NRC Monitoring of Salt Waste Disposal at the Savannah River Site – 13147

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ABSTRACT

As part of monitoring required under Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA), the NRC staff reviewed an updated DOE performance assessment (PA) for salt waste disposal at the Saltstone Disposal Facility (SDF). The NRC staff concluded that it has reasonable assurance that waste disposal at the SDF meets the 10 CFR 61 performance objectives for protection of individuals against intrusion (§61.42), protection of individuals during operations (§61.43), and site stability (§61.44). However, based on its evaluation of DOE's results and independent sensitivity analyses conducted with DOE's models, the NRC staff concluded that it did not have reasonable assurance that DOE's disposal activities at the SDF meet the performance objective for protection of the general population from releases of radioactivity (§61.41) evaluated at a dose limit of 0.25 mSv/yr (25 mrem/yr) total effective dose equivalent (TEDE). NRC staff also concluded that the potential dose to a member of the public is expected to be limited (i.e., is expected to be similar to or less than the public dose limit in §20.1301 of 1 mSv/yr [100 mrem/yr] TEDE) and is expected to occur many years after site closure. The NRC staff used risk insights gained from review of the SDF PA, its experience monitoring DOE disposal actions at the SDF over the last 5 years, as well as independent analysis and modeling to identify factors that are important to assessing whether DOE's disposal actions meet the performance objectives. Many of these factors are similar to factors identified in the NRC staff's 2005 review of salt waste disposal at the SDF. Key areas of interest continue to be waste form and disposal unit degradation, the effectiveness of infiltration and erosion controls, and estimation of the radiological inventory. Based on these factors, NRC is revising its plan for monitoring salt waste disposal at the SDF in coordination with South Carolina Department of Health and Environmental Control (SCDHEC). DOE has completed or begun additional work related to salt waste disposal to address these factors. NRC staff continues to evaluate information related to the performance of the SDF and has been working with DOE and SCDHEC to resolve NRC staff's technical concerns.

INTRODUCTION

Section 3116 of the Ronald W. Reagan National Defense Authorization Act for Fiscal Year 2005 (NDAA) requires the U.S. Department of Energy (DOE) to consult with the U.S. Nuclear Regulatory Commission (NRC) for certain non-high level waste (HLW) determinations. The NDAA specifies three criteria for determining whether waste is non-HLW: (i) the waste does not require disposal in a geologic repository, (ii) the waste has had "highly radioactive radionuclides" (HRRs) removed to the maximum extent practical, and (iii) disposal will meet the performance objectives outlined in 10 CFR Part 61 Subpart C for land disposal of radioactive waste. The NDAA also requires NRC, in coordination with the covered State, to monitor DOE's disposal actions related to those determinations to assess compliance with NRC regulations in 10 CFR Part 61, Subpart C. The four specific performance objectives included in the regulations in

10 CFR Part 61, Subpart C are: (i) protection of the general population from releases of radioactivity (§61.41), (ii) protection of individuals against inadvertent intrusion (§61.42), (iii) protection of individuals during operations (§61.43), and (iv) stability of the disposal site after closure (§61.44). Figure 1 shows the potential sources of non-compliance with the performance objectives in 10 CFR Pat 61, Subpart C, which are based on the collection of indirect and direct evidence.

