February 19, 2013

Ms. Sonitza Blanco, Acting Director
Waste Disposition Programs Division
U.S. Department of Energy
Savannah River Operations Office
P.O. Box A
Aiken, SC 29802

SUBJECT: THE U.S. NUCLEAR REGULATORY COMMISSION RESPONSE TO THE U.S. DEPARTMENT OF ENERGY LETTER DATED DECEMBER 14, 2012, RE: MODELING ACTIVITIES FOR THE SALTSTONE DISPOSAL FACILITY AT THE SAVANNAH RIVER SITE

Dear Ms. Blanco:

The purpose of this letter is to respond to the December 14, 2012, letter from the U.S. Department of Energy (DOE) regarding modeling activities for the Saltstone Disposal Facility (SDF) at the Savannah River Site (SRS) under the National Defense Authorization Act for Fiscal Year 2005 (NDAA). As is discussed in your letter, DOE is planning to perform additional modeling to address the issues expressed in the U.S. Nuclear Regulatory Commission (NRC) April 30, 2012, Technical Evaluation Report (TER) [available via the NRC's Agencywide Documents Access and Management System (ADAMS) at Accession Number ML121020140] and Type IV Letter of Concern [ML120650576].

Your letter proposed an NRC public meeting to engage with my staff in discussions about the technical bases for an updated PORFLOW modeling run. In response to your request, the NRC staff reviewed the materials associated with the parameter values and modeling approaches and met with your staff on January 17, 2013, in a NRC public meeting at the NRC Headquarters in Rockville, MD. In response to your request to receive feedback related to the information in Enclosure 1 of your letter, the NRC staff provided comments at the January 17, 2013 public meeting that are summarized in the enclosure to this letter. However, as was stated in past technical exchanges, final conclusions will be reached only after NRC staff completes a review of DOE's model as a whole, including intermediate model results.

In addition to the summary of technical points provided in the enclosure, below are some

high-level points to consider during development of your revised model:

(1) The NRC staff expects that it will be important to examine intermediate model outputs to ensure the mathematical model cases adequately represent DOE's conceptual models. Important intermediate outputs are expected to include; but, not be limited to, the following examples:

- Flow through the various engineered cover layers (including the drainage layers) as a function of time;

- Flow through fractures and joints in saltstone and the disposal structure concrete as a function of time, as compared to the amount of water flowing through the porous matrices;

- The physical distribution of radionuclides in the saltstone and disposal structure as a function of time (e.g., to evaluate whether the projected retention of radionuclides in the disposal structure concrete is realistic); and

- Saturation of saltstone and disposal structure concrete as a function of location and time.

(2) The NRC staff expects that it will be important for DOE to justify the extent of fracturing (or range of extents of fracturing) of saltstone and disposal structure concrete represented in the revised model as well as how the potential effects of fractures are represented in the model. The staff expects fracturing will affect water flow, oxidation, and the progress of cementitious materials degradation. The staff expects it will be particularly important to justify the surface area assumed in projecting processes that proceed from surfaces, including oxidation and degradation. The staff does not expect saltstone to remain intact (i.e., without fractures) for 10,000 years after site closure.

(3) As discussed at the January 17, 2013, public meeting, key references supporting DOE's representation of saltstone degradation and oxidation have not yet been supplied to NRC staff. The staff looks forward to receiving these references. The staff cannot fully comment on DOE's planned representation of these technical areas until the staff reviews these key references.

(4) The NRC staff would welcome the opportunity for further discussions with the researchers, whose work is being used to support key areas of the revised model, including saltstone degradation, oxidation, and radionuclide solubility and sorption.

A copy of this letter will be available electronically for public inspection in the NRC Public Document Room or using its ADAMS accession number ML13025A018. ADAMS is accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

If you have any questions or need additional information, please call me at (301) 415-6686, or call Nishka Devaser, the SDF Project Manager, at (301) 415-5196.

