Comments Derived from Review of Center for Nuclear Waste Regulatory Analyses (CNWRA) Milestone 06002.01.282.531

The CNWRA should consider the comments below, and address them to the extent practicable, as it continues work in the Concentration of Radionuclides in Groundwater (DOSE1) program element, and to the extent applicable, in other program elements, such as Methodology and Overall System Performance, and Radionuclide Transport in the Saturated Zone. The comments have been grouped into two areas: technical basis; and communication.

A. Technical basis

1. The authors stated that "The TPA [Total system Performance Assessment] Version 5.0.1 code software validation has not been completed. The use of parameter ranges from the code, therefore, represent current unofficial best estimates that may change in the official release of the code." In future documentation on work in this area it may be helpful to discuss how much the conclusions documented in this deliverable may be affected by changes in the parameter ranges, especially if the values change in the released version of the TPA 5.0.1 code.

2. The following comment and associated questions may be need to be considered in the future modeling or otherwise the topic of dual domain versus dual permeability modeling should be communicated more clearly. The authors describe MT3DMS as a dual-porosity (dual-domain) model with one domain mobile and the other immobile. However, on page 4-2, the authors proposed to investigate the importance of dual-permeability models, which are different from dual-domain models. Do the authors propose to use MT3DMS for this purpose or another simulator? Because MODFLOW is a single-domain, continuum simulator, would a dual-domain or dual-permeability model require re-calculations of the flow fields with another simulator?

3. On page 2-5 of the deliverable there was a suggestion that fixed-type and flux-type boundary conditions will produce different results. This type of behavior has been reported previously by Parker and van Genuchten (1987(?) in Water Resources Research). This is may be one area that the authors may want to address in the future given that there are three source area configurations.

4. On page 3-2, the authors suggest that " . . . the uncertainty in the horizontal transverse dispersivity values considered in the analysis may generate enough lateral spreading to compensate for the potentially smaller source region." Spreading as a result of dispersion in the unsaturated zone, which is not considered in this study, is a process-induced prediction uncertainty. However, spreading as a result of varying transverse dispersivity is an uncertainty propagated into model predictions as a result of parameter uncertainty. The outcome of the simulations (e.g., Monte Carlo) may looks similar but the inner working of flow and transport mechanisms is different. The technical basis for this topic could be improved by bringing in previous modeling results for the unsaturated zone (see comment two below, under communication). Future descriptions of this topic should consider the implications of previous studies and the differences between model and parameter uncertainty.

5. Regarding future work it is not immediately clear that adding smaller geological structures into the model will improve uncertainty calculations regarding the transport of small plumes at the site. This is particularly the case if there is a lack of information regarding the locations and extent of these features.

6. In the future when describing the importance of radionuclide transport in the saturated zone, the technical basis provided in the U.S. Nuclear Regulatory Commission (NRC) Risk Insights Baseline Report (2004), which is also captured as Appendix D in NUREG-1762, Volume 2, Revision 1, should be used instead of older sensitivity studies such as Mohanty et al., 2002.

7. The summary of this report suggests that the travel distance in the alluvium determined through the analyses is consistent with the range sampled in the NRC TPA 5.0.1. code. While the ranges overlap, the lower end of the distribution in the TPA 5.0.1 code is 3 times less than indicated by this study. The CNWRA should consider whether the range in the TPA 5.0.01 code should be adjusted to reflect the results of this study.

B. Communication

1. An important area for clarification in future descriptions of this work concerns description of plume dimensions (width and thickness) derived from previous CNWRA studies. For instance, on page 2-3, the document cites Winterle (2003) and states " . . . plume dimensions . . . that were in the order if a few meters." However, the cited study indicates plume dimensions on the order of a few hundred of meters.

2. Consistent with NRC verbal guidance previously provided to the CNWRA, in the future, the CNWRA should strive to incorporate and communicate the results from the Ground-Water Pathways Analyses chapter in the report titled "Preliminary Performance-Based Analyses Relevant to Dose-Based Performance Measures for a Proposed Geologic Repository at Yucca Mountain (NUREG-1538)," when describing the results of the current and future analyses in this technical area.

3. In future descriptions of this work, the lack of modeling the sorption effects could be emphasized a bit more. For instance, in describing the dilution factor it will be important to indicate the limitations of the current work (i.e., lack of modeling the sorption effects).

4. Future communications on the application of MT3DMS to simulate saturated zone transport at Yucca Mountain, you should more clearly differentiate the two different approaches that the CNWRA and the U.S. Department of Energy (DOE) are using. The DOE is using a convolution integral technique and CNWRA is not.

5. When discussing your work in the future, as it relates to dispersivities values used, and if information is available, then it would be beneficial to explain why the DOE is using smaller dispersivity values.

6. Future descriptions of this work should clarify some of the terminology. For instance, the term transversivity was used instead of the clearer transverse dispersivity terminology.

7. In future descriptions of the work one may want to point out that the simulations use a constant boundary concentration of 10 mg/L for all scenarios. As we compare plumes from various scenarios, it will be important to remind the audience that the total mass entering the subsurface is different from scenario to scenario.

8. When describing these results, more careful expression of the limitations of the results should be considered. For instance, the document indicated that " . . . small plumes migrating from opposite ends of the repository are generally focused through a narrow region south of the repository and, as a result, there appears to be no potential for distinct, widely spaced small plumes at the location of the regulatory compliance boundary." Yet elsewhere in the document the author identifies that the observation is conditioned on the current flow field conceptualization. It may be necessary to more clearly express the limitations so that the audiences realize that the observation has certain underlying uncertainty associated with it.

9. In explaining diffusion coefficients used by DOE, it would be beneficial in the future to identify whether the values cited in the report are effective diffusion coefficients and which species constrain the range of cited values.

10. Concerning the description of DOE's range of dispersivity values for dual-domain or dual-permeability models, as supposedly used in Total System Performance Assessment-License Application, the general scientific understanding is that the longitudinal and transverse dispersivities obtained from curve fitting are smaller than that obtained with equivalent porous medium models. The reason that has been given in the scientific literature is that matrix diffusion has accounted for part of the macro- and micro-dispersion. In the future this explanation may need to be incorporated when comparing and describing model predictions to the results of this study.

11. One area identified in the report that could be communicated more clearly in the future is that of the interface between the alluvium and tuff. The figures that depict the plane view of the plumes seem to highlight that interface, yet the report discusses that observation only in the summary.

12. Although the report indicates on page 3-7 that Table 3-1 summarizes the dispersivity values used to evaluate the evolution of small plumes, that information is provided in Table 3-4.