May 22, 2009

Mr. Thomas Gutmann, 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 MARCH 25-26, 2009 ONSITE OBSERVATION REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE FACILITY

Dear Mr. Gutmann:

The enclosed report describes the U.S. Nuclear Regulatory Commission's (NRC's) onsite observation activities on March 25-26, 2009, at the Savannah River Site (SRS) Saltstone Facility. This onsite observation was conducted in accordance with Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (Section 3116), 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 visits, this onsite observation at SRS was primarily focused on assessing compliance with 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 ongoing construction of disposal cells at the Saltstone Disposal Facility (SDF), requesting additional information about the methods used by DOE to estimate the inventory of radionuclides in the SDF, and discussing staff questions and comments on 10 of 14 technical reports provided to NRC since November 2008. Since the quality of saltstone grout is relevant to 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.

One new open issue was identified by NRC staff, in which staff determined that DOE should provide additional support for assumptions that: (1) technetium-99 in salt waste is converted to its reduced chemical form in saltstone grout during the curing of saltstone grout, and is thereby strongly retained in saltstone grout, and (2) the sorption of dissolved technetium-99 onto saltstone grout and vault concrete is consistent with Kd values for technetium-99 that were assumed in the performance assessment. NRC and DOE staff also identified 21 DOE follow-up actions, which are mostly in response to NRC staff questions on 10 of 14 technical reports, which DOE provided to NRC staff since November 2008. NRC staff will continue its reviews of these reports, pending DOE responses to the follow-up actions identified in the attached report.

Based on our observations, NRC continues to conclude that there is reasonable assurance that the applicable criteria of Section 3116 can be met if key assumptions made in DOE's waste determination analyses prove to be correct. In accordance with the requirements of Section 3116 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. Several onsite observation visits and technical reviews 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 26, 2009, 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 David Brown of my staff at (301) 415-6116.

Sincerely,

/RA/

Patrice Bubar, 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. Wilson
Federal Facilities Liaison
Environmental Quality Control Administration
South Carolina Department of Health
and Environmental Control
2600 Bull Street
Columbia, SC 29201-1708

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NUCLEAR REGULATORY COMMISSION MARCH 25-26, 2009 ONSITE OBSERVATION REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE FACILITY

EXECUTIVE SUMMARY

The Nuclear Regulatory Commission staff conducted its fourth onsite observation visit of the Saltstone Facility at the Savannah River Site (SRS) on March 25-26, 2009. 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 The U.S. Department of Energy (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.

There is one new open issue as a result of the staff's ongoing technical reviews of 14 technical reports provided to NRC staff since November 2008, which was discussed with observation participants on March 26. In Open Issue 2009-1, staff has determined that DOE should provide additional support for assumptions that: (1) technetium-99 in salt waste is converted to its reduced chemical form in saltstone grout during the curing of saltstone grout, and is thereby strongly retained in saltstone grout, and (2) the sorption of dissolved technetium-99 onto saltstone grout and vault concrete is consistent with Kd values for technetium-99 that were assumed in the performance assessment. A summary of the staff's other observations and conclusions is provided below:

Disposal Cell Construction

- The staff observed ongoing construction at Saltstone Disposal Facility Cells 2A and 2B. At the time of the staff's visit, the base mud mat, geosynthetic clay liner and 100-mil high-density polyethylene liner, Type V mud mat and floor had been installed for Cells 2A and 2B, and the floor was curing. Rebar pedestals had been cast in place for the 48 columns that will support the roof in each cell. Forms were installed at several locations on the ground outside the cells for casting 32 15-ton wall panels for each cell, but no wall panels had been cast. DOE has two follow-up actions from this activity relating to NRC staff requests for (i) photographs of construction joints that will be covered by successive layers of construction material before NRC staff can return to directly observe the joints, and (ii) construction design drawings.

Saltstone Radionuclide Inventory

- The staff discussed with DOE and DOE contractor staff the assumptions and data used to quantify the inventory of radionuclides in liquid waste that is transferred to the SDF. DOE has three follow-up actions pertaining to NRC staff requests for additional information that supports the quarterly Saltstone Permit Reports published on the DOE Savannah River Operations office website.

