June 5, 2008

Lawrence T. Ling, Director
Waste Disposition Programs Division
U.S. Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, SC 29802

SUBJECT: NUCLEAR REGULATORY COMMISSION ONSITE OBSERVATION REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE PRODUCTION AND DISPOSAL FACILITIES

Dear Mr. Ling:

The enclosed report describes the U.S. Nuclear Regulatory Commission's (NRC's) onsite observation activities on March 24-28, 2008, at the Savannah River Site (SRS), Saltstone Production Facility (SPF) and Saltstone Disposal Facility (SDF). The report also incorporates supplemental information received from the U.S. Department of Energy (DOE) on April 10, 2008. This onsite observation was conducted in accordance with the Ronald Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), which requires NRC to monitor disposal actions taken by DOE for the purpose of assessing compliance with the performance objectives set out in 10 CFR Part 61, Subpart C. The activities conducted during the site visit were consistent with those described in the NRC's monitoring plan for salt waste disposal at SRS (dated May 3, 2007) and NRC's staff guidance for activities related to waste determinations (NUREG-1854, dated August, 2007).

Similar to NRC's previous visit in October, 2007 (NRC 2008), this onsite observation at SRS was primarily focused on two performance objectives, 10 CFR 61.41, protection of the general population from releases of radioactivity, and 10 CFR 61.43, protection of individuals during operations, by observing DOE's saltstone wasteform production and disposal operations, and verifying DOE's radiation protection measures associated with those operations. Since saltstone wasteform production operations could impact the long-term stability of the disposal facility after its closure, this observation also partially assessed the performance objective in 10 CFR 61.44, stability of the disposal site after closure.

A number of open issues resulted from the previous NRC onsite observation visit (NRC, 2008). During this March observation visit, NRC staff paid considerable attention to following up on these issues. One previously opened issue was closed as a result of discussions with DOE and DOE contractor personnel during this onsite observation visit and a technical review of supplemental information received from DOE on April 10, 2008. Specifically, NRC staff was able to conclude that the impact of the differences in the observed conditions of the disposal vaults compared to the assumptions in the performance assessment supporting the waste determination has been assessed by DOE [(Romanowski 2007), (Rosenberger 2008)]. That analysis demonstrated that there is reasonable assurance that Vault 4 can meet the performance objectives in spite of the observed vault conditions, if the system is emptied of liquids prior to closure.

DOE presented plans for additional studies (some of which are ongoing) that, when completed, should provide the information needed to address the remaining open issues from the October 2007 report. However, no additional quantitative information was available during this second monitoring visit sufficient to close the remaining previously open issues, therefore, they remain open. In addition to following up on the open issues from the October 2007 report, NRC staff conducted monitoring activities related to waste sampling and radionuclide inventory, vault operation and characterization, and radiation protection. No new open issues were identified.

Based on our observations, NRC continues to conclude that there is reasonable assurance that the applicable criteria of the NDAA can be met if key assumptions made in DOE's waste determination analyses prove to be correct. In accordance with the requirements of the NDAA and consistent with NRC's monitoring plan for the salt waste disposal facility, NRC will continue to monitor DOE's disposal actions at SRS. The monitoring activities are expected to be an iterative process and several onsite observation visits, and technical reviews of various reports, studies, etc., may be necessary in order to obtain the information needed to close all of the current open issues, as well as issues that may be opened in the future.

On March 28, 2008, at the conclusion of the onsite observation activities, NRC staff members discussed the topics addressed in this report with you, other DOE representatives, and representatives from the State of South Carolina. If you have any questions or need additional information regarding this report, please contact Michael Fuller, at 301-415-0520, or David Brown at 301-415-6116.

Sincerely,

/RA/

Scott Flanders, Deputy Director
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

Enclosure:
NRC Observation Report

cc: w encl:
S. Sherritt
Federal Facilities Liaison
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SAVANNAH RIVER SITE SALTSTONE PRODUCTION AND DISPOSAL FACILITIES
U. S. NUCLEAR REGULATORY COMMISSION ONSITE OBSERVATION REPORT

EXECUTIVE SUMMARY

NRC staff conducted its second onsite observation visit of the Saltstone Production Facility (SPF) and Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) on March 24-28, 2008. In addition NRC staff reviewed supplemental information received from DOE on April 10, 2008. This visit was intended to focus on two of the four performance objectives—10 CFR 61.41, "*protection of the general population from releases of radioactivity"*, and 10 CFR 61.43, "*protection of individuals during operations"*—by obtaining information on DOE saltstone wasteform production and saltstone disposal facility operations and verifying DOE's radiation protection measures for relevant operations. Because the saltstone wasteform production operations could impact the long-term stability of the disposal facility after its closure, this observation also was intended to partially assess compliance with the performance objective in 10 CFR 61.44, *stability of the disposal site after closure*. This report provides a description of NRC onsite observation activities and identifies NRC observations from the visit. Based on the results of the visit, the NRC continues to have reasonable assurance that the performance objectives of 10 CFR 61 can be met in the areas reviewed.

A number of open issues resulted from the previous NRC onsite observation visit on October 29-30, 2007 (NRC 2008). NRC staff paid particular attention to the follow up of these issues during this onsite observation visit. DOE provided two analyses, and a change to an operational requirement, demonstrating that the observed differences between the disposal system and the assumptions in the performance assessment supporting the waste determination would not result in non-compliance with the performance objectives. Therefore, the open issue described in Section 2.2.3 of NRC's onsite observation report dated January 31, 2007, has been closed. No additional quantitative information was available during this second monitoring visit to address the remaining issues. Therefore, these issues remain open. However, DOE presented plans for additional studies (some of which are ongoing) that when executed should provide the information needed to address the open issues. DOE outlined eleven projects and model support activities, such as, a reducing capacity of saltstone study and a degradation mechanism study that will likely be completed in FY 2008 and be incorporated into a revision of the saltstone performance assessment (PA). Eight additional future activities were outlined that will probably not be completed by the time of the PA revision in early FY 2009. Examples of additional future studies that were outlined by DOE included: long-term testing of saltstone and vault degradation, and their hydraulic properties; long-term testing of saltstone and vault cracking, and transport through cracks; and the study of the drainage layer plugging.

NRC staff evaluated the (i) saltstone characterization and testing program; (ii) environmental monitoring program for groundwater, soil, and air effluents; (iii) modifications to the saltstone disposal facility vaults; (iv) waste sampling and characterization program; and (v) radiation protection program. Staff interviewed key SRS and contractor personnel and also reviewed pertinent records. NRC staff toured the SPF and observed the SDF (Vault 4). NRC staff observed activities and reviewed data to assess consistency of the data with the assumptions DOE made in its waste determination (DOE, 2006).

