Summary Notes from 31 January 2008 Savannah River Site F-Area Tank Farm Performance Assessment Input Meeting

Attendees: Representatives from Department of Energy-Savannah River (DOE-SR), DOE-Headquarters (DOE-HQ), the South Carolina Department of Health and Environmental Control (SCDHEC), the U.S. Environmental Protection Agency, Region IV (EPA-IV), and the U.S. Nuclear Regulatory Commission (NRC), met at the SCDHEC offices in Columbia, South Carolina on 31 January 2008. Additional staff from the Savannah River Site (SRS), SCDHEC, and DOE participated by phone.

Discussion: DOE is pursuing final closure on the F-Area Tank Farm (FTF) located at Savannah River Site (SRS). At some point in the future, DOE and NRC will consult on waste determinations for these tank closures; additionally these tanks will be closed in coordination with EPA and SCDHEC in accordance with the Federal Facility Agreement for the Savannah River Site and the State-approved closure plans pursuant to the State Industrial Wastewater permit. The DOE, NRC, EPA, and SCDHEC met for the eighth in a series of technical exchanges on the proposed inputs for a revision to the FTF Performance Assessment (PA). The technical exchanges are intended to capitalize on early interactions between the agencies with a goal of improving DOE's FTF PA. Technical discussion during the meeting allowed for the clarification of general modeling approaches and for the identification of other specific questions.

Topics: The following two specific topical areas were discussed during the meeting:

1. Overview of the FTF PA model
2. Sensitivity analysis and uncertainty analysis

Summary: The following summarizes the discussion during the meeting, by topical area.

Overview of the FTF PA model

- DOE is preparing the final parameter input packages for the FTF PA. DOE stated that modeling input parameter development is completed and 16 key technical references (parameter input packages) have been sent to NRC, SCDHEC, and EPA. To the extent possible, results from previous scoping meetings have been incorporated into the updated parameter input packages. NRC staff indicated that,

since not all topics can be covered during the meeting and the discussion will be of a general nature, there may be additional questions on the reference documents or topics discussed during the scoping meeting once the performance assessment is submitted.

- DOE reiterated that it is using a deterministic/probabilistic hybrid modeling approach for the FTF PA. PORFLOW (deterministic code) is being used to determine radionuclide concentration results in baseline dose calculations. GoldSim (probabilistic code) is being used to conduct sensitivity and uncertainty evaluations. DOE will use the deterministic model results for demonstrating compliance.
- NRC staff stated that probabilistic distributions that are more subjective and significant to the results will require more justification (e.g., probability weighting of the solubility limiting phases, liner failure scenarios).
- NRC staff also noted that probability distributions should be developed for or should consider less likely, alternate scenarios (e.g., steel liner in contact with soil or humid air).

Sensitivity analysis and uncertainty analysis

- DOE is benchmarking the FTF PA model based on preliminary model runs. The intent of the benchmarking activity is to verify the GoldSim model runs against the PORFLOW model runs and the understanding of how the conceptual model should perform.
- DOE is using stochastic distributions in the GoldSim model runs. Preliminary parameter distributions are based on literature searches of maximum and minimum values and triangular distributions, and then refining distributions based on additional information following initial model runs.
- NRC staff questioned whether the PORFLOW model had been validated against actual system performance or the conceptual model before benchmarking (e.g., flow direction, timing, and transport properties such as dispersivity) and stated that the results should only be benchmarked to model output that has been determined to be accurate (e.g., numerical errors limited) and validated or calibrated. DOE agreed to provide additional evidence of PORFLOW model validation or calibration.

- NRC staff questioned the apparent difference in technetium peaks from initial sensitivity runs versus the actinium series. DOE staff noted that this was being driven by the assumptions of the waste release model concerning the reducing conditions of the waste form and how and when oxidation occurs in the model.
- DOE stated that the GoldSim runs included numerous distributions related to bioaccumulation factors, consumption rates, residual material inventory, tank basemat thickness, vadose zone thickness, tank configurations, distribution coefficients, pore volume transitions, basemat fast flow, solubility limits (for plutonium, uranium, technetium and neptunium), well depth, etc.
- DOE stated that each configuration of assumptions has its own set of probabilities when loaded into the GoldSim platform, and configurations are selected randomly. Configurations represent ranges of assumptions about time and extent of failures in waste form, liners, caps, and other parameters that affect infiltration, flow, and transport.
- NRC staff recommended that DOE consider using GoldSim to manage more of the stochastic modeling rather than trying to mechanistically generate the different possible scenarios or probability distribution functions outside of GoldSim. Using GoldSim in this manner may be a more efficient way to consider a comprehensive set of failure, release, and transport scenarios that may be more difficult to evaluate using more resource intensive deterministic codes or models. DOE agreed that it would be beneficial to run GoldSim scoping level calculations to evaluate parameter distributions not constrained to predetermined configurations to identify risk significance and compare those to reality (e.g., wide range of flow rates through the contamination zone and times to failure of engineered systems). DOE and NRC agreed that such analyses should be documented clearly.
- NRC staff questioned whether there is a configuration that assumes fast flow and oxidized water contacting the waste at an early time. NRC asked whether condition 2 (fast flow case) from the waste release package is ever modeled. DOE staff confirmed that there is a model run that captures the important parameters of the fast flow scenario.
- DOE presented how probabilities of water usage are assigned to the different aquifers and percentages of contamination concentrations assumed for each aquifer in the model runs. NRC recommended that probabilities of water usage