Ongoing NRC Staff Technical Reviews

- The NRC staff discussed with DOE and DOE contractor staff 10 of 14 technical reports provided to NRC staff since November 2008. These reports covered the results of studies on soil contamination in the vicinity of Vault 4 and the results of physical and chemical studies on both actual disposal cells (e.g., video of Vault 4, Cell G), and laboratory-prepared saltstone grout and vault concrete. Aside from the open issue described above, DOE has 16 follow-up actions related to staff questions on these studies.

1.0 BACKGROUND

Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (Section 3116) 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. Section 3116 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 Section 3116 criteria including demonstration of compliance with the performance objectives in 10 CFR Part 61, Subpart C (DOE, 2005). In its consultation role, the NRC staff reviewed the draft waste determination and concluded that there was reasonable assurance that the applicable criteria of Section 3116 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 (NRC, 2005). DOE issued a final waste determination in January 2006 taking into consideration the assumptions, conclusions, and recommendations documented in NRC's TER (DOE, 2006).

To carry out its monitoring responsibility under Section 3116, 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 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.

On March 25-26, 2009, the NRC staff onsite observation visit 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's ongoing construction of disposal cells at the Saltstone Disposal Facility (SDF), requesting additional information about the methods used by DOE to estimate the inventory of radionuclides in the SDF, and discussing staff questions and comments on 10 of 14 technical reports provided to NRC since November 2008. Because the vaults and saltstone grout 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.

Saltstone Facility Operational Status at the time of the Observation

At the request of NRC staff, DOE and DOE contractor staff provided a brief overview of operations at the Saltstone Facility since the last onsite observation (NRC, 2008). DOE explained that salt waste in Tank 50 was not processed at the SPF between April 2008 and December 2008. In January, the transfer of material from Tank 50 to the SPF resumed. In addition, batch 1 of salt waste in Tank 49 was treated at the Actinide Removal Process/Modular Caustic Side Solvent Extraction process (ARP/MCU) through September 2008. Batch 2 of ARP/MCU feed was qualified in November and December 2008, with approximately 70,000 gallons of batch 2 waste having since been sent to ARP/MCU for treatment.

2.0 NRC ONSITE OBSERVATION ACTIVITIES

2.1 Disposal Cell Construction

NRC staff monitors ongoing construction of disposal cells, as described in section 3.2.3, "Vault Construction," of the staff's monitoring plan (NRC, 2007).

2.1.1 Observation Scope

The general purpose of NRC staff observations of ongoing construction of Saltstone Disposal Facility Cells 2A and 2B is to identify noticeable deviations from the vault design,ocusing on changes that could affect potential pathways for water to intrude into the vaults, such as penetrations or joints. A specific objective of this monitoring visit was to become familiar with the construction area and methods being used to construct new disposal cells.

2.1.2 Observation Results

The staff observed ongoing construction at Saltstone Disposal Facility Cells 2A and 2B. At the time of the staff's visit, the base mud mat, geosynthetic clay liner and 100-mil high-density polyethyline liner, Type V mud mat and floor had been installed for Cells 2A and 2B, and the Type V concrete floor was curing under plastic covers. Rebar pedestals had been cast in place in the floor for the 48 columns that will support the roof in each cell. Forms were constructed at various locations on the ground outside the cells for casting 32 15-ton wall panels for each cell, but no wall panels had been cast at the time of the observation.

2.1.3 Conclusions and Followup Actions

No issues or concerns were identified during the observation of disposal cell construction. Staff plans to return to the site in late May or June 2009 to observe installation of wall panels. In the interim, DOE agreed to take photographs of construction joints, prior to covering the joints with additional construction layers or concrete. At NRC staff's request, DOE will provide a complete set of Vault 2 design drawings. NRC staff will provide specific requests for construction photographs to DOE after reviewing the drawings.

DOE Follow-up Actions

1. DOE agreed to take photographs of construction joints, prior to covering the joint with additional construction layers or concrete.

2. At NRC staff's request, DOE will provide a complete set of Vault 2 design drawings.
Action 2 complete: see NRC, 2009

2.2 Saltstone Radionuclide Inventory

NRC staff monitors feed tank sampling and waste sampling, as described in section 3.1.1, "Data Reviews," section 3.1.6., "Factor 6--Feed Tank Sampling," section 3.2.2., "Waste Sampling," and section 3.1.8, "Factor 8—Removal Efficiencies," of the staff's monitoring plan (NRC, 2007).