Status of Open Issues from the October 29-30, 2007 visit and other conclusions:

Saltstone Characterization

- Since the previous monitoring visit, DOE stated that they did not have additional information to support the physical characteristics of the saltstone wasteform assumed in the waste determination. However, DOE provided plans to develop information throughout the remainder of fiscal year 2008 and into 2009 that will address assumed saltstone wasteform characteristics. Final product characteristics remains an open issue that will be followed up through future monitoring activities because inadequate quality of saltstone could result in the saltstone disposal facility being noncompliant with the 10 CFR 61.41 performance objective.

- No additional information was available to quantify the impact on final product properties of potential bulk component intrabatch variability, flush water additions, and additives used to ensure processability. DOE presented a saltstone product quality assurance strategy that would quantify the impact of these factors on the processability of the materials and on the wasteform properties that are important to performance assessment. Inadequate quality of saltstone could result in the disposal of saltstone being noncompliant with the 10 CFR 61.41 performance objective. Therefore, this issue remains open and will be followed up by NRC through future monitoring activities.

Vault Operation and Characterization

- The observation determined that DOE has acted to mitigate the impact on facility performance of previously identified vault construction defects (e.g., cracking). Recent DOE actions appeared to be more effective than earlier efforts to mitigate the release of radiologically contaminated water from the disposal cells during operations. However, the modifications do not, nor are they intended to, repair the defects in the vaults. The observation determined that DOE appropriately characterizes and manages the contamination. The measured level of contamination on the outside of the vault does not pose an immediate health and safety concern to workers or the public. DOE has sampled the soil at several locations around Vault 4 where liquid has leaked in order to characterize the soil contamination. The sampling results were not available at the time of the NRC monitoring visit but will be evaluated through future monitoring activities.

- During the monitoring visit, DOE provided an Unreviewed Disposal Question Evaluation (UDQE) to determine the significance of the liquid seeping from the saltstone Vault 4 exterior walls (Romanowski 2007). NRC reviewed a revised UDQE (Rosenberger 2008) DOE provided after the monitoring visit and determined that, combined with a requirement to flush the vault drain water system prior to closure, DOE has adequately assessed the risk significance of the differences between the observed vault conditions and the conditions assumed in the final waste determination and PA. DOE's assessment concluded that the performance objectives could be met even if small quantities of waste were released to the environment in the near-term, due to radioactive decay and dilution during transport. NRC's review verified this assessment. Therefore, the open issue described in Section 2.2.3 of NRC's onsite observation report dated January 31, 2007, is closed.

Waste Sampling and Inventory

- The observation determined that DOE's procedures used to characterize the waste in Tank 50, the feed tank to the SPF, appeared to be adequate to determine the inventory of radionuclides that are sent to the SPF. Since the disposal of salt waste will be an ongoing activity for several years, NRC staff will continue to monitor the characterization of the waste and the radionuclide inventory for the foreseeable future.

- The observation determined that DOE has made modifications to the salt feed tank that should mitigate the potential solids buildup in this tank. Since the SPF was not operating during the onsite observation visit, NRC staff did not have an opportunity to observe the effects of this modification. Therefore, this remains an open issue that NRC will continue to follow up on through future monitoring activities.

Radiation Protection Program

- The observation determined that DOE continues to have an adequate program for protecting its personnel and the public from radiation exposures during operations at the SPF and SDF.

1.0 BACKGROUND

The National Defense Authorization Act for Fiscal Year 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. The NDAA also requires NRC to monitor DOE disposal actions to assess compliance with the performance objectives in 10 CFR Part 61, Subpart C.

On March 31, 2005, DOE submitted a “Draft Section 3116 Determination, Salt Waste Disposal Savannah River Site” 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 and concluded that there was reasonable assurance that the applicable criteria of the NDAA could be met, provided certain assumptions made in DOE's analyses are verified via monitoring. NRC documented the results of its review in a technical evaluation report (TER) issued in December 2005. DOE issued a final waste determination in January 2006 taking into consideration the assumptions, conclusions, and recommendations documented in NRC’s TER.

To carry out its monitoring responsibility under the NDAA, NRC plans to perform three types of activities: (i) technical reviews, (ii) onsite observations, and (iii) data reviews. These activities will focus on key assumptions—called “factors”—identified in the NRC monitoring plan for saltwaste disposal at SRS (NRC, 2007). Technical reviews generally will focus on obtaining additional model support for assumptions DOE made in its performance assessment (PA) that are considered important to DOE's compliance demonstration. Onsite observations generally will be performed to (i) 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, or (ii) observe key disposal (or closure) activities related to technical review areas (e.g., slag and other material storage, grout formulation and preparation, and grout placements). Data reviews will supplement technical reviews by focusing on real-time monitoring data that may also indicate future system performance or by reviewing records or reports that can be used to directly assess compliance with performance objectives.

The October 2007 and March 2008 NRC onsite observation visits at SRS focused primarily on two performance objectives, 10 CFR 61.41, *protection of the general population from releases of radioactivity*, and 10 CFR 61.43, *protection of individuals during operations*, by observing DOE operations at the SPF and SDF, and verifying DOE radiation protection measures at those facilities. Because the saltstone wasteform production operations could impact the long-term stability of the disposal facility after its closure, this observation also was intended to partially assess compliance with the performance objective in 10 CFR 61.44, *stability of the disposal site after closure*. Future visits will assess the performance objective in 10 CFR 61.42, *protection of individuals against inadvertent intrusion*, and also continue to assess DOE compliance with the other performance objectives.

2.0 NRC ONSITE OBSERVATION ACTIVITIES

2.1 Saltstone Characterization

2.1.1 Observation Scope

The observation of DOE saltstone processing and disposal operations is related to two factors identified in the NRC monitoring plan for the SRS SPF and SDF (NRC, 2007): Factor 1–"Oxidation of Saltstone" and Factor 2–"Hydraulic Isolation of Saltstone." The general objectives of NRC monitoring activities related to Factors 1 and 2 are to ensure that the saltstone that is produced is of sufficient quality such that there is reasonable assurance the performance objectives of 10 CFR Part 61 will be achieved. As discussed in the NRC TER for review of salt waste disposal at the SRS, the hydraulic and chemical properties of the wasteform are important for isolating the radioactivity contained in the waste from the environment (NRC, 2005). A specific objective of the monitoring visit was to ensure saltstone that has or will be produced is of sufficient quality. Staff also attempted to obtain information DOE has collected to further evaluate uncertainties (discussed in the NRC TER).

