

November 19, 2012

Mr. James Folk, Director (Acting)
Waste Disposition Programs Division
U.S. Department of Energy
Savannah River Operations Office
P.O. Box A
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SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION AUGUST 7-8, 2012, ONSITE
OBSERVATION VISIT REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE
DISPOSAL FACILITY (DOCKET NO. PROJ0734)

Dear Mr. Folk:

The enclosed report describes the U.S. Nuclear Regulatory Commission (NRC) onsite observation visit on August 7-8, 2012, at the Savannah River Site (SRS) Saltstone Disposal Facility (SDF). That visit was conducted in accordance with Section 3116(b) of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (Section 3116), which requires NRC to monitor certain disposal actions taken by the U.S. Department of Energy (DOE) for the purpose of assessing compliance with the performance objectives set out in 10 CFR Part 61, Subpart C. The activities conducted during that visit were consistent with those described in the NRC monitoring plan for salt waste disposal at SRS (dated May 3, 2007) and the NRC staff guidance for activities related to waste determinations (NUREG-1854, dated August 2007).

On every onsite observation visit to SRS, NRC is focused on assessing compliance with four performance objectives in 10 CFR Part 61, Subpart C: (1) protection of the general population from releases of radioactivity (§61.41), (2) protection of individuals from inadvertent intrusion (§61.42), (3) protection of individuals during operations (§61.43), and (4) stability of the disposal site after closure (§61.44).

On April 30, 2012, NRC issued both the Technical Evaluation Report (TER) [available via the NRC's Agencywide Documents Access and Management System (ADAMS) at Accession Number ML121020140] and Type IV Letter of Concern [ML120650576]. That TER concluded that NRC did not have reasonable assurance that salt waste disposal at the SDF met the performance objectives in 10 CFR Part 61, specifically §61.41. The Type IV Letter of Concern formally communicated the NRC concerns to both DOE and the South Carolina Department of Health and Environmental Control.

On June 13, DOE provided results of research DOE had performed since August 2011 to NRC. On July 12 and July 26, 2012, DOE provided responses to the Type IV Letter to NRC. The June 13 and July 12, 2012, submittals included information about updated technetium-99 (Tc-99) inventory projection for SRS saltstone disposal units 2, 3, and 5; and information about DOE Case K and K1 uncertainty and sensitivity analyses. The information in the June 13 and July 12, 2012, submittals was discussed during the August 2012 onsite observation visit; however, the information in the July 26, 2012, submittal was not discussed because it had not been evaluated by NRC at the time of this visit.

It is worth noting that since this visit, NRC issued a letter of acknowledgement, dated August 31, 2012, stating that a Letter to the U.S. Congress (Type II) is not needed at this time. Based on the NRC's TER analyses and DOE's revised Tc-99 inventory, the staff determined that, if DOE's new projected Tc-99 inventory for Saltstone Disposal Units 2, 3, and 5 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)).

The August 2012 onsite observation visit focused on the technical concerns in the NRC 2012 TER. There are no new Open Issues resulting from that visit. The previous Open Issues are now rolled into the concerns identified by NRC in that TER. Those NRC concerns will be rolled into the monitoring factors in the revised monitoring plan that is being drafted by NRC.

This observation addressed a subset of the concerns raised in the 2012 TER. During the observation, staff was encouraged by DOE's progress in developing a research plan that will provide useful information. However, the DOE and NRC continue to work in the monitoring process to resolve all outstanding issues that led to issuance of the NRC's April 30, 2012, Letter of Concern (Type IV). In accordance with the requirements of Section 3116, NRC will continue to monitor DOE disposal actions at SRS. Further onsite observation visits, technical reviews, and data reviews may be necessary to obtain the information needed to close any Open Issues.

If you have any questions or need additional information regarding this report, then please contact Nishka Devaser of my staff at (301) 415-5196.

