July 25, 2011

ORGANIZATION: U.S. Department of Energy

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Low-Level Waste Branch
Environmental Protection
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and Environmental Protection
Office of Federal and State Materials
and Environmental Management Programs

PROJECT: Savannah River Site, Saltstone Facility

SUBJECT: MAY 17, 2011, SUMMARY OF TELEPHONE CONFERENCE CALL TO DISCUSS SECOND REQUEST FOR ADDITIONAL INFORMATION FOR REVIEW OF THE UPDATED PERFORMANCE ASSESSMENT FOR THE SALTSTONE DISPOSAL FACILITY, DOCKET NUMBER PROJ0734

On May 17, 2011, the U.S. Nuclear Regulatory Commission (NRC) participated in a working-level phone call with the U.S. Department of Energy (DOE) to discuss DOE's proposed approach for responses to the NRC staff's second request for additional information (RAI). The purpose of the call was to ensure the comments are fully understood by DOE such that DOE may adequately respond to the NRC's second RAI made during review of the Performance Assessment for the Saltstone Facility at the Savannah River Site. NRC is reviewing the Saltstone Performance Assessment in accordance with its monitoring responsibilities under Section 3116 of the National Defense Authorization Act for Fiscal Year 2005. No formal decisions were made or intended to be made at this meeting. The purpose was for information exchange at the technical staff level and no management was present at the meeting.

Enclosure 1 provides a listing of the telephone conference participants. Enclosure 2 contains a listing of the RAIs discussed and a brief description of the status of each item. A copy of this summary was provided to the DOE for comment.

Docket No.: PROJ0734

Enclosures: As stated

CC w/enclosures: WIR Service List

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Regarding the Savannah River Site, Saltstone Facility

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Request for Additional Information Discussion and Status with Regard to the U.S. Nuclear Regulatory Commission Monitoring Activities at the Saltstone Disposal Facility at the Savannah River Site
May 17, 2011

The U.S. Nuclear Regulatory Commission (NRC) sent its second Request for Additional Information (RAI) on December 15, 2010 (ML103400571). Due to the complexity of performance assessments (PA) and associated RAIs, extensive clarification of RAI comments is sometimes necessary. Additionally, the NRC staff provided some indication of the risk significance of the basis for various RAI comments to the U.S. Department of Energy (DOE).

SP-19: ***Comment***: Research related to the release of Tc-99 from saltstone appears to be inconsistent with the Tc-99 releases modeled in the PA.

Discussion: In response to the discussions between the NRC and DOE on May 12, 2011, the DOE contractor provided some additional clarifications about the methodology that they intend to use to model the oxidation and release of Tc from saltstone. The DOE contractor added advective flow through the oxidized cells in their GoldSim model and found that this did not affect the overall modeling results by much. NRC suggested a larger effect might be seen if the oxidized cells were not modeled as being completely physically intact (i.e., if they were partially hydraulically degraded). Additionally, the DOE contractor provided information on the diffusion of Tc out of the matrix into the fracture cell and the diffusion back into the reduced region from the oxidized region. This information showed that as the column of cells is modeled as becoming oxidized, there is initially a diffusive flux back into the reduced region, but then the net diffusion reverses direction and Tc moves out of the wasteform.

DOE staff stated that the results of their calculations indicated that the performance of their "single porosity" model (in which the oxidation of Tc was modeled by using a K_d value based on a weighted average of the oxidized and reduced K_d values) was comparable to a more complicated model that modeled the oxidized and reduced regions separately. NRC staff stated that the information provided by DOE from their simple GoldSim models that compared the single porosity weighted K_d model with a more complex model that treated technetium sorption in oxidizing and reducing saltstone separately was very helpful and was the type of information that NRC was looking for as part of model support. However, NRC staff also noted that there did not seem to be a physical basis for these two models to produce the same results under all possible sets of parameters (e.g., flow rates, rates of oxidation, and the rate and extent of fracturing, and diffusivity). Therefore, NRC staff stated that it is important for DOE to perform similar calculations for the range of parameter values included at different time steps in their PORFLOW model to confirm that the use of the weighted K_d value is appropriate. DOE contractor staff stated that they understood the NRC concern and that they would perform similar GoldSim calculations for the range of parameter values observed in their PORFLOW model.