2.1.2 Observation Results

The SPF was not operating at the time of the NRC visit. However, NRC toured the SPF and had detailed discussions with DOE staff about facility operations, upgrades to the facility, and plans to better characterize the saltstone wasteform. DOE presented a saltstone product quality assurance strategy intended to ensure that adequate saltstone quality is achieved and that the process, underlying science, and PA are properly integrated. The strategy, when implemented, would conduct measurements of grout properties, including hydraulic properties, compressive strength, distribution coefficient (Kd), and reduction capacity (for saltstone) using laboratory prepared grout without radionuclides, laboratory prepared samples with radionuclides, and possibly in-process and emplaced grout. Five different grout mix types are planned: (i) saltstone from Deliquification, Dissolution, and Adjustment (DDA) waste, (ii) saltstone from Actinide Removal Process (ARP) and the Modular Caustic Side Solvent Extraction Unit (MCU) waste, (iii) saltstone from Salt Waste Processing Facility waste, (iv) Vault 1 concrete, and (v) Vault 4 concrete. Some of these tests have been initiated. NRC will evaluate information generated from these tests as it becomes available. The potential outputs of the strategy are revisions to the waste acceptance criteria, process parameters and controls, and inputs to the PA maintenance program. The strategy was beginning to be implemented at the time of the monitoring visit, with the availability of some products anticipated later in fiscal year 2008.

Modifications or upgrades to the facility and operations included, but were not limited to (i) replacement of the mechanical seal on the mixer, (ii) improvement in the hopper crossover flushing system to reduce the accumulation of material in the crossover piping (the crossover system is used to convey dry bulk materials to the SPF for blending with salt solution to form saltstone), (iii) installation of a new grout density meter, and (iv) installation of a new salt feed tank agitator motor. In the previous monitoring report, NRC discussed the potential for buildup of solids in the SPF feed tank. The DOE modification of the feed tank should mitigate this potential solids buildup (see Section 2.4.2 for additional discussion). Facility modifications also were designed to improve operational efficiencies with higher equipment reliability and better instrumentation.

As discussed in the previous NRC monitoring report, a number of process variables could potentially impact saltstone quality. DOE did not have any measurement or test results available for NRC to review, but presented plans to assess the quality of the saltstone wasteform. The DOE saltstone product quality assurance strategy is expected to address variability in dry feeds, variability in salt solution composition, flush water additions, and the impact of additives.

The method to sample as-emplaced saltstone has not yet been determined, and DOE stated it would have to consider a variety of issues, such as radiological protection of workers, when deciding how to implement such activity. NRC previously indicated that sampling and measurement of the characteristics of as-emplaced saltstone is the most direct way to quantify the quality of the wasteform. Laboratory scale measurements of saltstone may not adequately reproduce the thermal, mechanical, and chemical conditions of emplaced material due to the difference in scale between laboratory specimens and emplaced materials. The saltstone product quality assurance strategy should provide the information needed to resolve the open issues, with the exception of the issue of scale noted above. NRC will follow up on the DOE plans to sample as-emplaced saltstone or the DOE strategy to address scale issues as those become available.

DOE discussed specific experiments that are currently ongoing that may provide information to address the key monitoring areas in the NRC's monitoring plan for the saltstone facility, including batch type Kd experiments of radionuclides in contact with crushed cement and oxygenated groundwater, oxidation/reduction experiments with technetium and saltstone, and hydraulic conductivity measurements. In addition, a variety of activities are planned to address factors from the NRC TER although most are not scheduled to start until FY2009 or after (NRC, 2005). DOE salt disposition activities are expected to be ongoing until 2020. NRC will observe DOE experiments that are ongoing during future monitoring visits, as practical.

During the monitoring visit, NRC observed videographic information of saltstone pouring operations. Resolution of surface features is limited by condensation that develops within the cell during curing of saltstone. The saltstone surface appeared to be relatively level, with localized pools of water. The significance of the water on product quality is not expected to be significant, because the water flows to the sheet drain system as the saltstone pour proceeds (i.e., the pooling water is transient). At the center of the monolith where the pour enters the vault, a depression formed on the surface that was large enough to hold roughly a few hundred liters of water. DOE performed a video analysis to look for potential saltstone cracking of the top of cell G in Vault 4. Frequent cracking was not observed, however two major cracks were observed in the cell. The depth of those cracks cannot be determined from the video analysis. A shrinkage gap of about 0.5 cm was observed between the wall and the sheet drain. As noted in section 2.3.2 below, DOE completed an analysis to demonstrate that, in spite of the differences between the observed vault conditions and performance assessment assumptions, the system could meet the performance objectives.

2.1.3 Conclusions and Followup Actions

DOE presented a strategy to ensure the quality of the saltstone product. The implementation of that strategy is in the early stages; however when it is implemented it should provide information to verify the quality of the saltstone product or to define conditions and controls that will ensure future product quality. NRC will follow up on the DOE strategy to address scale issues as those become available. Previous DOE effort had been focused on process implementation and control. Verifying the quality of the saltstone wasteform is important to assessing whether the 10 CFR 61.41 performance objective will be satisfied. Final product characterization remains an open issue that will be evaluated during future monitoring activities as the product quality assurance strategy is implemented. NRC staff intends to return to SRS to observe future saltstone production, characterization, associated experiments, and disposal operations, and follow up on open issues.

2.2 Vault Operation and Characterization

2.2.1. Observation Scope

The observation of DOE saltstone disposal operations is related to Factor 1—"Oxidation of Saltstone" and Factor 2—"Hydraulic Isolation of Saltstone," which were identified in the NRC monitoring plan for the SRS SPF and SDF (NRC, 2007). The reinforced concrete vaults of the SDF were assumed in the DOE waste determination to provide secondary containment for the radioactivity contained in saltstone and to limit the exposure of the saltstone wasteform to aggressive environmental conditions. A specific objective of the monitoring visit was to observe the saltstone disposal vaults to ensure that the assumptions regarding vault performance in the waste determination were valid.

2.2.2 Observation Results

As discussed in the previous monitoring report, DOE observed a number of problems with the vault during the early operations of the SDF. Subsequent to the October 2007 monitoring visit, DOE completed a number of facility modifications to mitigate the occurrence and impact of liquid seeping from the vaults. NRC toured the SDF to observe the facility modifications, and discussed the modifications and operational changes with DOE staff.