Sincerely,

/RA/

Aby Mohseni, Deputy Director
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Enclosure:
NRC Onsite Observation Visit Report

cc w /enclosure:
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U.S. NUCLEAR REGULATORY COMMISSION AUGUST 7-8, 2012, ONSITE OBSERVATION VISIT REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE DISPOSAL FACILITY

EXECUTIVE SUMMARY:

The U.S. Nuclear Regulatory Commission (NRC) staff conducted its twelfth onsite observation visit, Observation 2012-01, to the Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) on August 7-8, 2012. On every onsite observation visit to SRS, NRC is focused on assessing compliance with four performance objectives in 10 CFR Part 61, Subpart C: (1) protection of the general population from releases of radioactivity (§61.41), (2) protection of individuals from inadvertent intrusion (§61.42), (3) protection of individuals during operations (§61.43), and (4) stability of the disposal site after closure (§61.44).

For Observation 2012-01, NRC focused on information regarding the April 30, 2012, NRC Technical Evaluation Report (TER), where NRC concluded that it did not have reasonable assurance that salt waste disposal at the SDF met the performance objectives in 10 CFR Part 61, specifically §61.41. NRC performs monitoring activities in coordination with the State, so staff from the South Carolina Department of Health and Environmental Control (SC DHEC) also participated in that visit.

To accomplish those goals during Observation 2012-01, NRC staff and DOE (i.e., includes DOE contractors throughout this report), discussed the following topics: Salt Waste Processing, Disposal Unit Construction, and Quality Assurance; technetium-99 (Tc-99) Inventory and New Inventory Quantification Methods; and Performance Assessment Maintenance and Path Forward for SDF Monitoring. In addition, NRC staff and DOE toured the SDF, including a facility overview and closer views of Vault 4 and Saltstone Disposal Units (SDUs) 2, 3, and 5. Also, NRC staff and DOE toured the Lysimeter Experiment Apparatus. This report provides a description of the NRC activities during Observation 2012-01, including observations that NRC staff made during Observation 2012-01.

There are no new Open Issues resulting from Observation 2012-01. NRC staff received documentation and a DOE presentation that pertained to the activities observed. The presentation that DOE provided to NRC staff is accessible via the NRC's document repository, the Agencywide Documents Access and Management System (ADAMS), via accession number ML12235A359.

The previous Open Issues are now rolled into the concerns identified by NRC in the 2012 TER. Those NRC concerns will be rolled into the monitoring factors in the revised monitoring plan that is being drafted by NRC. Observation 2012-01 addressed a subset of the concerns raised in the 2012 TER. During the observation, staff was encouraged by DOE's progress in developing a research plan that will provide useful information. However, the DOE and NRC continue to work in the monitoring process to resolve all outstanding issues that led to issuance of the NRC's April 30, 2012, Letter of Concern (Type IV).

A summary of NRC staff observations and conclusions in those areas is provided below:

- Tour of the SDF:

After a facility overview, NRC staff and DOE viewed Vault 4 and SDUs 2, 3, and 5. NRC staff and DOE discussed DOE plans for the remaining space in Vault 4 and construction details of the SDUs. SDUs 2A/2B have been backfilled (i.e., surrounded with soil); but, had not been filled with saltstone, which meant that NRC staff observed the roofs of those SDUs. SDUs 3 and 5 had completed hydrotesting; but had not been backfilled. DOE is in the process of installing the high density polyethylene (HDPE) external cover on the walls of SDUs 3 and 5.

- Technical Discussion – Salt Waste Processing, Disposal Unit Construction, and Quality Assurance:

DOE provided NRC staff with an update of salt waste processing and the status of construction of SDUs 2, 3, and 5. Regarding Saltstone Processing Facility (SPF) operations, NRC staff and DOE discussed the following topics: (1) recent SPF operating history, including doses during operations; (2) the current operating outage, which began on December 1, 2011, and was scheduled to end in late August 2012; (3) the formation of salt batches; and (4) fiscal year 2013 (FY13) production goals.

DOE told NRC staff of the upcoming readiness assessment for SDUs 2A/2B and the expected introduction of grout into those SDUs in September 2012. In response to NRC questions, DOE provided construction details of the leak detection system (i.e., HDPE-lined sump) under SDU 3A.

DOE provided an overview of its quality assurance program and explained the DOE Unreviewed Waste Management Question Evaluation process.

In response to NRC questions, DOE led a discussion of the formed core sampling technique that DOE is developing to obtain samples of field-emplaced saltstone. DOE reviewed results of recent tests with a pilot-scale system and discussed challenges related to sample extraction that need to be addressed prior to installation in an operating radiological facility.

