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

August 13, 2019

Mr. Aaron J. White
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 MARCH 18 – 19, 2019, ONSITE OBSERVATION VISIT REPORT FOR THE SAVANNAH RIVER SITE TANK FARMS

Dear Mr. White:

The enclosed Onsite Observation Visit (OOV) Report describes the OOV that the U.S. Nuclear Regulatory Commission (NRC) conducted on March 18-19, 2019, at the Savannah River Site (SRS) Tank Farms (TFs). The SRS TFs consists of the F-Tank Farm (FTF) and the H-Tank Farm (HTF). The March 2019 TFs 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* (10 CFR) Part 61, Subpart C. The five 10 CFR Part 61 Subpart C performance objectives are: §61.40 (General Requirements); §61.41 (Protection of the General Population from Releases of Radioactivity); §61.42 (Protection of Individuals from Inadvertent Intrusion); §61.43 (Protection of Individuals during Operations); and §61.44 (Stability of the Disposal Site after Closure). The March 2019 TFs OOV was the ninth TFs OOV conducted since the NRC began monitoring the DOE TFs disposal actions under NDAA Section 3116(b) in June 2012.

The main activities conducted during the March 2019 TFs OOV were: (1) tour of several of the accessible geologic and hydrologic features relevant to the development of the General Separations Area (GSA) PORFLOW groundwater flow and transport model; (2) discuss updates to the GSA PORFLOW Model; (3) discuss the *Real Waste Testing Results for Tank 18F* Technical Review Report (TRR); (4) discuss the DOE's updates and assumptions related to engineered cover performance and anticipated treatment in future Performance Assessment (PA) updates; and (5) discuss the DOE and NRC contractor research.

Those OOV activities were consistent with the activities described in the NRC Guidance Memorandum for the March 2019 TFs OOV dated February 7, 2019 (available via the NRC Agencywide Documents Access and Management System [ADAMS] at Accession No. ML19016A468), which was developed using the TFs Monitoring Plan, Rev. 0, dated October 2015 (ADAMS Accession No. ML15238A761). The NRC 2015 TFs Monitoring Plan contains the monitoring areas and monitoring factors that describe how the NRC will monitor the DOE TFs 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.

As provided in the NRC Guidance Memorandum, a primary objective for conducting the OOV was to tour the GSA surface water and other features important to developing mathematical models of contaminant fate and transport used in the PAs for the Tank Farm and Saltstone Disposal facilities. In addition, this provided the NRC staff an opportunity to continue discussions with DOE on hydrogeological and other technical issues from previous OOVs, TRRs, and teleconference calls.

The March 2019 TFs OOV did not result in any changes to the overall conclusions from either the NRC Technical Evaluation Report (TER) for the FTF dated October 2011 (ADAMS Accession No. ML112371751) or the NRC TER for the HTF dated June 2014 (ADAMS Accession No. ML14094A496). The staff was able to physically observe and/or discuss key features represented in DOE's updated PORFLOW flow model of the General Separation Area used to simulate flow and transport of radionuclides released from the TFs and SDF as well as discuss other technical issues from this and previous NRC monitoring activities. This will support future staff technical reviews related to DOE meeting the requirements of the performance objectives in 10 CFR Part 61, Subpart C. 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 TFs.

If you have any questions, or need additional information, regarding this OOV Report, then please contact Mr. Lloyd Desotell of my staff at Lloyd.Desotell@nrc.gov or at (301) 415-5969.

Sincerely,

for

Patricia K. Holahan, 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:
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SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION MARCH 18 – 19, 2019, ONSITE OBSERVATION VISIT REPORT FOR THE SAVANNAH RIVER SITE TANK FARMS DATE**: August 13, 2019**

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U.S. NUCLEAR REGULATORY COMMISSION
MARCH 18 – 19, 2019, ONSITE OBSERVATION VISIT REPORT FOR
THE SAVANNAH RIVER SITE TANK FARMS

EXECUTIVE SUMMARY:

The U.S. Nuclear Regulatory Commission (NRC) staff conducted its ninth Onsite Observation Visit (OOV) to the Tank Farms (TFs) at the Savannah River Site (SRS) on March 18 – 19, 2019 (TFs Observation 2019-01). The SRS TFs consists of the F-Tank Farm (FTF) and the H-Tank Farm (HTF). On every OOV to SRS under Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), 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: §61.41 (Protection of the General Population from Releases of Radioactivity), §61.42 (Protection of Individuals from Inadvertent Intrusion), §61.43, (Protection of Individuals during Operations), and §61.44, (Stability of the Disposal Site after Closure). Also, if the NRC concludes with reasonable assurance that the DOE complies with the §61.41, §61.42, §61.43, and §61.44 performance objectives, then the NRC will also conclude with reasonable assurance that the DOE complies with the §61.40 "General Requirement" performance objective.

In conducting the OOV, the NRC focused on the monitoring areas (MAs) and monitoring factors (MFs) in the NRC TFs Monitoring Plan, Rev. 0 dated October 2015 (available via Agencywide Documents Access and Management System (ADAMS) at Accession No. ML15238A761). The 2015 TFs Monitoring Plan describes the NRC's monitoring process with regards to the SRS TFs, including discussions on MAs, MFs, and Follow-up Action Items (FUAIs). All NRC concerns prior to the 2015 TFs Monitoring Plan were rolled into the monitoring factors in the 2015 TFs Monitoring Plan. While this OOV is primarily related to the F and H Area TFs, some of the material is also applicable to the SRS Saltstone Disposal Facility. 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 February 6, 2019, (ADAMS Accession No. ML19016A468), the main activities conducted during this OOV were: (1) tour several of the accessible geologic and hydrologic features relevant to the development of the General Separations Area (GSA) groundwater flow and transport model; (2) discuss updates to the GSA PORFLOW Model; (3) discuss the *Real Waste Testing Results for Tank 18F* Technical Review Report (TRR); (4) discuss the DOE's updates and assumptions related to engineered cover performance and anticipated treatment in future Performance Assessment (PA) updates; and (5) discuss the DOE and NRC contractor research. The specific Monitoring Areas and Monitoring Factors associated with these activities are provided in Section 2 of this report.

