Follow-Up Action Items are specific short-term actions to be performed by the NRC or the DOE. Usually, most of those Follow-Up Action items are closed before the next OOV, meeting, clarification teleconference call, or technical teleconference call. During this OOV, there were eight Follow-Up Action Items opened.

A main focus of an SDF OOV is the NRC 2012 TER [ADAMS Accession No. ML121020140] and the NRC Type-IV Letter of Concern [ADAMS Accession No. ML120650576], which were both issued on April 30, 2012, and both pertain to waste disposal at the SRS SDF. The NRC staff concluded that projected future doses in many of the scenarios the NRC staff considered reasonable fell within a range of approximately 0.25 mSv/yr (25 mrem/yr), which is the limit established in the §61.41 performance objective, to approximately 1 mSv/yr (100 mrem/yr), which is the public dose limit found in 10 CFR 20.1301. Thus, although the NRC staff could not conclude that the performance objective in §61.41 was met, the potential dose to an off-site member of the public from the DOE disposal actions was still expected to be relatively low. In the TER, the NRC concluded that it did not have reasonable assurance that the DOE salt waste disposal at the SDF met the performance objectives in 10 CFR Part 61, specifically §61.41.

The NRC Type-IV Letter of Concern formally communicated the NRC concerns to both the DOE and the South Carolina Department of Health and Environmental Control (i.e., South Carolina regulator of SRS). In July 2012, the DOE provided responses to the NRC Type-IV Letter in multiple submittals [ADAMS Accession Nos. ML12198A258 and ML12215A081]. Those submittals included an updated technetium-99 (Tc-99) inventory projection limited to the constructed disposal structures that were similar in design to SDS 2A (i.e., SDS 2A, SDS 2B, SDS 3A, SDS 3B, SDS 5A, SDS 5B) and information about the DOE Case K and Case K1 uncertainty and sensitivity analyses.

In August 2012, the NRC issued a letter of acknowledgement to the DOE [ADAMS Accession No ML12213A447], which included the statement that: "… the NRC staff concludes that a Type-II Letter to the U.S. Congress is not needed at this time." A Type-II Letter means that there is a "Lack of Compliance Demonstration" where the NRC staff concludes that indirect evidence exists that indicates the DOE disposal actions do not meet one or more of the 10 CFR Part 61 performance objectives and the NRC will issue a Type-II Letter if the DOE cannot adequately address the NRC technical concerns. Based on the NRC 2012 TER and the later DOE revised Tc-99 inventory, "[the NRC staff] determined that, if DOE's new projected Tc-99 inventory [for the disposal structures similar to SDS 2A (i.e., SDS 2A, SDS 2B, SDS 3A, SDS 3B, SDS 5A, and SDS 5B) that were constructed at that time] is correct, then it is unlikely to cause an off-site peak dose exceeding the requirements of §61.41 (i.e., 0.25 mSv/yr (25 mrem/yr))."

However, the NRC Type-IV Letter and the NRC 2012 TER conclusion that the NRC did not have reasonable assurance that the DOE salt waste disposal at the SDF met the performance objective of §61.41 is still in place because the NRC conclusion in the TER refers to the projected future dose from the entire SDF. However, the updated inventory only related to certain disposal structures. The NRC needs to assess the entire SDF inventory in the context of new information about waste form and SDF performance in order to make conclusions about the DOE meeting the performance objectives.

The NRC and the DOE continue to work in the NDAA monitoring process to resolve all outstanding concerns that led to issuance of the NRC Type-IV Letter of Concern. The NRC also conducts routine monitoring activities described in the NRC 2013 SDF Monitoring Plan that are not directly related to the specific issues in the NRC Type-IV Letter of Concern. In accordance with the requirements of NDAA Section 3116(b), the NRC, in coordination with the NDAA-Covered State of South Carolina, will continue to monitor the DOE disposal actions at the SRS SDF.

If you have any questions or need additional information regarding this OOV Report, then please contact Mr. Harry Felsher of my staff at Harry.Felsher@nrc.gov or at (301) 415-6559.

Sincerely,

/RA/

Andrea Kock, Deputy Director
Division of Decommissioning, Uranium Recovery,
and Waste Programs
Office of Nuclear Material Safety
and Safeguards

Docket No. PROJ0734

Enclosure:
NRC Onsite Observation Visit Report

cc: w/ Enclosure:
WIR Service List
WIR ListServ

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION JULY 9 – 11, 2018, ONSITE OBSERVATION VISIT REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE DISPOSAL FACILITY **DATE: November 1, 2018**

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U.S. NUCLEAR REGULATORY COMMISSION
JULY 9 – 11, 2018, ONSITE OBSERVATION VISIT REPORT FOR
THE SAVANNAH RIVER SITE SALTSTONE DISPOSAL FACILITY

EXECUTIVE SUMMARY:

The U.S. Nuclear Regulatory Commission (NRC) staff conducted its 20th Onsite Observation Visit (OOV) to the Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) on July 9 – 11, 2018 (SDF Observation 2018-01). That was the first SDF OOV in Calendar Year (CY) 2018. On every OOV to SRS, the NRC is focused on assessing the U.S. Department of Energy (DOE) compliance with the following performance objectives in Title 10 of the *Code of Federal Regulations* (CFR) Part 61, Subpart C: (1) §61.41 (Protection of the General Population from Releases of Radioactivity), (2) §61.42 (Protection of Individuals from Inadvertent Intrusion), (3) §61.43, (Protection of Individuals during Operations), and (4) §61.44, (Stability of the Disposal Site after Closure). Also, if the NRC concludes with reasonable assurance that the DOE complies with §61.41, §61.42, §61.43, and §61.44, then the NRC will also conclude with reasonable assurance that the DOE complies with the performance objective §61.40 "General Requirement". Please see the Attachment to this OOV Report for the detailed technical information from this OOV.

For this OOV, the NRC focused on the monitoring areas and monitoring factors in the NRC SDF Monitoring Plan, Rev. 1 dated September 2013 [available via the NRC Agencywide Documents Access and Management System (ADAMS) at Accession No. ML13100A113], as supplemented by the three NRC letters to the DOE [ADAMS Accession Nos. ML17097A351, ML18033A071, and ML18107A161]. This is the sixth SDF OOV under the 2013 SDF Monitoring Plan. All NRC concerns prior to the 2013 SDF Monitoring Plan were rolled into the monitoring factors in the 2013 SDF Monitoring Plan. The NRC performs monitoring activities in coordination with the NDAA-Covered State of South Carolina. Therefore, the South Carolina Department of Health and Environmental Control (SCDHEC) staff also participated in this OOV.

Consistent with the NRC Guidance Memorandum for this OOV dated June 6, 2018, [ADAMS Accession No. ML18155A389], the main activities conducted during this OOV were: (1) discuss operating and disposal structure status; (2) tour the construction of the Saltstone Disposal Structure (SDS) 7 and the Z-Area perimeter; (3) discuss the recent DOE research involving samples of cores from SDS 2A; (4) discuss the recent DOE information about the closure cap; (5) discuss the recent DOE information about features, events, and processes (FEPs) as well as the conceptual model for the expected 2019 SDF performance assessment (PA); (6) discuss the recent DOE reports about the inventory of iodine-129 (I-129) and technetium-99 (Tc-99) expected to be placed in the SDF; and (7) provide the opportunity for the DOE to ask questions about the NRC technical review reports (TRRs) issued since April 2016.

The NRC does not expect to close any of the SDF monitoring factors or change the overall conclusions from the NRC 2012 Technical Evaluation Report (TER) for the SDF as a result of this OOV. There were no SDF Open Issues before this OOV and there were no SDF Open Issues identified during this OOV. The NRC and the DOE continue to work in the NDAA

monitoring process to resolve all outstanding concerns that led to issuance of the NRC Type-IV Letter of Concern.

The NRC received the updated DOE OOV presentation (SRR-CWDA-2018-00035, Rev. 1) [ADAMS Accession No. ML18205A653] that pertained to the activities during this OOV. The updated DOE presentation also included pictures that were taken during the tour and the July 2018 DOE presentation, "Long-Term Percolation Rates for the Saltstone Disposal Facility Closure Cap." Separately, the NRC received three July 2018 DOE briefings held during the OOV on the topics of: (1) "Features, Events, and Processes and the Conceptual Model for the 2019 Saltstone Disposal Facility Performance Assessment" [ADAMS Accession No. ML18198A088]; (2) "Inventory Reports for Iodine-129 (I-129) and Technetium-99 (Tc-99)" [ADAMS Accession No. ML18198A140]; and (3) "Research Results/Status" [ADAMS Accession No. ML18198A210].

1.0 BACKGROUND:

Section 3116(a) of the National Defense Authorization Act for Fiscal Year (FY) 2005 (NDAA) authorizes the DOE, in consultation with the NRC, to determine that certain radioactive waste related to the reprocessing of spent nuclear fuel is not high-level waste, provided certain criteria are met. NDAA Section 3116(b) requires the NRC to monitor the DOE disposal actions to assess compliance with the performance objectives in 10 CFR Part 61, Subpart C.

On March 31, 2005, the DOE submitted to the NRC the *Draft Section 3116 Determination for Salt Waste Disposal Savannah River Site* (DOE-WD-2005-001, Rev. 0) [ADAMS Accession No. ML051020072] to demonstrate compliance with the NDAA criteria, including demonstration of compliance with the performance objectives in 10 CFR Part 61, Subpart C. In its consultation role, the NRC staff reviewed the draft Waste Determination. In the NRC TER issued in December 2005 [ADAMS Accession No. ML053010225], the NRC documented the results of its review and concluded that there was reasonable assurance that the applicable criteria of NDAA could be met, provided certain assumptions made in the DOE analyses were verified via NDAA monitoring. Taking into consideration the assumptions, conclusions, and recommendations in the NRC 2005 TER, the DOE issued the Final Waste Determination in January 2006 (DOE-WD-2005-001, Rev. 1) [ADAMS Accession No. ML102850319].

The DOE submitted a revised SDF PA to the NRC in 2009 (SRR-CWDA-2009-00017) [ADAMS Accession No. ML101590008]. The NRC staff reviewed SRR-CWDA-2009-00017, including holding public meetings, sending requests for additional information, and reviewing the DOE responses. On April 30, 2012, the NRC issued both a new TER [ADAMS Accession No. ML121020140] and a Type-IV Letter of Concern [ADAMS Accession No. ML120650576].