- Technical Discussion – Tc-99 Inventory and New Inventory Quantification Methods:

DOE provided NRC staff with an overview of the new DOE approach for tracking inventory. NRC staff and DOE discussed the references used to generate the revised predicted inventory of Tc-99 expected to be disposed of in SDUs 2, 3, and 5. NRC staff requested three analytical documents and information related to expected future Tc-99 concentrations. NRC staff told DOE that, because Tc-99 is responsible for most of the projected dose from saltstone, information related to the inventory of Tc-99 is very important to the determination of the expected dose from SDUs 2, 3, and 5.

- Tour of the Lysimeter Experiment Apparatus:

NRC staff and DOE toured the new DOE lysimeter experiment apparatus, which was designed to test radionuclide leaching from simulated saltstone samples and radionuclide sorption to soils under conditions similar to field conditions (e.g., lysimeters open to site precipitation). NRC staff and DOE discussed the experimental protocols, including DOE plans for sample collection and data interpretation. DOE told NRC staff that DOE planned to complete a mass balance calculation on collected radionuclides when test lysimeters are sacrificed during the planned 10-year operating life of the experiment. DOE told NRC staff that DOE would not be able to complete a mass balance on water because evapotranspiration is not quantified. DOE told NRC staff that water flow through all of the lysimeters will be estimated by detailed measurement of water flow through a single highly instrumented test lysimeter.

- Technical Discussion – Performance Assessment Maintenance and Path Forward for SDF Monitoring:

DOE led a discussion of the DOE performance assessment maintenance. NRC staff expects that the documents regarding the effects of curing profiles on saltstone properties, the curing profiles of field-emplaced saltstone, and the literature review of cementitious material fracturing will be useful for model support. DOE agreed to provide to NRC staff the update to the performance maintenance plan, which is expected to be completed by December 2012.

NRC staff led a discussion of the path forward for SDF monitoring. NRC staff told DOE that NRC is drafting a revised monitoring plan, which will be based on the NRC 2012 TER (NRC, 2012b). NRC staff told DOE that the draft monitoring plan will be coordinated with the State of South Carolina. DOE requested that NRC staff provide DOE with a draft prioritized list of the draft monitoring factors in the draft revised monitoring plan. NRC staff agreed to provide that draft prioritized list to DOE by August 31, 2012. In addition, DOE agreed to provide a document list and action list to NRC, as discussed during the June 21, 2012, teleconference call.

1.0 BACKGROUND:

Section 3116 of the National Defense Authorization Act for Fiscal Year 2005 (Section 3116) authorizes DOE, in consultation with 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. Section 3116 also requires NRC to monitor DOE disposal actions related to those determinations to assess compliance with the performance objectives in 10 CFR Part 61, Subpart C.

To carry out its monitoring responsibility under Section 3116, NRC, in coordination with the State site regulator – SC DHEC, performs three types of activities: (1) technical reviews, (2) onsite observation visits, and (3) data reviews. Those activities focus on key assumptions identified in the NRC monitoring plan. Technical reviews generally focus on reviewing additional model support for assumptions that DOE made in its performance assessment, which are considered important to the DOE compliance demonstration. Onsite observation visits generally are performed to: (1) observe the collection of data (e.g., observation of waste sampling used to generate radionuclide inventory data) and review the data to assess consistency with

assumptions made in the waste determination; and (2) observe key disposal or closure activities related to technical review areas (e.g., slag/other material storage, grout formulation, preparation, or placements). Data reviews supplement technical reviews by focusing on monitoring data that may indicate future system performance or by reviewing records or reports that can be used to directly assess compliance with the performance objectives.

On March 31, 2005, DOE submitted to NRC the "Draft Section 3116 Determination Salt Waste Disposal Savannah River Site" (DOE-WD-2005-001, Rev. 0) to demonstrate compliance with the Section 3116 criteria, including demonstration of compliance with the performance objectives in 10 CFR Part 61, Subpart C. In its consultation role, NRC staff reviewed the draft waste determination. In the TER issued in December 2005 (NRC, 2005), NRC documented the results of its review and concluded that there was reasonable assurance that the applicable criteria of Section 3116 could be met, provided certain assumptions made in the DOE analyses were verified via monitoring. Taking into consideration the assumptions, conclusions, and recommendations in the NRC 2005 TER, DOE issued the final waste determination in January 2006 (DOE-WD-2005-001, Rev. 1).