Sincerely,

/RA/

Aby Mohseni, 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:
Comments or Questions from Technical
Discussions at January 17, 2013,
Public Meeting on Upcoming
DOE PORFLOW Model

cc: 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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Comments or Questions From Technical Discussions at January 17, 2013, Public Meeting on Upcoming DOE PORFLOW Model

<table>
<tr><th>Slide Number</th><th>Comment or Question</th></tr>
<tr><td rowspan="3">General</td><td>DOE indicated that, per DOE requirements, the PA Maintenance Program describes the research and development activities that generate data supporting the modeling described during the presentation. Since the Maintenance Program is an ongoing process, future research and development efforts are planned to continue to strengthen and support modeling activities and will be made available as they are completed.</td></tr>
<tr><td>The NRC staff expects that it will be important to examine intermediate model outputs to ensure the mathematical model cases adequately represent DOE's conceptual models. Important intermediate outputs are expected to include, but not be limited to, the following examples:
o Flow through the various engineered cover layers (including the drainage layers) as a function of time;
o Flow through fractures and joints in saltstone and the disposal structure concrete as a function of time as compared to the amount of water flowing through the porous matrices;
o The physical distribution of radionuclides in the saltstone and disposal structure as a function of time (e.g., to evaluate whether the projected retention of radionuclides in the disposal structure concrete is realistic); and
o Saturation of saltstone and disposal structure concrete as a function of location and time.</td></tr>
<tr><td>The NRC staff discussed the variation in the average peaks and valleys in Tc inventory across the disposal cells given the new inventory information that was provided to NRC in July 2012. DOE indicated that the histograms from the RAI response (SRR-CWDA-2010-00033, Rev. 1, IN-3 response) are still the best available information related to Tc inventory distributions.</td></tr>
<tr><td>Slide 7</td><td>The NRC staff requested the basis for the selection of data between the two reports in discussed in this slide. The NRC staff also requested clarification of the comment in the conclusion of report SRNL-STI-2012-00596 specifically related to the relationship of pH vs. solubility in PNNL-21723 given the approximately constant pH shown in PNNL-21723 Figure 3.2.</td></tr>
<tr><td>Slide 8</td><td>The NRC staff recommended that DOE consider oxygen from liquid flowing through saltstone as well as diffusion of gaseous oxygen at all saltstone surfaces. If either mechanism is not included in the revised model, then justification should be provided.
o The justification could require multiple calculations to demonstrate which mechanism is dominant given a range of assumptions about hydraulic conductivity, oxygen concentration in subsurface gas, diffusivity, and the effects of degradation on diffusivity and hydraulic conductivity.
o The NRC staff suggested that DOE provide support for how DOE represents fracturing. Justification should be provided for the surface area modeled in the explicit shrinking core model to explain how it accounts for fracturing.
o The NRC staff requested a copy of the peer-reviewed solubility report when available.</td></tr>
</table>

