Hanford Waste Management Area C WIR Evaluation
10-11-2018 DOE-NRC Teleconference Summary

Department of Energy (DOE) Attendees: Sherri Ross (DOE-HQ), Jan Bovier (DOE-ORP)

Nuclear Regulatory Commission (NRC) Attendees: David Esh, Hans Arlt, Lloyd Desotell

DOE Contractor Attendees: Marcel Bergeron (WRPS), Doug DeFord (WRPS), Sunil Mehta (INTERA), Matt Kozak (INTERA), Paul Rutland (WRPS), Keith Quigley (Veolia), Raziuddin Khaleel (INTERA)

Member of the Public Attendees: Jeff Burright (Oregon Department of Energy)

The following topics regarding NRC's review of the Draft Waste Incidental to Reprocessing (WIR) Evaluation for Closure of Waste Management Area C (WMA C) at the Hanford Site were discussed during an October 11, 2018 teleconference. Note that several items scheduled to be discussed on this call were not covered due to time constraints and will be addressed at a later date. This teleconference was open to the public. The call in information for this teleconference was posted on the following DOE Hanford webpage:
https://www.hanford.gov/page.cfm/WasteManagementAreaC

Unsaturated Flow and Transport

1. The gravel correction applied to distribution coefficients (Kd's) was discussed. DOE stated that the simulated moisture regime at WMA C is compatible with the moisture (tension) of up to 300 cm used in the original paper on the gravel correction procedure. [Ref: Khaleel, R. and J. Relyea, "*Correcting laboratory-measured moisture retention data*," Water Resources Research, VOL. 33, NO. 8, PAGES 1875-1878, 1997]. Though WMA C moisture regime is relatively dry, it is not so dry (i.e., the tensions are not 1000's of cm) to make the correction procedure not applicable.

2. The sensitivity of model results to the assumed pore-size distribution parameter of 0.5 was discussed. DOE stated that this value is built into the Mualem model for unsaturated hydraulic conductivity. DOE also stated that while they haven't conducted sensitivity analyses with respect to this parameter, as part of a separate study, upscaled modeling was performed for the Sisson and Lu field injection site in 200 East Area and the use of directionally dependent pore-connectivity estimates resulted in a reasonable match to the field-measured moisture profiles. [Citation: Zhang, Z. F., and R. Khaleel (2010), *Simulating field‐scale moisture flow using a combined power‐averaging and tensorial connectivity‐tortuosity approach*, Water Resources Research, 46, W09505, doi:10.1029/2009WR008595]

3. NRC staff asked why the simulated moisture content for the H2 sand zone does not reflect the measured increased moisture contents in two portions of the H2 sand zone (e.g. RPP-ENV-58782, or the PA, Figure 6-62). DOE stated that they used an upscaling procedure that represents an average moisture content profile rather than multiple

discrete layers which may include silty interlayers. Following the equivalent homogeneous medium (EHM) upscaling, the PA simulations are based on upscaled or effective hydraulic properties; each heterogeneous formation is replaced by its homogeneous equivalent, and the upscaled or effective flow parameters are used to represent the EHM. This effectively results in a smoothing of the model estimates. Therefore, the variability of field-measured moisture contents, induced by media heterogeneities, is inherently larger in comparison to that based on PA simulations using homogenized upscaled properties; the ensemble average (average of multiple realizations), which is embedded in the EHM approximation, cannot capture the field-scale variability. DOE further stated that a heterogeneous geologic model case is presented in Appendix F of the PA document.

4. NRC staff asked why the moisture content histogram for the H1 zone for areas outside the SST footprint has a much larger tail (frequency of high moisture contents) than that inside the SST footprint even though recharge is higher inside (see PA document Figures B-9a and B-9b). DOE stated that there is some spatial variability of moisture contents and there are more data points outside the footprint area. Additionally, DOE stated that they suspect that the material may contain more fines outside the footprint than inside the footprint, which includes backfill, and therefore may have higher moisture contents. As has been observed at WMA C and other sites across the Hanford Site, the amount of fines is a primary driver of observed higher moisture contents.

5. (This topic will be revisited when Bill McMahon is available.)