DOE submitted a revised performance assessment to NRC in 2009 (SRR-CWDA-2009-00017). NRC reviewed the DOE 2009 performance assessment, including holding public meetings, sending requests for additional information, and reviewing the DOE responses. On April 30, 2012, NRC issued both the TER (NRC, 2012b) and the Type IV Letter of Concern (NRC, 2012a). In the 2012 TER, NRC concluded that it did not have reasonable assurance that salt waste disposal at the SDF met the performance objectives in 10 CFR Part 61, specifically §61.41. The Type IV Letter of Concern formally communicated the NRC concerns to both DOE and the SC DHEC.

On June 13, DOE provided results of research DOE had performed since August 2011 to NRC (DOE, 2012a). On July 12 and July 26, 2012, DOE provided responses to the Type IV Letter to NRC (DOE, 2012b; DOE, 2012c). The June 13 and July 12, 2012, submittals included information about updated technetium-99 (Tc-99) inventory projection for SDUs 2, 3, and 5; and information about the DOE Case K and K1 uncertainty and sensitivity analyses. The information in the June 13 and July 12, 2012, submittals was discussed during Observation 2012-01; however, the information in the July 26, 2012, submittal was not discussed because it had not been evaluated by NRC at the time of Observation 2012-01.

2.0 NRC ONSITE OBSERVATION VISIT ACTIVITIES:

Observation 2012-01 began with a short briefing on the agenda and site safety procedures presented by DOE contractor, Savannah River Remediation (SRR) and attended by representatives from DOE, NRC, Savannah River National Laboratory (SRNL), and SC DHEC. There were discussions between NRC and DOE regarding Salt Waste Processing, Disposal Unit Construction, and Quality Assurance; Tc-99 inventory and New Inventory Quantification Methods; and Performance Assessment Maintenance and Path Forward for SDF Monitoring. In addition, NRC staff and DOE toured the SDF, including a facility overview and closer views of Vault 4 and SDUs 2, 3, and 5. Also, NRC staff and DOE toured the new lysimeter experiment apparatus related to radionuclide leaching and sorption. The report sections below contain detailed accounts of those discussions and tours.

2.1 Tour of the SDF

2.1.1 Observation Scope:

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

2.1.2 Observation Results:

NRC staff observed an overview of the SDF atop the landing area adjacent to the process area at the SPF, went to Vault 4 and observed the patched cracks on Vault 4 Cell A, and discussed with DOE whether any infiltration was observed in the Vault 4 drain system.

NRC staff went to SDUs 2A/2B. The soil had been backfilled around those SDUs; but, the tanks were not filled, so, the tops of the SDUs were easily accessible. NRC staff observed the tops of the SDUs and discussed with DOE the DOE plan for sealing penetrations in the SDU roofs prior to site closure. NRC staff discussed with DOE the DOE plan for maintaining the neoprene seals used to ensure that any roof penetrations do not allow infiltration into the tanks. DOE told NRC staff that seals would be chosen with service lives exceeding the time between tank closure and SDF closure to minimize the potential need for replacement. NRC staff observed small pools of water collected on the roofs of SDUs 2A/2B, apparently attributable to a recent rainfall event.

NRC staff went to the SDUs 3A/3B and 5A/5B construction site. NRC staff observed the external HDPE liner in different stages of installation on each of the four SDUs. In response to NRC questions about leak checking the HDPE liner, DOE explained that each joint was welded along two vertical lines with the resulting vertical pocket between the welds tested by being pressurized.

DOE discussed the use of settlement markers/surveys to measure the settlement of SDUs during construction. Settlement has the potential to disrupt SDU performance. The data collected during construction and filling of SDUs could be used to evaluate near- and long-term settlement estimates and help support assumptions of long-term SDU performance.

2.1.3 Conclusions and Follow-up Actions:

NRC staff will continue to monitor construction of the new SDUs and disposal cells; and will continue to monitor them when the DOE puts them into operation.