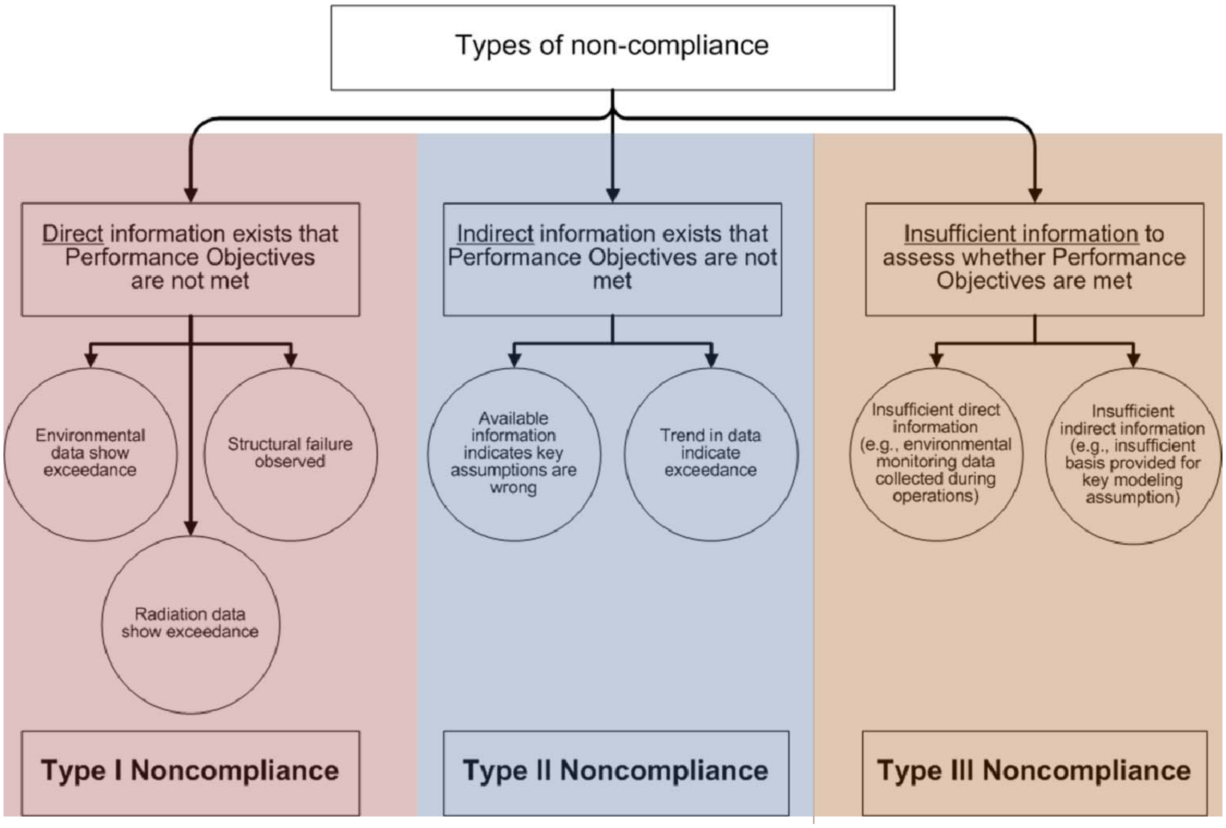

Figure 1. Potential Sources of Non-Compliance with the Performance Objectives in 10 CFR 61, Subpart C [1]

As part of the monitoring required by the NDAA, the NRC staff reviewed an updated DOE performance assessment (PA) for salt waste disposal at the Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) for which the DOE issued a waste determination (WD) in 2006 [2]. Tank closure entails removing liquid waste, solid salt waste, and precipitated sludge from waste tanks and stabilizing the residual waste by filling the tanks with a reducing grout. As the tanks are closed, the high activity fraction retrieved from the tanks is made into a glass waste form and is managed as HLW. The low activity fraction, called salt waste, is treated to reduce the concentrations of certain key radionuclides and then solidified with dry materials (i.e., cement, blast furnace slag, and fly ash) to form a reducing grout waste form called saltstone. The saltstone is disposed of in disposal units in the SDF. The first disposal units to be built, Vaults 1 and 4, were constructed in the 1980s and were constructed of reinforced concrete containing blast furnace slag. Saltstone has been placed in some of the cells in Vaults 1 and 4. After short-term performance issues with the existing vault design (such as cracking in the walls of Vault 4), DOE redesigned the vaults and referred to the new disposal units as "future disposal cells" (FDCs). In the updated PA for the SDF, DOE assumed that 64 FDCs would be constructed to hold the saltstone that is expected to be produced from the closure of the F and H tank farms.