2.2.1. Observation Scope

NRC staff interviewed DOE and DOE contractor staff on topics related to liquid waste sampling and tracking of the radionuclide inventory transferred to the SDF during this onsite observation visit. The purpose of the interviews was to better understand and evaluate the methods used by DOE to quantify the inventory of radionuclides in liquid waste that is transferred to the SDF. This review was performed as part of the evaluation of Factor 6, Feed Tank Sampling, and Factor 8, Removal Efficiencies, identified in the NRC monitoring plan (NRC, 2007). Adequate characterization of the liquid 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 methods used for waste sampling and tracking of the radionuclide inventory transferred to the SPF/SDF were previously reviewed during the October 2007 and March 2008 onsite observation visits.

2.2.2 Observation Results

DOE contractor staff provided an explanation of the data and assumptions that are used to prepare quarterly Saltstone Permit Reports that are available on the DOE Savannah River Operations Office website. This included an explanation of how information from a Tank 50 material balance worksheet, and other supporting information, is used to estimate volume weighted concentrations of radionuclides that are sent to the SDF each quarter. NRC staff asked why quarterly totals of radionuclides in grout (calculated by multiplying the total amount of grout reported in the Saltstone Permit Reports by the volume weighted average concentration in grout reported for each radionuclide) did not match quarterly totals of radionuclides in liquid waste (similarly calculated by multiplying the total amount of liquid salt waste solidified at the SDF by the volume weighted average concentration in liquid salt waste reported for each radionuclide). DOE contractor staff explained that total quantities of grout reported in the Permit Reports include grout used to form cold caps, and that bleedwater and flushwater from the SDF and SPF, respectively, are seen by a grout line flow transmitter as "grout," even though these transfers would not add radionuclides to the SDF. As a result, the reported liquid salt waste concentrations and volumes are considered by DOE to be a more reliable basis for estimating quarterly radionuclide inventory in the SDF. In addition, DOE staff stated that the quarterly concentrations reported for the radionuclides that have "limits" set for them in the Saltstone WAC are based on volume weighted averages calculated based on the concentrations calculated in

the materials balance worksheet. However, the quarterly concentrations reported for the radionuclides that have "target" acceptance criteria are based only on the concentration measured in a semi-annual sample.

NRC and DOE contractor staff also discussed how semi-annual Tank 50 confirmatory samples taken for measurements of radionuclide concentrations are used to adjust estimates of radionuclide inventory in Tank 50, which are more routinely updated using process knowledge and sampling results for influent liquid wastes to Tank 50.

NRC staff plan to continue monitoring the inventory of radionuclides being added to the SDF. DOE agreed to provide additional information that NRC staff plan to review, including documentation, such as the materials balance worksheets, that supports the calculations used to derive the inventory estimates provided in quarterly Saltstone Permit Reports from the third calendar quarter of 2007 through the second quarter of 2008. DOE will also evaluate Tank 50 sample results vs. the Tank 50 material balance to verify that the materials balance is able to accurately estimate the concentration of radionuclides in Tank 50. Observation participants also discussed ongoing operations under the ARP/MCU management control plan (MCP). Under the MCP, DOE continues to sample and hold each batch of salt waste to be processed by the ARP/MCU, pending results of sample analysis. Ultimately, DOE intends to change to a "sample and send" mode of operation, wherein waste is processed, even while sample results are pending. The "sample and send" mode will enable DOE to increase waste treatment throughput. DOE also is considering developing a statistical basis for sampling less frequently than every microbatch.

DOE Follow-up Actions

3. Provide sufficient documentation to support quarterly Saltstone Permit Reports for the period from third quarter 2007 through second quarter 2008.

4. Provide evaluation of Tank 50 material balance, from third quarter 2007 to present.

5. Inform NRC when DOE is ready to exit its ARP/MCU management control plan.

2.2.3 Conclusions and Followup Actions

There are no new open issues or recommendations resulting from staff observations at this time. DOE follow up actions are listed above.

2.3 Ongoing NRC Staff Technical Reviews

NRC staff continues to monitor the quality of saltstone grout and vault concrete, as described in section 3.1.2., "Factor 1—Oxidation of Saltstone," and section 3.1.3., "Factor 2 - Hydraulic Isolation of Saltstone," and section 3.1.4, "Factor 3 – Model Support," of the staff's monitoring plan (NRC, 2007).

