

August 19, 2011

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: U.S. NUCLEAR REGULATORY COMMISSION APRIL 26, 2011 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 April 26, 2011, 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 the U.S. Department of Energy (DOE) for the purpose of assessing compliance with the performance objectives set out in 10 CFR Part 61, Subpart C. The activities conducted during 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).

This onsite observation at SRS was focused on assessing compliance with the four performance objectives: (i) protection of the general population from releases of radioactivity (§61.41), (ii) protection of individuals from inadvertent intrusion (§61.42), (iii) protection of individuals during operations (§61.43), and (iv) stability of the disposal site after closure (§61.44). Meeting these performance objectives is predicated on the performance of the disposal cells within the period of compliance.

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 Saltstone Disposal Facility (SDF), NRC will continue to monitor DOE's disposal actions at SRS. Presently, three issues previously identified by the staff remain open: (1) the hydraulic and chemical properties of the saltstone grout, (2) the variability of saltstone from batch to batch, and (3) the reduction and retention of Technetium-99 within the saltstone waste form. Further 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 other issues that may be opened in the future.

T. Gutmann

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

Sincerely,

**/RA/**

Andrew Persinko, Deputy Director  
Environmental Protection  
and Performance Assessment Directorate  
Division of Waste Management  
and Environmental Protection  
Office of Federal and State Materials  
and Environmental Management Programs

Enclosure:  
NRC Observation Report

cc w /enclosure:

WIR Service List

S. Wilson  
Federal Facilities Liaison  
Environmental Quality Control Administration  
South Carolina Department of Health  
and Environmental Control  
2600 Bull Street  
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## **U.S. NUCLEAR REGULATORY COMMISSION APRIL 26, 2011 ONSITE OBSERVATION REPORT FOR THE SAVANNAH RIVER SITE SALTSTONE FACILITY**

### **EXECUTIVE SUMMARY:**

The U.S. Nuclear Regulatory Commission (NRC) staff conducted its eleventh onsite observation visit, Observation 2011-02, to the Saltstone Facility at the Savannah River Site (SRS) on April 26, 2011. The purpose of this visit was to focus on compliance with the performance objectives set out in 10 CFR Part 61, Subpart C: (i) protection of the general population from releases of radioactivity (§61.41), (ii) protection of individuals from inadvertent intrusion (§61.42), (iii) protection of individuals during operations (§61.43), and (iv) stability of the disposal site after closure (§61.44). To accomplish these goals, NRC staff discussed testing of saltstone properties, Vault 4 inventory, disposal unit construction, and recent research on Tc reduction and oxidation in saltstone performed by SRS. This report provides a description of NRC onsite observation activities and identifies NRC observations made during 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, as long as key assumptions made in the U.S. Department of Energy's (DOE's) waste determination analysis prove to be correct.

There are no new open issues resulting from this observation. The NRC staff received documentation during the observation that pertained to the observation activities scheduled for this onsite observation. Each of the documents received by the NRC staff during the observation are accessible via NRC's document repository, the Agencywide Documents Access and Management System (ADAMS), via the package accession number ML111310169.

A summary of the staff's observations and conclusions is provided below:

#### Technical Discussion – Saltstone Radionuclide Inventory:

- DOE contractor staff presented a reevaluation of the inventory of I-129 currently disposed of in Vault 4 based on sample results. The NRC staff believes that the method used for this reevaluation seems reasonable. NRC staff will continue to monitor DOE's inventory tracking methodology.
- DOE provided NRC staff with an updated inventory document containing the inventory of radionuclides disposed in the Saltstone Disposal Facility as of 9/30/10.

#### Technical Discussion – New Research on Long-Term Testing Waste Oxidation and Technetium Release:

- DOE proposed closing Open Issue 2009-1 due to successful results of recent research. NRC expressed concern with some details of the new research.
- NRC staff concerns with new research were sufficient such that Open Issue 2009-1 remains open.

### Discussion of Disposal Unit 2 Construction:

- DOE discussed their strategy for repairing the hydraulic leaks and provided documentation describing the design changes made to the new disposal cells.
- The NRC staff will continue to monitor the construction of the new disposal cells.

