From: **Arnold, Bill W** <bwarnol@sandia.gov>
Date: Tue, Mar 31, 2009 at 10:41 AM MOL.20090422.0060 QA: NA
Subject:
To: "Joseph_Rivers@ymp.gov" <Joseph_Rivers@ymp.gov>, "dhlester@gmail.com" <dhlester@gmail.com>
Cc: "Zhu, Ming" <mzhu@sandia.gov>, "Mackinnon, Robert" <rjmacki@sandia.gov>, "James, Scott C" <scjames@sandia.gov>, "Eric_Smitstad@ymp.gov" <Eric_Smitstad@ymp.gov>, "Wayne_Belcher@ymp.gov" <Wayne_Belcher@ymp.gov>, "Arnold, Bill W" <bwarnol@sandia.gov>

4/6/09

PRIVILEGED
FEDERAL RECORD
~~NOT~~ LSN RELEVANT

Dave and Joe,

Attached is a summary of the additional information on flow paths, hydrogeologic units, and transport parameters for the SEIS analysis that we discussed in the teleconference last Wednesday.

This document has undergone an informal technical review by Scott James and Wayne Belcher. However, it has not been through the complete checking and review process that the LSA-AR-037 document containing other information for the SEIS has been through. Consequently, it should be considered preliminary and is being provided in this e-mail to expedite the SEIS analyses.

It should also be noted that there is extensive primary scientific literature on radionuclide sorption coefficients on carbonate rocks and basalt that was not exhaustively reviewed in preparing this summary. Instead, representative values of Kds were taken from the performance assessment work at WIPP and INEEL for this summary.

If you have any questions or comments please contact me.

Bill Arnold
Sandia National Laboratories
505-284-4603

SEIS_regional_model_path_analysis.doc

This document provides more detailed information about the hydrogeologic units along the simulated particle paths from the 18-km boundary with the Death Valley regional groundwater flow model. It also provides information on the radionuclide transport parameters of effective porosity, bulk density, and sorption coefficients for these hydrogeologic units. Results are presented for the case in which no pumping occurs in the Amargosa Desert and the particles are simulated to discharge in Death Valley. Results are also presented for the case in which pumping is simulated to occur and the particles are captured by the pumping wells in the Amargosa Desert.

Information for the non-pumping and pumping cases is provided in Table 1 and Table 2, respectively. The average total flow path length for particles in the non-pumping case is 55.9 km and the percentages of the flow path length within each of the hydrogeologic units along the flow path are given in Table 1. The average total flow path length from the 18-km boundary of the accessible environment to the point of discharge for the pumping case is 17.0 km and the corresponding percentages of flow path length are provided in Table 2.

Table 1. Average Flow Path Lengths and Expected Transport Model Parameter Values in Hydrogeologic Units (Non-pumping Case)

Hydrogeologic Unit Abbreviation [a]	Average % of Total Flow Path Length	Effective Porosity [b]	Bulk Density (g/cm^3) [b]	Np K_d (mL/g)	U K_d (mL/g)	Pu K_d (mL/g)	Am K_d (mL/g)
YACU	4.2	0.32	2.50	6.35 [b]	4.6 [b]	100. [b]	5500. [b]
OAA	1.8	0.18	1.91	6.35 [b]	4.6 [b]	100. [b]	5500. [b]
LA	0.4	0.01	2.77	-	-	-	-
LFU	6.0	0.08	2.44	8 [d]	3 [d]	100 [d]	70 [d]
Upper VSU	25.3	0.18	1.91	6.35 [b]	4.6 [b]	100. [b]	5500. [b]
CFPPA	0.2	0.001	1.84	1.30 [b]	6.78 [b]	104.2 [b]	5500. [b]
Lower VSU	21.2	0.18	1.91	6.35 [b]	4.6 [b]	100. [b]	5500. [b]
LCA	40.4	0.01	2.77	100.5 [c]	15.0 [c]	260. [c]	260. [c]
XCU	0.5	0.0001	2.65	-	-	-	-

NOTE: Units that are less than 0.1% of the average total flow path length are not included in the table.

