**NRC staff questions for Technical phone call and onsite observation regarding SRNL-STI-2012-00769**

## Scope of Questions

The authors of SRNL-STI-2012-00769 indicate that part of the purpose of the paper is to generate recommendations for values of saltstone solubility and sorption coefficients to be used in performance assessments (PA) for the saltstone disposal facility. Therefore, the NRC staff has questions about how the values recommended in SRNL-STI-2012-00769 will be used in future PAs, in addition to questions related to the text and figures of SRNL-STI-2012-00769 and how they were developed from its supporting references. The comments below are named in the following way: *NRC-(Onsite Observation)-(last three digits of technical report)-#*.

## SRNL-STI-2012-00769 and Supporting References

NRC-OO-769-01 Additional information is needed regarding the basis for the value recommended for future PA work with respect to middle-aged reducing grout (Table 11).

- Solubility values appear to be based on modeling results for saltstone leachate (Table 7). Is that accurate?
- Were the other modeling results discussed in the paper used to develop the values in Table 11? If so, how were they used?

NRC-OO-769-02 The authors address concerns about Tc solubility at high ionic strengths by stating that saltstone is only expected to have a high ionic strength environment for a short period of time. The NRC staff is concerned that the error associated with the difficulty of modeling Tc solubility in high ionic strength solutions may be more significant than stated in this paper. Additional information is needed to determine if a high-solubility period could cause an initial high-concentration flush of Tc out of emplaced saltstone.

- Can DOE bound the solubility of Tc in the high ionic strength solutions?
- Can the authors elaborate on what they mean by a “short time,” in terms of pore volumes?

NRC-OO-769-03 In PNNL-21723, the concentrations of Tc in solution were indicative of certain species. However, other minerals could have resulted in the same aqueous Tc concentrations. What uncertainty is associated with limiting the geochemical modeling to these species?

NRC-OO-769-04 The authors of SRNL-STI-2012-00769 conclude saltstone effectively re-reduces Tc based on diminishing aqueous Tc concentrations for two weeks after Tc was oxidized by a purge with 100% $O_{2(g)}$ (Figure 3.7 of PNNL-21723). However, the amount of re-reduction shown is small because it does not appear that much of the Tc was oxidized following the introduction of oxygen into the system in reactor 3. A much large fraction was oxidized by a second and third oxygen purge in reactor 2.

- What are the authors thoughts related to the relatively small fraction of Tc oxidized by one 30 minute purge with 100% oxygen (reactor 3) with the relatively large fraction of Tc oxidized by two thirty-minute purges?

- How do the authors compare the oxidation of Tc with in PNNL-21723 with the fraction of Tc oxidized by the continuous presence of 30-60 ppm of oxygen in SRNL-STI-2010-00667?

**Use of SRNL-STI-2012-00769 to support a PA**

NRC-OO-769PA-01 Which of the values in Table 11 will be used in the PA?

NRC-OO-769PA-02 How will the transitions between the stages be calculated?

NRC-OO-769PA-03 Table 11 indicates "young" cement has a pH of approximately 12, moderately-aged cement has a pH of approximately 10.5, and aged cement has a pH of approximately 5.5. Are 10.5 and 5.5 the cut-off values used to estimate the transition to moderately-aged and aged cement, respectively? If not, what are the cut-off values?

NRC-OO-769PA-04 Are the solubility limits proposed for Tc going to be modeled probabilistically? If so, what distributions will be used?

NRC-OO-769PA-05 Based on DOE's previous PA for the Saltstone Disposal Facility, the NRC staff expects that the Tc solubility values for moderately-aged saltstone will be risk-significant. The thermodynamic databases discussed in this report appear to under predict the concentrations observed by Cantrell (PNNL-21723) for young cement.

- What uncertainty is associated with relying on database values derived from experiments conducted under young cement conditions and applying them to moderate-aged cement conditions?

- Is DOE considering conducting Tc-solubility experiments under moderately-aged saltstone conditions?

NRC-OO-769PA-06 Does DOE plan to use pyrrohtite as a surrogate for reduced sulfur in blast furnace slag in geochemical transport models representing transport of Tc through saltstone? It appears that a more soluble phase (e.g., CaS) would be leached from the saltstone more quickly than pyrrohtite and could lead to faster oxidation than pyrrohtite would.

- Is the solubility of pyrrohtite consistent with the estimated solubility of reduced sulfur phases in emplaced saltstone?

- Does DOE plan to rely on assuming soluble sulfur phases transition to less soluble phases over long periods of time? If so, what is the basis for this assumption?

**Comments**

1) The use of the uncertainty distributions from Almond has not been justified for cementitious materials. This distribution was based on a limited number of data points and is based on soil Kd values.

2) Table 7 appears to list the same results twice (i.e., the columns for “this work” and “Denham” do not seem to represent separate sources of information).