### Follow-up Discussion – Topics from Previous Observations:

- In addition to the specific technical discussions that took place during the observation, additional topics were discussed to follow-up on discussions that took place during previous observation activities. A detailed list and description of these topics can be found later in this report. Several items were closed from this discussion; however, some items discussed remain open and will require further discussion.

## 1.0 BACKGROUND:

Section 3116 of the National Defense Authorization Act for Fiscal Year 2005 (Section 3116) authorizes 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, 2005a). 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 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 Technical Evaluation Report (DOE, 2006).

To carry out its monitoring responsibility under Section 3116, NRC performs three types of activities: (i) technical reviews, (ii) onsite observations, and (iii) data reviews in coordination with the State of South Carolina site regulator, South Carolina Department of Health and Environmental Control (SC DHEC). These activities focus on key assumptions – called “factors” – identified in the NRC monitoring plan for salt waste disposal at SRS (NRC, 2007). Technical reviews generally 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 are 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 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.

## 2.0 NRC ONSITE OBSERVATION ACTIVITIES:

The observation began with a short briefing on the observation agenda and site safety procedures presented by the DOE contractor, Savannah River Remediation (SRR) and attended by representatives from DOE, NRC, Savannah River National Laboratory (SRNL), and SRR. The observation continued with a discussion between NRC, DOE, and associated DOE contractor staff regarding the inventory of Vault 4, the new technetium oxidation research, and various follow-up discussions from previous observations. Sections below contain detailed accounts of these discussions.

### 2.1 Technical Discussion – Saltstone Radionuclide Inventory

#### 2.1.1 Observation Scope:

As noted in Section 3.1.1.1, “Data Reviews – Radioactive Inventory” of the May 2007 monitoring plan, it is important for NRC staff to verify the radioactive inventory disposed of at the Saltstone Disposal Facility because the inventory is an important factor in the compliance with the performance objective identified in §61.41, “*Protection of the General Population from Releases of Radioactivity*” and §61.42 “*Protection of Individuals from Inadvertent Intrusion.*”

#### 2.1.2 Observation Results:

During the observation, DOE provided a presentation for discussion on Vault 4 Inventory Reporting (ML111310182). The discussion focused on the calculated inventory of I-129 and the inventory of I-129 assumed for Vault 4 in the 2009 Performance Assessment (PA).

NRC staff sent an email containing three questions related to inventory to DOE prior to this April 2011 onsite observation. The questions and DOE’s responses are listed below.

NRC Inventory Question	Discussion Points
NRC staff asked DOE to provide the inventory of each radionuclide disposed of in Vault 4 since March of 2009 (i.e., since X-CLC-Z-00027 [ML102160640] was published).	DOE provided the NRC staff with the document X-CLC-Z-00034, “ <i>Inventory Determination of Podd/SA Radionuclides in the Saltstone Disposal Facility Through 9/30/10</i> ” (ML111310276), which provided the requested information. NRC staff noted that they would appreciate receiving a document with this information yearly when it is produced. This issue was resolved during the observation.

NRC Inventory Question	Discussion Points
<p>NRC staff asked DOE to provide the method used to estimate the predicted Th-230 in the 2009 PA and the method currently being used to track the inventory of Th-230 disposed of in Vault 4.</p>	<p>This question, which is related to RAI IN-5, was discussed in detail during the NRC/DOE public meeting on April 27, 2011 (ML111950042). This issue was not resolved during the observation, but will be addressed by DOE in its response to the NRC staff's second RAI.</p>
<p>NRC staff asked DOE to indicate how the current inventory in Vault 4 compares to the assumed inventory in the 2009 PA. The NRC staff noted that, based on X-CLC-Z-00027 (ML102160640) and the quarterly monitoring reports, it appears that the I-129 disposed of in Vault 4 to date exceeds the inventory predicted in the revised PA.</p>	<p>NRC staff was concerned that the estimated inventory in the 2009 PA did not bound the actual inventory, and therefore, the PA might not adequately capture dose. NRC staff noted that the inventory of I-129 in the 2009 PA (0.28 Ci) was less than the reported inventory already disposed in Vault 4 (0.3 Ci), based on the website quarterly reports. I-129 is a dose significant radionuclide that was identified as a highly radioactive radionuclide (HRR) in the 2005 Waste Determination. In addition, Vault 4 has not been completely filled yet, so it is expected that the final inventory in this vault will be higher.</p> <p>DOE indicated the I-129 inventory in Vault 4 does not exceed the inventory predicted in the revised PA (SRR-CWDA-2011-00070) (ML111310182) based on a reevaluation of the inventory of I-129 disposed of to date in Vault 4. DOE noted that the preliminary concentrations of I-129 reported in the quarterly reports were based on estimates determined using the Tank 50 material balance and were not based directly on sample results. DOE believes that this approach can lead to an overestimation of the radionuclide inventories. When DOE compared the concentration of I-129 reported in the quarterly reports to the Tank 50 sample results, they found that the concentration of I-129 reported in the quarterly sample reports was significantly higher than the concentration measured in the Tank 50 sample during 2009. During this time period, Tank 50 had a relatively low volume of liquid in it, and the inputs into Tank 50 primarily consisted of inputs from H-canyon. The H-canyon waste stream contains I-129 at a concentration that is below the detection limit. However, in the materials balance calculation, the concentration of I-129 in this waste stream is assumed to be at the detection limit. DOE performed a recalculation of the I-129 inventory based on the sample results and estimated that the inventory in Vault 4 was 0.16 Ci.</p>