PREVIOUS NRC MONITORING AT THE SDF

In December 2005, the NRC staff documented a review of DOE's 2005 WD and PA for the SDF. At that time, the NRC concluded that it had reasonable assurance that salt waste disposal at the SDF can meet the Criteria 1 and 2 provided in the NDAA in Section 3116 (i.e., the waste does not require disposal in a geologic repository and the waste has had "highly radioactive radionuclides" (HRRs) removed to the maximum extent practical). The NRC also concluded that it had reasonable assurance that Criterion 3 can be met provided certain assumptions in DOE's analyses were verified during monitoring [3]. These assumptions were identified as key monitoring factors and fall into the following general groups: waste form and vault degradation, the effectiveness of infiltration and erosion controls, and estimation of the radiological inventory. The main NRC findings for long-term performance in 2005 were that to contain the major risk driver, Tc, over the long-term, (1) the as-emplaced waste form would need to chemically reduce the Tc sufficiently to make it immobile, and (2) the waste form and other engineered features would need to limit water flow into the waste form. Water flow into the facility could bring oxygen into the waste form and oxidize the Tc, allowing release. In addition, the water would provide transport out of the waste form for any mobilized radionuclides, including Tc.

Following the January 2006 completion of the DOE's final waste determination for salt waste disposal [2], the NRC staff developed Revision 0 of the SDF Monitoring Plan [1]. The plan describes activities designed to monitor DOE's disposal activities as they relate to the eight key monitoring factors identified as part of NRC's PA review as well as other relevant activities that were identified early in the monitoring process (e.g., review of environmental monitoring data and worker dose records). NRC monitoring activities of the SDF began following completion of this monitoring plan. Those activities included Onsite Observation Visits, Technical Reviews, and meetings with DOE and are documented in a series of Annual Monitoring Reports [4, 5, 6, 7, 8]. Since the Monitoring Plan was issued in 2007, DOE has continued to gather additional information regarding their assumptions for long-term performance while producing saltstone and disposing of it at the SDF. The NRC staff has been reviewing this research as it becomes available.

During NRC monitoring at SRS, the NRC staff identified four Open Issues of relatively high risk significance that could affect compliance (Table I). These Open Issues relate to factors that either DOE has not taken sufficient action to address or instances where data collected by DOE was not consistent with key assumptions in the PA. One Open Issue was adequately addressed by DOE and has been closed (Open Issue 2007-3), and three remain open. DOE research related to these Open Issues is ongoing. These Open Issues are being incorporated in NRC's revised monitoring plan, as discussed below.

TABLE I. Saltstone Disposal Facility Open Issues

Number	Brief Description of Issue	Identified
2007−1 (Open)	DOE should determine the hydraulic and chemical properties of as-emplaced saltstone grout.	10/2007
2007−2 (Open)	DOE should demonstrate that intrabatch variability, flush water additions to freshly poured saltstone grout at the end of each production run, and additives used to ensure processability are not adversely affecting the hydraulic and chemical properties of the final saltstone grout.	10/2007
2007−3 (Closed)	DOE should reassess the risk significance of the as-built conditions of Vault 4 in light of the presence of contaminated seeps on the exterior wall of Vault 4.	10/2007
2009−1 (Open)	DOE should demonstrate that (1) Tc−99 in salt waste is strongly retained in saltstone grout and (2) the sorption of dissolved Tc−99 onto saltstone grout and vault concrete is consistent with the K_d values for Tc−99 assumed in the PA.	03/2009

NRC REVIEW CONCLUSIONS FOR THE 2009 PA

On November 23, 2009, the U.S. Department of Energy (DOE) submitted the "Performance Assessment for the Saltstone Disposal Facility at the Savannah River Site" [9] to the U.S. Nuclear Regulatory Commission (NRC) for review. The 2009 PA is an update to DOE's February 28, 2005 Performance Assessment (PA) performed in support of the "Section 3116 Determination, Salt Waste Disposal, Savannah River Site" [2]. The updated PA includes new information about issues raised in NRC's 2005 review, and information about changes to the disposal cell design made since the 2005 PA. On April 30, 2012, NRC completed its review of the DOE 2009 PA for the SDF in accordance with the NDAA, as documented in its SDF Technical Evaluation Report (TER) [10].