The NRC did not close any of the TFs monitoring factors or change the overall conclusions from either the NRC Technical Evaluation Report (TER) for the FTF dated October 2011 (ADAMS Accession No. ML112371751) or the NRC TER for the HTF dated June 2014 (ADAMS Accession No. ML14094A496) as a result of this OOV.

During the NDAA monitoring process, the NRC does expect to open and close FUAIs during OOVs, meetings, clarification teleconference calls, or technical teleconference calls. Frequently, the FUAIs are specific short-term actions that are closed before the next OOV,

meeting, clarification teleconference call, or technical teleconference call. During this OOV, 14 FUAIs were opened.

After the OOV, the NRC received the updated DOE OOV presentation (SRR-CWDA-2019-00022, Rev. 1) (ADAMS Accession No. ML19116A208) pertaining to the activities during this OOV.

1.0 BACKGROUND:

Section 3116(a) of the 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 September 30, 2010, the DOE submitted to the NRC the *Draft Basis for 3116 Determination for Closure of F Tank Farm at the Savannah River Site* (DOE/SRS-WD-2010-001, Rev. 0) (ADAMS Accession No. ML102790078) to demonstrate compliance with the NDAA criteria, including demonstration of compliance with the performance objectives in 10 CFR Part 61, Subpart C at the FTF. In its consultation role, the NRC staff reviewed the FTF draft Waste Determination and associated documents, including the performance assessment. In the NRC FTF TER issued in October 2011 (ADAMS Accession No. ML112371751), the NRC documented the results of its review and did not make a conclusion on the ability of the DOE to meet the requirements of the performance objectives in 10 CFR Part 61, Subpart C due to uncertainty in the final inventories for the remaining tanks in the FTF; but, did make observations and recommendations. Taking into consideration the observations and recommendations in the NRC 2011 FTF TER, in March 2012, the DOE issued both the Final Waste Determination for the FTF (DOE-WD-2012-001, Rev. 0) (ADAMS Accession No. ML121140043) and the Final Basis Document (DOE/SRS-WD-2012-001, Rev. 0) (ADAMS Accession No. ML121140051) for the FTF. After the DOE issued the Final Basis Document for the FTF, the NRC began monitoring at the FTF. In January 2013, the NRC issued the NRC Monitoring Plan for the FTF, Rev. 0 (ADAMS Accession No. ML12212A192) and began using it to monitor the DOE disposal actions at the FTF.

On February 6, 2013, the DOE submitted to the NRC the *Draft Basis for 3116 Determination for Closure of H-Tank Farm at the Savannah River Site* (DOE/SRS-WD-2013-001, Rev. 0) (ADAMS Accession No. ML13045A504) to demonstrate compliance with the NDAA criteria, including demonstration of compliance with the performance objectives in 10 CFR Part 61, Subpart C at the HTF. In its consultation role, the NRC staff reviewed the HTF draft Waste Determination and associated documents, including the performance assessment. In the NRC HTF TER issued in June 2014 (ADAMS Accession No. ML14094A496), the NRC documented the results of its review and did not make a conclusion on the ability of the DOE to meet the requirements of the performance objectives in 10 CFR Part 61, Subpart C due to uncertainty in the final inventories for the remaining tanks in the HTF; but did make observations and recommendations. Taking into consideration the observations and recommendations in the NRC 2013 HTF TER, in December 2014, the DOE issued both the Final Waste Determination (DOE-WD-2014-001, Rev. 0) (ADAMS Accession No. ML15051A352) for the HTF and the Final Basis Document (DOE/SRS-WD-2014-001, Rev. 0) (ADAMS Accession No. ML15051A353) for the HTF. After the DOE issued the Final Basis Document for the HTF, the NRC began monitoring at the TFs (i.e., both FTF and HTF). In October 2015, the NRC issued the NRC

Monitoring Plan for the TFs, Rev. 0 (ADAMS Accession No. ML15238A761) and began using it to monitor the DOE disposal actions at the TFs.

As described in the NRC Monitoring Plan for the TFs, Rev. 0, 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 TFs performance assessment 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. In between revisions of a monitoring plan, the NRC may issue one or more letters to the DOE that supplement a monitoring plan.

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 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 FUAI 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 be related to routine NRC monitoring activities that are described in monitoring plan, as supplemented by any NRC letters to the DOE.

2.0 ONSITE OBSERVATION VISIT ACTIVITIES:

On February 7, 2019, the NRC issued the OOV Guidance Memorandum (Accession No. ML19016A468) for the March 2019 TFs OOV, TFs Observation 2019-01. 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 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 geologic and hydrologic features of the General Separations Area (GSA). The technical discussions were focused on: (1) updates to the GSA PORFLOW Model; (2) NRC's *Real Waste Testing Results for Tank 18F* Technical Review Report (TRR); (3) updates related to the planned engineered cover; and (4) DOE and NRC contractor research.

2.1 Tour – GSA Hydrological Features

2.1.1 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 TFs Monitoring Plan, Rev. 0:

- Monitoring Area (MA) 4 (Natural System Performance):
  - Calcareous Zone Characterization
  - Monitoring Factor (MF) 4.3 (Environmental Monitoring)
- MA 6 (Performance Assessment Maintenance):
  - MF 6.3 (Tank Farms Performance Assessment Revisions)

The tour was most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1 (ADAMS Accession No. ML13100A113):

- Monitoring Area (MA) 10 (Performance Assessment Model Revisions):
  - Monitoring Factor (MF) 10.02 Defensibility of Conceptual Models
  - Monitoring Factor (MF) 10.13 Impact of Calcareous Zones on Contaminant Flow and Transport

2.1.2 Observation Results:

The morning and afternoon tours were of several of the accessible geologic and hydrologic features relevant to the development of the GSA PORFLOW model. The DOE provided a handout marking tour locations (Fig. 1) (ADAMS Accession No. ML19116A208). Several of photographs taken by the DOE during the tour (ADAMS Accession No. ML19116A225) are presented in the following discussions.