The following five follow-up actions resulted from that Tour:

- DOE to provide an estimate of the volume of water from environmental sources, if any, intruding into Vault 4.
- DOE to describe the expected surveillance and maintenance program for cell penetrations after operations and prior to final site closure.

- DOE to describe the plans to maintain or close the drain water removal system after operations and prior to final closure (e.g., maintenance of instrumentation for liquid detection).
- DOE to provide the distance of groundwater monitoring wells to SDUs 2A/2B; and to identify which aquifer the wells are screened in. Later during Observation 2012-01, DOE directed NRC staff to the document with that information, so this is no longer a follow-up action.
- DOE to provide cure temperature profiles for field-emplaced saltstone. DOE informed NRC that the data was from an ongoing research and development effort. DOE expected that the data would be available by the end of December 2012.

2.2 Technical Discussion – Salt Waste Processing, Disposal Unit Construction, and Quality Assurance:

2.2.1 Observation Scope:

NRC staff monitors salt waste processing, including qualification of salt batches. Salt waste processing and quality assurance are also critical to grout quality. SDU construction is related to SDU performance. Worker doses during salt waste processing and SDU construction and operation is directly related to the performance objective for protection of individuals during operations (i.e., §61.43). Section 3.2.2, “Waste Sampling”, Section 3.2.3, “Vault Construction”, Section 3.2.4, “Grout Formulation and Placement”, and Section 5, “Monitoring to Assess Compliance with 10 CFR 61.43 – Protection During Operations” of the May 2007 monitoring plan (NRC, 2007) provide details of the basis for NRC staff review areas.

DOE formed-core sampling method is directly related to the previous Open Issues 2007-1 and 2007-2 because formed-core sampling is being developed to obtain representative measurements of samples of field-emplaced saltstone. Also, salt waste processing is related to those Open Issues. Those previous Open Issues are now rolled into the concerns identified by NRC in the 2012 TER (NRC, 2012b). Those NRC concerns will be rolled into the monitoring factors in the revised monitoring plan that is being drafted by NRC.

2.2.2 Observation Results:

DOE provided an update of salt waste processing and the status of construction of SDUs 2, 3, and 5. DOE described the recent SPF operating history, including doses during operations. DOE provided dose information for the 10 individuals with the greatest dose attributable to the SDF and told NRC staff that all exposures were within regulatory limits. DOE described the current operating outage, which began on December 1, 2011, and was scheduled to end in late August 2012. The operating outage will allow the completion of grout transfer lines from the SPF to SDU 2.

DOE discussed the FY13 production goals and how those goals related to the formation of individual salt batches. Specifically, DOE plans to process approximately 4,500 cubic meters (1.2 million gallons) of treated salt waste in FY13. This waste will include material currently in Tank 50 (Salt Batch 4) and Salt Batch 5, which is currently being qualified. Approximately 800 cubic meters (200,000 gallons) of usable space are left in Vault 4. DOE is evaluating

whether or not Vault 4 cells C and I can be upgraded by adding a drain water collection system so that they can be approved to accept saltstone. DOE told NRC staff of the upcoming readiness assessment for SDUs 2A/2B and the expected introduction of grout into those SDUs in September 2012.

DOE told NRC staff that SDUs 3 and 5 are expected to undergo a readiness assessment in late 2013 or early 2014 and are expected to receive saltstone grout from July 2014 to July 2015. DOE told NRC staff that the transfer from SPF to SDUs 3 and 5 is the longest planned grout transfer distance at the SDF.

In response to NRC questions, the DOE provided a detailed discussion of the formed-core sampling method and the status of its development. DOE described how the samplers would be deployed and aligned in the sampling tube. DOE described observations of the flow of grout into the samplers during pilot-scale tests, challenges associated with removing the samplers from the sampling tube, and challenges associated with removing the grout samples from the samplers (SRNL-STI-2011-00706). The formed-core samples are formed from single lifts, so, DOE and NRC staff discussed the need to relate the properties of drilled cores to formed cores and the properties of drilled cores that do not intersect saltstone lift boundaries to the properties of drilled cores that do intersect saltstone lift boundaries.

DOE provided an overview of the quality assurance program for research and development, SDU construction, and the Unreviewed Waste Management Question Evaluation (UWMQE) process in the DOE presentation for Observation 2012-01 (SRR-CWDA-2012-00108).