In DOE's revised PA, DOE evaluated a base case (alternately, called Case A), which DOE indicates reflects its expectation of long-term performance, and a number of alternate analyses. In Case A, the upper cover is assumed to degrade with time, but there is no degradation of the saltstone and limited degradation of the disposal units assumed over a 20,000 year evaluation period. The walls in Vaults 1 and 4 are assumed to be initially cracked, while the floor and roof remain essentially intact. The new FDC walls, like the floor and roof, are assumed to experience only minimal degradation. Primarily due to a lack of roof degradation, Case A modeling results show that over 99% of the water is shed around the disposal units from 400 to 10,000 years after site closure. This significant limitation of modeled water contact with the waste limits the modeled release of radioactivity out of the waste. In addition, because oxidation from gas-phase transport of oxygen is not included in Case A, the flow restriction significantly limits the modeled dissolved or aqueous phase oxygen oxidation of saltstone, further limiting Tc mobilization and release.

DOE also supplied a number of alternate assessments as part of the 2009 PA. In these assessments, the impacts of increased degradation of one or more barriers (as compared to the base case) were evaluated. For example, in Cases B and C, DOE evaluates the impact of fast-flow paths, such as gaps between the saltstone and disposal unit walls. However, in almost all of the alternate assessments provided with the PA, the roof remains largely intact so the shedding of over 99% of the water around the disposal units occurs masking the impact of fast flow paths and other barrier degradation on the results. In one case, the Synergistic Case, DOE evaluated multiple degradation mechanisms, including roof degradation. Although more water flows to the disposal unit in the Synergistic Case (as compared to the base case), because the saltstone matrix is assumed to have a very low hydraulic conductivity, most of the flow is diverted through the disposal unit walls (for the FDCs) or saltstone fractures (for Vault 4). Because almost all of the infiltrating water bypasses most of the saltstone inventory in the cases DOE supplied with the PA, these cases do not appear to realistically assess potential doses from saltstone. In addition to these deterministic cases, DOE also performed probabilistic analyses. However, because of concerns about the design and implementation of the probabilistic model, the NRC staff did not rely on the probabilistic model in its compliance evaluation.

The staff questioned support for several of DOE's assumptions in its base case analysis, including (1) the lack of saltstone fractures, given that cracking of saltstone already has been observed; (2) the performance provided by the roof and lower drainage layer in shedding over 99% of the water around the disposal units throughout a 10,000 year performance period; and (3) the basis for a number of parameters (e.g., hydraulic conductivity, Tc sorption coefficients), because recent research does not support DOE assumptions. The NRC sent two rounds of questions, called requests for additional information [11, 12]. In the second round [12], NRC requested a revised base case to address assumptions in DOE's base case that the NRC staff determined were unrealistically optimistic or inadequately supported. For example, the NRC staff requested that the revised base case represent degradation of the engineered disposal units and saltstone over time (e.g., cracks developing which allows additional water to oxidize saltstone and release the mobilized Tc).

DOE responded to this request with the Case K model, which addresses a number of NRC concerns. The roof and disposal unit walls degrade over time, developing cracks and increased water flow. The saltstone develops a number of cracks, which results in the saltstone becoming oxidized sooner than in previous DOE cases. The fractures are not represented explicitly in the flow model, but water transport through the system is greater than DOE assumes in the base case because of greater assumed hydraulic conductivity in the saltstone and disposal unit concrete. Although more water flows through the disposal units and saltstone in Case K, DOE assumes that the disposal unit concrete acts as a significant barrier to Tc release. Because DOE changed the way Tc sorption was modeled from a discrete-fracture model to a model based on an average sorption coefficient, Tc is not modeled as leaving the disposal unit through oxidized pathways. Instead, in the Case K model, intermediate model outputs show Tc is retained in the disposal unit floor for thousands of years until it nears complete oxidation. This level of performance for the floor is unexpected because the disposal unit floor will likely develop flow pathways through cracks and joints which would oxidize quickly and would not significantly retain Tc.