As noted in the previous report, although mitigative actions were taken by DOE, the vaults continue to have contaminated seeps that appear on the exterior surface of the vaults as they are filled with saltstone. NRC staff did not observe active seeps during this visit as the facility was not in operation. A commercially available concrete sealant coating had been previously applied to the outside of the vaults to a height of approximately 1.8 m (5 ft). The purpose of the sealant coating was to mitigate the seepage of liquid to the exterior of the vault walls. The seeps occur at imperfections in the vault walls, primarily as a result of fluid buildup in the gap between the saltstone and vault wall. DOE changed operations to pump the built up liquid to the SPF at the end of an operation shift. Previously the liquid was not pumped back to the SPF until the next morning. This operational change has lessened, but not eliminated, the occurrence of seeps. The bottom joint where the vault wall meets the vault floor has been a primary location of seeps. The sealant coating applied in this area has been ineffective at eliminating seeps, in part because the aperture of the joint changes significantly with temperature. DOE has applied a new sealant coating material to the bottom 1 m [3 ft] of the vault wall to mitigate seeps in that area. The new sealant coating provides an approximately 8 cm (3 in) layer over the joint area. This new sealant coating will likely reduce seepage of liquid to the environment, but will be unlikely to prevent seepage of liquid at the joint/sealant coating interface. In addition to applying the sealant coatings, DOE has installed a rain shield, certified huts, and a drip pan on the exterior walls of the vault cells that will be filled during current or future operations. These modifications should be effective at significantly reducing or eliminating contamination from the vault from reaching the environment in the short term.

DOE stated that the seeps dry relatively quickly as the vaults are filled and the saltstone sets. The drying of the seeps appears to be due to removal of the excess water (the driving force) from inside the vaults, and not due to sealing of the fractures in the walls. A large quantity of water in Cell E was pumped to Cell F, which reactivated the seep sites that had previously dried. Similar occurrences were observed at a different set of cells. DOE stated that rainwater enters Cell A relatively frequently and must be drained. This water is sampled, characterized, and released to the environment if the contaminant concentration is below release limits, which has always been the case, to date. Therefore, the future performance assessment for Vault 4 should include advective pathways through the vault wall as part of the base case analysis (see Section 2.3).

The area adjacent to the vaults is maintained as a radiologically controlled area. Contamination samples are taken of the seeps to characterize the amount of removable radioactive contamination. The area is roped off with appropriate signs and markers. Since the last monitoring visit, DOE sampled soil adjacent to known leak sites in order to quantify the amount and extent of contamination (See Section 2.5).

DOE has an inspection program for Z-Area Vault 4 (Plummer, 2008). The inspection procedure provides the responsibilities, requirements and methods, frequency and extent, and records of the inspections. The inspections will use digital photography to record wet spots and monitor potential changes over time. Daily visual inspections will be performed of the Vault 4 exterior. NRC will evaluate results of the inspection program during future monitoring activities.

The previous observation report (NRC, 2008 Section 2.2) discussed the observed vault conditions and the differences between these conditions and the performance assessment assumptions. This issue is discussed further in Section 2.3 of this report.

2.2.3 Conclusions and Followup Actions

The NRC staff determined that the vaults provide adequate containment from a waste processing standpoint. That is, the vaults isolate the vast majority of the radioactivity in saltstone from the environment while the saltstone sets. However, quality problems previously identified by DOE have been a challenge to mitigate. It is likely that recent modifications (since the October monitoring visit) will significantly reduce releases during operations. However, the modifications do not, nor are they intended to, repair the defects in the vaults. The vault defects should be included in future performance assessments of Vault 4.

2.3 Performance Assessment

2.3.1 Observation Scope

The observation of DOE performance assessment modifications and revisions is related to all factors identified in the NRC monitoring plan for the SPF and SDF (NRC, 2007). The general objective of NRC monitoring activities related to the DOE performance assessment is to assess whether there is reasonable assurance that the performance objectives of 10 CFR Part 61, Subpart C, will be achieved. A specific objective of the monitoring visit was to evaluate the consistency of observations of the current disposal facility and wasteform with the performance assessment assumptions. NRC staff also attempted to obtain information on future disposal facility designs and how those designs may be evaluated in a revision to the performance assessment.

2.3.2 Observation Results

As discussed in the previous monitoring report, the condition of Vault 4 is not consistent with the assumptions in the base case analysis supporting the waste determination (DOE, 2006). These differences include the (i) active advective hydraulic pathways in the vault walls, (ii) presence of waste inventory in the vault walls, and (iii) remaining liquid waste inventory in the drain water system of the vault cells. As discussed below, DOE, using its UDQE process, completed an analysis to demonstrate that, in spite of the differences between the observed vault conditions and performance assessment assumptions, the system could meet the performance objectives. The analysis stated that the drain water collection system would be flushed to remove liquid waste, and that the system will not contain liquid at the time of closure.

The waste determination and supporting performance objective demonstration document assumed the saturated hydraulic conductivity of the vault would be less than or equal to 1×10^{-12} cm/s [4×10^{-13} in/s] (which is representative of a very high quality concrete) for 100 years after facility closure. The saturated hydraulic conductivity of the saltstone was assumed to be 1×10^{-11} cm/s [4×10^{-12} in/s] over this time period. The performance assessment increased the hydraulic conductivity in a stepwise manner over the 10,000 year performance period. The observed seeps suggest that the vault is of insufficient quality to achieve a 1×10^{-12} cm/s [4×10^{-13} in/s] hydraulic conductivity. NRC previously documented the importance and relevance of the physical properties of the vault and saltstone in its TER (NRC, 2005). DOE performed sensitivity analysis to evaluate the impact of higher hydraulic conductivities of the vault and saltstone in response to NRC requests for additional information during the NRC review of the waste determination (NRC, 2005). Sensitivity cases evaluated in-filled saturated cracks scenarios. The analyses resulted in increases of the dose from 0.05 mrem/yr (base case) to 1.1 to 3.5 mrem/yr (sensitivity cases). The results are well within the 25 mrem/yr performance objective, but indicated the need to revise the performance assessment based on the observed facility condition. DOE plans to update the performance assessment supporting the saltstone waste determination, including the actual vault conditions in fiscal year 2009.