2.3.1 Observation Scope

Observation participants discussed 10 of 14 technical reports provided to NRC staff since November 2008. The reports are listed in Table 1 below.

Table 1. Ongoing NRC staff technical reviews

No.	Description	ADAMS Accession No.
1	Rosenberger, K. H., *Comparison of Vault 4 Soil Sampling Results to Existing Unreviewed Disposal Question Evaluation SRS-REG-2007-00041*, SRNS-J2100-2008-00013, Savannah River Nuclear Solutions. December 3, 2008	ML090120429
2	Kubilius, W., *Z-area Vault 4 Phase 2 Soil Sample Analytical Data Report*, ERD-EN-2008-0083, Savannah River Site, December 2008.	ML090120404
3	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, April 2008.	ML090120475
4	Kent, E., Letter to J. Buczek, WSRC, re: Samples received on February 14, 2008, GEL Laboratories, March 13, 2008.	ML090120546
5	Kent, E., Letter to J. Buczek, WSRC, re: Samples received on July 16, 2008, GEL Laboratories, September 16, 2008.	ML090120539
6	Kaplan, D. I., K. Roberts, J. Coates, M. Siegfried, S. Serkiz, *Saltstone and Concrete Interactions with Radionuclides: Sorption (Kd), Desorption, and Reduction Capacity Measurements*, SRNS-STI-2008-00045, Savannah River National Laboratory, WSRC. October 2008	ML090150234
7	Dixon, K., J. Harbour, and M. Phifer, *Hydraulic and Physical Properties of Saltstone Grouts and Vault Concretes*, SRNL-STI-2008-00421, Revision 0, Savannah River National Laboratory, WSRC. November 2008	ML090150298
8	Langton, C., *Evaluation of Sulfate Attack on Saltstone Vault Concrete and Saltstone, Part I: Final Report*, SRNS-STI-2008-00050, Revision 0, Savannah River National Laboratory, SRNS. August 19, 2008	ML090150306
9	Langton, C., *Evaluation of Sulfate Attack on Saltstone Vault Concrete and Saltstone, Part II: Test Methods to Support Moisture and Ionic Transport Modeling using the STADIUM® Code*, SRNS-STI-2008-00052, Revision 0, Savannah River National Laboratory, SRNS. August 19, 2008	ML090150312
14	Dixon, K., J., *Video Survey of Saltstone Vault 4, Cell G*, SRNL-ESB-2008-00017, Savannah River National Laboratory, WSRC. April 25, 2008	ML090150154

2.3.2 Observation Results

Summaries of the technical review discussions, including follow-up actions by DOE, are provided below.

Vault 4 soil sampling

Reports 1-5 listed above pertain to studies of soil contamination that occurred outside of Cell E of Vault 4 at the SDF as a result of active weep sites in the exterior vault wall. Of particular interest to NRC staff is the concentration of iodine-129 that was observed in one sample, as described in Section 4.3 of Report 2. The reported iodine-129 concentration in a phase 2 gravel sample from 3" to 12" in depth next to Cell E was 69 pCi/g (a 95 percent confidence interval, or uncertainty value, was not reported). The cesium-137 value for the corresponding phase 1 sample from the same depth and location was 11,700 pCi/g. Using these values, staff calculated a concentration ratio of Cs-137 to I-129 of about 170. Using expected SDF inventories cited in the salt waste performance assessment (DOE, 2005), the expected average Cs-137:I-129 ratio in salt waste is about 75,000. NRC staff believes that the reasons for the large difference between an expected Cs-137:I-129 ratio of 75,000 and an observed ratio of 170 should be thoroughly understood by DOE. DOE believed that the data suggest no further sampling was needed for I-129, however, the NRC staff did not agree with this assessment based on the current information. The staff believes that further understanding of the differences may be derived from studying the waste that was being added to Cell E (which perhaps had a substantially different ratio of Cs-137:I-129 than that of the expected long-term average concentration of salt waste), or in terms of natural processes that may have governed the ratio of Cs-137:I-129 in the soil.