In the NRC 2012 TER, the NRC staff concluded that projected future doses in many of the scenarios the NRC staff considered reasonable fell within a range of approximately 0.25 mSv/yr (25 mrem/yr), the limit established in the §61.41 performance objective, to approximately 1 mSv/yr (100 mrem/yr), the public dose limit found in 10 CFR 20.1301. Thus, although the NRC staff could not conclude that the performance objective in §61.41 was met, the potential dose to an off-site member of the public from the DOE disposal actions was still expected to be relatively low. The NRC concluded that it did not have reasonable assurance that the DOE salt

waste disposal at the SDF met the performance objectives in 10 CFR Part 61, specifically §61.41.

The NRC Type-IV Letter of Concern formally communicated the NRC concerns to both the DOE and the SCDHEC (i.e., South Carolina regulator of SRS). In July 2012, the DOE provided responses to the NRC Type-IV Letter in multiple submittals [ADAMS Accession Nos. ML12198A258 and ML12215A081]. Those submittals included an updated technetium-99 (Tc-99) inventory projection limited to the constructed disposal structures that were similar in design to SDS 2A (i.e., SDS 2A, SDS 2B, SDS 3A, SDS 3B, SDS 5A, SDS 5B) and information about the DOE Case K and Case K1 uncertainty and sensitivity analysis.

In August 2012, the NRC issued a letter of acknowledgement to the DOE [ADAMS Accession No ML12213A447], which included the statement that: "… the NRC staff concludes that a Type-II Letter to the U.S. Congress is not needed at this time." A Type-II Letter means that there is a "Lack of Compliance Demonstration" where the NRC staff concludes that indirect evidence exists that indicates the DOE disposal actions do not meet one or more of the 10 CFR Part 61 performance objectives and the NRC will issue a Type-II Letter if the DOE cannot adequately address the NRC technical concerns. Based on the NRC 2012 TER and the later DOE revised Tc-99 inventory, "[the NRC staff] determined that, if DOE's new projected Tc-99 inventory [for the disposal structures similar to SDS 2A (i.e., SDS 2A, SDS 2B, SDS 3A, SDS 3B, SDS 5A, and SDS 5B) that were constructed at that time] is correct, then it is unlikely to cause an off-site peak dose exceeding the requirements of §61.41 (i.e., 0.25 mSv/yr (25 mrem/yr))."

However, the NRC Type-IV Letter and the NRC 2012 TER conclusion that the NRC did not have reasonable assurance that the DOE salt waste disposal at the SDF met the performance objective of §61.41 is still in place because the NRC conclusion in the TER refers to the projected future dose from the entire SDF, not just the projected future dose from the disposal structures constructed at the time of the TER, which were: SDS 1, SDS 2A, SDS 2B, SDS 3A, SDS 3B, SDS 4, SDS 5A, and SDS 5B.

To carry out its monitoring responsibility under NDAA Section 3116(b), the NRC, in coordination with the NDAA-Covered State of South Carolina (by SCDHEC), performs three NDAA monitoring activities: (1) technical reviews, (2) data reviews, and (3) OOVs. Specifically, technical reviews generally focus on reviewing information generated to provide support for key assumptions that the DOE made in the SDF PA or supplements, such as special analysis documents. Data reviews generally focus on supplementing technical reviews by focusing on monitoring data that may indicate future system performance or reviewing records or reports that can be used to directly assess compliance with the performance objectives. OOVs generally focus on either: (1) observing the collection of data and reviewing the data to assess consistency with assumptions made in the DOE Final Waste Determination; or (2) observing key disposal or closure activities related to technical review areas.

The information in an OOV Report is relevant to all aspects of the NDAA monitoring activities. The NRC will use the information in an OOV Report to evaluate whether or not DOE disposal actions comply with the performance objectives, whether to open new or close current monitoring areas, and whether to open new or close current monitoring factors. During an OOV, the DOE may present preliminary data and commit to provide final data in a publicly

available document or documents at a later time to the NRC. That DOE commitment to provide that future document or documents to the NRC would be a Follow-Up Action Item in an OOV Report. The future NRC decisions on performance objectives, monitoring areas, and monitoring factors will be based on evaluating the final data in that future DOE document or documents and will not be based on the preliminary data discussed at an OOV and summarized in an OOV Report. The NRC review of the final DOE data may be documented in a TRR or a TER, both of which would be publicly available. The issues evaluated in a TRR or a TER will either be directly related to the issues in the NRC Type-IV Letter or will be related to routine NRC monitoring activities that are described in the 2013 SDF Monitoring Plan, as supplemented by the NRC letters to the DOE.

2.0 ONSITE OBSERVATION VISIT ACTIVITIES:

On June 6, 2018, the NRC issued the OOV Guidance Memorandum [Accession No. ML18155A389] for the July 2018 SDF OOV, SDF Observation 2018-01. An OOV Guidance Memorandum is a plan for what the NRC expects to cover during an OOV, which may be changed based on what happens during the OOV. The detailed technical information collected during this OOV is presented as the Attachment to this OOV Report.

The OOV began with a short briefing on the agenda that was attended by representatives from the DOE (including the DOE contractors), the NRC, and the SCDHEC. Afterwards, there were welcoming remarks and introductions. The rest of the OOV consisted of a tour and technical discussions. The tour was focused on the construction of SDS 7 and the Z-Area perimeter. The technical discussions were focused on: (1) operating and disposal structure status; (2) recent DOE research involving samples of cores from SDS 2A; (3) recent DOE information about the closure cap; (4) recent DOE information about FEPs and the conceptual model for the expected 2019 SDF PA; (5) recent DOE reports about the inventory of I-129 and Tc-99 expected to be placed in the SDF; and (6) providing the opportunity for the DOE to ask questions about the NRC TRRs issued since April 2016.

2.1 Technical Discussion – Operating and Disposal Structure Status:

2.1.1 Observation Scope:

The technical discussion supported the NRC monitoring of the DOE disposal actions to assess compliance with 10 CFR 61.41, §61.42 and §61.43. The technical discussion was most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1, as supplemented by the NRC letters to the DOE:

- Monitoring Area (MA) 1 (Inventory):
  - Monitoring Factor (MF) 1.01 (Inventory in Disposal Structures)
  - MF 1.02 (Methods Used to Assess Inventory)

- MA 8 (Environmental Monitoring):
  - MF 8.01 (Leak Detection)

- MA 11 (Radiation Protection Program):
    - MF 11.01 (Dose to Individuals During Operations)

2.1.2 Observation Results:

The DOE presented an overview of the recent SDF operating and disposal structure status in the DOE presentation (SRR-CWDA-2018-00035, Rev. 1) [ADAMS Accession No. ML18205A653]. The key points from the technical discussion were:

- Regarding the SDF worker doses:
    - the DOE provided the NRC staff with data that showed that the SDF worker doses continue to meet the §61.43 performance objective

- Regarding the DOE quarterly inventory reports:
    - due to lack of operations, there will not be a FY 2017 4th quarter inventory report

    - the months for when the inventory reports are issued will change by one month and will now be: February, May, August, and November

- Regarding the status of SDS 3A, SDS 3B, SDS 5A, SDS 5B, and SDS 6:
    - the DOE designated SDS 5A as “full” in August 2016 and SDS 5B as “full” in February 2017

    - the DOE began filling SDS 3A in February 2017 and the DOE has the necessary approvals to begin filling SDS 3B and SDS 6

    - the values of the allowable volume of saltstone that can be added to SDS 3A, SDS 3B, and SDS 6 are currently limited by a DOE Potential Inadequacy of the Safety Analysis (PISA), which is based on a new evaluation of the potential hydrogen generation rate of tank waste:
        - the interim height limits are in effect while calculations and experiments are performed to resolve the PISA

        - the DOE plans to begin filling SDS 6 before adding grout to SDS 3B because of logistical considerations caused by the interim height limits due to the PISA and to ensure there is an alternate location available to fill if issues arise with the 375-foot disposal structures

        - the DOE expects the PISA to be resolved by the end of FY 2019 and that when the PISA is resolved its resolution will not result in height limits that affect the allowable volumes of saltstone in SDS 3A, SDS 3B, and SDS 6

        - the NRC staff indicated that resolving the PISA does not necessarily mean that there would be no height limits because the PISA could be resolved by concluding that there must be height limits

  - in the future, the DOE intends to fill SDS 3A and SDS 6 interchangeably, while only filling SDS 3B when SDS 3A is "full" and SDS 6 cannot be filled, which will allow the DOE to use SDS 3B as a flexible option for backup purposes

  - the DOE expects that SDS 7 will be constructed and available for use prior to SDS 3A, SDS 3B, and SDS 6 all being designated as "full"

- Regarding the amount of salt solution processed from Tank 50:
  - in FY 2016: 1,506,000 gallons (5,700,800 liters)

  - in FY 2017: 169,658 gallons (642,225 liters)

  - in FY 2018, as of this OOV: 268,384 gallons (1,015,900 liters)

- Regarding Saltstone levels and space availability as of this OOV:
  - saltstone level in SDS 3A is about 5.25 feet (1.60 meters), saltstone level in SDS 3B is 0 feet (0 meters), and saltstone level in SDS 6 is 0 feet (0 meters)

  - there is space available for about 4.9 million gallons (18.5 million liters) of saltstone if you combined the available spaces in SDS 3A and SDS 3B

  - there is space available for about 32.8 million gallons (124 million liters)) of saltstone in SDS 6

  - the DOE expects the allowed fill heights for SDS 3A, SDS 3B, and SDS 6 to be increased to interim values before the PISA is resolved, which would then increase the space available for saltstone in SDS 3A, SDS 3B, and SDS 6

- Regarding SDS 6 milestones:
  - November 2015: initial leak test not acceptable

  - February – March 2016: performed systems engineering evaluation

  - April – December 2016: evaluated and installed interior liner system

  - December 2016: leak check acceptable

  - March 2017: tested lines with non-radioactive grout

  - July 2017: ready for operation

  - the DOE expects to start filling SDS 6 in 3rd quarter CY 2018

- Regarding SDS 7 status:
  - June 2018 – initiated excavation

  - the DOE expects to begin to install the lower mud mat, Geosynthetic Clay Liner (GCL), and High Density Polyethylene (HDPE) in 3rd quarter CY 2018

  - the DOE expects to initiate construction of the structure in 4th quarter CY 2018

  - SDS 7 will not have pedestals for the roof support columns inside, as SDS 6 has

- Regarding status of interior liners in SDS 6 through SDS 12:
  - SDS 6 and SDS 7 will have interior liners and the DOE has not yet decided if SDS 8 through SDS 12 will have interior liners

- Regarding other status updates:
  - the DOE expects the Salt Waste Processing Facility (SWPF) to start up later than December 2018

  - the DOE will put a "clean cap" on SDS 2A, SDS 2B, SDS 5A, and SDS 5B (i.e., non-radioactive grout inside at the top of the disposal structure)

- Regarding the new DOE planned layout of the disposal structures in the SDF:
  - the DOE changed the planned layout from what was in the FY 2014 SDF Special Analysis Document [ADAMS Accession No. ML15097A366]

  - the current DOE planned layout is on Slide 28 of the DOE presentation (SRR-CWDA-2018-00035, Rev. 1) [ADAMS Accession No. ML18205A653] for this OOV

  - to avoid both worker exposure to contaminated soil and the logistic challenges of maneuvering equipment and staging materials in the limited space between SDS 1 and SDS 4, the DOE no longer plans to build disposal structures between SDS 1 and SDS 4

  - in the expected SDF 2019 PA, the DOE will evaluate the implications of the new disposal structure planned layout on both the closure cap design and the projected dose

  - in the future, the DOE will discuss with SCDHEC the implications of the new disposal structure planned layout on the location of monitoring wells

2.1.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE SDF activities. There were no Follow-Up Action Items that resulted from the technical discussion.