The morning portion of the tour consisted of driving to multiple locations, as described below. The key points from the morning portion of the tour were:

- The first stop (Fig. 1, location #1) was to observe a portion of Four Mile Branch (FMB). This location was also noted as a seepage location, but seepage was difficult to observe.
- The second stop (Fig. 1, location #2) was also on FMB, downstream of stop #1. The SRS Area Closure Projects groups collects monthly stream flow measurements at this location. The DOE indicated that the flow at this location is typically 0.057 to 0.085 cubic meters (2 to 3 cubic feet) per second.
- The third stop (Fig. 1, location #3) was at two sedimentation basins within the E-Area. These locations are modeled as areas of higher recharge in the GSA PORFLOW model. The DOE indicated that the north sedimentation basin collects stormwater runoff, not process water and therefore is not contaminated.
- The fourth stop (Fig. 1, location #6) was on the Crouch Branch tributary to UTR. The stream at this location was very clear and had a clean sandy bottom (Fig. 2). The surface geology at this location was uncertain but thought to be just below the Tan Clay Confining Zone (TCCZ). A second stop on the Crouch Branch upgradient of the TCCZ was at a location where stream flow measurements are taken. However, the DOE stated that the source of the stream water measured was a combination of FTF surface runoff and water from operations.

- The fifth stop (Fig. 1, location #7) was at the F-Area Process Sewer Line (FIPSL) where groundwater within the Western Operable Unit is impacted. The DOE indicated that this area could be impacted by both Tank 8 and the FIPSL.

- Fig. 1 Handout Making Tour Locations

Fig. 2 Crouch Branch down gradient of the TCCZ

The afternoon portion of the tour consisted of hiking along Waterfall Creek down to the Upper Three Runs (UTR) (see Fig. 1, location 8). The key points from the afternoon portion of the tour (see Fig. 3) were:

- Waterfall Creek abruptly transitions from a small ditch creek to a relatively large gorge with steep vertical drops approximately 6.1 meters (20 feet) deep. This gorge appears to have started above the TCCZ and extends down to the Santee Formation. Waterfall Creek tributaries had small flow rates at the time of the OOV; however, these tributary gorges were relatively large in their own right and numerous trees had fallen into these side gorges (Fig. 4). The main and tributary gorges included many seepage areas (Fig. 5).
- Outcrops from different units were visible due to the clean vertical faces of the gorges including the TCCZ and carbonates from the Santee Formation.
- Indurated fossil shell conglomerates were observed along and at the end of Waterfall Creek gorge. The calcium carbonate in the fossils apparently had been replaced by secondary minerals through to the process of silification and thereby sufficiently resistant to produce small waterfalls (Fig. 6).
- Thins bands of cementation of clastic sediments from various units was observed.
- The UTR was a blackwater stream from the organic matter in the wetlands. The landscape flattens on the northside in a wetland/marshy area. Tour guides noted the stark contrast in topography for northwesterly flowing tributaries on the south side of UTR with much steeper relief versus the flat marshy area to the north of UTR potentially due to the orientation of the southeasterly regional dip.
- Observed outcrop of Green Clay Confining unit at the head of a short gorge on UTR creek to the west of Waterfall creek.

- While hiking back uphill to the west of Waterfall Creek, another erosional feature was observed: a narrow, straight ravine on the hillside approximately 0.61 meters (2 feet) across and 2.43 meters (8 feet) deep (see Fig. 7),
- In addition, a rock weir was observed on one of the tributaries to the UTR consisting of five 1.2-meter (4-foot) high steps built to minimize erosion using granite riprap held in place by wire fencing near the top of the gorge (Fig. 8). Located approximately 75 meters (246.1 feet) downhill from an old waste disposal site including F-Area Burning Pits 231-F and 231-1F.