are not appropriate in the deterministic compliance case.

- DOE and NRC staff discussed the time frame represented in the model an whether information beyond the 10,000 year compliance period would be considered. DOE and NRC staff agrees that consideration of peak doses beyond the compliance period is a good practice and doses beyond 10,000 years should be considered commensurate with their significance and timing.
- DOE presented the current status of its sensitivity and uncertainty analyses with regard to additional efforts to benchmark the models. Additional benchmarking has been done to evaluate key radionuclide contributors and key source contributors.
- DOE stated that the parameters used for benchmarking included nodalization of the saturated zone, saturated zone Darcy velocity, and dispersion (via plume function). The configuration case that DOE used for the benchmarking is the baseline configuration, which is used for evaluating compliance.
- DOE presented specific benchmarking information with respect to uranium, neptunium, technetium, thorium, radium, plutonium, and americium for Tanks 1, 3, 5, 17, 18, and 34. Specific radionuclides used for benchmarking for each tank were selected based on their expected contribution to overall dose.
- DOE presented revised dose calculation distributions for the bioaccumulation and consumption rates assumed in the PA model, which were updated from the initial broad assumptions. Where evidence supported more reasonable ranges based on local conditions or additional information, the dose calculation distributions were revised. DOE stated that the baseline assumptions did not change, just the probabilistic ranges.
- DOE stated that select deterministic sensitivity and uncertainty analyses were also performed using the PORFLOW model. Single parameter sensitivity analyses were performed with the baseline configuration for waste tank inventory and basemat/soil Kd values. The results of the waste tank inventory sensitivity analysis show that for most radionuclides, the flux essentially varies linearly with the inventory with the exception of the solubility limited radionuclides. The results of the Kd sensitivity analysis show that the Tc-99 flux is relatively unaffected by Kd changes, while the Pu-239 flux can be impacted when the material layer is thick, e.g., Type I and Type III basemats.

- NRC staff recommended that DOE run some GoldSim analyses using additional flow assumptions based on alternative configuration assumptions to determine whether these differences created important differences in the model results. NRC staff commented that the sensitivity of the results to certain parameters could depend on the configuration assumptions used (e.g., results may not be sensitive to infiltration rate or the solubility of technetium under oxidizing conditions if the tank liner is assumed to remain intact for a long period of time; however, infiltration rate or oxidized technetium solubility may be important parameters in a configuration with early liner failure, especially if the early failure leads to oxidized preferential pathways through otherwise intact pieces of grout).
- DOE is conducting additional sensitivity and uncertainty GoldSim analyses incorporating new benchmarking results and distribution enhancements.
- NRC staff asked for clarification on the technetium solubility limit under oxidation conditions used in the model. Specifically, text on page 7 of the waste release report seems to indicate no solubility limit was used although the table on page 21 seems to indicate Tank 18 dip sample results were used to establish a solubility limit. DOE committed to follow up on the issue. NRC staff reiterated that, if Tank 18 dip samples are used to justify technetium solubility limits in oxidized grout, DOE would need to explain why the chemical conditions of Tank 18 dip samples are expected to be similar to the chemical conditions of oxidized grout pore fluid.
- NRC staff asked for clarification on the plus/minus two orders of magnitude range for solubility limits. NRC staff commented that the uncertainty is expected to be radionuclide specific.
- NRC staff asked for clarification relative to the assumptions concerning co-precipitation of plutonium with iron. Specifically, what is the basis for the ratio in solid reflecting the ratio in the liquid.
- NRC staff noted that on page 24 of the liner failure report calcium hydroxide concentration was inconsistent with later sections of the report.
- DOE committed to transmit updated Tanks 18 and 19 wall corrosion reports.
- DOE stated that the use of the 3-D model allowed confirmation of the 1-D abstraction.