At the time of the October monitoring visit, DOE had not performed an analysis to evaluate the effect of differences between the vault conditions and those assumed in the performance assessment. Subsequent to the October 2007 visit, DOE conducted an assessment called an Unreviewed Disposal Question Evaluation (UDQE) “Evaluation of Liquid Weeping from Saltstone Vault 4 Exterior Walls,” which NRC reviewed during this onsite observation visit. DOE submitted a revised UDQE assessment to NRC after the March monitoring visit (Rosenberger, 2008). The assessment evaluated the impact of waste inventory located in the vault walls using the NCRP-123 screening methodology for groundwater and a water ingestion screening limit of 2.5 mrem/yr. DOE stated that the analysis used conservative assumptions, such as assuming the total inventory was instantaneously mixed in the aquifer and the inventory of material available for release would not be limited by transport through the vault walls. The volume of waste was assumed to be 1,000 L, which is likely conservative based on known fracture frequency and size. The infiltration rate was assumed to be 41.78 cm/yr [16.4 in/yr], also likely to be conservative considering that the facility will have an engineered cap over the vaults at closure. The initial screening identified three radionuclides (Cs-137, 16.9 mrem/yr; Sr-90, 0.66 mrem/yr; and Pu-238, 0.11 mrem/yr) for additional analysis. When radioactive decay during transport was included, the potential dose from those three radionuclides was reduced to less than 0.02 mrem/yr. The transport calculation used distribution coefficients (Kds) of 50, 5, and 270 mL/g for Cs-137, Sr-90, and Pu-238, respectively. Future analyses of this type should consider whether the ambient soil Kds could change by interacting with liquid waste or cement-modified pore water.

DOE is envisioning a new vault design based on commercial water storage tank technology. NRC discussed the new design with DOE and the State of South Carolina. The new design will use prefabricated concrete slabs that will be assembled onsite and joined together using cast-in-place concrete. A high-density polyethylene (HDPE) liner will be used to provide an additional barrier to water flow and all the vaults eventually will be located below grade.

2.3.3 Conclusions and Followup Actions

The impact of the differences in the observed conditions of the disposal vault compared to the assumptions in the performance assessment supporting the waste determination has been assessed by DOE [(Romanowski 2007), (Rosenberger 2008)]. That analysis demonstrated that Vault 4 can meet the performance objectives in spite of the observed vault conditions, if the system is emptied of liquids prior to closure. DOE stated the Saltstone Disposal Facility Closure Plan would be revised to include this requirement. Therefore, this open issue has been resolved and is closed.

NRC will continue to follow up on DOE’s Saltstone Disposal Facility Closure Plan to verify that it includes the requirement to empty the liquids prior to the closure of Vault 4. In addition, NRC will review the updated PA to confirm actual vault conditions have been properly incorporated and will review the new vault design information as it becomes available and evaluate its potential impact on long-term SDF performance.

2.4 Waste Sampling and Inventory

2.4.1 Observation Scope

NRC staff conducted monitoring activities in the areas of waste sampling and tracking of the radionuclide inventory transferred to the SDF during this onsite observation visit to evaluate the methodology used to quantify the inventory of radionuclides that is transferred to the SDF. This review was performed as part of the evaluation of Factor 6, Feed Tank Sampling, identified in the NRC monitoring plan (NRC, 2007). Adequate sampling of the waste transferred to the SDF is important because the total inventory of radionuclides disposed of in the SDF affects whether the performance objectives of 10 CFR 61.41 can be met. The methodology used for waste sampling and tracking of the radionuclide inventory transferred to the SPF/SDF was previously reviewed during the October 2007 onsite observation visit. NRC staff reviewed this methodology in greater detail during the March 2008 onsite observation. In addition, during this onsite observation, NRC staff members reviewed: waste sampling data, the Waste Acceptance Criteria (WAC) and Waste Compliance Plans (WCPs) for the SDF and the tank farm, information about the expected radionuclide inventory and chemical properties of waste that will be disposed of at the SDF as a result of the new process to remove aluminum from tank sludge, and information related to the operational experience for the transfer of waste containing solids to the SDF. This was achieved by interviewing site personnel and reviewing relevant documents. NRC staff also toured the labs at Savannah River National Lab (SRNL) where the samples from the tank farm are analyzed and met with SRNL personnel to discuss their analytical methods and quality assurance (QA) procedures.

2.4.2 Observation Results

NRC staff reviewed documents related to the WACs and WCPs for saltstone and the tank farm. Tank 50 is the point of compliance for waste that is being transferred to the SPF and any waste transferred from this tank must meet the saltstone WAC (Culbertson, 2007). The saltstone WAC ensures that waste entering the SPF is within the documented safety analysis, PA, and operating permitted values. Transfers to Tank 50 from outside the tank farm, such as transfers from the Effluent Treatment Process (ETP), must also be done in accordance with the Waste Acceptance Criteria for Liquid Waste Transfers to the 241-F/H Tank Farms (Rogerson, 2007). Additionally, transfers to the SDF and to the tank farm must be done in accordance with other WCPs such as the Tank 50 Waste Compliance Plan for Transfers to Saltstone (Harrison, 2008a) and the Waste Compliance Program for Liquid Waste Transfers from H-Canyon to 241-H Tank Farm (Price, 2007). The purpose of the WCPs is to ensure that the waste streams generated and transferred comply with the applicable WACs. NRC staff reviewed documents demonstrating that the waste transferred to the SDF as part of the DDA batches met the saltstone WACs (Zeigler et al., 2007, Fowler, 2008). NRC staff also reviewed documents showing that the waste transferred into Tank 50 met the saltstone WACs prior to this transfer (Martino, 2005, Oji, 2005). These documents were prepared in support of the requirement on the Evaluated Transfer Approval Form (ETAF) that waste should be evaluated against the saltstone WAC prior to transfer into Tank 50. NRC staff found that the methodology used by DOE to estimate the inventory of the waste sent to the SDF during the DDA batches was adequate to ensure that the waste satisfied the saltstone WACs.

Based upon discussions with DOE and DOE contractor personnel and review of pertinent documentation, NRC staff determined that the Interim Salt Disposition Project (ISDP) process will begin as the DDA process is finishing. The ISDP process includes the ARP and the MCU. The ARP involves the addition of Monosodium Titanate (MST) to the salt solution followed by filtration of the salt solution. This process removes strontium and actinides from the salt solution. The clarified salt solution effluent from the ARP treatment is then transferred to the MCU. The MCU process involves a solvent extraction to remove cesium from the salt solution. The waste streams from the ARP/MCU process that will be sent to Tank 50 include the decontaminated salt solution from the solvent extraction process as well as the solids wash water from the ARP.