Because of DOE assumptions about (1) the way cracks develop in the saltstone over time (e.g., most of the cracks develop after 8,000 years) and (2) Tc retention in the disposal unit floor, projected peak doses are not projected to occur until approximately 12,000 - 14,000 years in DOE's Case K model. DOE calculated the peak doses to be between 0.5 mSv/yr (50 mrem/yr) and 0.9 mSv/yr (90 mrem/yr) in three related versions of the Case K model that assumed slightly different K_d values for saltstone. In its TER, the NRC staff concludes that the information supporting the delay of the projected peak by these two assumptions is weak and, therefore, there is not reasonable assurance that these peak doses will occur after 10,000 years. That is, with more supportable assumptions, it is likely the peak dose will be projected to occur before 10,000 years. In accordance with NUREG-1854, NRC Staff Guidance for Activities Related to U.S. Department of Energy Waste Determinations [13], the time for which the 0.25 mSv/yr (25 mrem/yr) dose limit in §61.41 must be met is generally 10,000 years. Although the NRC staff concluded the projected dose may occur within 10,000 years of site closure, the NRC staff also noted that certain modeling assumptions in Case K (e.g., the suddenness of saltstone fracturing and the suddenness of release in the Tc release model DOE used) appeared to be pessimistic (i.e., to over estimate dose). The NRC staff performed independent analyses to evaluate the overall effect on the projected dose from the combination of these assumptions and DOE's more optimistic assumptions (i.e., the superior chemical performance of the disposal unit floors). The NRC staff concluded that, based on current information, the projected dose is between approximately 0.25 mSv/yr (25 mrem/yr) and approximately 1 mSv/yr (100 mrem/yr).

DOE has indicated that it continues to believe that the limited degradation in Case A, their original base case, appropriately models the future behavior of the system. DOE also indicated it believes Case K is extremely pessimistic. NRC disagrees with this characterization and concludes that, with certain exceptions (e.g., the chemical performance of the disposal unit floors), Case K provides a more realistic estimate of the future behavior of the system than DOE's selected base case.

Based on its evaluation of DOE's results and independent sensitivity analyses conducted with DOE's models, the NRC staff concluded that it did not have reasonable assurance that DOE's disposal activities at the SDF meet the performance objective for protection of the general population from releases of radioactivity (§61.41) evaluated at a dose limit of 0.25 mSv/yr (25 mrem/yr) total effective dose equivalent (TEDE). NRC staff also concluded that the potential dose to a member of the public from DOE's disposal actions evaluated under §61.41 is expected to be limited (i.e., is expected to be similar to or less than the public dose limit in §20.1301 of 1 mSv/yr [100 mrem/yr] TEDE). Additionally, any exceedance of the public dose limit is expected to occur many years after site closure. The NRC staff concluded in its TER that it has reasonable assurance that waste disposal at the SDF meets the 10 CFR 61 performance objectives for protection of individuals against intrusion (§61.42), protection of individuals during operations (§61.43), and site stability (§61.44).

The NRC issued a Type IV letter of concern to DOE on April 30, 2012 [14], consistent with guidance in NUREG-1854 [13] and the SDF monitoring plan [1], to formally communicate its technical concerns regarding salt waste disposal. Two outcomes are possible as a result of NRC staff's issuance of the Type IV letter: (i) If DOE is able to resolve NRC staff's concerns, NRC staff will issue a Type V letter of resolution, otherwise (ii) NRC staff will issue a letter of noncompliance to DOE, Congress and the State in accordance with the NDAA.

REVISED MONITORING PLAN

Following the completion of the review of the 2009 PA, NRC is revising its plan for monitoring salt waste disposal at the SDF in coordination with the South Carolina Department of Health and Environmental Control (SCDHEC). The NRC staff used risk insights gained from review of the

SDF PA, its experience monitoring DOE disposal actions at the SDF over the last 5 years, as well as independent analysis and modeling to identify factors that are important to assessing whether DOE's disposal actions meet the performance objectives of 10 CFR 61, Subpart C. Many, though not all, of these factors are similar to factors identified in the NRC staff's 2005 TER for salt waste disposal at the SDF [3]. Additionally, DOE has identified areas of ongoing and future work that are similar to many of these factors [9, 15]. Key areas of interest continue to be waste form and disposal unit degradation, the effectiveness of infiltration and erosion controls, and estimation of the radiological inventory. The previously identified Open Issues (Table I) are incorporated into these monitoring factors.