Status: Topic required clarification, NRC staff clarified the RAI to DOE staff; no additional technical discussion is required. NRC looks forward to reviewing how the discussion is incorporated into the response.

SP-15: ***Comment***: The basis for the adopted technetium pseudo-K_d of 1,000 mL/g for reducing conditions is not sufficient.

Discussion: NRC staff also asked DOE for clarification regarding the selection of the value of 1000 mL/g for the K_d for the reduced wasteform since the measured K_d value for Tc under reducing conditions was closer to 500 mL/g. NRC staff noted that in a model in which the oxidized and reduced portions of the waste are modeled separately, there may not be much difference in the modeled release between a K_d value of 1000 mL/g versus 500 mL/g in the reducing zone because release would be expected to be dominated by release from the oxidized zone. However, in a model that uses a weighted average for the K_d value, this difference could be more significant. DOE contractor staff stated that a test case could be performed in GoldSim using a value of 500 mL/g for the reduced Tc K_d value to determine if this would affect the results.

NRC staff also noted that, as previously stated during the April onsite observation and public meeting, the most recent Tc research was performed in an atmosphere that contained $H_{2(g)}$. In addition, the most recent Tc research developed by DOE also concluded that the trace amounts of $O_{2(g)}$ were sufficient to oxidized the Tc. NRC staff reiterated that the oxidation and release of Tc is a key factor in the expected performance of the saltstone wasteform, and it is important to determine the applicability of the results obtained in the lab to the field conditions.

Status: Topic required clarification, NRC staff discussed the RAI with DOE staff; additional technical discussion is required.

Hydraulic Conductivity: ***Comment***: Pertains to entire table of comments below.

RAI	Comment
VP-2	Additional basis is required for neglecting disposal unit degradation mechanisms other than sulfate attack.
SP-3	The moisture characteristic curve for intact saltstone implemented in the PORFLOW model does not sufficiently account for experimental uncertainties and is inconsistent with literature results for material similar to saltstone and other cementitious materials.
SP-4	Characteristic curves implemented in the PA are based on a continuum approach that does not reflect non-equilibrium flow.
SP-5	Additional support is needed for the hydraulic conductivity of intact saltstone that is used in Case A, Case B, Case C, Case D, and the synergistic case.

Discussion: NRC and DOE staff discussed the assumptions for the hydraulic conductivity in the DOE model. DOE proposed to use a set of saturated hydraulic conductivity values to represent the degradation of cementitious materials over time in their model. DOE also proposed that their model would assume that the saturation was equal to one and that moisture characteristic curves for cementitious materials would not be included in the model.

NRC staff asked if ponding on the floors could occur if the assumed hydraulic conductivity in the floors is less than the assumed hydraulic conductivity for the roof and saltstone. DOE contractor staff stated that the relatively high hydraulic conductivity of the walls would prevent ponding conditions on the floor within the PORFLOW model.

NRC staff noted that they did not have their description of the basis for the performance of the lateral drainage layer yet, so this could not be reviewed at this time. The performance of the lateral drainage layer is potentially significant to the predicted dose. NRC staff noted that when a higher hydraulic conductivity is assumed for the vault roof less water is expected to be modeled as shedding off of the roof.

Status: Topic required clarification, NRC staff discussed the RAI with DOE staff; additional technical discussion is required.

SP-10: ***Comment***: There are indications that some measured plutonium and neptunium sorption coefficients in cementitious materials could reflect solubility rather than sorption, which could lead to a significant overestimate of plutonium and neptunium sorption.

Discussion: NRC staff commented on the methodology used to determine the K_d values in the SRNL-STI-2010-00667 report. In this report, K_d values were measured using desorption experiments. In measurements of K_d using adsorption experiments, if equilibrium is not reached in the experiment the measured K_d value will be less than the true value, which typically is conservative. However, in desorption experiments, the opposite is true. In the real system, equilibrium would likely be reached due to the relatively slow expected flow rates through saltstone. NRC staff asked DOE if equilibrium had been reached in their experiments. NRC staff stated that they were particularly interested in the K_d values for Pu because the measured K_d values were already lower than the ones assumed in the model. DOE stated that they would get back to the NRC on this topic.

Status: Topic required clarification, NRC staff discussed the RAI with DOE staff; additional technical discussion is required.