The ISDP sample plan (Duffey, 2008) describes the sampling strategy for this process during the initial non-radiological operations and also as the facility transitions to operations involving salt waste. Initially, samples will be taken frequently in order to develop a process history. Once enough information has been obtained to statistically model the process, samples will be taken less frequently. In addition, salt waste must be qualified prior to being transferred from Tank 49 to ARP/MCU. The qualification of ISDP Batch 1 is described in the Evaluation of ISDP Batch 1 Qualification Compliance to 512-S, DWPF, Tank Farm, and Saltstone Waste Acceptance Criteria (Campbell, 2008). The purpose of this qualification was to determine the acceptability of this batch, and to demonstrate compliance with the Tank Farm, Saltstone, and Defense Waste Processing Facility (DWPF) WACs. Variable depth samples were taken from Tank 49 in support of this evaluation, and chemical and radionuclide characterization was performed on these samples. In addition, laboratory tests were also performed on these samples to assess the decontamination factors that could be achieved for this waste with the ARP/MCU processes. NRC staff reviewed the qualification report (Campbell, 2008) and determined that the qualification process used for Batch 1 was adequate to meet its purpose.

NRC staff will review the sample data and the removal efficiencies observed in the lab scale experiments as well as in the actual treatment processes once this information becomes available. This information is necessary to evaluate Factor 8, Removal Efficiencies, identified in the NRC monitoring plan (NRC, 2007). In addition, variability in the removal efficiencies observed also affects the extent to which it is appropriate to rely on process knowledge for calculating the inventory that is transferred to Tank 50 and is ultimately disposed of at SDF. NRC staff will also review sampling plans developed for this treatment process and plans for how compliance of the waste streams from the ARP/MCU processes with the tank farm and saltstone WACs will be demonstrated. NRC staff will also review the methodology used to evaluate the radionuclide inventory sent to Tank 50 from ARP/MCU.

As described in the previous onsite observation report, a materials balance is maintained for Tank 50 to track the inventory of radionuclides located in the tank and to track the inventory that is sent to the SDF. Though the methodology used for the materials balance and for tracking the inventory that is sent to the SDF was reviewed during the previous monitoring trip, it was reviewed in more detail during the current onsite observation. As part of this review, NRC staff examined the Saltstone Run Worksheet, a spreadsheet that shows the transfers made from Tank 50 and the grout produced from this waste, and reviewed the materials balance spreadsheet calculated at the end of February 2008 (Harrison, 2008b). NRC staff and site personnel also discussed the method used to update these calculations. The materials balance spreadsheet is updated monthly, and the radionuclide inventory in the waste that was sent to the SDF is removed from the materials balance spreadsheet and the inventories in material that was transferred into the tank are added. In addition, the materials balance spreadsheet is re-baselined to measured concentrations when new sample results are obtained. The concentration calculated in Tank 50 at the end of previous month is used to calculate the inventory that is sent to the SDF. However, site personnel stated that if a major transfer into Tank 50 were to occur during the month, the spreadsheet would be updated to reflect the new concentration for any transfers to saltstone during that same month. Site personnel stated that it would be unlikely for there to be both major transfers into Tank 50 and transfers out to SDF during the same month because of the time that it takes to complete all of these transfers. NRC staff found that this approach to maintaining a materials balance for Tank 50 and tracking the inventory sent to the SDF is appropriate, though NRC staff believe that it is important for the materials balance update spreadsheet to be updated to account for the new waste if a major transfer happens during the month.

NRC staff also reviewed relevant portions of the “CST Sample Manual,” including the sections related to obtaining a 3 L sample, the sample data sheet, and instructions for receiving, closing and shipping the shielded sample cask. In addition, NRC staff visited the H-Tank Farm in order to see an example of a riser that is used for sample collection. The riser that NRC staff observed was located on Tank 51. This tank is identical to Tank 50, but the riser for it can be seen from outside of the Radiological Buffer Area, while the riser for Tank 50 cannot. While at the H-Tank Farm, site personnel described in detail the procedures used for collecting samples. NRC staff found that the procedure used to collect samples from the tanks was appropriate.

In the previous observation report, NRC staff noted that DOE planned to slurry Tank 50 during transfers of waste to the feed tank at the SDF, and that any settled particles in Tank 50 would be transferred to the salt feed tank. Because this feed tank could not be slurried while waste was being pumped from it, NRC staff expressed concern that solids could build up in this tank and recommended that DOE either confirm that the build up of solids would be readily identified during processing or take actions to mitigate such build up. As stated in Section 2.1.2 of this report, DOE has modified the salt feed tank, by adding a new agitator motor that should mitigate the potential solids buildup in this tank. NRC staff did not have an opportunity to observe the effects of this modification during this onsite monitoring visit. Therefore, staff will continue to follow up on this modification through future monitoring activities.

NRC and site personnel also discussed the potential impacts of waste generated from the new aluminum dissolution process on the total inventory disposed at SDF and whether the chemical properties of this waste would have any effect on the wasteform generated with this waste. The aluminum dissolution process was developed because some of the sludge has a high aluminum content, which affects the vitrification of this waste in DWPF. To reduce this problem, a method was devised to remove the aluminum from the sludge. This method involves adding caustic chemicals to raise the hydroxide concentration to approximately 3 molar and raising the temperature to 50-60°C for a period of 2 to 4 weeks. The supernate from this process is then decanted to another tank for storage. This waste will eventually be sent through the Salt Waste

Processing Facility (SWPF) and will be disposed of in the SDF. Staff at SRS stated that the waste generated as a result of this waste stream is chemically similar to the supernates present in other tanks. Site personnel also stated that the inventory of aluminum disposed of at SDF will be increased as a result of this waste. In addition, there will be an incremental increase in the inventory of radionuclides, such as actinides. It is expected that the treatment processes at SWPF will remove a significant fraction of these radionuclides from the waste prior to the disposal of it at SDF, though the SWPF processes do not effectively remove technetium. Site personnel stated that the additional amount of technetium expected to be transferred to the SDF from this waste stream is small compared to total inventory that will be disposed at the SDF. NRC staff will evaluate additional inventory sent to SDF as a result of the new aluminum dissolution process as part of the monitoring of the total inventory disposed of at SDF.

During the onsite observation, NRC staff visited SRNL and met with the staff that performs the analyses on the samples taken from the tank farm to measure the concentration of radionuclides as well as other chemical constituents. While at SRNL, NRC staff toured the labs and discussed the analytical methods used to quantify the radionuclides and chemical constituents, the sample handling procedures, and QA procedures with lab personnel. NRC staff also reviewed the Analytical Development Section Procedure Manual, the Task Technical and QA Plan, the Analytical Study Plan, lab notebooks related to the analyses of samples from Tank 50, and the sample results from third and fourth quarter sampling in 2007. NRC staff determined that the analytical procedures used and the sample handling and QA protocols were appropriate and adequate.

