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subject: Markerbed Concentrations for Undisturbed NUTS Scenarios in AP-137, Revision 1

As part of the Waste Isolation Pilot Plant Performance Assessment (WIPP PA), it is necessary to determine if there is any groundwater contamination for undisturbed scenarios (Garner 2003). The screening criterion used is if any of the vectors in Scenario 1 (the undisturbed scenario) results in a release of more than 10^{-7} kg/m^3 of a tracer component through the markerbeds at the Land Withdrawal Boundary (LWB), as measured by the NUTS transport code.

This memo therefore supersedes the results presented in Ismail (2008), and outlines the calculations carried out to determine the concentrations of radionuclides at the LWB in both the CRA-2004 PABC and the CRA-2009 PA. The original memo incorrectly reported that no markerbed releases occurred in undisturbed scenarios in the NUTS analysis for the Compliance Recertification Application 2009 Performance Assessment (CRA-2009 PA) (Ismail 2008). However, vector 53 in replicate 1 had a tracer concentration in the markerbeds at the Land Withdrawal Boundary (LWB) of 1.24×10^{-4} kg/m^3, which exceeds the screening limit of 10^{-7} kg/m^3. Although this vector also had a markerbed concentration of 4.73×10^{-7} kg/m^3 in the CRA-2004 Performance Assessment Baseline Calculations (PABC), no calculations of the individual component radionuclide releases at the LWB were performed at the time.

Consequently, we have followed the procedure used in the CRA-2004 PA (Lowry 2003) for determining releases of the five lumped radionuclides tracked by NUTS (Am-241, Pu-239, Pu-238, U-234, and Th-230). For each radionuclide, the concentration at the LWB was calculated as a function of time, and the maximum concentration of each radionuclide was determined. The calculations were carried out by running the script PA_NUTS_ISO_CONC.COM, which is stored in CMS class MARKERBED in the libraries LIBCRA1BC_NUT for the CRA-2004 PABC calculations and LIBCRA09_NUT for the CRA-2009 calculations. The script runs ALGEBRACDB with the input file PA_NUTS_ISO_S1_CONC.INP and the CDB file for Replicate 1, Vector 53 (which are stored in libraries LIBCRA1BC_NUTR1S1 and LIBCRA09_NUTR1S1), producing an output file which is then analyzed using SUMMARIZE with script PA_NUTS_ISO_S1_CONC.SMZ. The resulting output file is then processed by MBCON.EXE to determine the maximum concentration of each radionuclide during the 10,000-year horizon used in WIPP PA.

The maximum concentrations in curies per liter of the various radionuclides for the CCA, CRA-2004 PA, CRA-2004 PABC, and CRA-2009 are listed in Table 1. We believe that the very small concentrations of radionuclides at the LWB (which do not exceed 4×10^{-13} Ci/L) can be explained as a result of numerical dispersion caused by solving the transport equations on a coarse numerical grid.

Table 1 Maximum Concentrations of Radionuclides at the Land Withdrawal Boundary

	Maximum Concentration at LWB (Ci/L)			
Radionuclide	CCA	CRA-2004 PA	CRA-2004 PABC	CRA-2009 PA
Vector	Maximum[a]	Replicate 1, Vector 83	Replicate 1, Vector 53	Replicate 1, Vector 53
Am-241	5.98×10^{-17}	2.44×10^{-21}	9.61×10^{-21}	1.71×10^{-18}
Pu-239	4.33×10^{-12}	2.53×10^{-18}	1.45×10^{-15}	3.83×10^{-13}
Pu-238	$<10^{-18}$	3.51×10^{-35}	3.56×10^{-31}	1.51×10^{-28}
U-234	5.82×10^{-13}	1.98×10^{-20}	4.31×10^{-18}	1.14×10^{-15}
Th-230	2.10×10^{-14}	2.36×10^{-21}	6.99×10^{-19}	1.83×10^{-16}

[a]The maximum listed for each radionuclide is the maximum concentration observed for any of the nine vectors (Replicate 1, Vector 16; Replicate 2, Vectors 16, 25, 33, 81, and 90; Replicate 3, Vectors 3, 60, and 64) which exceeded the screening limit of 10^{-7} kg/m^3.

Comparing the values for the CRA-2004 PABC and the CRA-2009 with the CCA, we see that, for both analyses, the maximum concentration of the radionuclide measured in the CCA is greater than the corresponding maxima for the CRA-2004 PABC or for the CRA-2009. Since the concentrations of radionuclides are lower in the newer analyses than in the CCA analysis, and since the concentrations observed in the CCA did not lead to unacceptable doses of radionuclides, no new dose calculations are required for either of the analyses discussed above.

References

Ismail, A. E. 2008. "Markerbed Concentrations for Undisturbed NUTS Scenarios in AP-137." Carlsbad, NM: Sandia National Laboratories. ERMS 548150.

Lowry, T. S. 2003. Analysis Package for Salado Transport Calculations: Compliance Recertification Application." Rev. 0. Carlsbad, NM: Sandia National Laboratories. ERMS 530164.