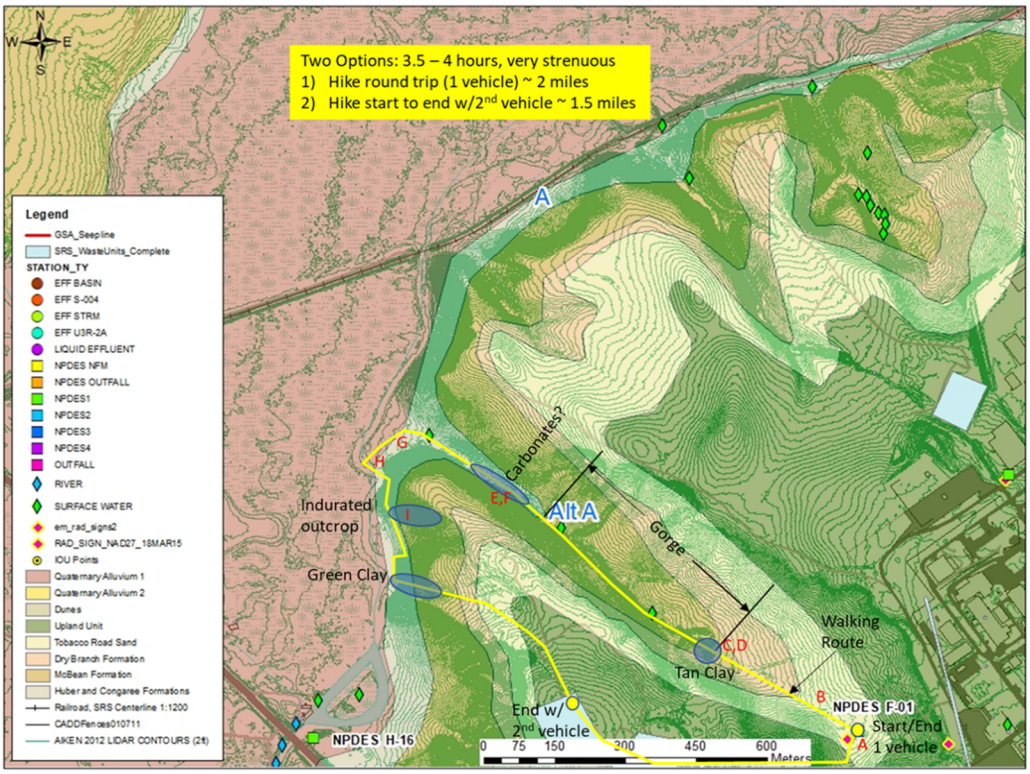

Fig. 3 Detailed Handout Making Afternoon Tour Locations

Fig. 4 Gorge Produced by Waterfall Creek Tributary

Fig. 5 Seepage Area A Long Waterfall Creek

Fig. 6 Small Waterfall Flowing Over Resistant, Silicified Santee Formation Sediments

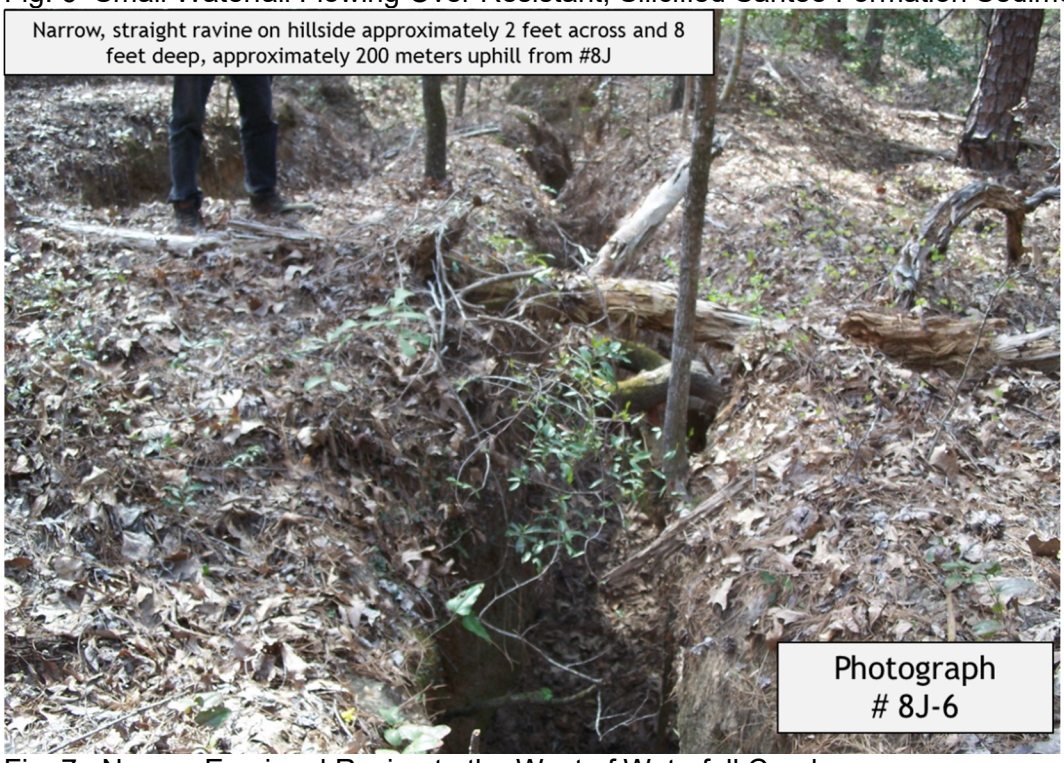

Fig. 7 Narrow Erosional Ravine to the West of Waterfall Creek

Fig. 8 Rock Weir on Small UTR Tributary Downhill from old F-Area Burning Pits 231-F and 231-1F

2.1.3 Conclusions and Follow-Up Action Items:

The walkdown of GSA surface and other features was helpful to the NRC staff in better understanding important features, events, and processes that may influence fate and transport of contaminants from the TF and SDF facilities. The following FUAIs resulted from the tour:

- The DOE to provide the NRC and SCDHEC an electronic copy of photographs from the March 18, 2019 GSA streams field observation.
- The DOE will investigate availability of SRS/GSA "erosion rate" reports/studies.

2.2 Technical Discussion – Tank Closure Status:

2.2.1 Observation Scope:

The technical discussion supported the NRC monitoring of the DOE disposal actions to assess compliance with all of the 10 CFR Part 61 performance objectives. The technical discussion was relevant to most of the monitoring areas and monitoring factors in the TFs Monitoring Plan, Rev. 0.

2.2.2 Observation Results:

The DOE presented an overview of the recent TFs tank closure activities and monitoring activities as well as an overview. The key points from the technical discussion were:

- The DOE discussed cleaning of Tank 15, which contains almost all H-Canyon Modified PUREX processed waste, including that the waste in Tank 15 has high aluminum content, is very viscous, and is difficult to remove.
- The DOE discussed that the Tank 15 waste was being transferred to Tank 13, where it is slurried and sent to Tank 51 for sludge batch preparation and in addition, that Tank 13 contains three submersible mixing pumps.
- The DOE indicated that Tank 15 will likely not be closed until at least year 2021.

2.2.3 Conclusions and Follow-Up Action Items:

Discussion on recent tank closure activities is helpful to the NRC staff in planning future monitoring activities and helping to ensure that NRC is in a better position to assess DOE compliance with the performance objectives in 10 CFR Part 61, Subpart C at the TFs. The NRC staff will continue to monitor the DOE TFs closure activities. There were no FUAIs that resulted from the technical discussion.