6. NRC staff asked if there is a figure in the PA document that shows the area used to represent the pipeline source within the STOMP model. DOE stated that the closest figure in the PA would be Fig. 6-11; however, a figure showing the assumed pipeline source area was not included in the PA document but that DOE would generate one.

7. Page 7-24 of the PA document states: *The contribution of individual sources within WMA C at PoCal 4 is shown in Figure 7-16. The peak contributor to the concentration of 99Tc at all times is seen to be tank C-105. The peak concentration results predominantly from the combination of the tank C-105 releases and releases from the pipelines.* Review of Figure 7-16 indicates that other tanks contribute more to the Tc-99 peak than the pipelines. DOE stated that the wording in the report is unclear and should be modified. The pipelines source is the peak contributor within 1,000 years, whereas in the post-1,000 year period it is C-105.

8. NRC asked if DOE could provide PA Figures 7-15 and 7-16 (pages 7-24 and 7-25) with a time scale of 0 to 2,000 years to better visualize Tc-99 concentrations during the compliance period. DOE indicated that they could provide these additional figures.

9. (This topic will be revisited when Bill McMahon is available.)

10. Sensitivity case inf03 was briefly discussed. NRC staff asked if other radionuclides beside Tc-99 were included in the PA document or GoldSim model. DOE stated that the only radionuclide simulated was Tc-99.

11. (This topic will be revisited when Bill McMahon is available.)

12. NRC staff stated that the regional groundwater and WMA C unsaturated zone models appear to be relatively insensitive to infiltration rates. After some clarifying discussion, DOE stated that recharge is a small part of the overall water budget and that there is some change in the modeled moisture content with increased recharge as shown in PA Figure 6-45 (page 6-108). NRC suggested that liquid saturations may be more illustrative.

13. NRC staff asked if there is a report available that describes the chemical composition and volumes of releases within WMA C. DOE stated that the process to estimate tank leak inventories is described in RPP-32681, "Process to Assess Tank Farm Leaks in Support of Retrieval and Closure Planning." Additional information for each of the releases is provided in RPP-ENV-33418. NRC staff asked if the impact of past releases on native geology (Kd's, etc.) have been evaluated and incorporated into the PA. DOE stated that the Kd values selected for the PA represent intermediate impact zones as described in PNNL report PNNL-17154. Parameters were chosen assuming low-salt, near-neutral waste chemistry, as discussed in Section 6.2.2.1.5 of the PA report.

<u>Saturated Flow and Transport</u>

14. NRC asked how the derived hydrologic properties for the 200 Areas compare to those of the whole site. DOE stated that the basis is presented in Appendix C of the PA report. There are few hydraulic tests in the WMA C area but that unconfined aquifer is very permeable in the 200 East area and influenced by paleochannels. DOE stated that they looked at multiple lines of evidence when selecting the hydrologic properties.

15. NRC staff asked if the impact from chelating agents and colloids on transport was considered. DOE stated that the amount of chelating agents (such as EDTA and TBP) in residual inventory is negligible and therefore unlikely to have any effect on radionuclide transport. Transport of cyanide and Co-60 from potential chelation is feasible during the past-leaks but direct evidence is lacking. Colloid-facilitated transport in the thick vadose zone is unlikely to occur over the transport distances evaluated in the PA and therefore was screened out. DOE stated that they could provide a reference document that describes how the unsaturated zone reduces colloidal transport. NRC staff asked if iron from the tanks or rebar could play a role in colloidal transport. DOE staff stated that although there is little information on the topic for Hanford Site, even if iron colloids were to form, they would be filtered out in the unsaturated zone within a short distance. NRC staff suggested DOE consider conducting additional sensitivity analysis whereby a fraction of the highly sorbing radionuclide inventory has an effectively lower or zero Kd value due to chelating agents/colloids, etc. DOE staff stated that for such sensitivity

analyses to be carried out, many assumptions would need to be made and indicated that they believe there is already considerable conservatism in the analyses conducted.