In the 2012 review of the SDF PA, NRC staff took a similar approach to identify Monitoring Factors as in the previous review, in that staff has focused on risk-significant issues. However, based on staff's monitoring experience since the previous review, staff determined that making individual Monitoring Factors more specific (i.e., smaller in scope), though leading to a larger number of individual Monitoring Factors, would facilitate monitoring. In the revised Monitoring Plan, related Monitoring Factors are grouped into Monitoring Areas.

The Monitoring Factors in the Monitoring Areas support the demonstration of compliance with one or more of the performance objectives (Table II). Each Monitoring Factor will be tracked as Open or Closed. Closing a Monitoring Factor does not necessarily mean there is reasonable assurance the disposal actions meet the performance objectives. For example, a Monitoring Factor about uncertainty in hydraulic conductivity measurements may be closed when sufficient model support (e.g., experimental data) exists to limit the uncertainty. However, the experimental data may lead to model projections that exceed the performance objectives.

If NRC staff concerns arise related to a Monitoring Factor, then NRC staff may develop an "Open Issue" to document concerns related to that Monitoring Factor. In that way, NRC staff will have a mechanism to communicate to DOE early in the process of the need for corrective action, prior to issuance of a notification letter of concern or letter of non-compliance.

TABLE II. Link Between Monitoring Areas and Performance Objectives

		Performance Objective			
MA#	**Description of Monitoring Area**	**§61.41**	**§61.42**	**§61.43**	**§61.44**
1	Inventory	X	X		
2	Infiltration and Erosion Control	X	X		
3	Waste Form Hydraulic Performance	X	X		
4	Waste Form Physical Degradation	X	X		
5	Waste Form Chemical Degradation	X	X		
6	Disposal Unit Performance	X	X		
7	Subsurface Transport	X	X		
8	Environmental Monitoring	X	X		
9	Site Stability	X	X		X
10	PA Model Revisions	X	X		
11	Radiation Protection Program			X	

Inventory (MA 1) is important to §61.41 and §61.42 because DOE assumed radionuclide release is limited by sorption and DOE does not take credit for potential limits on radionuclide solubility, which means that Inventory is linearly related to potential dose. Infiltration and Erosion Control (MA 2) is important to §61.41 and §61.42 because the closure cap is designed to limit infiltration and provide erosion control. Waste Form Hydraulic Performance (MA 3) is important to §61.41 and §61.42 because the effects of the hydraulic properties of saltstone on the rate of radionuclide release into groundwater are important to SDF performance. Waste Form Physical Degradation (MA 4) is important to §61.41 and §61.42 and is critical to SDF performance because the physical integrity of saltstone plays an important role in both limiting water infiltration and limiting saltstone oxidation, which have a significant effect on Tc-99 release.

Waste Form Chemical Performance (MA 5), Disposal Unit Performance (MA 6), and Subsurface Transport (MA 7) are important to §61.41 and §61.42 and SDF performance primarily because of the critical importance of radionuclide sorption in controlling the magnitude and the timing of the peak dose. In general, more sorption in the source material limits the peak dose by lowering the radionuclide's annual fractional release rate (i.e., higher sorption coefficient in the source reduces the quantity of a radionuclide released in any one year). Sorption in downstream areas, such as in the disposal unit concrete or vadose zone, delays radionuclide transport to the receptor site, which can reduce the peak dose from short-lived radionuclides and result in attenuation of pulse-like releases (i.e., a lower peak dose). Also, in the DOE Case K analyses, DOE modeled significantly more Tc-99 sorption in disposal unit concrete than in saltstone, resulting in re-concentration of Tc-99 in the disposal unit concrete. Thus, disposal unit concrete became a de facto new source. Therefore, increasing K_d values in disposal unit concrete directly limits the modeled peak dose in the DOE Case K model [16] by limiting the annual fractional release of Tc-99 into the environment.