2.3 Technical Discussion – Updates to the 2016 GSA hydrologic flow and transport model

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 area and monitoring factor in the TFs Monitoring Plan, Rev. 0:

- MA 6 (Performance Assessment Maintenance)
    - MF 6.2 (Model and Parameter Support)
    - MF 6.3 (Tank Farm PA Revisions)

The discussions were most relevant to the following monitoring areas and monitoring factors in the SDF Monitoring Plan, Rev. 1:

- Monitoring Area (MA) 8 (Environmental Monitoring):
    - Monitoring Factor (MF) 8.02 Groundwater Monitoring
- Monitoring Area (MA) 10 (Performance Assessment Model Revisions):
    - Monitoring Factor (MF) 10.02 Defensibility of Conceptual Models

2.3.2 Observation Results:

The DOE briefed the NRC staff on activities related to the GSA PORFLOW model. The technical discussion focused primarily on the discussion questions the NRC staff submitted in advance of the OOV. The DOE provided a handout that presented responses to the NRC staff questions (ADAMS Accession No. ML19094B051). The key points from the technical discussion were:

- The DOE indicated that the vertical hydraulic conductivity value of the Green Clay Unit used in the optimized model is 3.05×10^{-6} meters/day (10^{-5} feet/day).
- The merits of modeling long-term transient flow versus steady-state flow were discussed.
- The NRC staff and the DOE discussed that although there are relatively few data points

near the eastern and western model boundaries, the boundaries are sufficiently far from the areas of concern or have streams that can be used to establish boundary conditions (e.g., McQueen Branch on the eastern boundary).

- The DOE clarified that the northern boundary condition was established in the middle of the marshy area to the north of UTR where seepage is occurring rather than establishing the boundary at UTR. No flow boundaries were established in the lower aquifer zones at the northern boundary, while drain boundary conditions are used for truncated upper layers to allow seepage to occur.
- The southern boundary is influenced by incision of Four Mile Branch into the UTR, while the potentiometric surface for the Gordon Aquifer does not appear to show any influence from the Four Mile Branch.
- In response to an NRC staff comment, the DOE indicated that the main reason for the increase in modeled groundwater plume concentrations beneath many of the SDUs is due to reducing groundwater recharge to 38.1 cm/year (15 inches/year). The reduced recharge resulted in slower groundwater flow rates and a lower water table.
- The DOE clarified that the only recharge zones in the interior model that differed from 38.1 cm/year (15 inches/year) were the northern and southern sedimentation basins which are areas of enhanced infiltration.
- The NRC staff questioned the use of pre-2000 baseflow data when the calibration period of record included 2004 to present day. The NRC staff also inquired about support for the assumption that 50 percent of baseflow/seepage occurred from the north side of UTR given the stark contrast in topography on the south and north sides of UTR, as well as uncertainty in the baseflow measurements. The DOE indicated that they were unaware of the ongoing stream flow data collection by Soil and Groundwater Closure Projects.
- The NRC staff stated that the recharge rate of 38.1 cm/year (15 inches/year) used almost exclusively over the GSA model domain (with the exception of the sedimentation basins) is uncertain and should be considered as part of the calibration process or the sensitivity of the results due to changes in recharge rates studied.
- The NRC staff questioned whether short-term data for recently installed wells is representative of long-term average water levels and requested additional clarification of the cumulative departure from long-term data presented in SRNL-STI-2015-00351, Rev. 0 (ADAMS Accession No. ML18107A071).
- The NRC staff indicated that backward particle tracking simulations may be useful to provide better support for potential contaminant sources within FTF as well as to better understand the influence of the Crouch Branch tributary to flow and transport in the UTR near HTF.
- The NRC staff noted that the most problematic area of the model with respect to calibration appeared to be H-Area.
- The NRC staff noted that it may be useful to develop a local flow model of the H-Area using boundary conditions from the regional model.
- The DOE indicated that additional analyses would be conducted to better understand hydraulic behavior near the study areas (HTF, FTF, and SDF) based on the 2018 GSA model results (similar to those impact analyses performed for the 2016 model).
- The DOE discussed how transients in the near-field model may be more important to consider compared to a transient far-field model. The NRC staff agreed and noted that the far-field model is not the most risk-significant part of the PA model based on reviewing PAs for the FTF, HTF, and SDF.
- The NRC staff stated that the DOE should consider uncertainty in the conceptual model for flow, perhaps through consideration of the set of PEST simulations that meet certain

minimum calibration criteria such as RMS error, baseflow, and other criteria to better understand the impact on dose. For example, the results of the 2016 and 2018 GSA models differ significantly in flow direction from the HTF and these differences could lead to significant differences in key radionuclide concentrations at the compliance point.
- Given the amount of incision observed on the tributaries to UTR, the NRC staff requested documentation of any work on GSA erosion studies.
- The NRC staff may have follow-up questions following completion of its review of the updated GSA PORFLOW documentation. Although not specifically listed as a FUAI, the NRC would like to receive those reports when they are completed.

2.3.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE TFs closure activities. The following FUAI resulted from the technical discussion:

- The DOE to provide the NRC and SCDHEC an electronic copy of the *General Separations Area Groundwater Flow Modeling* presentation (SRR-CWDA-2019-00028, Revision 0).
- The DOE to provide the NRC an electronic copy of *2018 Annual Groundwater Monitoring Report for the F- and H- Area Radioactive Liquid Waste Tank Farms*, SRNS-RP-2019-00097, when available.
- The DOE to provide the NRC and SCDHEC an electronic copy of *Savannah River Site Liquid Waste Facilities Performance Assessment Maintenance Program, FY2019 Implementation Plan*, SRR-CWDA-2018-00092, when available.
- The DOE to provide the NRC the ARC GIS shape files for a) surface geology, and b) gauging stations.
- The DOE to conduct particle tracking using GSA_2018 model: a) forward tracking from potential FIPSL and Tank 8 sources, b) reverse tracking from FTF-28 and FTF-12R monitoring wells, and c) reverse tracking from the Crouch Branch seepage areas that are located above the Tan Clay Confining Zone.
- The DOE to provide the NRC and SCDHEC with a copy of GSA_2018 flow model summary poster showing particle tracking from F-Tank Farm, H-Tank Farm, and Saltstone PA sources.
- The DOE to provide the NRC and SCDHEC with copies of references listed on slide 37 in the GSA groundwater flow modeling presentation, SRR-CWDA-2019-00028, Revision 0.
- The DOE to provide the NRC and SCDHEC with a GSA_2018 model water budget summary comparable to Figure 46 in WSRC-TR-96-0399 Revision 1 (ADAMS Accession No. ML101600586).
- The DOE to provide the NRC and SCDHEC with GSA_2018 model cross section views similar to Figure 2-8 in WSRC-TR-2004-00106 (ADAMS Accession No. ML101600449).
- The DOE to provide the NRC an electronic copy of *2017 Annual Groundwater Monitoring Report for the F- and H- Area Radioactive Liquid Waste Tank Farms*, SRNS-RP-2018-00226.