16. NRC staff asked what the impact of the upstream dams has on subsurface hydrology at the site and what is the long-term plan for the dams. DOE stated that they believe that if a dam is removed it would be replaced and that PNNL has conducted some hydrodynamic modeling of the Hanford Reach of the Columbia River that may provide some useful information (PNNL-15226). NRC stated that DOE should clearly state in the PA that the assumption is that the dams will remain intact. DOE staff stated that due to the current state of information, the best scenario for the base case is a long-term, steady-state hydraulic gradient for the 200 East area. DOE went on to state that the PA looked at a range of groundwater fluxes which is the primary variable of interest with respect to dilution of radionuclides entering the saturated zone from the overlying unsaturated zone.

17. NRC staff asked about the reliability of the water level data discussed on PA page 6-93 and shown in Fig. 6-41. DOE stated that there were few measurements taken in 1944 and that the data and map contain significant uncertainties.

18. NRC staff asked about the sensitivity of the vertical anisotropy ratio. DOE stated that they did not conduct sensitivity runs for this parameter but indicated that only minor sensitivity was reported to anisotropy and dispersivity in related work conducted for the Environmental Restoration Disposal Facility as presented in Washington Closure Hanford document WCH-520.

19. NRC staff asked why total and effective porosity were set to be equal in the saturated zone. DOE stated that insufficient information was available to make a distinction between the two porosities.

20. (This topic will be revisited when Bill McMahon is available.)

21. NRC staff asked if the PA model could, without calibration, reasonably reproduce past leaks and travel times within WMA C. DOE staff mentioned that this would be difficult due to the transient nature of the leaks and intentional direct injections and further stated that their efforts have focused on first arrival analyses as presented in WRPS document RPP-RPT-59197. Although NRC staff thought that the 3D STOMP model should still be able to reasonably represent the past leaks, plumes and travel times, NRC stated that it will review RPP-RPT-59197 and revisit the issue if needed.

Note: Several items related to Saturated Flow and Transport were not addressed on the 10-11-18 teleconference due to time constraints. These items will be addressed on the next teleconference. The following non-sequential numbering is the result of skipping some items which will be addressed on a future call.

28. NRC staff asked about the source of I-129 in the wells located in the WMA C area. DOE stated that there are many sources for I -129 and the source is likely from other 200 East facilities and not C Tank Farm.

31. NRC staff identified several potential typographical errors (listed below). DOE stated that the below were reviewed and require corrections in the PA.

    a. PA Figures 7-7 and 7-8 (pages 7-11 and 7-12) indicate that figure (c) represents the moisture content profile 100 years after closure while text on figure (c) indicates 80 years after closure.

    b. PA Figure 7-1 (page 7-3) includes C-205 in the legend, should this be C-301?

    c. Page 8-82 of the PA states: T*he peak groundwater concentration ranges between 23 and 48 pCi/L for these cases (Figure 8-39).*
    The figure reference here may be to 8-43 rather than 8-39.

    d. Page 10-4 of the PA states: *Peak calculated radionuclide groundwater concentrations are summarized and compared to applicable groundwater protection criteria in Table 10-4.*
    The table reference here may be to 10-5 rather than 10-4.

    e. Page 10-6 of the PA states: *The maximum deviation from the base case was a factor of 4.8 higher than the base case, which occurred for sensitivity case INV01, which assumed the maximum 99Tc inventory in the unretrieved tanks, as shown in Table 10-5.*
    The table reference here may be to 10-6 rather than 10-5.

    f. Page B-17 of the PA states: *The fitted van Genuchten-Mualem parameters for the IDF H2 sandy sequence (44 samples) are reproduced in Table B-1.*
    The table reference here may be to B-3 rather than B-1.

    g. In PA Table D-4 (page B-21) the pore interaction term (I) has appears to have a superscript which is not defined.

    h. Are the dashed and solid lines in the legend for PA Figure D-9 (page D-39) reversed?

    i. Page D-42 of the PA states: *In particular, the screening analysis applies the maximum recharge rates associated with each period for each surface type (Table D-16), assigns the vadose zone hydraulic properties that produce the fastest pore water velocity for each HSU as determined for the uncertainty analysis (Table D-17), and implements an advection release function for the radionuclides.*
    Should the references to Tables 16 and 17 in the above be switched?