Environmental Monitoring (MA 8) is important for §61.41 and §61.42. DOE monitors radionuclide and relevant chemical concentrations in a variety of environmental media (e.g., soil, air, surface water, animal meat, groundwater). Of those measurements, the NRC staff expects that groundwater monitoring to be most important to the demonstration of compliance with §61.41 because the potential dose from the SDF to an off-site receptor is projected to be dominated by groundwater pathways. Groundwater monitoring also includes measurements of other parameters that may serve as early indicators of releases from the SDF (e.g., groundwater nitrate concentrations, pH). Environmental Monitoring includes monitoring of data from the leak detection system that DOE will install at the SDF.

Site Stability (MA 9) is important to §61.41, §61.42, and §61.44. Site stability is important in limiting the infiltration through the SDF, which is important in maintaining compliance with both §61.41 and §61.42. Site stability is important to maintaining an adequate barrier to intrusion, which is important in maintaining compliance with §61.42. By definition, site stability is important to §61.44. PA Model Revisions (MA 10) is important to §61.41 and §61.42 because the Monitoring Factors under MA 10 are items that are cross-cutting among the other MAs and the NRC staff does not expect them to be closed before DOE updates the PA. Thus, they are items that the NRC staff will review when DOE next revises the PA under the DOE PA maintenance program. Radiation Protection Program (MA11) is important to §61.43 because DOE's radiation protection program is responsible for ensuring the protection of individuals during operations.

The NRC staff developed a draft prioritization of the Monitoring Factors [17] based on the relative risk significance of the factors (Tables III and IV). The final version of the revised Monitoring Plan will have the final prioritization of the Monitoring Factors. The factors were categorized as being low, medium, or high priority or as being Periodic Monitoring Factors. These factors are expected to be reviewed on a periodic basis. For example, information related to the inventory disposed will be reviewed on a quarterly basis. Monitoring Area 10 (PA Model Revisions) relates to items that are not expected to be fully addressed prior to the development of a revised PA, so these factors were not included as part of this prioritization.

TABLE III. NRC Prioritization of Monitoring Factors under Monitoring Areas 1 – 5

MA 1 Inventory	MA 2 Infiltration and Erosion Control	MA 3 Waste Form Hydraulic Performance	MA 4 Waste Form Physical Degradation	MA 5 Waste Form Chemical Degradation
- 1.01 - Inventory in Disposal Units[1]	- 2.01 - Hydraulic Performance of Closure Cap[2]	- 3.01 - Hydraulic Conductivity of Field-Emplaced Saltstone[4]	- 4.01 - Waste Form Matrix Degradation[4]	- 5.01 - Radionuclide Release from Field-Emplaced Saltstone[4]
- 1.02 - Methods Used to Assess Inventory[3]	- 2.02 - Erosion Protection[2]	- 3.02 - Variability of Field-Emplaced Saltstone[4]	- 4.02 - Waste Form Macroscopic Fracturing[4]	- 5.02 - Chemical Reduction of Tc by Saltstone[4]
		- 3.03 - Applicability of Laboratory Data to Field-Emplaced Saltstone[4]		- 5.03 - Reducing Capacity of Saltstone[3]
		- 3.04 - Effect of Curing Temperature on Saltstone Hydraulic Properties[4]		- 5.04 - Certain Risk-Significant K_d Values for Saltstone[3]
				- 5.05 - Potential for Short-Term Rinse-Release from Saltstone[3]

1 Periodic Monitoring Factors (i.e., factors related to data that the NRC staff expects to review on a periodic basis)
2 Low Priority
3 Medium Priority
4 High Priority

TABLE IV. NRC Prioritization of Monitoring Factors under Monitoring Areas 6-9, 11*

MA 6 Disposal Unit Performance	MA 7 Subsurface Transport	MA 8 Environmental Monitoring	MA 9 Site Stability	MA 11 Radiation Protection Program
- 6.01 - Certain Risk-Significant K_d Values in Disposal Unit Concrete[3]	- 7.01 - Certain Risk-Significant K_d Values in Site Sand and Clay[3]	- 8.01 - Leak Detection[1]	- 9.01 - Settlement Due to Increased Overburden[3]	- 11.01 - Dose to Individuals During Operations[1]
- 6.02 - Tc Sorption in Disposal Unit Concrete[4]		- 8.02 - Groundwater Monitoring[1]	- 9.02 - Settlement Due to Dissolution of Calcareous Sediment[3]	- 11.02 - Air Monitoring[1]
- 6.03 - Performance of Disposal Unit Roofs and HDPE/GCL Layers[3]				
- 6.04 - Disposal Unit Concrete Fracturing[3]				
- 6.05 - Integrity of Non-cementitious Materials[3]				