2.2 Tour – Construction of SDS 7 and the Z-Area Perimeter

2.2.1 Observation Scope:

The tour supported the NRC monitoring of the DOE disposal actions to assess compliance with §61.41 and §61.42. The tour was most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1, as supplemented by the NRC letters to the DOE:

- MA 6 (Disposal Structure Performance):
  - MF 6.03 (Performance of Disposal Structure Roofs and High Density Polyethylene/Geosynthetic Clay Liner (HDPE/GCL) Layers)
  - MF 6.04 (Disposal Structure Concrete Fracturing)
  - MF 6.05 (Integrity of Non-Cementitious Materials)

- MA 8 (Environmental Monitoring):
  - MF 8.02 (Groundwater Monitoring)

2.2.2 Observation Results:

The tour consisted of observing the construction of SDS 7 on foot and the Z-Area perimeter from a vehicle, including observing changes in the terrain or disposal structures, such as: evidence of subsidence, signs of erosion, or cracking in the disposal structures. The key points from the tour were:

- The NRC staff observed the construction site of SDS 7 on foot and, as requested by the NRC staff, the DOE took pictures of key features of SDS 7 being constructed

- The NRC staff observed the Z-Area perimeter from a vehicle, including the vast clearing of trees related to construction of SDS 7 and, in the future, SDS 8 through SDS 12

2.2.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE SDF activities. The following Follow-Up Action item resulted from the tour:

- The DOE to provide the NRC with electronic versions of pictures taken during the tour

2.3 Technical Discussion – Recent DOE Research Involving Samples of Cores from SDS 2A

2.3.1 Observation Scope:

The technical discussion supported the NRC monitoring of the DOE disposal actions to assess compliance with §61.41 and §61.42. The technical discussion was most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1, as supplemented by the NRC letters to the DOE:

- MA 3 (Waste Form Hydraulic Performance):
    - MF 3.03 (Applicability of Laboratory Data to Field-Emplaced Saltstone)

- MA 5 (Waste Form Chemical Degradation):
    - MF 5.01 (Radionuclide Release from Field-Emplaced Saltstone)
    - MF 5.02 (Chemical Reduction of Technetium (Tc) by Saltstone)
    - MF 5.03 (Reducing Capacity of Saltstone)
    - MF 5.04 (Certain Risk-Significant K_d Values for Saltstone)

2.3.2 Observation Results:

The DOE briefed the NRC on the "Research Results/Status" [ADAMS Accession No. ML18198A210]. The key points from the technical discussion were:

- In the future, the DOE will use a different blast furnace slag (BFS) (i.e., designated as Lehigh BFS) as part of the dry feed composition and so, the DOE has begun to use it in their research experiments

- In recent research, simulated saltstone samples made with Lehigh BFS released more Tc-99 per pore volume than both:
    - simulated samples made with Holcim BFS; and

    - a core sample of field-emplaced saltstone, which was made with Holcim BFS

- The DOE indicated that preliminary research results appear to support modeling I-129 sorption with a non-zero sorption coefficient (K_d value)

- The NRC staff asked the DOE if the DOE had compared the I-129 results with the results for nitrate, which also took more than a pore volume to be completely released from comparable samples, because nitrate is not expected to undergo chemical sorption but may take more than a pore volume to be released because of diffusion from inactive pore spaces

- The DOE indicated that nitrate could not be measured in that experiment because of laboratory limitations related to working with I-129

- The DOE plans to begin new dynamic leaching method (DLM) experiments:
    - an untested SDS 2A core will be removed from storage and testing is to begin during the summer of 2018

    - testing new simulated saltstone samples is expected to begin in January 2019 with simulated saltstone samples spiked with both I-129 and Tc-99 and formulated to represent waste from the SWPF, which will replace the Actinide Removal Process (ARP) / Modular Caustic Solvent Side Extraction Unit (MCU)

2.3.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE SDF activities. The following Follow-Up Action Item resulted from the technical discussion:

- The DOE to provide the NRC with the electronic version of the DOE presentation: "Research Results/Status"

2.4 Technical Discussion – Recent DOE Information on the Closure Cap

2.4.1 Observation Scope:

The technical discussion supported the NRC monitoring of the DOE disposal actions to assess compliance with §61.41 and §61.42. The technical discussion was most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1, as supplemented by the NRC letters to the DOE:

- MA 2 (Infiltration and Erosion Control):
  - MF 2.01 (Hydraulic Performance of Closure Cap)
  - *(new title)* MF 2.02 (Erosion Control of the SDF Engineered Surface Cover and Adjacent Area)

- MA 10 (Performance Assessment Model Revisions):
  - MF 10.02 (Defensibility of Conceptual Models)

2.4.2 Observation Results:

Dr. Benson, lead author of the DOE contractor report, provided the NRC with an overview of: "Predicting Long-Term Percolation from the SDF Closure Cap" (SRRA107772-000009, Rev. A) [ADAMS Accession No. ML18170A244], which will be referred to in this OOV Report as the Closure Cap Report. The key points from the technical discussion were:

- The NRC staff informed the DOE that if the recommended infiltration rates from the Closure Cap Report are used in the expected SDF 2019 PA, then the closure cap is likely to be extremely important to the projected dose and the NRC staff will do a very thorough review of both the Closure Cap Report and the references

- The NRC staff indicated that the uncertainty in both many parts of the DOE analysis as well as in the Closure Cap Report did not appear to be adequately represented (for more information, see the Appendix below)

- The NRC staff indicated that model projections of infiltration at thousands of years after site closure should be based on multiple lines of reasoning and should not be dismissed as unrealistic on the basis that the projected infiltration rates had not been observed in much younger (i.e., ten to thirty year old) engineered systems

- Dr. Benson and the NRC staff agreed that additional quantitative information would be needed to support assumptions about Loblolly Pine root depth because of the importance of the erosion barrier to projections of the hydraulic performance of the closure cap – pine tree roots could create channels in the cover and create or expand holes in the GCL and HDPE

- The NRC staff indicated that NUREG/CR-7028, "Engineered Covers for Waste Containment: Changes in Engineering Properties and Implications for Long-Term Performance Assessment" is a contractor report (i.e., the CR designation) and that any recommendations in it are the recommendations of the contractor rather than recommendations from the NRC

- The DOE indicated that it planned to use the "upper bound with average climate" case projection as the infiltration rate through the engineered cover in the expected SDF 2019 PA Evaluation Case

- The DOE agreed with the NRC staff suggestion that running the model with the infiltration rate used in the Evaluation Case in the FY 2014 SDF Special Analysis Document would provide a useful benchmark to evaluate the importance of the cover to model projections

- SCDHEC informed the DOE and the NRC staff of a 2008 South Carolina regulation that requires a specific slope of an engineering cover in all solid waste landfills regulated by SCDHEC in South Carolina (Regulation 61-107.19, SWM: Solid Waste Landfills and Structural Fill – Effective Date: May 23, 2008) in Subpart F (Closure and Post-closure Care) Section 258.60 (Closure Criteria):
    - "n. The final cover system shall promote positive drainage by grading to create at least a 3%, but not greater than 5%, surface slope and a side slope that does not exceed three horizontal feet to one vertical foot, i.e., a 3:1 slope."

2.4.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE SDF activities. The following Follow-Up Action Item resulted from the technical discussion:

- The DOE to provide the NRC with electronic versions of the reference documents for the Closure Cap Report (SRRA107772-000009, Rev. A)

2.5 Technical Discussion – Recent DOE Information on FEPs as well as the Conceptual Model for the Expected 2019 SDF PA

2.5.1 Observation Scope:

The technical discussion supported the NRC monitoring of the DOE disposal actions to assess compliance with §61.41 and §61.42. The technical discussion was most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1, as supplemented by the NRC letters to the DOE:

- MA 10 (Performance Assessment Model Revisions):
    - MF 10.02 (Defensibility of Conceptual Models)
    - (new) MF 10.14 (Scenario Development and Defensibility)

2.5.2 Observation Results:

The DOE briefed the NRC on "FEPs and the Conceptual Model for the 2019 Saltstone Disposal Facility PA" [ADAMS Accession No. ML18198A088]. The key points from the technical discussion were:

- Regarding FEPs:
    - the DOE indicated that the distinct engineered features of the closure cap (e.g., resistive layers, drainage layers) and processes relevant to those layers (e.g., degradation, siltation) were not represented in detail in the DOE FEPs Analysis (SRR-CWDA-2017-00057, Rev. 0) [ADAMS Accession No. ML18170A253] because they were evaluated implicitly in the evaluation of the projected cover performance (i.e., Closure Cap Report)

    - the DOE indicated that FEPs that were evaluated implicitly in the evaluation of the projected cover performance were not documented separately in the FEPs Analysis and are not expected to be documented separately in any future such FEPs analysis

    - the NRC staff indicated that the potential for erosion appeared to be underrepresented in the FEPs Analysis

    - the DOE does not plan to issue a revision to the FEPs Analysis
        - the DOE will capture any changes in the expected DOE SDF 2019 PA

- Regarding the Conceptual Model for the Expected 2019 SDF PA:
    - the NRC staff disagreed with a DOE comment that the NRC had previously accepted that assuming a linear progression of saltstone degradation (i.e., a constant degradation rate) is conservative:
        - the NRC staff indicated that it had previously expressed concern to the DOE that that assuming linear degradation might not be conservative (see the NRC Request for Additional Information Question SP-3 on the FY 2014 SDF Special Analysis Document [ADAMS Accession No. ML15161A541])