Additional clarification topics:

A. DOE and NRC staffs discussed the terminology as given in Fig. 3-38 (p, 3-90) in the PA. DOE staff explained that “Alternative Geologic Model I” is actually the conceptual model used as the base case in the PA and the WIR Evaluation document while

"Alternative Geologic Model II" is DOE's first alternative conceptual model and that the "Heterogeneous Case" as shown in Appendix F in Figures F-7, F-8, and F-9 is DOE's second alternative conceptual model.

Action Items

Item Number	Date	Action	Status
9-6.3a	9-6-18	NRC to provide GoldSim run log to DOE	Completed 9-25-18
9-6.3b	9-6-18	DOE to provide NRC with GoldSim model for 400,000 year simulation	Completed 9-27-18
9-6.5	9-6-18	DOE to provide additional details regarding the scaling for other uranium isotopes	pending
9-6.6	9-6-18	DOE to provide the aqueous relative permeability parameters assigned in STOMP model	pending
9-6.8	9-6-18	DOE to provide map showing the location of node 69 in relation to the tank footprint	pending
9-6.9	9-6-18	DOE to provide a water budget table with inflow at the surface and inflow/outflow at the four aquifer boundaries	pending
9-6.12	9-6-18	DOE to provide the simulated hydraulic heads from the STOMP model for the monitoring wells as seen in Fig. C-11, page C-22	pending
9-6.14	9-6-18	Future presentation on Leapfrog geological model	pending
9-6.15	9-6-18	DOE to check the discrepancy between 580 m^3/d on PA p. C-8 and 730 m^3/d on p. C-12.	pending
10-2.10	10-2-18	DOE to send information on tank specific retrieval technology selection information	pending
10-2.12	10-2-18	NRC to check information in NUREG 1854 on waste classification criterion guidelines	pending
10-2.a	10-2-18	DOE to check posting on website	Completed 10-02-18
10-11.5	10-11-18	Item #5 from the 10-11-18 clarification call list will be revisited next call when Bill McMahon is available.	pending
10-11.6	10-11-18	DOE will generate a figure that represents the pipeline source area used in the STOMP model.	pending
10-11.7	10-11-18	DOE will review the discussion of Figure 7-16 on page 7-24 of the PA document and make corrections as needed.	pending
10-11.8	10-11-18	DOE will produce a revised figure showing the early times (0 to 2000 years) for figures 7-15 and 7-16.	pending
10-11.9	10-11-18	Item #9 from the 10-11-18 clarification call list will be revisited next call when Bill McMahon is available.	pending
10-11.11	10-11-18	Item #11 from the 10-11-18 clarification call list will be revisited next call when Bill McMahon is available.	pending
10-11.13	10-11-18	DOE to provide access to WRPS document RPP-ENV-334418 and CH2M Hill Hanford Group Inc. document RPP-32681	Completed 10-11-18

10-11.15	10-11-18	DOE to provide NRC document that discusses how the unsaturated zone is effective at filtering colloids.	pending
10-11.16	10-11-18	DOE to provide access to PNNL document PNNL-15226	Completed 10-11-18
10-11.18	10-11-18	DOE to provide access to Washington Closure Hanford document WCH-520	Completed 10-11-18
10-11.20	10-11-18	Item #20 from the 10-11-18 clarification call list will be revisited next call when Bill McMahon is available.	pending
10-11.21	10-11-18	NRC will locate the Sr-90 plume map it referenced in Item #21 from the 10-11-18 clarification call list.	pending
10-11.31	10-11-18	DOE will address the typographic errors identified in Item #31 from the 10-11-18 clarification call list.	pending

Acronyms and Abbreviations

DOE U.S.	Department of Energy
DOE-ORP	U.S. Department of Energy Office of River Protection
DOE-HQ	U.S. Department of Energy Headquarters
EHM	equivalent homogeneous media
NRC	US Nuclear Regulatory Commission
PA	performance assessment
PNNL	Pacific Northwest National Laboratory
SST	single-shell tank
WIR	waste incidental to reprocessing
WMA	waste management area
WMA C	Waste Management Area C
WRPS	Washington River Protection Solutions, LLC