2.4 Technical Discussion – *Tank 18 Real Waste Release Testing and Associated PA Documentation*

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 TFs Monitoring Plan, Rev. 0:

- MA 2 (Waste Release):
    - MF 2.1 (Solubility Limiting Phases/Limits and Validation)

2.4.2 Observation Results:

The NRC staff and the DOE discussed *Tank 18 Real Waste Release Testing and Associated PA Documentation* TRR issued on September 21, 2018 (ADAMS Accession No. ML18242A259). The key points from the technical discussion were:

- The NRC staff discussed correlation between washing and solubility and noted that the location of the sample FTF-1 used for waste release testing for Tank 18 was at the periphery of the tank, which may not have been cleaned as well (the high solubility of U and other key radionuclides might be explained by limited washing in this area). The NRC staff reiterated the importance of tank washing to ensuring low solubility of key radionuclides consistent with PA modeling.
- The NRC staff indicated that the results of the waste release experiments demonstrate the difficulty in projecting solubility of key radionuclides for these unique tank wastes, as the results of the Tank 18 and Tank 12 testing were significantly (orders of magnitude) different.
- The NRC staff indicated that the DOE should consider performing updated geochemical modeling using information gained from characterization of the tanks and knowledge gained from comparisons of the experimental to previously modeled results.
- Given the high, risk-significant solubility of Pu in Tank 18 waste release testing, the NRC staff also indicated that the DOE should continue to study and develop models to account for higher mobility forms of Pu in the natural system.

2.4.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE TFs closure activities. The following FUAI resulted from the technical discussion:

- The DOE to provide the NRC and SCDHEC with copies of the Waste Release Testing references listed on slide 60 of SRR-CWDA-2019-00022, Revision 0.

2.5 Technical Discussion – Engineered Closure Cover Assumptions for TFs

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 area and monitoring factors in the TFs Monitoring Plan, Rev. 0:

- MA 5 (Closure Cap Performance):
    - MF 5.1 (Long-Term Hydraulic Performance)
    - MF 5.2 (Long-Term Erosion Design)

2.5.2 Observation Results:

The DOE presented a brief overview of the planned closure cover for SDF and indicated that they intend to implement a similar design for the TFs. The cover overview the DOE presented was based on information provided during a SDF OOV in July 2018 (ADAMS Accession No. ML18219B859). The DOE indicated that a revised TF PA may be issued in the next couple years that includes a revised cover design.

2.5.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE TFs closure activities. There were no FUAIs that resulted from the technical discussion.

2.6 Technical Discussion – *The DOE and NRC Contractor Research*

2.6.1 Observation Scope:

The technical discussion supported the NRC monitoring of the DOE disposal actions to assess compliance with all of the 10 CFR Part 61 performance objectives. The technical discussion was relevant to most of the monitoring areas and monitoring factors in the TFs Monitoring Plan, Rev. 0.

2.6.2 Observation Results:

The DOE and the NRC staff discussed the recent DOE research and the NRC contractor, Center for Nuclear Waste Regulatory Analyses (CNWRA), research that has been conducted or that is still ongoing. The key points from the technical discussion were:

- The DOE discussed their Tank 12 waste release research. The DOE indicated that iodine was found to be relatively insoluble in the Tank 12 waste release testing (formed solids with metals such as silver or mercury). No solubility control was assumed for Tank 12 in the PA and Tank 12 Special Analysis (ADAMS Accession No. ML17277B235); therefore, it is expected that there is greater safety margin based on the results of the waste release testing.
- The DOE discussed revising its geochemical model based on testing results obtained.
- The DOE discussed its upcoming research including research on tank grout which is similar to the work CNWRA is performing under contract for the NRC studying the ability of tank grout to condition infiltrating groundwater.
    - The DOE indicated that they will study two systems, a closed system that minimizes the amount of dissolved oxygen and carbon dioxide present, and an open system that does not limit the amount of oxygen and carbon dioxide present.
    - The DOE indicated they plan to use a simulated vadose zone water rather than groundwater in their experiments.
- The DOE indicated that they are evaluating which tank wastes could be studied in the future. The NRC staff suggested that testing Tank 16 annular waste may be useful.
- The NRC staff discussed research conducted by the CNWRA:
    - Tank grout groundwater conditioning experiments conducted by CNWRA based on the NRC staff's direction.
    - Tank grout groundwater –conditioning experiments are being conducting under

both open (sparged with either N_2 or CO_2/N_2 gas) and closed systems with cubed grout.
- The NRC staff requested that CNWRA perform additional experiments with crushed grout to increase reactive surface area, these experiments using crushed grout are currently being conducted.
- The NRC staff indicated that a report should be issued within a month that will contain information from FY2017 and FY2018 testing, as well as information obtained from roughly the first quarter of FY2019 using crushed grout.
- The NRC staff also discussed the saltstone experiments. Comments on the FY2017 and FY2018 report were provided to CNWRA and the NRC expects the report to be issued in the next month or two. The next saltstone experiments will include a re-reduction experiment with a spiked and unspiked (with Tc-99) sample in series.
- The NRC staff will follow-up to ensure that the DOE receives the CNWRA reports, and future TRRs, after they are completed.