    - the NRC staff expressed a concern that the title of the DOE Interaction Matrix element (IM) 08.06, "Gaseous Phases to Saltstone Reducing Capacity" implied that it would represent the consumption of saltstone reducing capacity by oxygen that entered saltstone as a gas; however, the description of the IM element only discussed consideration of oxygen dissolved in infiltrating water:
        - the NRC staff indicated that the importance of including gas-phase oxygen ingress into saltstone is likely to increase if the projected inflow of water into saltstone was decreased in the manner that the DOE described in the Cover Cap Report

    - the DOE indicated that it would need to evaluate the effects of new assumptions about cover performance on saltstone fracture saturation

- in response to the NRC staff questions, the DOE provided detailed information about how disposal structure degradation will be modeled in the expected SDF 2019 PA

- in response to the NRC staff questions, the DOE provided several clarifications about the Conceptual Model Report (SRR-CWDA-2018-00006, Rev. 0) [ADAMS Accession No. ML18143B265] (for more information, see the Appendix below)

- the NRC staff discussed the terms “conceptual model” and “scenario,” as described in the 2015 NRC NUREG-2175, “Guidance for Conducting Technical Analyses for 10 CFR Part 61 – Draft Report for Comment” [ADAMS Accession No. ML15056A516]
    - the NRC staff indicated that the term “scenario” is used to indicate different plausible evolutions of site conditions

    - the NRC staff clarified that the term “conceptual model” indicates different plausible ways a site could function

    - the NRC staff clarified that a “sensitivity analysis” is typically designed to provide information about the importance of a parameter or engineered feature to projected system performance and does not necessarily reflect plausible site conditions (e.g., complete omission of a closure cap)

- the NRC staff indicated that there was a difference between how the NRC would use a FEPs analysis to generate plausible alternative conceptual models and the results of both the DOE FEPs Analysis and Conceptual Model Report, which included implausible states, such as a “no closure cap” alternative conceptual model that the NRC staff would regard as a sensitivity analysis

- the NRC staff indicated that the Conceptual Model Report appears to use the terms “sensitivity analysis,” “conceptual model,” and “scenario” interchangeably

- In response to a DOE question, the NRC staff indicated that the Conceptual Model Report was responsive to the technical concern in MF 10.02; however, the NRC staff indicated that MF 10.02 relates specifically to the defensibility of conceptual models and the Conceptual Model Report did not appear to distinguish between conceptual models and sensitivity analyses.

- the DOE does not plan to issue a revision to the Conceptual Model Report
    - the DOE will capture any changes in the expected SDF 2019 PA

2.5.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE SDF activities. The following Follow-Up Action Items resulted from the technical discussion:

- The DOE to provide the NRC with the electronic version of the DOE presentation: "FEPs and the Conceptual Model for the 2019 Saltstone Disposal Facility PA"

- The DOE to provide the NRC with the electronic version of the Vanderbilt Report, "Predicting the Hydraulic Conductivity Over Time for Degrading Saltstone Vault Concrete" (SRRA110110-000004, Rev. 0)

- The DOE to provide the NRC with the electronic version of the graphic "Overview of Activities to Support Development of the Compliance Model for the Saltstone Disposal Facility (SDF) Performance Assessment (PA)" (SRR-CWDA-2018-00020, Rev. 1)

2.6 Technical Discussion – Recent DOE Reports about the Inventory of I-129 and Tc-99 Expected to be Placed in the SDF

2.6.1 Observation Scope:

The technical discussion supported the NRC monitoring of the DOE disposal actions to assess compliance with §61.41 and §61.42. The technical discussion was most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1, as supplemented by the NRC letters to the DOE:

- MA 1 (Inventory):
    - MF 1.01 (Inventory in Disposal Structures)
    - MF 1.02 (Methods Used to Assess Inventory)

2.6.2 Observation Results:

Prior to the OOV, the DOE provided the NRC with two documents: (1) "Evaluation of I-129 Concentration Data to Improve Liquid Waste Inventory Projections," (SRR-CWDA-2015-00077, Rev. 2) [ADAMS Accession No. ML18170A269]; and (2) "Evaluation of Tc-99 Concentration Data to Improve Liquid Waste Inventory Projections," (SRR-CWDA-2015-00123, Rev. 2) [ADAMS Accession No. ML18170A279]. The DOE briefed the NRC on "Inventory Reports for Iodine-129 (I-129) and Technetium-99 (Tc-99)" [ADAMS Accession No. ML18198A140]. The key points from the technical discussion were:

- The DOE indicated that the inventory of Tc-99 and I-129 in the Waste Characterization System (WCS) were based on a fixed ratio to Cs-137 that did not account for the difference in the decay rate between Cs-137 and the much longer-lived Tc-99 and I-129

- The DOE indicated that uncertainty in the inventory estimates for Tc-99 and I-129 has been significantly reduced by increased sampling, such as:

- approximately 70% to 80% of the I-129 and Tc-99 inventory is now based on direct measurements of those radionuclides from the Tank Farms, which has significantly reduced uncertainty in the projected inventory of those radionuclides

- the remaining inventory of I-129 and Tc-99 is based on new statistical relationships between those radionuclides and measured values of Cs-137

- the projected inventory of Tc-99 for future SDF disposal decreased from an estimate of 2.9 x 10^4 Curie (Ci) used in the FY 2014 SDF Special Analysis Document to an estimate of 2.12 x 10^4 Ci

- the projected inventory of I-129 for future SDF disposal increased from an estimate of 12.2 Ci used in the FY 2014 SDF Special Analysis Document to an estimate of 15.0 Ci

2.6.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE SDF activities. The following Follow-Up Action Item resulted from the technical discussion:

- The DOE to provide the NRC with the electronic version of the DOE presentation: "Inventory Reports for Iodine-129 (I-129) and Technetium-99 (Tc-99)"

2.7 Technical Discussion – NRC Technical Review Reports Issued Since April 2016

2.7.1 Observation Scope:

The NRC staff presented a summary of the SDF-related NRC TRRs issued since April 2016 in the NRC presentation [ADAMS Accession No. ML18187A373]. The technical discussion supported the NRC monitoring of the DOE disposal actions to assess compliance with §61.41 §61.42, and §61.43. The technical discussion was most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1, as supplemented by the NRC letters to the DOE:

- MA 2 (Infiltration and Erosion Control):
  - MF 2.01 (Hydraulic Performance of Closure Cap)
  - *(new title)* MF 2.02 (Erosion Control of the SDF Engineered Surface Cover and Adjacent Area)

- MA 3 (Waste Form Hydraulic Performance):
  - *(closed)* MF 3.01 (Hydraulic Conductivity of Field-Emplaced Saltstone)
  - *(closed)* MF 3.02 (Variability of Field-Emplaced Saltstone)
  - MF 3.03 (Applicability of Laboratory Data to Field-Emplaced Saltstone)
  - *(closed)* MF 3.04 (Effect of Curing Temperature on Saltstone Hydraulic Properties)

- MA 4 (Waste Form Physical Degradation):
  - MF 4.01 (Waste Form Matrix Degradation)
  - MF 4.02 (Waste Form Macroscopic Fracturing)

- MA 5 (Waste Form Chemical Degradation):
  - 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)
  - *(closed)* MF 5.05 (Potential for Short-Term Rinse-Release from Saltstone)

- MA 6 (Disposal Structure Performance):
  - MF 6.01 (Certain Risk-Significant K_d Values in Disposal Structure Concrete)
  - *(closed)* 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)

- MA 7 (Subsurface Transport):
  - MF 7.01 (Certain Risk-Significant K_d Values in Site Sand and Clay)

- MA 8 (Environmental Monitoring):
  - MF 8.02 (Groundwater Monitoring)
  - *(new)* MF 8.03 (Identification and Monitoring of Groundwater Plumes in the Z-Area)

- MA 10 (Performance Assessment Model Revisions):
  - MF 10.02 (Defensibility of Conceptual Models)
  - 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)
  - *(new)* MF 10.14 (Scenario Development and Defensibility)

2.7.2 Observation Results:

The key points from the technical discussion were:

- The NRC staff discussed each monitoring factor listed in Section 2.7.1 and provided the technical basis for any changes in the monitoring factor priority, title, scope, or status (i.e., open or closed)

- The DOE indicated that there would be another revision to the General Separations Area (GSA) groundwater model in addition to the revision that was documented in the DOE document, “Groundwater Flow Simulation of the Savannah River Site General

Separations Area" (SRNL-STI-2017-00008 Rev. 1):

- the DOE indicated that the new revised document would be available in FY 2018 and would be based on additional monitoring well data in the Z-Area

- the NRC staff indicated that it would consider the best timing of the planned TRR on the GSA model considering the expected new information on the forthcoming revised DOE model

- In response to a DOE question, the NRC staff clarified that the purpose of MF 8.03, (Identification and Monitoring of Groundwater Plumes in the Z-Area) is to apply lessons-learned from the monitoring of the plume from SDS 4 to the placement of other monitoring wells in the Z-Area

- In response to a DOE question, the NRC staff discussed the meaning of the term "average member of the critical group" regarding MF 10.08 (Consumption Factors and Uncertainty Distributions for Transfer Factors):
  - the NRC staff discussed the importance of using exposure factors applicable to the chosen critical group (e.g., "consumers-only" data for fish consumption instead of a population average that includes persons who do not consume fish)

- in response to a DOE question about when the NRC would issue a revised monitoring plan to capture the changes to monitoring factors discussed during the technical discussion:
  - the NRC staff indicated that it expected to issue a revised SDF monitoring plan after the NRC issued the TER based on the NRC staff's review of the expected DOE SDF 2019 PA

  - the DOE indicated that the NRC should receive the expected SDF 2019 PA for review in February 2020

  - the NRC staff indicated that the NRC has sent and will continue to send letters to the DOE that supplement the 2013 SDF Monitoring Plan and the NRC letters clearly indicated (and will continue to clearly indicate) that the changes in the 2013 SDF Monitoring Plan are effective immediately

2.7.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE SDF activities. The following Follow-Up Action Item resulted from the technical discussion:

- The DOE to provide the NRC with the electronic version of "Graphic Depicting Revisions to the SDF Monitoring Factors"" (SRR-CWDA-2018-00043, Rev. 0)

3.0 OVERALL CONCLUSIONS, STATUS OF MONITORING FACTORS, OPEN ISSUES, OPEN FOLLOW-UP ACTION ITEMS; AND ISSUANCE OF NRC TECHNICAL REVIEW REPORTS:

3.1 Overall Conclusions:

The information gathered during SDF Observation 2018-01 will be used for multiple NRC TRRs and future OOVs, based on the topics discussed. There is no change to the overall conclusions from the NRC 2012 SDF TER regarding compliance of DOE disposal actions with the 10 CFR Part 61 performance objectives.