2.2.3 Conclusions and Follow-up Actions:

The NRC staff will continue to monitor SPF activities, including any changes in the SPF quality assurance program, as the SPF exits its current outage and DOE transfers saltstone grout to Vault 4 and SDUs 2, 3, and 5. There were no follow-up actions that resulted from that Technical Discussion.

2.3 Technical Discussion – Tc-99 Inventory and New Inventory Quantification Methods:

2.3.1 Observation Scope:

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

2.3.2 Observation Results:

DOE provided an overview of the revised methodology for calculating inventory. As part of that overview, DOE described the process that will be used for radionuclides for which analytical results do not exist or that are present below the detection limit. That revised approach was used by DOE to revise the inventory currently disposed of in Vault 4 (SRR-CWDA-2012-00002, SRR-CWDA-2012-00067). Also, DOE provided an overview of a UWMQE (SRR-CWDA-2012-00112) performed to determine the potential dose from filling the remaining

volume in Vault 4 Cell H with salt waste that is consistent with the concentrations in the waste currently in Tank 50. DOE agreed to provide SRR-CWDA-2012-00112 to NRC. In addition, DOE provided a demonstration of the new inventory calculator software tool.

NRC staff and DOE discussed the methodology used to generate the revised Tc-99 inventory for SDUs 2, 3, and 5 (SRR-CWDA-2012-00095). In particular, NRC staff was interested in understanding the basis for the projected curies of Tc-99 for the future batches that was provided in Table 1 of SRR-CWDA-2012-00095. DOE told NRC staff that the inventory for Actinide Removal Process/Modular Caustic Side Solvent Extraction Unit (ARP/MCU) Batches B4, B5, B6, and B7 was based on analytical results from samples of salt waste that is expected to be included in each of those batches. DOE agreed to provide the references listed in Table 1 of SRR-CWDA-2012-00095 to NRC that have more detail on those analytical measurements. In response to questions from NRC about the uncertainty in the inventory of the Salt Waste Processing Facility (SWPF) Batches B1, B2, B3, and B4, given that those batches have not been created or sampled yet, DOE agreed to provide to NRC additional information on the Tc-99 concentrations in the salt waste that is anticipated to comprise those batches.

2.3.3 Conclusions and Follow-up Actions:

The NRC staff will continue to monitor the Tc-99 inventory in SDUs 2, 3, and 5.

The following three follow-up actions resulted from that Technical Discussion:

- DOE to provide SRR-CWDA-2012-00112. *This follow-up action was not originally captured during the observation because it was discussed during the visit (SRR-CWDA-2012-00108, slide 33) and was marked as being provided to the NRC during the observation, however, the NRC staff has not yet received this document.*
- DOE to provide analytical documents referenced in Table 1 from SRR-CWDA-2012-00095:
 - SRNL-I3100-2012-00062
 - X-ESR-H-00377
 - SRR-LWE-2012-00130
- DOE to provide information related to Tc-99 concentrations beyond Batch 7 and anticipated through 2015.

2.4 Tour of the Lysimeter Experiment Apparatus:

2.4.1 Observation Scope:

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

2.4.2 Observation Results:

NRC staff and DOE toured the lysimeter experiment apparatus that DOE is using to test radionuclide sorption in site soils and radionuclide leaching for simulated saltstone samples. The experiment apparatus consists of 48 lysimeter tubes constructed above ground in a thermally insulated housing. NRC staff observed the housing for the water collection containers at ground level and the tops of the lysimeters. The tops of the lysimeters were accessible by a ladder leading to a platform along the top of the experiment apparatus.

DOE provided an overview of the experiment, including plans for data collection and a brief description of the construction of the apparatus. The radionuclide concentrations and chemical parameters (e.g., nitrate concentration, pH) will be measured quarterly in water collected from the lysimeters. The lysimeters will be sacrificed periodically (e.g., 2, 6, 10 years after the start of the experiment) so that DOE can measure the radionuclide movement that had occurred in the soil inside the lysimeters. DOE will evaluate the radionuclide mass that could be accounted for in the aqueous and solid samples (i.e., DOE will attempt to close the radionuclide mass balance).