[a] Belcher et al. 2004 [DIRS 173179], Table E-1

[b] SNL 2008 [DIRS 183750], Tables 6-8, 6-13, and 6-14

[c] EPA 1998, Table 1

[d] Dicke 1997, Table 4

Table 2. Average Flow Path Lengths and Expected Transport Model Parameter Values in Hydrogeologic Units (Pumping Case)

Hydrogeologic Unit Abbreviation [a]	Average % of Total Flow Path Length	Effective Porosity [b]	Bulk Density (g/cm^3) [b]	Np K_d (mL/g)	U K_d (mL/g)	Pu K_d (mL/g)	Am K_d (mL/g)
YAA	5.0	0.18	1.91	6.35 [b]	4.6 [b]	100. [b]	5500. [b]
OAA	16.9	0.18	1.91	6.35 [b]	4.6 [b]	100. [b]	5500. [b]
LA	6.9	0.01	2.77	-	-	-	-
LFU	6.6	0.08	2.44	8 [d]	3 [d]	100 [d]	70 [d]
Upper VSU	54.6	0.18	1.91	6.35 [b]	4.6 [b]	100. [b]	5500. [b]
CFPPA	1.1	0.001	1.84	1.30 [b]	6.78 [b]	104.2 [b]	5500. [b]
Lower VSU	8.9	0.18	1.91	6.35 [b]	4.6 [b]	100. [b]	5500. [b]

NOTE: Units that are less than 0.1% of the average total flow path length are not included in the table.

[a] Belcher et al. 2004 [DIRS 173179], Table E-1

[b] SNL 2008 [DIRS 183750], Tables 6-8, 6-13, and 6-14

[c] EPA 1998, Table 1

[d] Dicke 1997, Table 4

Values of effective porosity and bulk density are given for all of the hydrogeologic units for the non-pumping and the pumping cases, based on the expected values from the saturated zone flow and transport abstraction model (SNL 2008 [DIRS 183750]). In addition, the expected values of sorption coefficients for Np, U, Pu, and Am for the YAA, YACU, OAA, Upper VSU, CFPPA, and Lower VSU hydrogeologic units are also based on information from SNL 2008 [DIRS 183750]. Values of sorption coefficients for the LA and XCU hydrogeologic units are not given in Tables 1 and 2; these units constitute a minor fraction of the flow path length or, in the case of the LA unit in the pumping case, can be conservatively assumed to provide no sorption.

Expected values of sorption coefficients for the LFU and LCA hydrogeologic units are taken from evaluations of sorption data for similar rock types at the Idaho National Engineering and Environmental Laboratory (INEL) and the Waste Isolation Pilot Plant (WIPP), respectively. Primary sources of data on sorption coefficients were not compiled for the information presented in Table 1 and Table 2. The LFU hydrogeologic unit is composed of basaltic lava flows in the area to the south of Yucca Mountain (Belcher et al. 2004 [DIRS 173179], Chapter B) and the estimated INEL performance assessment values of sorption coefficients on basalt from Dicke 1997, Table 4 are assigned to this unit. The LCA (Lower Carbonate Aquifer) hydrogeologic unit is lithologically variable, but dominated by dolomite (Belcher et al. 2004 [DIRS 173179], Chapter B). The median values from the ranges of sorption coefficients for dolomite from the WIPP performance assessment (EPA 1998, Table 1) are assigned to the LCA unit.

One-dimensional radionuclide transport modeling along the flow paths from the 18-km boundary can be simplified by combining hydrogeologic units with identical transport parameter values and by disregarding hydrogeologic units that do not constitute a significant percentage of the flow path length. For example, in the non-pumping case the OAA, Upper VSU, and Lower VSU units are composed of alluvium along the flow path and can be combined into a single segment that consists of about 48 % of the total flow path length. Also, the LA, CFPPA, and XCU hydrogeologic units are each less than 1% of the total flow path length for the non-pumping case and could reasonably be eliminated from the one-dimensional radionuclide transport model.

References

173179 Belcher, W.R. 2004. *Death Valley Regional Ground-Water Flow System, Nevada and California - Hydrogeologic Framework and Transient Ground-Water Flow Model.* Scientific Investigations Report 2004-5205. Reston, Virginia: U.S. Geological Survey. ACC: MOL.20050323.0070.

Dicke, C.A. 1997. *Distribution Coefficients and Contaminant Solubilities for the Waste Area 7 Baseline Risk Assessment.* INEL/EXT-97-00201. Idaho Falls, Idaho: Idaho National Engineering and Environmental Laboratory.

EPA (U.S. Environmental Protection Agency) 1998. *Technical Support Document for Section 194.14: Assessment of K_ds Used in the CCA*. Washington, DC: U.S. Environmental Protection Agency.

183750 SNL (Sandia National Laboratories) 2008. *Saturated Zone Flow and Transport Model Abstraction.* MDL-NBS-HS-000021 REV 03 AD 02. Las Vegas, Nevada: Sandia National Laboratories. ACC: DOC.20080107.0006; LLR.20080408.0256.