The main key message from this OOV was that the NRC staff did not identify the need for any new monitoring areas or any new monitoring factors at this time. However, the recently provided DOE information from May 2018 about the new design and performance of the engineering cover, which is expected to be constructed in about 20 years, is expected to make the cover an extremely risk-significant element of the DOE demonstration of meeting the performance objectives. As such, the NRC will review the new information and, if need be, then open up new high-priority monitoring factors.

During the OOV, the NRC staff appreciated the DOE discussion on the recent DOE information about FEPs, the recent information about the Conceptual Model for the expected 2019 SDF PA, the recent DOE research with the core samples, and the discussion of the I-129 and Tc-99 inventory. The NRC is interested in how the DOE takes into account the information that SCDHEC provided about the South Carolina requirements from 2008 regarding the engineered cover.

3.2 Status of Monitoring Factors in SDF Monitoring Plan, Rev.1. as Supplemented

SDF Observation 2018-01 is the sixth OOV under the SDF Monitoring Plan, Rev.1, as supplemented by the NRC letters to the DOE. The NRC staff did not close any monitoring factors based on this OOV.

- In the NRC letter dated June 5, 2017, [ADAMS Accession No. ML17097A351], the NRC closed MF 3.01, MF 3.02, and MF 3.04 under both performance objectives §61.41 and §61.42

- In the NRC letter dated March 1, 2018, [ADAMS Accession No. ML18033A071], the NRC clarified the number of monitoring factors in the SRS SDF and Tank Farms Monitoring Plans, such that the total number of monitoring factors when the SDF Monitoring Plan, Rev. 1 was issued was 40

- In the NRC letter dated June 29, 2018, [ADAMS Accession No. ML18107A161], the NRC opened the new MF 10.14 (Scenario Development and Defensibility) under both performance objectives §61.41 and §61.42

- In the NRC letter dated October 16, 2018, [ADAMS Accession No. ML18219B035], the NRC opened the new MF 8.03 (Identification and Monitoring of Groundwater Plumes in

the Z-Area) under performance objectives §61.41, §61.42, and §61.43; and closed both MF 5.05 and MF 6.02 under both performance objectives §61.41 and §61.42

- Thus, at the time the Report for SDF Observation 2018-01 was issued, there were 37 open SDF monitoring factors

3.3 Status of Open Issues for SDF Monitoring:

All previous NRC concerns were rolled into the monitoring factors in the 2013 SDF Monitoring Plan, Rev. 1. There were no SDF Open Issues at the beginning of SDF Observation 2018-01. The NRC staff did not open any new Open Issues during this OOV.

3.4 Status of Open Follow-Up Action Items from Previous SDF OOV Reports:

There were 19 previous NRC SDF OOVs. All but two of the Follow-Up Action Items from those OOVs were closed prior to SDF Observation 2018-01. Those two Follow-Up Action Items were not closed during SDF Observation 2018-01 and remain open as listed below:

- SDF-CY16-01-013 – *The DOE to provide the NRC with velocity field and cross-section through the Z-Area*

- SDF-CY17-01-002 – *The DOE to provide the NRC with a map identifying locations for pictures from the tours during the January 2017 OOV*

3.5 Status of Open Follow-Up Action Items from Clarifying Teleconference Calls and Technical Teleconference Calls:

All Follow-Up Action Items from previous clarification teleconference calls and technical teleconference calls were closed prior to SDF Observation 2018-01.

3.6 Summary of Follow-Up Action Items Opened During this Onsite Observation Visit:

The table below contains the nine Follow-Up Action Items that were opened during SDF Observation 2018-01, including a unique NRC identifier for each Follow-Up Action Item:

Unique Identifier	Follow-Up Action Item
SDF-CY18-01-001	The DOE to provide the NRC with electronic versions of pictures taken during the tour
SDF-CY18-01-002	The DOE to provide the NRC with the electronic version of the DOE presentation: “Research Results/Status”
SDF-CY-18-01-003	The DOE to provide the NRC with electronic versions of the reference documents for the Closure Cap Report (SRRA107772-000009, Rev. A)
SDF-CY-18-01-004	The DOE to provide the NRC with the electronic version of the DOE presentation: “FEPs and the Conceptual Model for the 2019 Saltstone Disposal Facility PA”

Unique Identifier	Follow-Up Action Item
SDF-CY-18-01-005	The DOE to provide the NRC with the electronic version of the Vanderbilt Report, "Predicting the Hydraulic Conductivity Over Time for Degrading Saltstone Vault Concrete" (SRRA110110-000004, Rev. 0)
SDF-CY-18-01-006	The DOE to provide the NRC with the electronic version of the graphic "Overview of Activities to Support Development of the Compliance Model for the Saltstone Disposal Facility (SDF) Performance Assessment (PA)" (SRR-CWDA-2018-00020, Rev. 1)
SDF-CY-18-01-007	The DOE to provide the NRC with the electronic version of the DOE presentation: "Inventory Reports for Iodine-129 (I-129) and Technetium-99 (Tc-99)"
SDF-CY-18-01-008	The DOE to provide the NRC with the electronic version of "Graphic Depicting Revisions to the SDF Monitoring Factors"" (SRR-CWDA-2018-00043, Rev. 0)

3.7 Issuance of NRC Technical Review Reports:

Between the previous OOV and SDF Observation 2018-01, the NRC issued the following six TRRs related to the SDF:

Unique Identifier	Title	*Date / Accession No.*	No. of Follow-up Action Items
SDF-TRR-005	*Technical Review: Saltstone Waste Form Hydraulic Performance*	03/23/17 / ML17018A137	0
SDF-TRR-006	*Technical Review: Performance of the High Density Polyethylene, High Density Polyethylene / Geosynthetic Clay Liner, and the Lower Lateral Drainage Layer*	04/12/17 / ML17081A187	0
SDF-TRR-007	*Technical Review: Hydraulic Performance and Erosion Control of the Planned Saltstone Disposal Facility Closure Cap and Adjacent Area*	01/31/18 / ML18002A545	0
SDF-TRR-008	*Technical Review: Groundwater Monitoring at and Near the Planned Saltstone Disposal Facility*	05/17/18 / ML18117A494	0
SDF-TRR-009	*Technical Review: Update on Projected Technetium Release from Saltstone*	05/22/18 / ML18095A122	0
SDF-TRR-010	*Technical Review: Summary of Activities Related to the Review of the U.S. Department of*	06/29/18 / ML18158A172	0

	Energy Savannah River Site Fiscal Year 2013 and Fiscal Year 2014 Special Analysis Documents for the Saltstone Disposal Facility		

4.0 PARTICIPANTS:

U.S. NRC	SCDHEC	U.S. DOE	DOE Contractors
George Alexander	Justin Koon	Daniel Ferguson	Craig Benson
Hans Arlt	Marie McElmurray	Patricia Suggs	Tim Coffield
Lloyd Desotell	Alan Risa		Steve Hommel
Harry Felsher			Terry Killeen
Christepher McKenney			Scott Kirk
Karen Pinkston			Keith Liner
A. Christianne Ridge			Jeremiah Mangold
			Larry Romanowski
			Kent Rosenberger
			John Seaman
			Steve Thomas
			David Watkins

5.0 REFERENCES:

10 CFR Part 61, *Federal Register*, "Licensing Requirements for Land Disposal of Radioactive Waste," *Code of Federal Regulations*, Office of the Federal Register, January 2001

U.S. Congress, Public Law 108-375, "Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005, Section 3116, Defense Site Acceleration Completion," October 2004

U.S. Department of Energy (DOE), DOE Manual 435.1-1, Change 1, "Radioactive Waste Management Manual," June 2001. ML15022A083

_____ DOE Order 435.1, Change 1, "Radioactive Waste Management," August 2001. ML15022A088

_____ DOE-WD-2005-001, Rev. 0, "DOE Draft Basis for Section 3116 Determination Salt Waste Disposal at the Savannah River Site," February 2005. ML051020072

_____ DOE-WD-2005-001, Rev. 1, "DOE Basis for Section 3116 Determination Salt Waste Disposal at the Savannah River Site," January 2006. ML102850319

_____ SRR-CWDA-2009-00017, Rev. 0, "Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site," October 2009. ML101590008

_____SRR-CWDA-2012-00011, Rev. 0, “Features, Events, and Processes for Liquid Waste Performance Assessments,” February 2012. ML17354A268

_____SRR-CWDA-2012-00022, Rev. 0, “Evaluation of Features, Events, and Processes in the F-Area Tank Farm Performance Assessment,” February 2012. ML18220B368

_____ “Response to NRC Letter of Concern (Type-IV) Regarding DOE Disposal Activities at the Savannah River Site Saltstone Disposal Facility,” July 2012. ML12198A258

_____ “Additional Response to NRC Technical Evaluation Report for Revised Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site, South Carolina and the Letter of Concern,” July 2012. ML12215A081

_____ SRR-CWDA-2013-00062, Rev. 2, “Fiscal Year 2013 Special Analysis for the Saltstone Disposal Facility at the Savannah River Site,” October 2013. ML14002A069

_____ SRR-CWDA-2014-00006, Rev. 2, “Fiscal Year 2014 Special Analysis for the Saltstone Disposal Facility at the Savannah River Site,” September 2014. ML15097A366

_____ SRR-CWDA-2014-00999, Rev. 1, “Comment Response Matrix for the U.S. NRC Staff Request for Additional Information on the Fiscal Year 2013 Special Analysis for the Saltstone Disposal Facility at the Savannah River Site,” January 2015. ML15020A672

_____ SRR-CWDA-2016-00004, Rev. 1, “Comment Response Matrix for the U.S. NRC Staff Request for Additional Information on the Fiscal Year 2014 Special Analysis for the Saltstone Disposal Facility at the Savannah River Site,” March 2016. ML16105A043

_____ SRR-CWDA-2017-00057, Rev. 0, “Features, Events, and Processes for the Saltstone Disposal Facility Performance Assessment,” August 2017. ML18170A253

_____ SRNL-STI-2017-00008, Rev. 1, “Groundwater Flow Simulation of the Savannah River Site General Separations Area” September 2017. ML18081A304

_____ SRR-CWDA-2015-00077, Rev. 2, “Evaluation of I-129 Concentration Data to Improve Liquid Waste Inventory Projections,” February 2018. ML18170A269

_____ SRR-CWDA-2015-00123, Rev. 2, “Evaluation of Tc-99 Concentration Data to Improve Liquid Waste Inventory Projections,” March 2018. ML18170A279