DOE told NRC staff that a water mass balance could not be performed because evaporation from the tops of the lysimeters will not be measured. NRC staff observed that the sample collection containers were not air-tight and would allow evaporation. Evaporation from the sample collection containers is a greater concern than evaporation from the tops of the lysimeters because evaporation from the sample containers will change measured concentrations. DOE explained that the containers were deliberately not sealed to avoid creating inappropriate back-pressure on the columns. However, DOE did not explain how DOE would account for the unmeasured extent of evaporation in interpreting measured constituent concentrations.

NRC staff told DOE that it could be difficult to interpret the radionuclide release data without a good understanding of the amount of water flowing through, as opposed to around, the simulated saltstone samples. NRC staff would expect significant scale effects in the flow through the saltstone samples, as compared to field-emplaced saltstone, because the saltstone samples represent a relatively small portion of the lysimeter area. NRC staff would expect that the hydraulic conductivity of the saltstone samples would be significantly lower than the hydraulic conductivity of the surrounding soil, so, the water in the lysimeter experiment would be expected to principally flow around the samples. In addition, NRC staff told DOE that it was not clear whether water infiltrating into the SDUs will flow principally through fast flow paths or the saltstone matrix and this difference could cause an underestimate of release unless the flow through the samples in the lysimeter experiment was well understood and appropriately scaled by DOE.

2.4.3 Conclusions and Follow-up Actions:

NRC staff found the lysimeter experiment to have the potential to supply useful information about radionuclide release from saltstone and migration in site soil if appropriate data are collected. Specifically, NRC staff told DOE that the plan to evaluate the mass balance of radionuclides was critically important. NRC staff told DOE that the plan to evaluate evidence of rinse-release in the early data from the simulated saltstone samples could provide useful information about the DOE conceptual model used in the performance assessment. NRC staff

told DOE that the DOE plan to monitor nitrate releases from the lysimeters containing simulated saltstone samples was expected to be useful.

The following two follow-up actions resulted from that Tour:

- DOE to clarify the interpretation of lysimeter concentration data as it relates to evaporation from the collection vessels.
- DOE to clarify the interpretation of data related to water that flows around the lysimeter cementitious samples.

2.5 Technical Discussion – Performance Assessment Maintenance and Path Forward for SDF Monitoring

2.5.1 Observation Scope:

DOE uses its performance assessment maintenance program to both satisfy DOE internal requirements and address technical topics in the NRC monitoring plan. As part of Monitoring under Section 3116 of the NDAA, NRC is responsible for reviewing updates to the DOE performance assessment. Section 3.1.2 “Oxidation of Saltstone,” Section 3.1.3, “Hydraulic Isolation of Saltstone,” and Section 3.1.4, “Model Support” of the May 2007 monitoring plan (NRC, 2007) provide details of the basis for the NRC staff review areas.

2.5.2 Observation Results:

DOE Manual 435.1-1 (DOE, 2001a) requires DOE to implement a performance assessment maintenance program to evaluate changes that could affect the performance, design, and operating bases for the SDF. DOE Order 435.1 (DOE, 2001b) includes that the performance assessment maintenance must include the conduct of research, field studies, and monitoring needed to address uncertainties or gaps in existing data. In addition to fulfilling those internal DOE requirements, DOE uses performance assessment maintenance activities to address technical topics in the NRC monitoring plan.

DOE provided NRC staff with an overview of the FY 2012 Performance Assessment Maintenance Program (SRR-CWDA-2012-00020) and discussed funding decisions for various projects (SRR-CWDA-2012-00020, Table 2.3-1). DOE and NRC staff discussed the general strategy of comparing field and laboratory samples to establish the representativeness of laboratory samples and then using laboratory experiments to test the effects of a wide range of parameters on saltstone properties. DOE described current research related to the effects of curing temperature profiles on saltstone properties and measurements of curing temperatures in field-emplaced saltstone. DOE described the long-term experiment where saltstone samples would be exposed to environmental conditions for several years during which time their physical properties would be monitored. DOE described a current literature review related to the long-term fracturing of cementitious materials. DOE agreed to provide the research results related to curing temperatures and the literature review related to cementitious material fracturing to NRC when they are available, expected in December 2012. In addition, DOE agreed to provide the updated performance assessment maintenance plan to NRC by December 2012.

