July 29, 2013

NOTE TO: File PROJ0734

FROM: James Shaffner, Project Manager **/RA/**
Low-Level Waste Branch
Environmental Protection
and Performance Assessment Directorate
Division of Waste Management
and Environmental Protection
Office of Federal and State Materials
and Environmental Management Program

SUBJECT: SUMMARY OF CLARIFICATION DISCUSSION BETWEEN THE U.S. NUCLEAR REGULATORY COMMISSION STAFF AND THE U.S DEPARTMENT OF ENERGY AND SAVANNAH RIVER REMEDIATION STAFF CONCERNING PERFORMANCE ASSESSMENT MODELLING UNCERTAINTY/SENSITIVITY RELATED TO H AREA TANK FARM AT THE SAVANNAH RIVER SITE

On July 3, 2013, a discussion (teleconference) occurred between the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) technical staff and contractors to address clarifying questions related to performance assessment model uncertainty and sensitivity of the H-Area Tank Farm at the Savannah River Site. The questions were based on NRC staff review of DOE's performance assessment and related reference material. The discussions were conducted as part of NRC's consultation responsibility per section 3116 of the Ronald W. Reagan National Defense Authorization Act of 2005. The discussions were needed to clarify specific technical areas highlighted in this summary. No decisions or conclusions resulted from the meeting.

Meeting participants are included in Enclosure 1; summary of discussion is included in Enclosure 2.

Docket No.: PROJ0734

Enclosures:
1. Meeting Participants
2. Summary

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List of Participants
Teleconference with U.S. Department of Energy Staff Re: Savannah River Site, H-Area Tank Farm regarding Performance Assessment Modeling Uncertainty and Sensitivity
July 3, 2013

Participant	Affiliation
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Dan Ferguson	DOE Savannah River
Barry Lester	Savannah River Remediation (SRR)
Mark Layton	SRR
Kent Rosenberger	SRR
Ben Dean	SRR
Gregory Flach	Savannah River National Laboratory (SRNL)
Christopher Grossman	U.S. Nuclear Regulatory Commission (NRC)/Division of Waste Management and Environmental Protection (DWMEP)
Leah Parks	NRC/DWMEP
Cynthia Barr	NRC/DWMEP
Maurice Heath	NRC/DWMEP
Leigh Beatty	South Carolina Department of Health and Environmental Conservation SCDHEC)

Meeting Summary

Teleconference Between the U.S. Nuclear Regulatory Commission and U.S. Department of Energy Staff Regarding H-Area Tank Farm Section 3116 Consultation NRC Staff Request for Clarification regarding Performance Assessment Modeling Uncertainty and Sensitivity
July 3, 2013

In association with its review of the H-Area Tank Farm (HTF) draft waste determination and associated Performance Assessment (PA), the U.S. Nuclear Regulatory Commission (NRC) staff requested clarifications related to DOE's probabilistic uncertainty and sensitivity analysis, as well as deterministic modeling approaches and assumptions. Discussion topics included Goldsim model construction/application; benchmarking; model abstraction issues; inventory uncertainty; waste release; waste classification; general performance assessment; and near-field and far-field flow.

NOTE: Herein, the use of the term NRC staff refers collectively to NRC staff and its contractors; the use of the term the U.S. Department of Energy (DOE) staff refers collectively to DOE staff and its contractors.

Topic: *GoldSim Model Construction/Application*

Discussion:

The NRC staff had a number of clarifying questions related to: (i) inadvertent intruder well locations, (ii) GoldSim probabilistic model's abstraction of far-field flow and transport including simulation of dispersion and dilution along flow paths, (iii) approximate dilution factors (DFs) from HTF sources to the compliance boundary, (iv) use of flows output from PORFLOW modeling in GoldSim modeling, (v) representativeness of flow fields used for alternative cases, (vi) correlation of by-pass flow with by-pass fraction, and (vii) miscellaneous questions regarding execution of GoldSim model simulations.