2.4.3 Conclusions and Followup Actions

NRC staff determined that the methodology used to track the inventory of radionuclides sent to the SDF and to demonstrate compliance with the saltstone WACs appears to be adequate. NRC staff has also determined that the procedures used for obtaining samples, and the analytical procedures used for quantifying the constituents in the samples are appropriate. NRC staff determined that it is unlikely that the waste stream from the aluminum dissolution process will have a significant effect on the inventory in the SDF or the performance of the wasteform made with this waste stream. In addition, NRC staff has found that DOE has taken steps to mitigate the potential build up of particles in the salt feed tank discussed in the previous monitoring report (NRC, 2008). NRC staff will evaluate the aluminum dissolution process and DOE's actions to mitigate the potential build up of particles in the salt feed tank through future monitoring activities.

2.5 Radiation Protection Program

2.5.1 Groundwater, Air Effluent and Worker Dose Monitoring

2.5.1.1 Observation Scope

NRC staff interviewed DOE and DOE contractor environmental monitoring personnel and reviewed records of the environmental monitoring (EM) program pertaining to SDF Vault 4 (designated "451-Z" in EM records) and the SPF stack (designated "210-Z building" in EM records). The staff focused specifically on: i) the 2007 groundwater monitoring program results for eight groundwater monitoring wells installed in or near the salt waste disposal area; ii) 2007 air effluent monitoring program for the SPF stack and Vault 4; and iii) the soil sampling results in the vicinity of Vault 4. Staff toured the SPF and the vicinity of Vault 4 to develop an understanding of the facility layout. In addition, staff observed a groundwater sampling event from the up-gradient background monitoring well (designated "ZBG-1" in EM records). The staff's reviews were guided by the NRC monitoring plan (NRC, 2007).

2.5.1.2 Observation Results

With regard to groundwater monitoring, NRC staff and DOE contractor personnel discussed the location of up-and down-gradient monitoring wells, sample collection procedures, frequencies of sample collection, sample analysis, and recent sample results. NRC staff reviewed the following documents: (1) Revision 4 of the Groundwater Monitoring Plan for the Z-Area Saltstone Disposal Facility (WSRC, 2006); and (2) Z-Area Groundwater Monitoring Report for 2007 (WSRC, 2008a). NRC staff also observed that groundwater sampling by DOE contractor personnel was performed in accordance with appropriate sample collection procedures.

NRC staff noted that the groundwater monitoring report (WSRC, 2008a) indicates the existence of a groundwater divide and larger groundwater velocity between the up-gradient background monitoring well (ZBG-1) and Vault 4. This interpretation is reportedly the result of the steeper hydraulic gradient observed after the installation of new monitoring wells near Vault 1. NRC staff and DOE contractor personnel discussed how this information is being assessed for impacts in the performance assessment supporting the waste determination. DOE contractor staff indicated that the reporting of this groundwater divide is currently expected to have neither a significant impact on groundwater modeling supporting the waste determination nor negate the use of monitoring well ZBG-1 as an indicator of background groundwater quality for Vault 4. DOE plans to update the performance assessment supporting the saltstone waste determination in fiscal year 2009. NRC staff will evaluate the significance of any impacts of the groundwater divide and hydraulic gradient in the performance assessment update.

NRC staff also noted elevated observations in WSRC (2008a) of tritium in monitoring wells installed immediately down-gradient of Vault 1, which is located up-gradient of Vault 4. The release of tritium from Vault 1 could potentially be an indicator of the performance of Vault 4. DOE contractor staff indicated that the source of this tritium is inconclusive at this time. Of particular interest to NRC staff was the result for nitrate analysis which is a major soluble component of the grouted wastes. The observed nitrate concentration in these wells was similar to measurements from the up-gradient well, ZBG-1. NRC staff will continue to monitor groundwater monitoring data through future monitoring activities.

With regard to air effluent monitoring, NRC staff and DOE contractor personnel discussed airborne radioactivity levels measured during Vault 4 operations involving 0.2 curie (Ci) per gallon (nominal) waste at Cell D in February 2008 and resulting radiological controls. NRC staff reviewed the following documents: (1) Guidance for Determining the Need for Continuous Air Monitors (WSRC, 2004) and (2) Air Sampling Plan for Saltstone Vault 4 During 0.2 Low Curie Salt Processing (WSRC, 2008b). Based on discussions with key DOE personnel, NRC staff determined that DOE had anticipated increases in the activity of the effluent released through the passive vent stacks (exhausts) atop Vault 4 when the higher activity waste stream processing was initiated in February 2008. DOE constructed temporary "huts" around the passive vent stacks in order to sample the air released during filling operations. Sample results were higher than anticipated, but within applicable regulatory limits (see discussion below).

The results from air samples collected during the initial filling of the 0.2 Ci/gal salt waste ranged from 20 to 33 derived air concentration (DAC)-hours (alpha) and from 16 to 19 DAC-hrs (beta/gamma) inside the huts. Airborne concentrations outside the huts ranged from 7 to 10 DAC-hrs (alpha) and from 0.4 to 0.6 DAC-hrs (beta/gamma). As a result of these measurements, DOE officials suspended saltstone filling operations and installed passive filters on the Vault 4 vent stacks. After the filters were installed, saltstone filling operations resumed. The resulting airborne concentrations for alpha emitters were non-detectable, and ranged from approximately 0.1 to 0.8 DAC-hrs for beta/gamma emitters, inside the huts. Airborne concentrations, after filtration, were non-detectable for both alpha and beta/gamma emitters outside the huts. According to DOE regulations (10 CFR 835.403), monitoring for airborne radioactivity is required when an individual is likely to receive an exposure of 40 or more DAC - hrs in a year.

For comparison purposes, NRC regulations limit occupational dose to 5,000 mrem, total effective dose equivalent (TEDE). TEDE is comprised of both external exposure (deep dose) and internal exposure to ionizing radiation. Committed effective dose equivalent (CEDE) refers to the dose from ionizing radiation that is deposited internally in the body. A dose of 5000 millirem (mrem), CEDE is equal to 2000 DAC-hrs of exposure to airborne radioactive material. Assuming that a particular worker replaced air filters inside a hut, or carried out some other operation there, every day for a year (200 days), the resulting exposure could potentially be as much as 200 DAC-hrs per year resulting in a dose of 500 mrem CEDE. This scenario does not provide for any respiratory protection factor. Based upon discussions with DOE and DOE contractor personnel, NRC staff determined that respiratory protection devices were used during the actual operations atop Vault 4.