NRC Inventory Question	Discussion Points
<p>(cont.)</p> <p>NRC staff asked DOE to indicate how the current inventory in Vault 4 compares to the assumed inventory in the 2009 PA. The NRC staff noted that, based on X-CLC-Z-00027 (ML102160640) and the quarterly monitoring reports, it appears that the I-129 disposed of in Vault 4 to date exceeds the inventory predicted in the revised PA.</p>	<p>DOE therefore concluded that the final inventory of I-129 in Vault 4 will be bounded by the assumed inventory in the PA. DOE stated that the final inventories for each vault will be determined using sample results, or best available information, once the filling of the vault has been completed.</p> <p>The NRC staff believes that the method used in DOE's reevaluation of the inventory of I-129 in Vault 4 seems reasonable and this issue was resolved during the observation. Based on this reevaluation, the current inventory of I-129 in Vault 4 is estimated to be less than the inventory assumed in the 2009 PA.</p> <p>The DOE indicated that they would be providing the NRC with the final inventory on an annual basis under monitoring.</p>

### 2.1.3 Conclusions and Follow-up Actions:

Questions (1) and (3) were resolved during the observation. Question (2) will be addressed in DOE's response to the NRC staff's second RAI. No additional issues or concerns were identified during the technical discussion on the radionuclide inventory of Vault 4 apart from DOE's continued effort to respond to RAI-2009-02.

## 2.2 Technical Discussion – New Research on Long-Term Testing Waste Oxidation and Technetium Release:

### 2.2.1 Observation Scope:

As noted in Section 3.1.2, "Factor 1 – Oxidation of Saltstone" of the May 2007 monitoring plan, saltstone oxidation is considered to be important to compliance with the performance objectives primarily because oxidation can lead to increased releases of technetium from the wasteform. The release of Tc-99 from the wasteform is an important factor in the compliance with the performance objective identified in §61.41, "*Protection of the General Population from Releases of Radioactivity*" and §61.42 "*Protection of Individuals from Inadvertent Intrusion.*"

### 2.2.2 Observation Results:

For greater detail of the discussion that took place during this part of the observation, please refer to SRR-CWDA-2011-00071 (ML111310199), the DOE document provided to the NRC during the observation.



Based on the results of recent research (SRNL-STI-2010-00667 and SRNL-STI-2010-00668) (ML111310222 and ML111310234), DOE proposed to close Open Issue 2009-1, related to the initial chemical reduction of and the  $K_d$  value for Tc-99 in saltstone. DOE measured  $K_d$  values up to ~700 mL/g for Tc to saltstone formulated with 45% slag (nominal concentration) under a nitrogen atmosphere with 2% hydrogen gas. NRC staff questioned whether results obtained in an atmosphere with 2% hydrogen are applicable to as-emplaced saltstone. In addition, the slag-free control samples had similar measured  $K_d$  values for Tc-99, which indicates that the reduction and sorption of the Tc was not caused by the slag and might have been caused by the hydrogen gas instead. DOE indicated that, because the  $E_H$  of the leachate decreased with increasing slag concentrations, they conclude that slag controlled the  $E_H$  in the reducing cementitious materials.