NRC staff also asked whether DOE had considered sampling under footers at the base of the Vault south wall, in order to test whether the floor of the vault may also have active weep sites. DOE explained that the causes of the discontinuities in construction that resulted in active weep sites in the vault walls are not anticipated in the floor of the vault, and believes that no sampling below the footers is necessary. Downgradient groundwater monitoring will continue to be relied upon to ascertain whether contamination from active weep sites, or any other potential sources, is migrating away from Vault 4. NRC staff commented that valuable lessons can be learned by the observed distribution of contamination in the subsurface, and that those lessons should be applied to revisions of the performance assessment.

<u>DOE Follow-up Actions</u>

6. DOE should continue to investigate the source of iodine-129 detected in soil samples.

Sorption (Kd), Desorption, and Reduction Capacity Measurements

Report 6 provides the results of research on sorption, desorption, and reduction capacity measurements that were performed on laboratory-prepared samples of saltstone grout and vault concrete. DOE explained that data from this report will be used in its update of the salt waste performance assessment. Of particular interest to NRC staff, are the results for sorption (Kd) and desorption of technetium-99 in this report. The Kd values obtained for technetium in these experiments were significantly less than the values assumed in the performance assessment, indicating that it would be significantly more mobile than assumed in the performance assessment. Additionally, technetium was apparently not reduced in the experiments described in this report. NRC staff recognizes that the purpose of these experiments was to determine the transport of technetium through the saltstone vault rather than the ability of saltstone to immobilize technetium during curing. However,

because the technetium did not become reduced in the presence of saltstone, staff requested additional information about the basis for DOE's confidence that technetium in salt waste would be reduced as saltstone grout cures.

During the observation, DOE explained that while there is currently no experimental basis that specifically supports DOE's assumption that technetium-99 in salt waste will be reduced, and thereby retained, in the current saltstone grout formulation, DOE plans to perform additional experiments that will be designed to support such an assumption later this year. Given the risk significance of this assumption in DOE's performance assessment (DOE, 2005), this is a new open issue under Section 3.2.4 of the NRC monitoring plan (NRC, 2007).

Open Issue 2009-1

At the SRS Saltstone Facility, DOE should demonstrate that (1) technetium-99 in salt waste is converted to its reduced chemical form in saltstone grout during the curing of saltstone grout, and is thereby strongly retained in saltstone grout, and (2) the sorption of dissolved technetium-99 onto saltstone grout and vault concrete is consistent with K_d values for technetium-99 that were assumed in the performance assessment.

DOE Follow-up Actions

7. Explain what measures were taken to ensure that experiments with technetium were not affected by experimental losses, such as technetium holdup in labware, resulting in underestimates of technetium concentration.

8. Clarify the pH of the calcite solution used in these experiments (page 9 and 16 state the pH = 10; page 7 states that solution pH = 8.3).

9. Clarify the selenium Kd value reported in Table 5, which is different than the value reported previously in the report.

Hydraulic and Physical Properties of Saltstone Grouts and Vault Concretes

Report 7 provides the results of research on physical properties of laboratory-prepared samples of saltstone grout and vault concrete. NRC staff noted that material porosity measurements were as expected, but that the saturated hydraulic conductivity measurements for both saltstone grout and vault concrete and the porosity of saltstone were much higher than expected. Higher saturated hydraulic conductivity would be expected to lead to higher water flow rates, and higher associated degradation of saltstone grout and vault concrete than calculated in the salt waste performance assessment. NRC staff expressed the concern that the wasteform properties are one of the key components to mitigating risk from saltstone, and that inferior hydraulic properties are likely correlated with inferior diffusivity, which can impact long-term durability. NRC staff asked how the new measurement information will be incorporated into the performance assessment. DOE stated that it compares the information to sensitivity cases, and the new information would be reflected in the new performance assessment. The annual regulatory report identifies new information and identifies when the performance assessment needs to be updated. NRC staff indicated that the new information on hydraulic and physical properties could impact other activities, such as degradation assessments. DOE indicated that an

integration team helps to ensure that new information is reflected in other products. NRC staff inquired about the status of implementation of the Saltstone Product Quality Plan. DOE indicated they would provide a status of implementation and may update analysis after it is fully implemented.