DOE indicated that it did not evaluate intruder doses at the 1-m boundary in GoldSim. Rather, DOE selected seven intruder well locations that were thought to maximize cumulative impacts with up-gradient wells contributing to dose at the seven selected exposure point locations. Although professional judgment was used in selecting well locations and no formal study was conducted, DOE thought that the well locations were conservatively placed.

DOE clarified that the length of the pipe element pathway in GoldSim is determined solely by horizontal distance from the tank footprint to the 100-m boundary. The pipe element represents the entire aquifer thickness. DOE uses the GoldSim plume function to recalculate concentrations based on the assumed source dimensions and assigned dispersivities. DOE used a source thickness of 3-m, which is comparable to the thickness of a numerical cell in the PORFLOW modeling.

DOE provided preliminary estimates of saturated zone dilution factors (DFs). DOE noted that only transverse dispersion (not longitudinal) was considered in calculating these DFs.

With respect to source loading, DOE indicated that in GoldSim, integrated flux from the bottom of the Unsaturated Zone (UZ) into a single cell (multiplied by 10) is used to load contaminants from the unsaturated to the saturated zone. Note that GoldSim automatically distributes the UZ release equally among the 10 footprint mixing cells, which is why the multiplier is used to generate the integrated source term used in the pipe (analytical) model. In PORFLOW, DOE indicated that the radionuclide flux from the near-field modeling was loaded into the saturated zone in the cell with the highest elevation that is fully saturated and has a centroid within the tank footprint. For tanks that are submerged, DOE indicated that the source cell was located at the saturated elevation closest to the basemat. DOE indicated that it believes that the sensitivity of concentrations to loading cell dimensions is insignificant.

DOE indicated that a saturated zone dilution/mixing factor was applied at the end of the pipe element for GoldSim modeling. The factor was calculated as the ratio of the Darcy velocity near the compliance point to the Darcy velocity along the flow path to the compliance point. This factor was needed to account for increased velocity near the compliance point and was found to be more significant for F-Area Tank Farm (FTF). DOE indicated that it would need to confirm DFs for HTF.

DOE indicated that it believed that most sources are probably spread over both the Upper Three Runs Aquifer (UTRA) and the Gordon Aquifer (GA). DOE will confirm this information, if needed. NRC noted the difficulty in assigning longitudinal and transverse dispersivities in the abstracted model due to issues with changing vertical and horizontal flow directions in the 3D model that are simplified to 1D horizontal flows in GoldSim. DOE indicated that Figures 7.1-1 to 7.1-7 in the HTF Stochastic Fate and Transport Model Report (SRR-CWDA-2010-00093, Rev. 2) depict the plumes formed by conservative tracers for Tanks 9 (Type I), 12 (Type I), 15 (Type II), 24 (Type IV), 29 (Type III), 40 (Type IIIA), and 49 (Type IIIA).

With respect to flows used in the probabilistic analysis, DOE indicated that the GoldSim probabilistic model selects only from 72 flow profiles. Deterministic runs in GoldSim use the basecase flow (Case A). Case A flows were also used for benchmarking. Deterministic case B-D flows were placeholders and were not used. DOE indicated that they attempted to represent flow field variability in the 72 flow cases which used probabilistic analysis. However, no explicit consideration was given to how much flow was through the preferential pathways in preferential pathway cases such as Case E.

DOE indicated that there was no direct correlation between by-pass flow and by-pass fraction. DOE indicated that the probabilistic model evaluates a range of potential by-pass, in general, as insufficient information is available to predict exactly how and to what degree by-pass will occur. Review of maximum realizations is helpful in evaluating potentially more risk-significant alternative scenarios. Once this review is complete, DOE can then evaluate the likelihood of those potential scenarios.

Status: DOE provided information that addressed most of NRC staff's clarifying questions related to GoldSim model construction and application. DOE will provide source code and other dynamic link library documentation associated with the GoldSim probabilistic modeling.