DOE measured less sorption ( $K_d$  of 139 mL/g) of Tc-99 onto cores of saltstone taken from Vault 4, cell E (SRNL-STI-2010-00667) (ML111310222). DOE hypothesized that the  $K_d$  value was significantly less than 1000 mL/g because 30-60 ppm oxygen present in the glove box oxidized the saltstone. NRC suggested that a complete response to the open issue would indicate whether this range of oxygen concentrations could be present in the as-emplaced saltstone environment.

### 2.2.3 Conclusions and Follow-up Actions:

Because of the NRC staff's concerns discussed above, Open Issue 2009-1 remains open. No additional issues or concerns were identified during the technical discussion regarding technetium release and oxidation in the saltstone wasteform.

## 2.3 Discussion of Disposal Unit 2 Construction:

### 2.3.1 Observation Scope:

The staff's interest in discussing construction activities of the new disposal cells relates to ensuring the integrity of the disposal units and identifying the potential mechanisms of contaminant release from the facility. Section 3.1.3, "Hydraulic Isolation of Saltstone," of the May 2007 monitoring plan (NRC, 2007) provides details of the basis for the staff's intended review areas.

### 2.3.2 Observation Results:

DOE discussed cell design changes to deal with hydraulic leaks include flush cutting anchor bolts, cold cap of type V concrete without anchor bolt, washer and nut mechanical seal, flexible coating (see also Hydrotest Results in the table below). DOE provided SRR-CWDA-2011-00082 (ML111320032 and ML111320049) which describes the design changes made to the new disposal cells.

### 2.3.3 Conclusions and Follow-up Actions:

The NRC staff will continue to monitor the construction of the new disposal cells and will continue to monitor the cells when they are put into operation.

## 2.4 Follow-up Discussion – Topics from Previous Observations:

### 2.4.1 Observation Scope:

The staff's interest in discussing the list of topics in this section relates to multiple sections of the May 2007 monitoring plan and also relates to all four of the §61.41 performance objectives. Topics discussed included the following:

- *Performance Assessment/Research Activity*
- *Open Issues 2007-1, 2007-2, and 2009-1*
- *Follow-up Actions*
  - *Disposal Unit 2 Water Tightness Test Quality Assurance Records*
  - *Radiological Composition of Inadvertent Transfer Material*
  - *Status of ARP/MCU Management Control Plan*
  - *Assess Impact of Anchor Bolt Penetrations in Vault 4*
  - *Develop Data Related to Impact of Scale on Formed Core Sampling Methodology*
- *Email Questions from NRC Staff*
  - *Curing Temperature*
  - *Saltstone Fracturing*
  - *Hydrotest Results*
  - *Vault 4 Floor Performance*

### 2.4.2 Observation Results:

During the observation, DOE provided a document, SRR-CWDA-2011-00043 (ML111310214), which contains many of the details of the discussion provided in this section of the report. This document provides good context on the topics below.

- *Performance Assessment/Research Activity*

DOE discussed current and future SDF PA maintenance activities. The current research activities include 11 studies on parameters such as the reducing environment, dispersion coefficients, degradation mechanisms, closure cap infiltration, and hydrology/geology. The planned PA maintenance activities include degradation studies, impacts of waste oxidation, vault cracking and attendant transport, and code upgrade.

- *Open Issues 2007-1 and 2007-2*

*Open Issues 2007-1 and 2007-2:* DOE described plans to continue efforts to determine the hydraulic and chemical properties of as-emplaced saltstone grout. DOE indicated it would complete analysis of existing saltstone core samples and use formed-core sampling to verify the characteristics of as-emplaced saltstone. DOE is developing an integrated sampling plan to correlate the properties of laboratory-prepared and as-emplaced saltstone samples. DOE indicated it was working to quantify variability in the dry feed and the water-to premix ratios. DOE also indicated it is working to test the hydraulic and physical properties of saltstone formed with various dry feed compositions and cure temperature profiles. Determining the impact of these variations on the performance assessment is planned future work. NRC staff indicated that the plans to address the open issues sound reasonable. These two issues remain open at this time.

- *Open Issue 2009-1*

The discussion on Open Issue 2009-1 is described in detail in Section 2.2 above. As noted above, this issue remains open at this time.