NRC staff discussed the measurement of moisture characteristics curves. The report provided recent measurements for saltstone and vault concrete that were substantially different than similar measurement completed by the Idaho National Laboratory (INL). NRC staff discussed how the data were going to be used and interpreted. DOE indicated that they had planned to use the data from INL and they had not performed an evaluation of the impact of different moisture characteristic curves. NRC staff indicated that the moisture characteristics curves can have a large impact on projected waste release rates, and if there is significant uncertainty or variability in the values that the uncertainty and variability should be evaluated in the performance assessment.

DOE Follow-up Actions

10. Clarify whether bleedwater was leaking from sealed containers during the hydraulic properties study, when the report indicated the samples were sealed.

11. Clarify the impact of changing pore solution concentration on measured hydraulic properties on page 8 of Report 7.

12. Explain how uncertainty will be addressed for moisture characteristic curves that are fit to data reported on page 18 of Report 7.

13. Justify the use of logarithmic averages for recommended hydraulic property values on p. 19.

NRC also requested additional information about the results of physical or chemical tests being performed on core samples that were taken from three locations along the western wall of Cell E of Vault 4 in September 2008. Each core was approximately 3 to 4 inches in diameter and 6 inches deep. DOE explained that it is planning laboratory studies that may begin during the third quarter Fiscal Year 2009, in which it will test porosity, saturated hydraulic conductivity, and distribution coefficients for radionuclides. NRC staff will follow up on DOE's progress in preparing experiments for these core samples in future monitoring activities. A representative from the South Carolina Department of Health and Environmental Control suggested that it would be very useful to perform leaching studies of the saltstone core samples, and NRC staff agreed.

Video Survey of Vault 4, Cell G

Observation participants watched a video survey of Cell G in Vault 4 (Report 14). The video showed fractures on the surface of the saltstone. Of particular interest was a large aperture crack emanating from the north corner of Cell G. This crack propagates out from the corner at approximately a 45 degree angle and appears to extend entirely across the cell. Staff also noted, as stated in Report 14, that there is no obvious separation between the vault wall and saltstone associated with shrinkage of the saltstone grout. The surface of the saltstone appeared to be rough and contained areas of darker color. DOE explained that the roughness was attributed to dripping condensation during curing and the dark

spots were attributed to corrosion of steel in the vault roof that dripped onto the surface of the saltstone. Staining along one of the cracks likely indicated that water contained corrosion products collected and flowed into the fracture. NRC staff noted that the fractures do not appear to be extensive, but that conclusion was hindered by lack of scale and a limited survey area. DOE plans to do more surveys in the future.

Evaluation of Sulfate Attack on Saltstone Vault Concrete and Saltstone

Observation participants discussed NRC staff questions on Reports 8 and 9.

DOE Follow-up Actions

14. Provide up-to-date copy of the PA maintenance plan

15. Evaluate the sensitivity of grid spacing to predicted front propagation in the sulfate attack evaluation.

16. Explain how spatial representation in the numerical experiments of sulfate attack will be translated into a PA model, since the geometries of the real system will be much more complex (e.g., a random collection of different size blocks determined by crack distributions) than those considered in the numerical experiments.

17. Explain how cracks are incorporated into the sulfate attack representation in the PA model, since cracks could significantly impact the degradation assessment (page 15). Explain assumption I that the transport rate through damaged concrete of sulfate ions is not different from undamaged concrete (page 21).

18. Clarify the conceptual model for sulfate attack. For example, does sulfate attack proceed along a front, or is it a generalized mechanism

19. Clarify the conceptual model represented by case 2 (page 6). If the concentration was diluted by diffusion, then what is the fate of diffused species? If species are diffusing through the vault wall, then why isn't the vault wall degraded.

20. Explain why it is appropriate to neglect minor species (page A2-14).

21. Justify the use of Berner's approach for these materials and solutions (page A2-15).

2.3.3 Conclusions and Followup Actions

There are no recommendations resulting from staff observations at this time.

There is one new open issue regarding whether: (1) technetium-99 in salt waste is converted to its reduced chemical form in saltstone grout during the curing of saltstone grout, and is thereby strongly retained in saltstone grout, and (2) the sorption of dissolved technetium-99 onto saltstone grout and vault concrete is consistent with K_d values for technetium-99 that were assumed in the performance assessment.

DOE follow up actions are listed in section 2.3.2 above.

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