Topic: *Benchmarking*

Discussion:

NRC staff had clarifying questions regarding potential limitations in model benchmarking. In particular, NRC staff were concerned that benchmarking comparisons were only carried out for the basecase. Further, benchmarking was only performed for a limited number of radionuclides (Ra-226, I-129, Np-237, Tc-99, Cs-135. Staff indicated that benchmarking for relatively short-lived radionuclides would be beneficial. Finally, staff inquired as to why only certain exposure point locations were benchmarked. DOE indicated that they choose to only benchmark Case A because it is used in the deterministic PORFLOW model. Alternative cases were run in PORFLOW and GoldSim.

NRC also sought clarification on the use of the benchmarking factor of 0.08 applied to flux from the annulus to the vault wall. DOE explained that the benchmarking factor was needed to represent the effects of a circulation cell in the annulus seen in the PORFLOW model that could not be simulated effectively in the GoldSim modeling.

Status: DOE provided clarifying information. NRC staff has no further information needs. Any remaining concerns associated with benchmarking will be documented in the NRC staff's technical evaluation report.

Topic: *Model Abstraction Issues*

Discussion:

NRC staff had questions related to tracking of flow in tank annuli for parameterization of the GoldSim model. Staff questioned the aggregation of PORFLOW flows and their utility in calculating chemical transition times in GoldSim. Although the peak doses for Tc-99 were similar for both models, there were significant differences in chemical transition times.

DOE clarified that only flows in the abbreviated annulus were extracted from PORFLOW for use in GoldSim. This led to differences in chemical transition times for the annulus.

Status: DOE provided clarifying information for model abstraction issues. NRC staff has no further information needs. Any remaining concerns associated with model abstraction will be documented in the staff's NRC technical evaluation report.

Topic: *Inventory Uncertainty*

Discussion:

NRC staff questioned the adequacy of waste inventory multipliers in light of sample results that showed differences larger differences in projected versus actual values. Staff noted that in some cases multipliers appeared to be conservative, but in others not so conservative. Staff requested that DOE further explain why non conservative multipliers were not risk significant.

DOE indicated that although certain specific radionuclides were greater than one order of magnitude over the projected values, the general trends from sample results did not suggest that a multiplier more than an order-of-magnitude (i.e., 10x) would be necessary. DOE stated that it wanted to avoid 'double-counting' conservatism with inventory multipliers since it also increased estimated volumes in comparison to FTF volume assumptions and increased concentrations used in response to the Tanks 5 and 6 final sample analyses. DOE expects the estimated volume of 4,000 gallons to be conservative. DOE plans to focus on updating inventory projections rather than adjusting multipliers in special analyses as tanks are cleaned.

DOE indicated that it revised inventories from SRR-CWDA-2010-00023 Rev. 1 to Rev. 3, but that the models for the PA were not updated because of schedule conflicts. DOE evaluated whether updating the model to Rev. 3 values was risk-significant on a radionuclide-by-radionuclide basis by inspection. The PA (SRR-CWDA-2010-00128, Rev. 1), on page 609, discusses the risk significance for specific radionuclides including Pu-241, Th-232, U-236, U-238. DOE indicated that these radionuclides were not Highly Radioactive Radionuclides (HRRs) and that the
non-conservatism was limited to a small number of tanks. Therefore, DOE concluded that updating the inventory multipliers in the model was not necessary.

Status: DOE provided clarifying information in response to NRC comments. NRC has no additional information needs at this time. NRC will document any remaining technical concerns related to inventory in its technical evaluation report.

Topic: *Waste Release*

Discussion:

NRC staff had a number of follow-up clarifications related to waste release including several questions related to annular source release assumptions and mechanisms (e.g., solubility control of annular waste, annular source loading locations, liner failure assumptions).