- *Follow-up Action: Disposal Unit 2 Water Tightness Test Quality Assurance Records*

DOE will provide NRC staff with documentation of cell design changes and hydrotesting results for review when they are available following the Operational Readiness Review. This Follow-up action remains open.

- *Follow-up Action: Radiological Composition of Inadvertent Transfer Material*

During the July 2010 onsite observation, the NRC staff requested information on the radionuclide composition of the salt solution that was inadvertently transferred to Vault 4. DOE provided document SRR-WSE-2010-00186 (ML111780337) to the NRC on October 26, 2010 to respond to this request.

The inadvertent transfer of approximately 1900 gallons (7192 L) of liquid salt solution to Vault 4 occurred on May 19, 2010. This inadvertent transfer was caused by valve misalignment during tests of the Salt Feed Tank agitator. Following the inadvertent transfer, drain water removal was performed to remove the salt waste. DOE estimates that less than 50 gallons (189 L) of this material remained on top of the saltstone monolith following this removal. When Saltstone Production Facility was restarted, clean grout was added for 15-20 minutes to attempt to encapsulate this remaining liquid.

Because the radiological inventory disposed of in Vault 4 is determined as the waste is transferred from Tank 50, the inventory in the inadvertent transfer material is already accounted for in the total inventory disposed of in Vault 4. However, it is useful to understand the radiological content of this material because the inventory in the inadvertent transfer material may not be encapsulated in the grout well because it was not disposed of in the form of grout. The removal of the inadvertently transferred liquid to the maximum extent practical and the placement of clean grout when the Saltstone Production Facility was restarted likely reduced this concern.

The material in the inadvertent transfer consisted of salt waste that originated in Tank 50 plus clean cap drain water returns. A dip sample was taken of the salt waste solution remaining in the hopper at the time of the inadvertent transfer. This sample was characterized for chemical constituents, but the radiological constituents were not characterized. The sample was completely used in the chemical analyses, and no sample remains.

DOE estimated the radiological content of the material in the inadvertent transfer based on the radiological composition of the waste from Tank 50 and the estimated dilution from the clean cap drain water. The dilution was estimated based on the ratio of sodium in the dip sample to the Tank 50 sample.

NRC staff has reviewed this information and has concluded that while it would have been preferable to have actual radiological characterization data for the material in the inadvertent transfer, the approach used by DOE to estimate the radiological content of this material seems reasonable. Based on the information provided to the NRC in SRR-WSE-2010-00186 (ML111780337), the NRC staff considers this action item to be closed.

- *Follow-up Action: Status of ARP/MCU Management Control Plan*

During the March 2009 onsite observation (ML091320439), NRC staff identified a follow-up action for DOE to inform NRC when they exit the ARP/MCU management control plan. The basis for this follow-up action was that it was the understanding of the NRC staff that the sampling data obtained under the ARP/MCU management control plan was going to be used to represent the input from ARP/MCU in the material balance for Tank 50. However, during this observation, DOE stated that this sampling information was not going to be used as part of the inventory determination in the Tank 50 material balance.

A new follow-up action from this observation is for DOE to clarify to the NRC staff how the sampling data obtained under the ARP/MCU management control plan is used and how the inventory of radionuclides sent to Tank 50 from ARP/MCU is determined.

Additionally, DOE raised the concern that tracking long-term items (such as the exit strategy for the ARP/MCU management control plan) as follow-up actions, might not be the most efficient mechanism. NRC staff stated that a revised monitoring plan will be developed following the completion of the TER for the revised PA. In the new monitoring plan, NRC staff will generate a list of major changes to the salt waste disposal process that they would like to be made aware of, if and when they occur. The transition from the ARP/MCU management control plan is an example of what would be included on this list, and the follow-up action for DOE to notify NRC when the management control plan is exited can be handled in this manner in the future.

DOE stated that they have no immediate plans to cease operating under ARP/MCU Management Control Plan.

During the onsite observation, DOE staff asked the NRC staff why they were interested in the status of the ARP/MCU Management Control Plan. NRC staff stated that the basis for their interest in the status of the ARP/MCU Management Control Plan was that they believed that the sample results obtained under this plan were used for determining the inventory of material transferred from ARP/MCU to Tank 50. NRC staff was also interested in knowing when the operations under the ARP/MCU Management Control Plan are ceased because DOE had previously indicated samples would be taken less frequently once this happened.