_____ SRRA107772-000009, Rev. A, ‘Predicting Long-Term Percolation from the SDF Closure Cap,” April 2018. ML18170A244

_____ SRR-CWDA-2018-00006, Rev. 0, “Conceptual Model Development for the Saltstone Disposal Facility Performance Assessment,” May 2018. ML18143B265

_____ SRR-CWDA-2018-00035, Rev. 1, “Presentation for Savannah River Site Salt Waste Disposal NRC Onsite Observation Visit,” July 2018. ML18205A653

_____ SRR-CWDA-2018-00034, Rev. 0, “Briefing to the U.S. NRC: Features, Events, and Processes and the Conceptual Model for the 2019 Saltstone Disposal Facility Performance Assessment,” July 2018. ML18198A088

_____ SRR-CWDA-2018-00038, Rev. 0, “Briefing to the U.S. NRC: Inventory Reports for I-129 & Tc-99,” July 2018. ML18198A140

_____ SRR-CWDA-2018-00039, Rev. 0, “Briefing to the U.S. NRC: Research Results/Status,” July 2018. ML18198A210

U.S. Nuclear Regulatory Commission (NRC), “Technical Evaluation Report for Draft Waste Determination for Salt Waste Disposal,” December 2005. ML053010225

_____ “NRC Plan for Monitoring Disposal Actions Taken by DOE at the Savannah River Site Saltstone Disposal Facility in Accordance with the National Defense Authorization Act for Fiscal Year 2005,” Rev. 0, May 2007. ML070730363

_____ “Technical Evaluation Report for the Revised Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site, South Carolina,” April 2012. ML121020140

_____ “Letter of Concern (Type-IV) Regarding DOE Disposal Activities at the Savannah River Site Saltstone Disposal Facility,” April 2012. ML120650576

_____ “Letter to Terrel Spears of DOE, Acknowledging Receipt of July 12, 2012, Letter Regarding NRC's Letter of Concern (Type-IV) Regarding Disposal at the Savannah River Site,” August 29, 2012. ML12213A447

_____ “NRC Plan for Monitoring Disposal Actions Taken by DOE at the Savannah River Site Saltstone Disposal Facility in Accordance with the National Defense Authorization Act for Fiscal Year 2005,” Rev. 1, September 2013. ML13100A113

_____ “NRC Comments and Requests for Additional Information on the ‘DOE Fiscal Year 2013 Special Analysis for the Saltstone Disposal Facility at the Savannah River Site, SRR-CWDA-2013-00062, Rev. 2,’” June 2014. ML14148A153

_____ NUREG-2175, “Guidance for Conducting Technical Analyses for 10 CFR Part 61 – Draft Report for Comment,” March 2015. ML15056A516

_____ “NRC Request for Additional Information Questions on the ‘DOE Fiscal Year 2014 Special Analysis for the Saltstone Disposal Facility at the Savannah River Site, SRR-CWDA-2014-00006, Rev. 2,’” June 2015. ML15161A541

_____, “Technical Review: Dose Calculation Methodology for Liquid Waste Performance Assessments at the Savannah River Site,” December 2016. ML16277A060

_____, “Technical Review: Iodine Sorption Coefficients for Use in Performance Assessments for the Saltstone Disposal Facility,” January 2017. ML16342C575

_____ “Technical Review: Saltstone Waste Form Hydraulic Performance,” March 2017. ML17018A137

_____ “Technical Review: Performance of the High Density Polyethylene, High Density Polyethylene / Geosynthetic Clay Liner, and the Lower Lateral Drainage Layer,” April 2017. ML17081A187

_____ “Closure of Monitoring Factors in the 2013 U.S. Nuclear Regulatory Commission Saltstone Disposal Facility Monitoring Plan,” June 2017. ML17097A351

_____ “Technical Review: Hydraulic Performance and Erosion Control of the Planned Saltstone Disposal Facility Closure Cap and Adjacent Area,” January 2018. ML18002A545

_____ “Clarification of the Number of Monitoring Factors in Both the U.S. Nuclear Regulatory Commission’s 2013 Saltstone Disposal Facility Monitoring Plan and the 2015 Tank Farms Monitoring Plan,” March 2018. ML18033A071

_____ “Technical Review: Groundwater Monitoring at and Near the Planned Saltstone Disposal Facility,” May 2018. ML18117A494

_____ “Technical Review: Update on Projected Technetium Release from Saltstone,” May 2018. ML18095A122

_____ “Guidance for the July 9 – 11, 2018, Monitoring Onsite Observation Visit to the Savannah River Site, Saltstone Disposal Facility,” June 2018. ML18155A389

_____ “Supplement to the 2013 U.S. Nuclear Regulatory Commission Saltstone Disposal Facility Monitoring Plan Based on Recommendations in the Technical Review Report Issued on January 31, 2018,” June 2018. ML18107A161

_____ ”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,” June 2018. ML18158A172

_____ “Presentation: Summary of NRC Staff Recommendations to Modify 2013 NRC Saltstone Disposal Facility Monitoring Plan Based on NRC Staff Technical Review Reports,” July 2018. ML18187A373

_____ “Supplement to the 2013 U.S. Nuclear Regulatory Commission Saltstone Disposal Facility Monitoring Plan,” October 2018. Ml18219B035

APPENDIX: DETAILED TECHNICAL INFORMATION FROM U.S. NUCLEAR REGULATORY COMMISSION JULY 9 – 11, 2018, ONSITE OBSERVATION VISIT TO THE SAVANNAH RIVER SITE SALTSTONE DISPOSAL FACILITY

Technical Discussion – Operating and Disposal Structure Status

There is no additional information from this technical discussion.

Tour – Construction of SDS 7 and Z-Area Perimeter

There is no additional information from this tour.

Technical Discussion – Recent DOE Research Involving Samples of Cores from SDS 2A

There is no additional information from this technical discussion.

Technical Discussion – Recent DOE Information on the Closure Cap

Dr. Craig Benson presented an overview of the U.S. Department of Energy (DOE) contractor document that he co-authored, “Predicting Long-Term Percolation from the SDF Closure Cap” (SRRA107772-000009, Rev. A), which is referred to below as the Closure Cap Report. As part of the overview, Dr. Benson indicated that the unsaturated flow code WinUNSAT-H was used to project flow through the middle backfill layer of the closure cap and that flow from the middle backfill layer was used as input to a semi-analytical solution to project flow through the drainage layer. The output of the model described in the Closure Cap Report is the water flow out of the Geosynthetic Clay Liner (GCL) to the foundation layer of the closure cap.

Dr. Benson indicated that his research group tested different values for the thickness of the upper backfill and found that the thickness did not have a significant effect on the model output. Therefore, in the final calculations, one thickness was used. In response, the U.S. Nuclear Regulatory Commission (NRC) staff asked Dr. Benson whether the thickness of the middle backfill layer would be more significant if the erosion layer did not perform as expected and Dr. Benson agreed that it would. Dr. Benson and the NRC staff discussed the potential disruption of the erosion barrier by pine tree roots at the site. The NRC staff questioned the conclusion that plant roots would not significantly disrupt the site because the technical basis provided appeared to be based on work at western sites with shrubs instead of eastern sites with trees. Dr. Benson indicated that pine roots generally would go to where the water is and the NRC staff observed that that line of reasoning suggested that the tree roots would enter the erosion barrier, which was projected to be saturated. The NRC staff suggested quantitative measurements of Loblolly Pines are likely to be available and could provide support for a conclusion about whether pine tree roots are likely to disrupt the erosion barrier.

Dr. Benson discussed the semi-analytical equation used to project lateral flow through the drainage layer and composite liner leakage. The NRC staff asked what the condition of the GCL was when the empirical parameters in the equation were fit. Dr. Benson explained that the empirical parameters were fit using a data set that included GCL layers in different states. Dr. Benson also indicated that his research group had previously built a numerical model to test the equation and the equation tended to overpredict the leakage rate as compared to the numerical model.

In response to an NRC staff question, Dr. Benson indicated that the projected flow through the drainage layer varied in depth from a few inches to the whole thickness of the drainage layer. In response to an additional question from the NRC staff, Dr. Benson indicated that he did not know if the projected depth of flow ever exceeded the thickness of the drainage layer.

Dr. Benson noted the beneficial effect of allowing the GCL to remain completely saturated and indicated that benefit can be seen even when the clay has undergone complete cation exchange. In response to an NRC staff question, Dr. Benson indicated that more rapid hydration in covers in humid environments appears to protect them from damage seen at the same level of cation exchange in covers from arid environments. Dr. Benson referenced data from the Barnwell, South Carolina site and a 7-Mile Creek Site.

Dr. Benson and the NRC staff discussed natural analogs to the Savannah River Site (SRS) Saltstone Disposal Facility (SDF) closure cap. Dr. Benson showed photos of an 8-year old engineered cover in Nebraska and an approximately 2,000-year old engineered system in Japan. Dr. Benson indicated that fine particles did not appear to have migrated into the drainage layer in either system, even though neither system used geotextiles. In response, the NRC staff provided two observations: (1) it was unclear to the NRC staff whether observations from the 8-year old site could be extrapolated to indicate that fine particles would not migrate into the drainage layer after thousands of years; and (2) it was unclear to the NRC staff whether the site in Japan that was composed of clay and loam was applicable to a sand system, such as the proposed SDF closure cap. In addition, the NRC staff indicated that engineered systems tend to be different from natural soil layering because the original soil structure is destroyed when the engineered cover is placed.

Dr. Benson gave an overview of model outputs and indicated that certain outputs of his research group's model had been eliminated from further consideration because the projected values had not been observed in engineered systems that had been in service up to three decades. The NRC staff expressed that observations of 30-year old systems did not necessarily appear to bound the potential behavior of cover systems hundreds to thousands of years after closure.

Dr. Benson indicated that the service life of the high-density polyethylene (HDPE) barrier in the SDF closure cap was projected to be 1,970 years, which was based on research from the Consortium for Risk Evaluation with Stakeholder Participation. Dr. Benson indicated that the value was calculated based on rate constants for antioxidant depletion measured in accelerated leaching tests. The NRC staff indicated that the estimated service life provided appeared to indicate that there had been a significant amount of reduction in uncertainty in HDPE service life since NUREG/CR-7028 was published in 2011. That NUREG/CR indicated that the service life of HDPE in cover systems could be expected to be 50 years to 100 years. The NRC staff also

indicated that the level of confidence that was expressed in the service life of HDPE in the Closure Cap Report would need significant technical support.