2.6.3 Conclusions and Follow-Up Action Items:

The NRC staff will continue to monitor the DOE TFs closure activities. There was 1 FUAI that resulted from the technical discussion (the NRC staff will provide CNWRA reports and TRRs).

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

3.1 Overall Conclusions:

The information gathered during TFs Observation 2019-01 will be used for multiple NRC TRRs and future OOVs, based on the topics discussed. There is no change to the overall conclusions from either the NRC 2011 FTF TER or the NRC 2014 HTF TER regarding compliance of DOE disposal actions with the 10 CFR Part 61 performance objectives.

During the OOV, the NRC staff appreciated the DOE technical discussions and tour, as well as its preparation for the OOV. The NRC expects that the DOE will take into consideration the NRC staff information that was provided during the OOV.

3.2 Status of Monitoring Factors in TFs Monitoring Plan, Rev.0

TFs Observation 2019-01 is the ninth OOV for the TFs. The NRC staff did not close any monitoring factors based on this OOV. Therefore, all 26 TFs monitoring factors from the TFs Monitoring Plan, Rev. 0 are still open.

3.3 Status of Open Follow-Up Action Items from Previous TFs OOV Reports:

There were eight previous NRC TFs OOVs. With the exception of the items listed in the table below, all of the FUAIs from those OOVs were closed prior to TFs Observation 2019-01.

Unique identifier	FUAI
TFs CY 18-01-006	The DOE to provide the NRC with available documents from listing of follow-up items from *Tank 12 and Tank 16 Grouting* TRR (ADAMS Accession No. ML16231A444)
TFs CY 18-01-007	The NRC to hold teleconference with the DOE to follow-up on items from the Tank 12 and Tank 16 Grouting TRR

3.4 Status of Open Follow-Up Action Items from Clarifying Teleconference Calls, Technical Teleconference Calls and TRRs:

The FUAIs that remain open from the *Tank 12 and Tank 16 Grouting* TRR (and associated teleconference conducted on May 17, 2016) are as follows:

FUAIs from Tanks 12 and 16 Grout TRR

- #5: The DOE will gather information regarding the impact of caustic solution on clean cap grout reactivity and flowability.
- #7: The DOE will provide data and information on Grade 120 tank grout wet chemistry test, flow test, compressive strength test, bleed test, and heat of hydration as a function of time.
- #8: The DOE will clarify if the same strategy with respect to disposal of chromate-laden flushwater was used in Tank 12 as was used in Tank 16. The DOE will also provide any related work orders.
- #9: The DOE will provide a copy of SDDR No. 13307 and associated deviation disposition documents.
- #10: The DOE will provide clarification regarding the approach used for grouting the Tank 12 ventilation duct (see SRR-LWE-2014-00147 (ADAMS Accession No ML16057A499)).
- #11: The DOE will provide reference documents and confirmation to the NRC for the maximum drop height for Tank 12. The NRC staff will review the final configuration report for Tank 12 to see if any additional information is needed regarding Tank 12 grouting.

FUAIs from May 17, 2016 Tanks 12 and 16 Grout TRR Teleconference (ADAMS Accession No ML16167A237)

- #1: The DOE will gather information regarding the Tank 16 clean cap specification, explicitly whether Daratard or admixtures are used to increase flowability of the grout at a specified water:cement ratio.
- #2: The DOE will gather information to explain why compressive strength measurements are not required for the clean cap grout.
- #4: The DOE will provide attachments to work orders 01324150-64 and 01337683-33, as well as references related to the transition to use and testing of Grade 120 slag.
- #5: The DOE will gather information to clarify the testing of Grade 120 slag.

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

The table below contains the 14 FUAIs that were opened during TFs Observation 2019-01, including a unique NRC identifier for each FUAI.

Unique Identifier	**FUAI**
TFs-CY19-01-001	The DOE to provide the NRC and SCDHEC an electronic copy of the general presentation material including action items and attendance rosters. (SRR-CWDA-2019-00022, Revision 1)
TFs-CY19-01-002	The DOE to provide the NRC and SCDHEC an electronic copy of the *General Separations Area Groundwater Flow Modeling* presentation. (SRR-CWDA-2019-00028, Revision 0)
TFs-CY19-01-003	The DOE to provide the NRC an electronic copy of *2018 Annual*

	Groundwater Monitoring Report for the F- and H- Area Radioactive Liquid Waste Tank Farms, SRNS-RP-2019-00097, when available.
TFs-CY19-01-004	The DOE to provide the NRC and SCDHEC an electronic copy of *Savannah River Site Liquid Waste Facilities Performance Assessment Maintenance Program, FY2019 Implementation Plan*, SRR-CWDA-2018-00092, when available.
TFs CY19-01-005	The DOE to provide the NRC and SCDHEC an electronic copy of photographs from the March 18, 2019 GSA streams field observation.
TFs CY19-01-006	The DOE to provide the NRC the ARC GIS shape files for a) surface geology, and b) gauging stations.
TFs-CY19-01-007	The DOE to conduct particle tracking using GSA_2018 model: a) forward tracking from potential FIPSL and Tank 8 sources, b) reverse tracking from FTF-28 and FTF-12R monitoring wells, and c) reverse tracking from those Crouch Branch seepage areas above the Tan Clay Confining Zone.
TFs-CY19-01-008	The DOE to provide the NRC and SCDHEC with a copy of GSA_2018 flow model summary poster showing particle tracking from F-Tank Farm, H-Tank Farm, and Saltstone PA sources.
TFs-CY19-01-009	The DOE to provide the NRC and SCDHEC with copies of references listed on slide 37 in the GSA groundwater flow modeling presentation, SRR-CWDA-2019-00028, Revision 0.
TFs-CY19-01-010	The DOE to provide the NRC and SCDHEC with a GSA_2018 model water budget summary comparable to Figure 46 in WSRC-TR-96-0399 Revision 1.
TFs-CY19-01-011	The DOE to provide the NRC and SCDHEC with GSA_2018 model cross section views similar to Figure 2-8 in WSRC-TR-2004-00106.
TFs-CY19-01-012	The DOE to provide the NRC an electronic copy of *2017 Annual Groundwater Monitoring Report for the F- and H- Area Radioactive Liquid Waste Tank Farms*, SRNS-RP-2018-00226.
TFs-CY19-01-013	The DOE will investigate availability of SRS/GSA “erosion rate” reports/studies.
TFs CY19-01-014	The DOE to provide the NRC and SCDHEC with copies of the Waste Release Testing references listed on slide 60 of SRR-CWDA-2019-00022, Revision 0.