A follow-up discussion on this topic was held by phone on 6/30/11. During this phone call, DOE and contractor staff provided additional information to the NRC staff regarding the methodology used to determine the inventory transferred to Tank 50 from ARP/MCU.

DOE contractor staff stated that the purpose of the ARP/MCU samples is to obtain information related to safety (such as criticality) and process information and that these samples are not used to develop inventory information for the Saltstone Disposal Facility. Instead, the inventory information is based on direct analytical measurements of the Tank 50 samples, and the materials balance calculations for Tank 50. The inventory assumed for the ARP/MCU feed stream in the materials balance is based on the expected characterization of the waste in the particular salt batch. This assumed characterization may vary between different salt batches. DOE contractor staff stated that this assumed characterization is typically an upper bound of the inventory in the waste stream. However, in some cases, the assumed inventory can be exceeded. In these cases, DOE has a process to determine if it is acceptable to transfer the material to Tank 50.

NRC staff asked how the actual inventory being disposed is known if the inventory assumed in materials balance calculations represent an upper bound of the possible inventory. DOE contractor staff stated that as the actual Tank 50 sample data is made available, the inventory is updated to reflect the sample data, rather than the material balance information. DOE offered to provide a demonstration of the spreadsheet used for these calculations during the next onsite observation.

In this case, because the ARP/MCU sample data did not affect the inventory determination for the Saltstone Disposal Facility, NRC staff considers this follow-up action to be *closed*. However, NRC staff requests that it be informed when any major changes to the Salt Waste processes are made, such as exiting the ARP/MCU Management Control Plan, as these types of changes will affect the NRC's monitoring activities.

- *Follow-up Action: Anchor Bolt Penetrations in Vault 4*

During the July 2010 onsite observation, NRC and DOE staffs discussed leakage from the vault caused by anchor bolts on the floors of cells 2A and 2B during the hydrotests (no waste involved). NRC staff raised a concern with the integrity of Vault 1 and 4 floors based on the presence of a similar drain system and anchor bolts. NRC staff suggested that direct evidence of leakage could be determined by horizontal soil cores under Vaults 1 and 4. DOE contractor staff described the progress that has been made towards addressing this follow-up action to date. DOE has visually inspected several anchor bolts locations in cells B and H of Vault 4, which are empty, and did not see any evidence of cracking on the vault floor surface. DOE also discussed historical, semi-annual monitoring well data that does not indicate that there have been releases from Vault 4. The potential effects of bolt penetrations will be mitigated in the FDCs, and the need for bolts (to anchor cable brace) will be eliminated in the new design.

This follow-up action remains open pending the response to the above concern and the completion of the work DOE is performing on this follow-up action. The NRC staff will continue to review documentation regarding this follow-up action as it becomes available.

- *Follow-up Action: Impact of Scale on Core Sampling Methodology*

During the July 2010 onsite observation, NRC and DOE staffs discussed proposed future saltstone core sampling techniques. Alternate methods were discussed and each had its strengths and weaknesses. DOE presented information on an in-situ sampling technique essentially using embedded pipes, for which they tested the force required to remove the sampling device. NRC expressed concern that the sampling device may allow less disruption of the sample, however the sampling device may change the in-situ conditions of the wasteform such that the sample is not representative. The NRC stated that when its contractor conducted experiments to test the properties of large-scale samples, scale effects were evident in the results. This highlights the importance of measuring properties of representative samples at appropriate scale.

DOE is developing a formed-core sampling methodology to minimize the disruption to core samples that was discussed in the July 2010 onsite observation. NRC staff has commented that formed-core samples may not be representative of in-situ conditions, but it will continue to review core-sampling approaches and results.

DOE will move forward with formed-core sampling technology. Operational considerations such as worker exposure and logistics will be considered in sampling plan. This follow-up action remains open pending the response to the completion of the work DOE is performing on the impact of scale on core sampling methodology.