Enclosure

Slide Number	Comment or Question
Slide 10	The NRC staff indicated that DOE should account for degradation mechanisms that are not currently included in the Cement Barriers Partnership (CBP) Toolbox. The NRC staff also indicated that DOE should account for feedback mechanisms and the coupling of multiple degradation mechanisms.
Slide 12	The NRC staff asked if DOE considered any potential negative impacts from degradation of High Density Polyethylene. DOE clarified that the High Density Polyethylene does not impact degradation mechanisms internal to the cell and waste form.
Slide 13	The NRC staff considers intermediate outputs of the flow field important to demonstrate the amount of flow going through the wasteform and disposal structure. (e.g., a flow balance through walls, matrix, around monolith, through fractures, through joints) and NRC staff recommended that DOE provides it.
Slide 15	The NRC staff suggested that DOE provide support for assumptions related to saltstone saturation and noted that intermediate outputs showing saturation as a function of time and location in the wasteform and disposal structure may provide useful insight into the potential effects of saturation.
Slide 17	The NRC staff suggested that non-linear effects on fluid flow from different materials should be evaluated with support provided to validate the values chosen. o Blending Moisture Characteristic Curves (MCCs) of differing materials is not likely to be straightforward and is likely to require a significant amount of justification if MCCs significantly reduce the projected water flow. MCCs are a function of pore size distribution. Degradation alters the pore size distribution and may not linearly change the MCCs. Based on the complexity of this subject, NRC anticipates the need for some level of support (i.e., reasonable technical basis) from experimental evidence rather than a mathematical justification alone. o MCCs assume steady state conditions. Episodic flow would invalidate the use of MCCs. If saturation remains relatively constant at 96% then this would not have a significant impact. However, if saturation diminishes significantly, then use of the MCCs may become difficult to support.
Slide 21	The NRC staff recommended that DOE consider additional support for the use of average water-to-premix ratios given that there are startup and shutdown flushes that change the water-to-premix ratio significantly for short periods of time. The NRC staff noted that it may not be possible to adequately represent the system with average values if short-term increases in the water to premix ratio cause connected pathways of grout with elevated hydraulic conductivity or diffusivity. DOE will provide new information from test reports as available. It may be possible to refine the estimate of volume of saltstone affected by higher water-to-premix ratio from flushing.
	DOE mentioned that thermocouple data has been obtained and a report is being prepared for transmittal to NRC, as discussed in the NRC December 2012 Onsite Observation Visit Report [ML13010A499].
Slide 28	The NRC staff recommended that DOE provide support for degraded values of effective diffusivity used in the model. DOE stated that justification will be provided for the end state in a new report.
	The NRC staff requested that DOE consider the impact of degradation on the progression of the oxygen diffusion front. Specifically, the NRC staff noted that if the physical properties of the cementitious material change behind the oxidation front, the progress of the oxidation front may not conform to the typical square root of time relationship.

Slide Number	Comment or Question
Slide 29	The NRC staff suggested that additional model support is likely to be needed for the assumed reducing capacity of 607 µeq/g in saltstone.
	The NRC staff recommended that the rate of sulfide leaching and its impact on the reducing capacity of saltstone be considered (e.g., sulfide leaching reported in PNNL-21723).
	The NRC staff is concerned that modeling the disposal structures as reducing without considering fracture flow explicitly could result in an unrealistic level of performance. The NRC staff does not expect the disposal structures to remain intact (i.e., without cracks) throughout the performance period. As discussed in Section 2.13.3.2 (NRC 2012 TER), the NRC staff believes that the presence of fast pathways will limit the ability of the disposal structures to retain radionuclides. Recent DOE research indicates the equilibration time for precipitation of Tc-99 under reducing conditions may be long compared to the time required for liquid to flow through a fast pathway in disposal structure concrete. As discussed during the December 6, 2012, onsite observation visit, the NRC staff is concerned that the retention capability of the disposal structure may be overestimated if this behavior is not represented in the model.
	The NRC staff recommended that DOE provide support for how radionuclides are retained in a degraded (i.e., cracked) floor.
Slide 33	The NRC staff requested additional information related to the hydraulic properties associated with gravel (e.g., the MCC used).
Slide 35	The NRC staff recommended that DOE support the model simplifications made to represent disposal structure columns and modeled material properties. In particular, the NRC staff expressed concern that the assumptions DOE outlined regarding the hydraulic conductivity of the columns in the future disposal cells (i.e., initial and as a function of time) appear to be unrealistic and would tend to result in flow bypassing the saltstone grout. Those assumptions could result in a significant amount of credit to the SDF and would therefore require a commensurate level of justification.
Slide 39	The NRC stated that the reference that DOE cites in the PA supports a K_d value of 30 mL/g for selenium in oxidized middle aged cementitious materials. DOE's proposed value of 150 mL/g is reported for the more reduced form of selenium, selenite, rather than for the more oxidized form selenate. Therefore, the value of 30 mL/g appears to be more appropriate for oxidized region II and III cementitious material than DOE's proposed value of 150 mL/g (NRC 2012 TER, page 108). DOE indicated that the values used in the modeling will be reconfirmed.
Slide 40	The NRC requested clarification of the following points: o Most recent dose methodology from sensitivity run will be continued (i.e., dose methodology improvements in Case K sent to NRC in SRR-CWDA-2012-00103 will be retained). o Chronic intruder methodology will not change; but, the doses predicted by the model may change.