With regard to soil sampling, NRC staff and DOE contractor personnel discussed the recent soil samples taken in the vicinity of Vault 4 below the observed wet spots. Results of this sampling program were not available at the time of the onsite observation visit to adequately characterize the extent of any soil contamination there. NRC staff plans to follow up on the results of this sampling through future monitoring activities.

In addition, NRC staff and DOE contractor personnel discussed actions taken to characterize and remediate the observed Cs-137 contamination in soils from the drainage ditch adjacent to Vault 4, Cell G, which was noted in the previous observation report (NRC, 2008). DOE contractor personnel performed radiological surveys and remedial activities along the drainage ditch adjacent to Vault 4 that discharges to a nearby onsite sedimentation basin. Review of the radiological survey results suggests that the soil removal actions taken by DOE contractor personnel remediated the contamination in the drainage ditch.

2.5.1.3 Conclusions and Followup Actions

Similar to the previous NRC onsite observation visit on October 29-30, 2007 (NRC 2008), NRC staff reviewed sampling results for both the groundwater and air effluent monitoring programs at the SPF. NRC staff found that there is no conclusive indication of groundwater contamination in the vicinity of Vault 4 resulting from salt waste disposal operations; however, NRC staff will continue to monitor groundwater data. NRC staff also found that the air effluent sampling results for Vault 4 during filling operations indicate that doses to nearby workers and members of the public from air effluents were well below DOE regulatory limits. NRC staff also learned that personnel from the State of South Carolina Department of Health and Environmental Control (SCDHEC) periodically collect sediment samples from a nearby sedimentation basin. NRC staff plans to include this independent data collected by SCDHEC as part of the ongoing monitoring activities at the SDF. NRC will continue to assess DOE's radiation protection program through future monitoring activities.

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4.0 REFERENCES

Campbell, S.E., "Evaluation of ISDP Batch 1 Qualification Compliance to 512-S, DWPF, Tank Farm, and Saltstone Waste Acceptance Criteria." X-ESR-H-00120, Revision 0, 2008.

Culbertson, B.H., "Waste Acceptance Criteria for Aqueous Waste Sent to the Z-Area Saltstone Production Facility." X-SD-Z-00001, Revision 2, February 2007.

DOE. DOE–WD–2005–001, "Basis for Section 3116 Determination Salt Waste Disposal at the Savannah River Site." Washington, DC: DOE, 2006.

Duffey, C., "Interim Salt Disposition Project (ISDP) Sample Plan." U-ESR-H-00068, Revision 2, 2008.

Fowler, R.C., "Evaluation of DDA Batch 3 Material in Tank 50 for Transfer to Saltstone." X-ESR-H-00123, Revision 0, 2008.

Harrison, E.W., "Tank 50 Waste Compliance Plan for Transfers to Saltstone." X-WCP-H-00014, Revision 7, 2008a.

Harrison, E.W., "Update to Tank 50 Material Balance Thru February '08." LWO-LWE-2008-00059, Revision 0, March 2008b.

Martino, C.J., "Analysis of Tank 49H Samples for Saltstone Waste Acceptance Criteria Constituents." WSRC-TR-2005-00336, Revision 0, 2005.

NRC. "U.S. Nuclear Regulatory Commission Technical Evaluation Report for the U.S. Department of Energy Savannah River Site Draft Section 3116 Waste Determination for Salt Waste Disposal." Washington, DC: NRC, 2005.

NRC. "U.S. Nuclear Regulatory Commission Plan for Monitoring the U.S. Department of Energy Salt Waste Disposal at the Savannah River Site in Accordance with the National Defense Authorization Act for Fiscal Year 2005." Washington, DC: NRC, 2007.

NRC. "U.S. Nuclear Regulatory Commission Onsite Observation Report for the Savannah River Site Saltstone Production and Disposal Facilities." Washington, DC: NRC. 2008.

Oji, L.N., and M.S. Blume, "Characterization of Tank 23H Supernate per Saltstone Waste Acceptance Criteria Analysis Requirements - 2005." WSRC-TR-2005-00192, Revision 1, 2005.

Plummer, A. S., "Inspection Program Plan for Z-Area Vault 4", LWO-LWE-2008-00023, Westinghouse Savannah River Company, Aiken, South Carolina, 2008a.

Price, M.R., "Waste Compliance Program for Liquid Waste Transfers from H-Canyon to 241-H Tank Farm." X-WCP-H-00008, Revision 8, 2007.

Rogerson, P.B., "Waste Acceptance Criteria for Liquid Waste Transfers to the 241-F/H Tank Farms." X-SD-G-00001, Revision 23, 2007.

Romanowski, L. "Unreviewed Disposal Question Evaluation: Evaluation of Liquid Weeping from Saltstone Vault 4 Exterior Walls", SRS-REG-2007-00041, Revision 0, Westinghouse Savannah River Company, Aiken, South Carolina, 2007.

Rosenberger, K. H., "Unreviewed Disposal Question Evaluation: Evaluation of Liquid Weeping from Saltstone Vault 4 Exterior Walls", SRS-REG-2007-00041, Revision 1, Westinghouse Savannah River Company, Aiken, South Carolina, 2008.

Westinghouse Savannah River Company (WSRC), 2004. "Guidance for Determining the Need for Continuous Air Monitors." Revision 0. ESH-RPS-2004-00022. March 2, 2004.

Westinghouse Savannah River Company (WSRC), 2006. "Groundwater Monitoring Plan for the Z-Area Saltstone Disposal Facility." Revision 4. WSRC-TR-2005-00257. September, 2006.

Westinghouse Savannah River Company (WSRC), 2008a. "Z-Area Groundwater Monitoring Report for 2007." WSRC-TR-2008-00001. January 9, 2008.

Westinghouse Savannah River Company (WSRC), 2008b. "Air Sampling Plan for Saltstone Vault 4 During 0.2 Low Curie Salt Processing." Revision 4. LWO-SSF-2008-00002. February 26, 2008.

Zeigler, K.E., Bibler, N.E., and D.P. DiPrete, "Characterization of Tank 50 Slurry for Saltstone Waste Acceptance Criteria April 2007 Samples." WSRC-STI-2007-00554, Revision 0, 2007.