Discussion Topic	NRC Question	Discussion Points
<p>Cure Temperatures and Impact of Aluminate Concentration</p> <p>(October 2007 Observation)</p>	<p>The NRC onsite observation report for the October 2007 discussed the use of thermocouples within the vault and saltstone to monitor temperatures. At that point, the maximum observed temperature was ~50°C. What temperatures have been monitored since 2007 and what is the anticipated curing temperature based on the increase in aluminate concentration?</p>	<p>NRC staff inquired about the cure temperatures for saltstone grout as recent research has indicated its potential significance on the hydraulic properties of saltstone (WSRC-STI-2009-00419). A hydraulic conductivity of 8.6E-7 cm/s was measured for a saltstone grout simulant that was cured at 60°C, which is greater than the value assumed in the PA by more than a factor of 400. DOE stated that cure temperature profiles for saltstone are being compiled and will be considered in future testing. NRC staff discussed the importance of mimicking field conditions when practicable, including cure temperature and humidity.</p>
<p>Saltstone Fracturing</p> <p>(March 2009 Observation)</p>	<p>NRC staff noted that the saltstone fractures do not appear to be extensive, but that conclusion was hindered by lack of scale and a limited survey area and that DOE planned to do additional surveys in the future. Have there been any recent saltstone surveys in addition to Vault 4, Cell G?</p>	<p>During the March 2009 observation, participants watched a video survey that showed fractures on the surface of the saltstone grout in Cell G of Vault 4. The survey area was limited and DOE has since developed a video surveillance program to further evaluate fracturing of the saltstone surface. The video will be analyzed by DOE and evaluated with respect to the PA. NRC staff will review the video and analysis as they become available.</p>
<p>Hydrotest Results</p> <p>(April 2010 Observation)</p>	<p>What are the details of the recent hydrotests results for each cell (e.g., hydraulic head, test duration, observation procedures, observations)?</p>	<p>DOE stated that the hydrostatic testing of the new disposal cells, following the design changes showed no evidence of leaking. The follow-up testing consisted of a modified version of the earlier hydrotest. The new test consisted of a 12-foot head differential for 132 hours. The NRC staff considers this item to be closed.</p>
<p>Vault 4 Floor</p> <p>(July 2010 Observation)</p>	<p>Vault 4 Floor - NRC staff asked that DOE look into characterizing the Vault 4 floor (or the material under the floor) to see if the floor in Vault 4 had cracked. Has there been any progress on this topic?</p>	<p>The response to this email question was discussed in the Follow-up Action: Anchor Bolt Penetrations in Vault 4 section. This follow-up action remains open pending the response to the above question and the completion of the work DOE is performing on this follow-up action.</p>

### 2.4.3 Conclusions and Follow-up Actions:

No new issues or concerns were identified during the technical discussion; however, multiple follow-up actions were identified during the discussion. Below is a list of items discussed during this portion of the observation.

**Performance Assessment/Research Activity** - NRC staff would like to know the results of the current research activities regarding the current and future SDF PA maintenance activities. This is not a follow-up action; however, the staff maintains an interest in PA maintenance activities and will continue discussions with the DOE leading up to its upcoming revision to the 2007 NRC monitoring plan for the Saltstone Disposal Facility.

**Open Issues 2007-1 and 2007-2** - NRC staff indicated that DOE's plans to address the open issues sound reasonable and will review the results of DOE's planned efforts. *Currently, the two issues remain open.*

**Follow-up Action: Disposal Unit 2 Water Tightness Test Quality Assurance Records** - DOE stated they would provide the NRC staff documentation of the design changes and hydrotesting results of the new disposal cells. NRC will review these documents when provided. *This follow-up action remains open.*

**Follow-up Action: Radiological Composition of Inadvertent Transfer Material** - Based on the information provided to the NRC in SRR-WSE-2010-00186 (ML111780337) provided to the NRC on October 26, 2010, *the NRC staff considers this action item to be closed.*

**Follow-up Action: Status of ARP/MCU Management Control Plan** - The NRC would like DOE to clarify how the sampling data obtained under the ARP/MCU management control plan is used and how the inventory of radionuclides sent to Tank 50 from ARP/MCU is determined. *This is a new follow-up action from this observation.*

In response to the DOE concern that tracking of long-term items as follow-up actions might not be the most efficient mechanism, NRC staff stated that the new monitoring plan will contain a list of major changes to the salt waste disposal process that they would like to be made aware of, if and when they occur.