In response to an NRC staff question, Dr. Benson indicated that the welds between panels of HDPE had not been considered any differently from the rest of the HDPE panels. Dr. Benson also indicated that the welds could perform better than the rest of the panels because the welded areas are thicker than the rest of the panels. The NRC staff expressed concern that concentration of stress at the welds could cause weld failure. In response, Dr. Benson indicated that the only mechanism that he expected to contribute to HDPE degradation in the closure cap was antioxidant depletion. In response to the NRC staff questions, Dr. Benson indicated that that differential settlement had not been considered because HDPE is flexible. The NRC staff indicated that the performance of the welds will strongly depend on the quality of the installation and the DOE agreed.

The NRC staff asked how the model accounted for extreme events. Dr. Benson indicated that extreme events were accounted for by using daily data instead of annual averages. Dr. Benson also indicated that the impact of extreme events is expected to be reduced by depth below the land surface. Dr. Benson indicated that cover system behavior is expected to be driven by wet years or a series of wet years, rather than individual storm events. In response to an NRC staff question about whether that conclusion was based on model output or measured data, Dr. Benson indicated that it was based on both and referenced data from Albany, Georgia. In response to an NRC staff question about the basis for using a 10-year time series in a 1,000-year simulation, Dr. Benson referenced a research paper that addressed the issue. Dr. Benson also indicated that the model might project a different result if the climate changed systematically over time.

Dr. Benson and the NRC staff discussed the soil properties used as model input. The NRC staff indicated that, although NUREG/CR-7028 is frequently referenced throughout the Closure Cap Report, the GCLs in Table 2 of the Closure Cap Report are assigned a hydraulic conductivity value of $1x10^{-11}$ meters/second (m/s) based on a 14-year old Barnwell, South Carolina cover sample, which resulted in a percolation rate of less than one-fifth of that predicted for a GCL with a NUREG/CR-7028 value of $1x10^{-10}$ m/s. The NRC staff indicated that additional justification may be required as to why the individual Barnwell sample is more representative than the range of covers evaluated in NUREG/CR-7028. In response, Dr. Benson indicated that he was confident that changing the value of the hydraulic conductivity would not change the model projections. The NRC staff also indicated that NUREG/CR-7028 is a contractor report, which means that recommendations in it are the recommendations of the contractor and did not represent NRC recommendations or guidance.

SCDHEC informed the DOE and the NRC staff of a 2008 South Carolina regulation that requires the final cover system be graded to create at least a 3 percent (%); but, not greater than 5% with a surface slope and a side slope that does not exceed three horizontal feet to one vertical foot. The NRC is interested in how the DOE will take into account the information about the South Carolina requirements because this SCDHEC information on the design of the future closure cap seems to indicate that the DOE may need to re-design the closure cap and that the future cap could become a risk-significant element of the DOE demonstration on meeting the Title 10, *Code of Federal Regulations* Subpart C Performance Objectives.

Technical Discussion – Recent DOE Information on Features, Events, and Processes as well as the Conceptual Model for the Expected 2019 SDF Performance Assessment

The DOE indicated that the document "Features, Events, and Processes for the Saltstone Disposal Facility Performance Assessment" (SRR-CWDA-2017-00057, Rev. 0) [ADAMS Accession No. ML18170A253] included some Features, Events, and Processes (FEPs) that were discussed in a reference used to support a Performance Assessment (PA) for the SRS Tank Farms (SRR-CWDA-2012-00011 and SRR-CWEA-2012-00022). However, the DOE indicated that many new FEPs were included in the document SRR-CWDA-2017-00057, Rev. 0 that were specific to the SDF.

The DOE indicated that the distinct engineered features of the closure cap (e.g., resistive layers, drainage layers) and processes relevant to those layers (e.g., degradation, siltation) were not represented in detail in the FEPs Analysis because they were evaluated implicitly in the evaluation of the projected cover performance (i.e., Closure Cap Report). In response to an NRC staff question, the DOE indicated that FEPs that were evaluated implicitly in the evaluation of the projected cover performance were not documented separately in the FEPs Analysis and are not expected to be documented separately in any future such FEPs analysis. The NRC staff indicated that the potential for erosion appeared to be underrepresented in the FEPs Analysis.

The NRC staff disagreed with the DOE comment that the NRC had previously accepted the DOE assertion that assuming a linear progression of saltstone degradation (i.e., a constant degradation rate) is conservative and indicated that the NRC staff had previously expressed concern to the DOE that assuming linear degradation might not be conservative (see the NRC Request for Additional Information Question SP-3 on the Fiscal Year (FY) 2014 SDF Special Analysis Document [ADAMS Accession No. ML15161A541]).

The DOE and the NRC staff discussed disposal structure degradation. In response to an NRC staff question, the DOE indicated that potential degradation during the operational period is addressed, in part, by protective measures (e.g. pre-stressing wire around the disposal structures, internal liner) that protect the disposal structures during operation and are not credited with performance after closure. The DOE also indicated that the expected SDF 2019 PA could potentially project more hydraulic performance from the disposal structures than the Evaluation Case in the FY 2014 SDF Special Analysis Document did. However, the DOE indicated that disposal structure concrete for Saltstone Disposal Structure (SDS) 6 will be modeled as being initially degraded to account for observed cracking. Furthermore, although the DOE expects to understand how the cracks developed and to apply corrective measures to prevent similar cracking in SDS 7, the DOE will assume that SDS 7 is degraded in the expected SDF 2019 PA because the effectiveness of any improvements made will not be known until after SDS 7 has been constructed. In response to an NRC staff question about degradation caused by silica fume, the DOE indicated that further use of silica fume is not being pursued because of industrial hygiene concerns.

Regarding the DOE document "Conceptual Model Development for the Saltstone Disposal Facility performance Assessment" (SRR-CWDA-2018-00006, Rev. 0), referred to as the "Conceptual Model Report" below, the DOE clarified several specific points in response to the NRC staff questions. The DOE indicated that references to degraded hydraulic properties in the

Conceptual Model Report are intended to include increased diffusivity as well as increased hydraulic conductivity. The DOE indicated that the statement on page 41 of the Conceptual Model Report that "significant mechanical degradation of the disposal structures is not expected" does not apply to the degraded conditions assumed to exist in the conceptual model for certain components of SDS 1, SDS 4, SDS 6, and SDS 7. The DOE indicated that, although there are conflicting descriptions of the planned modeling of the SDS 1 and SDS 4 mud mats given in the Conceptual Model Report, the DOE expects to model them with soil properties. The DOE indicated that the roof support columns in the 375-foot disposal structures will be made from non-sulfate resistant concrete, which is unlike the floors, walls, and roofs that will be made with sulfate-resistant concrete. The DOE also indicated that the roof support columns in SDS 4 would be modeled as features that degrade in 0.6-meter (2-foot) segments. The DOE indicated that, in the expected SDF 2019 PA, all radionuclide sorption coefficients (K_d values) will be modeled as 0 milliliters per gram (mL/g) in fractures and joints modeled as gravel, as was done in the Evaluation Case in the FY 2014 SDF Special Analysis Document. The DOE also indicated that it expects to consider the effect of different potential water table elevations in the expected SDF 2019 PA.

Regarding Interaction Matrix (IM) element IM 07.18 in the Conceptual Model Report, the DOE agreed with the NRC staff observation that the basis for assuming radionuclide sorption is impacted by leachates "until the overlying saltstone is fully oxidized," was not clear because carbonate leaching from saltstone does not depend on saltstone oxidation.

The NRC staff expressed concern that the title of IM element 08.06, "Gaseous Phases to Saltstone Reducing Capacity " in the Conceptual Model Report could be misleading because the description of that IM element only includes oxygen entering saltstone as oxygen dissolved in water. The NRC staff indicated that the assumption that oxygen ingress into saltstone is limited by the amount of water entering saltstone could become more risk-significant if the projected inflow of water into saltstone is decreased, as the DOE described in the Closure Cap Report. The DOE indicated that it would evaluate the effects of new assumptions about cover performance on saltstone fracture saturation. The NRC staff expressed concern that PORFLOW may not accurately project fracture saturation because of potentially unrealistic moisture characteristic curves.

The NRC staff discussed the terms "conceptual model" and "scenario," as described in the 2015 NRC NUREG-2175, "Guidance for Conducting Technical Analyses for 10 CFR Part 61 – Draft Report for Comment" [ADAMS Accession No. ML15056A516]. Specifically, the NRC staff indicated that the term "scenario" is used to indicate different plausible evolutions of site conditions. The NRC staff clarified that the NRC use of the term "conceptual model" indicates different plausible ways a site could function. In contrast, a "sensitivity analysis" is typically designed to provide information about the importance of a parameter or engineered feature to projected system performance and does not necessarily reflect plausible site conditions (e.g., complete omission of a closure cap). The NRC staff indicated that there was a difference between how the NRC would use a FEPs analysis to generate plausible alternative conceptual models and the results of both the DOE FEPs Analysis and Conceptual Model Report, which included implausible states, such as a "no closure cap" alternative conceptual model that the NRC staff would regard as a sensitivity analysis. The NRC staff indicated that the Conceptual Model Report appears to use the terms "sensitivity analysis," "conceptual model," and "scenario" interchangeably. In response to a DOE question, the NRC staff indicated that the Conceptual

Model Report was responsive to the technical concern in MF 10.02; however, the NRC staff indicated that MF 10.02 relates specifically to the defensibility of conceptual models and the Conceptual Model Report did not appear to distinguish between conceptual models and sensitivity analyses.

Technical Discussion – Recent DOE Reports about the Inventory of I-129 and Tc-99 Expected to be Placed in the SDF

The DOE provided an overview of two DOE documents: (1) "Evaluation of I-129 Concentration Data to Improve Liquid Waste Inventory Projections," (SRR-CWDA-2015-00077 Rev. 2), which is referred to as the I-129 Inventory Report below, and (2) "Evaluation of Tc-99 Concentration Data to Improve Liquid Waste Inventory Projections," (SRR-CWDA-2015-00123 Rev. 2), which is referred to as the Tc-99 Inventory Report below. The DOE indicated that inventories of I-129 and Tc-99 had previously been based on the DOE Waste Characterization System (WCS), which did not account properly for the change in the ratios of those radionuclides to Cs-137 because Cs-137 decays more rapidly than does I-129 and Tc-99. The DOE indicated that both the FY 2013 SDF Special Analysis Document and the FY 2014 SDF Special Analysis Document were based on the WCS values. After the FY 2014 SDF Special Analysis was issued, a correction was made to the values of I-129 and Tc-99 in WCS; however those corrections appeared to have resulted in an overestimation of the I-129 and Tc-99 inventories, compared to more recent estimates based on an additional number of direct measurements of I-129 and Tc-99 in the waste in the SRS Tank Farms.