Table of Proposed Parameters: ***Comment***: Pertains to entire table of comments below.

RAI	Comment
PA-8	The base case does not represent the current and reasonably expected future conditions.
PA-9	Conclusions about the conservatism of the synergistic case are not clear as certain assumptions appear to be overly optimistic, while other assumptions are potentially conservative.
PA-10	Assumptions in the PA regarding the conceptual model and parameterization may result in unsupported modeled flow rates through saltstone.
IEC-8	The PA should provide a technical basis for the long-term performance of the geotextile filter fabric and the upper and lower lateral drainage layers.
SP-1	Additional justification is required for the assumption that saltstone is hydraulically undegraded for 20,000 years.
SP-2	A basis is required for the modeled extent of saltstone fracturing.
SP-3	The moisture characteristic curve for intact saltstone implemented in the PORFLOW model does not sufficiently account for experimental uncertainties and is inconsistent with literature results for material similar to saltstone and other cementitious materials.
SP-5	Additional support is needed for the hydraulic conductivity of intact saltstone that is used in Case A, Case B, Case C, Case D and the synergistic case.
SP-6	Additional basis is required for the values of the effective diffusivity of intact and degraded saltstone used in the base case and sensitivity cases.
SP-7	Additional bases are needed for key assumptions used in the simulation of sulfate attack with the STADIUM code.
SP-12	Model support is needed for the process models supporting PA predictions of Eh-pH evolution for cementitious materials.
SP-13	The effect of limiting the shrinking-core model to the effects of the Eh evolution of saltstone on Tc should be analyzed.
SP-17	Neglecting gas-phase diffusion of oxygen appears to be inconsistent with the PORFLOW result that saltstone fractures are not completely saturated.
VP-2	Additional basis is required for neglecting disposal unit degradation mechanisms other than sulfate attack.
VP-3	The effect of modeling disposal unit floors as completely reducing for the entire performance period, and beyond 20,000 years, should be analyzed.
VP-6	The bypassing of flow through Vaults 1 and 4 walls may not have a physical basis.

Discussion: DOE provided a description of proposed parameter values and modeling methodology to be used in their revised Case K, including the parameters and methodology for modeling the following features and processes: saltstone degradation, moisture characteristic curves, saturated hydraulic conductivity, effective diffusivity for saltstone, pore volumes for E_H and pH transitions, Tc release, drainage layer performance, degradation of disposal unit concrete, dose to the chronic intruder, assumed inventory, K_d values, and biosphere.

NRC staff asked why SP-17 (effect of gas-phase transport on the oxidation of saltstone) was listed by DOE as being closed out by their new assumptions on the degradation of saltstone. NRC staff noted that whether or not the fractures were saturated could affect the amount of oxidation of the saltstone. NRC staff also asked about the assumed fracture spacing and aperture. DOE contractor staff stated that because they are now determining the flow through the saltstone based on assumed saturated hydraulic conductivity values, instead of determining the flow based on an assumed amount of fracturing, the assumptions about fracture spacing and aperture no longer affect the calculation. NRC staff stated that although fracturing is not going to be modeled explicitly, the effect of gas-phase diffusion through fractures may need to be accounted for in an effective continuum approach. DOE contractor staff replied that they believe that gas-phase transport of oxygen through fractures would not be significant since the saltstone matrix is expected to be saturated and oxidation would still be controlled by aqueous-phase diffusion.

NRC staff stated that the pore volumes for E_H and pH transitions would be a topic that would be watched closely in monitoring.

NRC staff stated that they expect to depend heavily on Case K in the Technical Evaluation Report and in assessing compliance with the performance objectives.

Status: Topic required clarification, NRC staff clarified the RAI to DOE staff; no additional technical discussion is required. NRC looks forward to reviewing the response.

B-2: ***Comment***: The animal product pathways included in the dose assessment are the beef, milk, and finfish pathways. A basis for excluding the other animal product pathways (e.g., consumption of poultry and eggs) from the dose assessment is not provided.

Discussion: The discussion continued regarding NRC's comments on the biosphere model. NRC stated that they could provide the DOE some data on chicken dirt ingestion, as the NRC had previously suggested would be appropriate for use in the PA.

Status: Topic required clarification, NRC staff clarified the RAI to DOE staff; no additional technical discussion is required. NRC looks forward to reviewing the response.