NRC staff led a discussion of the path forward for SDF monitoring. NRC staff told DOE that NRC is drafting a revised monitoring plan, based on the 2012 TER. NRC staff told DOE that the draft monitoring plan will be coordinated with SC DHEC. DOE told NRC staff that the NRC staff prioritization of the draft monitoring factors in the draft revised monitoring plan is significant for DOE to determine future research plans. NRC staff agreed to provide that draft prioritized list of draft monitoring factors to DOE by August 31, 2012, with the understanding that the draft priority list and draft monitoring factors may change as the draft monitoring plan is finalized. In addition, DOE agreed to provide a document list and action list to NRC, as discussed during the June 21, 2012, teleconference call.

2.5.3 Conclusions and Follow-up Actions:

The following four follow-up actions resulted from that Technical Discussion:

- DOE to provide documents regarding the effects of curing profiles on saltstone properties and the curing profiles of field-emplaced saltstone
- DOE to provide a document list and action list, as discussed in the June 21, 2012, teleconference call by December 2012 and the update to the performance maintenance plan that will be completed by December 2012.
- NRC staff agreed to provide that draft prioritized list of draft monitoring factors to DOE by August 31, 2012, with the understanding that the draft priority list and draft monitoring factors may change as the draft monitoring plan is finalized.

3.0 FOLLOW-UP ACTIONS AND OVERALL CONCLUSIONS:

3.1 Follow-up Actions from the Tour of the SDF:

- DOE to provide an estimate of the volume of water from environmental sources, if any, intruding into Vault 4.
- DOE to describe the expected surveillance and maintenance program for cell penetrations after operations and prior to final site closure.
- DOE to describe the plans to maintain or close the drain water removal system after operations and prior to final closure (e.g., maintenance of instrumentation for liquid detection).
- DOE to provide cure temperature profiles for field-emplaced saltstone.

3.2 Follow-up Actions from the Technical Discussion – Salt Waste Processing, Disposal Unit Construction, and Quality Assurance:

- None

3.3 Follow-up Actions from the Technical Discussion – Tc-99 Inventory and New Inventory Quantification Methods:

- DOE to provide SRR-CWDA-2012-00112. *This follow-up action was not originally captured during the observation because it was discussed during the visit (SRR-CWDA-2012-00108, slide 33) and was marked as being provided to the NRC during the observation, however, the NRC staff has not yet received this document.*
- DOE to provide analytical documents referenced in Table 1 from SRR-CWDA-2012-00095:
 - SRNL-I3100-2012-00062
 - X-ESR-H-00377
 - SRR-LWE-2012-00130
- DOE to provide information related to Tc-99 concentrations beyond Batch 7 and anticipated through 2015.

3.4 Follow-up Actions from the Tour of the Lysimeter Experiment Apparatus:

- DOE to clarify the interpretation of lysimeter concentration data as it relates to evaporation from the collection vessels.
- DOE to clarify the interpretation of data related to water that flows around the lysimeter cementitious samples.

3.5 Follow-up Action from the Technical Discussion – Performance Maintenance and Path Forward on SDF Monitoring:

- DOE to provide documents regarding the effects of curing profiles on saltstone properties and the curing profiles of field-emplaced saltstone.
- DOE to provide a document list and action list, as discussed in the June 21, 2012, teleconference call by December 2012 and the update to the performance maintenance plan that will be completed by December 2012.
- NRC staff agreed to provide that draft prioritized list of draft monitoring factors to DOE by August 31, 2012, with the understanding that the draft priority list and draft monitoring factors may change as the draft monitoring plan is finalized.

3.6 Overall Conclusions:

There are no new Open Issues resulting from Observation 2012-01. The previous Open Issues are now rolled into the concerns identified by NRC in the 2012 TER (NRC, 2012b). Those NRC concerns will be rolled into the monitoring factors in the revised monitoring plan that is being drafted by NRC. This observation addressed a subset of the concerns raised in the 2012 TER. During the observation, staff was encouraged by DOE's progress in developing a research plan that will provide useful information. However, the DOE and NRC continue to work in the monitoring process to resolve all outstanding issues that led to issuance of the NRC's April 30, 2012 Letter of Concern (Type IV).

4.0 PARTICIPANTS

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