DOE offered to provide a demonstration of the spreadsheet used for these inventory-updating calculations during the next onsite observation. This is not a follow-up action; however, the NRC would like to observe this demonstration in the future. The NRC makes note that this will be a future observation activity.

Because the ARP/MCU sample data does not affect the inventory determination for the Saltstone Disposal Facility, *NRC staff considers this follow-up action, which was created during this observation, to be closed.*



**Follow-up Action: Anchor Bolt Penetrations in Vault 4** - Because of the pending response to the NRC concern regarding the integrity of Vault 1 and 4 floors based on the presence of a similar drain system and anchor bolts and the pending completion of the work DOE is performing on the impacts of anchor bolt penetrations, this follow-up action remains open.

**Follow-up Action: Impact of Scale on Core Sampling Methodology** - NRC staff will continue to review core-sampling approaches and results, and DOE will move forward with formed-core sampling technology with consideration of the discussed exposure and logistical techniques when developing the sampling plan.

**Cure Temperatures and Impact of Aluminate Concentration** - NRC staff will review the cure temperature profiles for saltstone when DOE compiles them following future testing.

**Saltstone Fracturing** - NRC will review saltstone surface fracturing surveillance captured by DOE's recently developed video surveillance program as they become available.

**Hydrotest Results** - DOE stated that the hydrostatic testing of the new disposal cells, following the design changes showed no evidence of leaking. The follow-up testing consisted of a modified version of the earlier hydrotest. The new test consisted of a 12-foot head differential for 132 hours. The NRC staff considers this follow-up action to be closed.

### 3.0 OVERALL CONCLUSIONS AND FOLLOW-UP ACTIONS:

#### 3.1 Technical Discussion – Saltstone Radionuclide Inventory:

Of the three questions discussed during this portion of the observation, only question (2) remains unanswered. Question (2) will be addressed in DOE's response to the NRC staff's second RAI (RAI-2009-02). No additional issues or concerns were identified during the technical discussion on the radionuclide inventory of Vault 4 apart from DOE's continued effort to respond to RAI-2009-02. The NRC continues to have reasonable assurance that the 10 CFR Part 61 performance objectives can be met provided that key assumptions made in the waste determination prove to be correct.

#### 3.2 Technical Discussion – New Research on Long-Term Testing Waste Oxidation and Technetium Release:

Because of the NRC staff's concerns discussed above, Open Issue 2009-1 remains open. No additional issues or concerns were identified during the technical discussion regarding technetium release and oxidation in the saltstone wasteform. The NRC continues to have reasonable assurance that the 10 CFR Part 61 performance objectives can be met provided that key assumptions made in the waste determination prove to be correct.

#### 3.3 Discussion of Disposal Unit 2 Construction:

The NRC staff will continue to monitor the construction of the new disposal cells and will continue to monitor the cells when they are put into operation.

### 3.4 Follow-up Discussion – Topics from Previous Observations:

The table below summarizes the status of each of the discussion topics. Each topic is classified as being open, closed, or a future topic for discussion. The following terms are used to classify the topics.

**Remains Open:** The NRC is still awaiting action on the part of DOE, or results from a recent action taken by DOE. Further discussion will need to take place before the NRC can close the topic.

**Topic Closed:** The specific inquiry posed by the NRC has been fully responded to by DOE.

**Future Consideration:** The specific inquiry posed by the NRC has been discussed and DOE has stated a path forward that seems acceptable to the NRC. The item is not open because the DOE plans to address the topic. The item is not closed because the NRC is interested in the results of the analysis being performed by DOE.

Discussion Topic	Remains Open	Topic Closed	Future Consideration
PA/Research Activity			X
Open Issues 2007-1 and 2007-2	X		
Follow-up Action: Disposal Unit 2 Water Tightness Test Quality Assurance Records	X		
Follow-up Action: Radiological Composition of Inadvertent Transfer Material		X	
Follow-up Action: Status of ARP/MCU Management Control Plan		X	X
Follow-up Action: Anchor Bolt Penetrations in Vault 4	X		
Follow-up Action: Impact of Scale on Core Sampling Methodology			X
Cure Temperatures and Impact of Aluminate Concentration			X
Saltstone Fracturing			X
Hydrotest Results		X	
Vault 4 Floor	X		

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