To improve the I-129 and Tc-99 inventory estimates, the DOE made a series of direct measurements of I-129 and Tc-99 in the waste in the SRS Tank Farms. The direct measurements limited uncertainty by adding measured data for I-129 and Tc-99 tank concentrations that had previously been represented by uncertain ratios to Cs-137. The additional measurements also enabled the DOE to develop more accurate relationships between Cs-137 and the two radionuclides of interest, which are I-129 and Tc-99. The DOE provided an overview of how the improved statistical relationship was developed and described a data normalization process whereby points that were not representative for physical reasons (e.g., samples that represented sludge rather than salt waste) were removed from the I-129-to-Cs-137 and Tc-99-to-Cs-137 relationships. The NRC staff indicated that it was useful to understand the physical considerations provided for any points that were removed rather than eliminating points on a purely statistical basis. After data normalization, the DOE considered removing I-129 data that were represented by detection limits. Because that resulted in a potential non-conservative relationship between I-129-to-Cs-137, the DOE added a 25% safety factor to the values for I-129.

The NRC staff and the DOE discussed expected future changes in the concentrations of I-129 and Tc-99 in salt waste. The DOE indicated that the Actinide Removal Process (ARP)/Modular Caustic Solvent Side Extraction Unit (MCU) could process salt waste up to approximately 9.8×10^9 Becquerel per liter (1 Ci per gallon) Cs-137. That limit on the Cs-137 concentration in waste processed by ARP/MCU limits the I-129 and Tc-99 concentrations in ARP/MCU waste because I-129 and Tc-99 concentrations are related to the Cs-137 concentration in waste. The DOE explained that the Salt Waste Processing Facility (SWPF) would be able to process waste with up to 4.9×10^{10} Becquerel per liter (5 Ci per gallon) Cs-137. However, the DOE indicated that it did not anticipate that much of the waste would exceed 2.0×10^{10} Becquerel per liter

(2 Ci per gallon) Cs-137. The DOE indicted that the future SDS 7 was expected to contain slightly higher concentration waste than the other disposal structures.

Technical Discussion – NRC Technical Review Reports Since April 2016

The NRC staff provided an overview of monitoring factors that were changed or will soon change in scope, priority, or status (i.e., open or closed) since the April 2016 SDF OOV. In response to a DOE question, the NRC staff indicated that an NRC Technical Review Report (TRR) is intended to provide the status of the NRC staff technical evaluation of a particular technical topic between reviews documented in an NRC Technical Evaluation Report (TER). The NRC staff indicated that the timing of future TRRs would depend in part on when the NRC received the DOE expected SDF 2019 PA because the NRC expected to document the review of the expected SDF 2019 PA in a TER. The NRC staff indicated that one exception might be the planned TRR regarding a recent revision to the General Separations Area (GSA) groundwater model because that TRR would affect both the SRS SDF and SRS Tank Farms.

Regarding the recent revision the GSA model, the DOE indicated that another revision was already being conducted and that that revision would include more data from wells in Z-Area. The DOE indicated that documentation of that revision was expected to be available in FY 2018. In response, the NRC staff indicated that it might wait to write a TRR on the GSA groundwater model revisions until it received documentation of the soon to be issued DOE revision.

The NRC staff and the DOE discussed the new MF 8.03 (Identification and Monitoring of Groundwater Plumes in the Z-Area). The NRC staff described the concern that the plume emanating from SDS 4 had been detected in downgradient wells in the Upper Three Runs (UTR) Aquifer Upper Zone that were further from SDS 4 than wells screened in the Lower Zone of the UTR Aquifer. In addition, the NRC staff indicated that contaminants originating from SDS 4 had reached regions of the subsurface outside of the Z-Area due to lateral transport above the Tan Clay Confining Zone (TCCZ) based on direct push technology (DPT) samples taken from ZDPT11, as reported in the DOE document “Z-Area Groundwater Characterization Data Report” (SRNS-RP-2015-00902, Rev. 0), [ADAMS Accession No. ML16057A135]. The NRC staff clarified that the purpose of the new MF 8.03 is to apply lessons-learned from the SDS 4 plume to the monitoring well system on site, not necessarily to take further action on the SDS 4 plume. Specifically, the NRC staff discussed the importance of having wells screened in the UTR Upper Zone as well as the UTR Lower Zone. For those instances where wells in the Upper Zone of the UTR are routinely dry, the NRC staff asked if the DOE could sample the wells after big rain events because that could enable the DOE to detect contaminant plumes before contamination reaches wells screened in the Lower Zone of the UTR Aquifer or UTR Aquifer Upper Zone wells with contaminated water due to lateral transport above the TCCZ. The DOE indicated that it was not currently being done and it was unclear if it would be possible.

The DOE discussed differences in the characteristics of water in the Lower and Upper Zones of the UTR Aquifer. The DOE indicated that the concentrations of tritium and nitrate were similar in the two aquifers; however, the concentration of calcium and the conductivity of the water is greater in the Lower Zone because of carbonate minerals in the Lower Zone.

In response to a question from SCDHEC, the DOE indicated that each of the disposal structures is monitored by three monitoring wells; however, the three wells closest to SDS 4 are all in the Lower Zone of the UTR Aquifer.

In response to a question from the DOE, the NRC staff indicated that the NRC staff determined that plume monitoring was important under performance objective §61.43 (Protection of Individuals during Operations). After the OOV, the NRC determined that all three monitoring factors (i.e., MF 8.01 (Leak Detection), MF 8.02 (Groundwater Monitoring), MF 8.03 (Identification and Monitoring of Groundwater Plumes in the Z-Area) in Monitoring Area 8 (Environmental Monitoring) are important to performance objective §61.41 (Protection of the General Population from Releases of Radioactivity), performance objective §61.42 (Protection of Individuals from Inadvertent Intrusion) and performance objective §61.43 (Protection of individuals during operations).

The DOE indicated that it had begun to consider the calibration of groundwater models of the Z-Area to the SDS 4 plume, as was suggested in the NRC TRR on Groundwater Monitoring [ADAMS Accession No. ML18117A494]. The NRC staff questioned the unexpectedly small amount of lateral transport in the vadose zone, as depicted in diagrams that the DOE had hung on the wall of the conference room where the OOV occurred. Regarding MF 6.03 (Performance of Disposal Structure Roofs and HDPE/GCL Layers), the NRC staff asked the DOE why the DOE assumed the HDPE would not fail at seams when the sump on SDS 3A experienced rainwater infiltration at seams. The DOE explained that the two situations were different because the HDPE on the sump used a different kind of seam, whereas the HDPE above the disposal structure roofs would be flat and the seams could be more thoroughly tested. The NRC staff suggested that the DOE document that information. In response to an NRC staff question, the DOE indicated that the seams cannot be re-tested after years of service because the DOE plans to bury the structures soon after the HDPE is emplaced to protect it from ultraviolet radiation, which can degrade the HDPE.

The DOE asked the NRC staff whether data from seepage basins was applicable to MF 7.01 (Certain Risk-Significant K_d Values in Site Sand and Clay) because the seepage basins contained organic contaminants. The DOE asked the NRC staff if those organic contaminants were the organic material referenced in the NRC staff TRR on Iodine (ADAMS Accession No. ML16342C575). The NRC staff replied that the organic material referenced in the TRR was the organic matter naturally present in soils; but, it is important for the soil used to determine K_ds to be comparable to the soil being modeled for other chemical properties too. The DOE indicated that the leachate impact factors reduce the projected dose from some radionuclides; but, increase the projected dose from I-129. The DOE indicated that meant that omitting the leachate impact factors was not necessarily conservative.

In response to a question from the DOE regarding MF 10.08 (Consumption Factors and Uncertainty Distributions for Transfer Factors), the NRC staff discussed the meaning of the term “average member of the critical group.” The NRC staff clarified that the “average member of the critical group” is not the maximally exposed person. Instead, the term referred to the average member of a group of approximately 20 people or more (e.g., local home gardeners, local recreational fishermen) where that group was likely to experience more exposure than other groups. The NRC staff indicated that to model the dose to the average member of the critical group, it was appropriate to use exposure factors applicable to the chosen critical group rather

than population averages. As an example, the NRC staff described the “consumer-only” data in the U.S. Environmental Protection Agency’s Exposure Factor Handbook for fish consumption (e.g., average fish ingestion for people who eat fish instead of a population-wide average).

In an additional question about consumption factors, the DOE asked the NRC staff for guidance to address a specific comment in the NRC TRR, “Dose Calculation Methodology for Liquid Waste Performance Assessments at the Savannah River Site” (ADAMS Accession No. ML16277A060). That TRR indicated that the DOE should not assume that the relative amounts of plants produced by home gardeners was equivalent to the relative amounts of plants produced commercially in the region. The DOE asked for guidance from the NRC staff in how to determine a better distribution. The NRC staff suggested requesting information from local agricultural extension programs and indicated that there may have been a survey done in the SRS region.

The NRC staff and the DOE discussed MF 10.02 (Defensibility of Conceptual Models) and the new MF 10.14 (Scenario Development and Defensibility). Previously during the OOV, the NRC staff provided an overview of how the terms “conceptual model” and “scenario” are used in the draft NUREG-2175. The DOE asked if the FEPs Analysis had helped to address the NRC staff concerns and the NRC staff indicated that it helped to address conceptual model uncertainty, although, it did not thoroughly address scenario uncertainty because it did not consider future evolutions of the site, except for potentially different climate evolutions. The NRC staff gave an example of scenario uncertainty specific to the SDF and indicated that the DOE assumed that Loblolly Pines would cover the site and an alternative scenario could assume a plausible climate with different fauna and flora with another plant species dominating the site. In response to a DOE question, the NRC staff clarified that “consideration” of a possibility did not necessarily require quantitative projections. The NRC staff also indicated that a future change, like a change in climate, would have multiple effects on the site, such as changing plant species, and that the only future effect of climate change discussed in the FEPs Analysis and Conceptual Model Report was a change in precipitation. In response to a DOE question about the significant uncertainty associated with climate change, the NRC staff indicated that the DOE can use data about paleo-climates to estimate the range of potential future changes. In response to a question from DOE about the range of time that would be reasonable to consider, the NRC staff suggested that looking back in time for a time period equivalent to the performance period for the site would be reasonable. The NRC staff also indicated that guidance for that was in the draft NUREG-2175. The NRC staff also indicated that it can be difficult to decide in advance which conceptual models will be most conservative and, therefore, it was important to carry forward both the expected case and the alternative conceptual models.