1 Periodic Monitoring Factors (i.e., factors related to data that the NRC staff expects to review on a periodic basis)
2 Low Priority
3 Medium Priority
4 High Priority
* Note that Monitoring Area 10 (PA Model Revisions) relates to items that are not expected to be addressed prior to the development of a revised PA

CONCLUSIONS

Based on its review of the 2009 PA for the SDF, the NRC concluded that it has reasonable assurance that waste disposal at the SDF meets the 10 CFR 61 performance objectives for protection of individuals against intrusion (§61.42), protection of individuals during operations (§61.43), and site stability (§61.44). However, based on its evaluation of DOE's results and independent sensitivity analyses conducted with DOE's models, the NRC concluded that it did not have reasonable assurance that DOE's disposal activities at the SDF meet the performance objective for protection of the general population from releases of radioactivity (§61.41) evaluated at a dose limit of 0.25 mSv/yr (25 mrem/yr) total effective dose equivalent (TEDE). NRC staff also determined that the potential dose to a member of the public is expected to be limited (i.e., is expected to be similar to or less than the public dose limit in §20.1301 of 1 mSv/yr [100 mrem/yr] TEDE) and is expected to occur many years after site closure. The NRC issued a Type IV letter of concern to DOE on April 30, 2012 consistent with guidance in

NUREG-1854 and the SDF monitoring plan to formally communicate its technical concerns regarding salt waste disposal. The NRC staff is developing a revised monitoring plan based on risk insights gained from review of the SDF PA, its experience monitoring DOE disposal actions at the SDF over the last 5 years, as well as independent analyses.

On July 12, 2012, DOE provided an updated Tc-99 inventory projection for Saltstone Disposal Units 2, 3, and 5 [18]. Based on the NRC's TER analyses and DOE's revised Tc-99 inventory, the NRC staff concluded that a Type II Letter to the U.S. Congress is not needed at this time [19]. The NRC staff determined that if DOE's new projected Tc-99 inventory for SDUs 2, 3, and 5 is correct, then the disposal of saltstone in these disposal units is unlikely to cause an off-site peak dose exceeding the requirements of 10 CFR 61.41 (i.e., 0.25 mSv/yr (25 mrem/yr)).

NRC staff is working with DOE and SCDHEC to resolve NRC staff's technical concerns regarding the disposal of salt waste at the SDF. Since the publication of the TER documenting the NRC staff's concerns, the NRC and DOE have held several public meetings to discuss the NRC staff's concerns and DOE's proposed actions to address these concerns [20, 21, 22]. NRC staff also conducted an Onsite Observation in August 2012 [23]. During this Onsite Observation NRC staff and DOE discussed the following topics: Salt Waste Processing, Disposal Unit Construction, and Quality Assurance, Tc-99 Inventory and New Inventory Quantification Methods, and Performance Assessment Maintenance and Path Forward for SDF Monitoring. In addition, NRC staff and DOE toured the SDF, including Vault 4 and Saltstone Disposal Units (SDUs) 2, 3, and 5.

DOE has completed or begun additional work related to salt waste disposal to address the NRC staff concerns about DOE meeting the performance objectives. This work includes a revised probabilistic model, a lysimeter field study, additional research related to the immobilization of Tc-99, a revised inventory of Tc-99 in waste that will be disposed in the near term, and efforts to improve understanding of the hydraulic properties of field-emplaced saltstone. NRC staff continues to evaluate information related to the performance of the SDF as DOE develops the information. If DOE is able to resolve NRC staff's concerns, then NRC will issue a Type V letter of resolution. Otherwise, NRC will issue a letter of noncompliance to DOE, Congress and the State in accordance with the NDAA.

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