3.6 Issuance of NRC Technical Review Reports:

Between the previous OOV in 2018 and TFs Observation 2019-01, the NRC issued the following TRR related to the TFs.

Unique Identifier	**Title**	***Date / Accession No.***	**No. of FUAIs**
TFs-TRR-015	*Technical Review of Real Waste Release Testing Results for Tank 18F and Associated Performance Assessment Documentation for F-Area and H-Area Tank Farm Facilities at Savannah River Site, Aiken, South Carolina*	09/21/18 ML18242A259	0

4.0 PARTICIPANTS:

U.S. NRC	SCDHEC	U.S. DOE	DOE Contractors
Lloyd Desotell	Leigh Beatty	Daniel Ferguson (3-18-19)	Kevin Boerstler (3-18-19)
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			Steve Thomas
			Jeff Thibault (3-18-19)
			Terry Killeen (3-18-19)
			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), WSRC-TR-96-0399, Rev. 1, "Integrated Hydrogeological Modeling of the General Separations Area, Volume 2, Groundwater Flow Model". April 1999. ML101600586

_____ WSRC-TR-2004-00106, Rev. 0, "Groundwater Flow Model of the General Separations Area Using PORFLOW". July 2004. ML101600449

_____ DOE/SRS-WD-2010-001, Rev. 0, "DOE Draft Basis for Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site," September 2010. ML102790078

_____ DOE/SRS-WD-2012-001, Rev. 0, "DOE Basis for Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site," March 2012. ML121140051

_____ DOE-WD-2012-001, Rev. 0, "DOE Section 3116 Determination for Closure of F-Tank Farm at the Savannah River Site," March 2012. ML121140043

_____ DOE/SRS-WD-2013-001, Rev. 0, "DOE Draft Basis for Section 3116 Determination for Closure of H-Tank Farm at the Savannah River Site," February 2013. ML13045A504

_____ DOE/SRS-WD-2014-001, Rev. 0, “DOE Basis for Section 3116 Determination for Closure of H-Tank Farm at the Savannah River Site,” December 2014. ML15051A353

_____ DOE-WD-2014-001, Rev. 0, “DOE Section 3116 Determination for Closure of H-Tank Farm at the Savannah River Site,” December 2014. ML15051A352

_____ SRR-LWE-2014-00147, Rev. 1, "Tank 12H Grout Strategy." August 2015. ML16057A499

_____ SRNL-STI-2015-00351, Rev. 0; "General Separations Areas Groundwater Model Calibration Targets." August 2015. ML18107A071

_____ SRR-CWDA-2019-00022, Rev. 1, “Savannah River Site F and H Area Tank Farms NRC Onsite Observation Visit,” March 2019. ML19116A208

_____ SRR-CWDA-2019-00028, Rev. 0, “General Separations Area Groundwater Flow Modeling Discussion Supporting NRC Onsite Observation Visit,” March 2019. ML19094B051

_____ SRR-CWDA-2019-00040, Rev. 0, “Savannah River Site F and H Area Tank Farms NRC Onsite Observation Visit Photos – GSA Streams Field Observation,” March 2019. ML19116A225

U.S. Nuclear Regulatory Commission (NRC), “Technical Evaluation Report for F-Area Tank Farm Facility, Savannah River Site, South Carolina,” Rev. 0, October 2011. ML112371751

_____ “NRC Plan for Monitoring Disposal Actions Taken by the U.S. Department of Energy at the Savannah River Site F-Area Tank Farm Facility in Accordance with the National Defense Authorization Act for Fiscal Year 2005,” Rev. 0, January 2013. ML12212A192

_____ “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

_____ “Technical Evaluation Report for H-Area Tank Farm Facility, Savannah River Site, South Carolina,” Rev. 0, June 2014. ML14094A496

_____ “NRC Plan for Monitoring Disposal Actions Taken by the U.S. Department of Energy at the Savannah River Site F-Area and H-Area Tank Farm Facilities in Accordance with the National Defense Authorization Act for Fiscal Year 2005,” Rev. 0, October 2015. ML15238A761

_____ “Summary of Telephone Conference Call Held on May 17, 2016, Between NRC Staff and DOE Representatives Concerning NRC Staff Questions Regarding Tanks 12H and 16H Grouting Operations.” July 2016. ML16167A237

_____ “Technical Review: Tanks 16H and 12H Grouting Operations with Emphases on Specifications, Testing, Recommendations and Placement Procedures,” September 2016. ML16231A444

_____ “Technical Review: Final Inventory and Special Analysis Documentation for Tank 12H,” January 2018. ML17277B235

_____ “Technical Review of Real Waste Release Testing Results for Tank 18F and Associated Performance Assessment Documentation for F-Area and H-Area Tank Farm Facilities at Savannah River Site, Aiken, South Carolina,” September 2018. ML18242A259

_____ “U.S. Nuclear Regulatory Commission July 9-11, 2018, Onsite Observation Visit Report for the Savannah River Site Saltstone Disposal Facility,” November 2018. ML18219B859

_____ “Guidance for the March 18 – 19, 2019, Monitoring Onsite Observation Visit to the Savannah River Site F and H Area Tank Farms,” February 2019. ML19016A468

_____ “Savannah River Site F and H Area Tank Farms NRC Onsite Observation Visit, March 18-19, 2019,” March 2019. ML19116A208