NRC staff noted that annular waste is assumed to have no solubility control; however, waste is able to diffuse upwards into the solubility controlled tank contaminated zone. DOE confirmed that annular waste can be transported into the solubility controlled tank contaminated zone. DOE indicated that annular waste is not expected to be risk-significant in general and plans to address the risk-significance of this phenomenon.

NRC staff noted that Type I annular waste is loaded in the annular reducing grout that can immobilize the waste for long periods until a chemical transition occurs. DOE indicted that loading the annular waste in the reducing grout maximizes the dose by allowing the waste to be held-up until the engineered barriers are assumed to fail at which time a higher peak dose occurs. NRC indicated that it was concerned with certain cases (e.g., short-lived radionuclides could be held up and allow for significant delay prior to release).

With regard to an NRC question regarding the basis for determining whether a liner will be assumed to be initially failed, DOE indicated that tanks with leak sites above the contaminated zone were not assumed to be initially failed. Tank inspection reports will provide details on annular inspections.

NRC inquired about the representation of the tank vault wall and basemat in PORFLOW and GoldSim, as well as the significance of the diffusive pathway from the tank wall to environment at early times prior to cementitious material degradation (in lieu of a tank wall to basemat to environment pathway). DOE confirmed that GoldSim dose not include a diffusive pathway from the tank wall to the environment. DOE does not expect this pathway to be significant in PORFLOW.

NRC questioned DOE's representation of preferential pathways through tank annuli. For example, no preferential pathways are present in the HTF base case while preferential pathways are known to exist through the tank vaults (e.g., Tank 16 waste is thought to have been released into the environment through construction joints in the vault wall). While DOE simulates preferential pathways through the tank and vault in alternative cases, Type I tanks with annular contamination have no waste in direct contact with preferential pathways and Type II tanks with annular contamination have only a fraction of the waste in direct contact with a preferential pathway through the center of the basemat.

DOE indicated that they do not have lateral fast flow paths in the Performance Assessment. DOE thinks there representation is conservative as it doesn't allow a small amount of waste to be released into the environment slowly over time and does not increase travel distance by allowing waste to be released out of the side of the tank. DOE thinks that insufficient activity is present in the tank annuli to be risk-significant. NRC indicated that if DOE modeled annular sources in the basecase with no preferential pathways, short-lived radionuclides would decay away prior to significant release. NRC pointed to maximum realizations for Case E in GoldSim for Tank 15/Sr-90 that had peak doses in the rem range. This result shows that Sr-90 can be a dose driver in certain preferential pathways cases.

Staff asked about the basis for transfer line location in modeling (all transfer lines were located within the 1 m boundary). DOE indicated that they attempted to maximize peaks by putting the transfer lines in a smaller area and also stated that the 1 m transfer line doses were not significant.

Status: DOE provided some clarifying information in response to NRC comments. Additional information will be obtained through the request for additional information process.

Topic: *Waste Classification*

Discussion:

NRC staff requested that DOE provide Goldsim files for waste classification calculations.

Status: DOE agreed to provide the requested information.

Topic: *General Performance Assessment*

Discussion:

NRC staff requested modeling results for alternative configurations using PORFLOW as PORFLOW transport modeling files were not provided for alternative configurations. DOE indicated that alternative configurations were run in PORFLOW and that DOE would check and see if the transport modeling files were provided previously to NRC.

NRC requested pathway dose conversion factors for HTF biosphere modeling, as well as recent changes in biosphere modeling. DOE listed changes to the biosphere modeling between FTF and HTF.

Status: DOE provided clarifying information to NRC in this area. DOE will provide NRC PORFLOW transport modeling files that were not previously provided for alternative cases. NRC will request pathway dose conversion factors from DOE in its request for additional information.

Topic: *Near-field/Far field Flow*

Discussion:

NRC staff requested PORFLOW modeling files presented in PORTAGE-08-022 and key modeling outputs related to flow vectors for intact and degraded conditions..

Status: DOE agreed to provide the PORFLOW modeling files that may not have been previously provided.