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To: SNL WIPP Records Center
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From: Sungtae Kim and Chris Camphouse Sungtae Kim

Subject: Marker Bed Concentrations and Radium-226 Concentration for Undisturbed NUTS Scenario in AP-164.

As part of the Waste Isolation Pilot Plant (WIPP) Performance Assessment (PA), it is necessary to determine if there is any groundwater contamination for undisturbed scenarios (Garner 2003 and Lowry 2003). The screening criterion used is if any of the vectors in Scenario 1 transports more than 1.0×10^{-7} kg/m^3 of a tracer component to the Marker Beds at the Land Withdrawal Boundary (LWB).

This memo outlines the calculations carried out to determine the concentrations of radionuclides at the LWB in the CRA-2014 PA. NUTS screening runs for the previous Compliance Recertification Applications (CRA-2004 PA, CRA-2004 Performance Assessment Baseline Calculation (PABC), CRA-2009 PA and CRA-2009 PABC) calculated radionuclides releases in the Marker Beds at the LWB (Table 1). A tracer concentration in the Marker Beds at the LWB of 1.02×10^{-7} kg/m^3 was calculated for vector 82 in replicate 1 in the CRA-2004 PA, 4.73×10^{-7} kg/m^3 for vector 53 in replicate 1 in the CRA-2004 PABC, 1.24×10^{-4} kg/m^3 for vector 53 in replicate 1 in the CRA-2009 PA, 1.00×10^{-4} kg/m^3 for vector 53 in replicate 1 in the CRA-2009 PABC. Since these vectors had a tracer concentration exceeding the screening limit of 1.0×10^{-7} kg/m^3, releases of the individual radionuclide components at the LWB were calculated (Table 1).

To compare the impact of a baseline (BL) set of changes relative to the CRA-2009 PABC, in the CRA-2014 PA the BL calculation as the first case was performed. Consistent with previous CRA, vector 53 in replicate 1 has a tracer concentration in the Marker Beds that exceeds the screening limit of 1.0×10^{-7} kg/m^3 at the LWB. In this case, a concentration of 6.51×10^{-7} kg/m^3 has been calculated, which can be found in **SCREEN_NUT_SCN_CRA14BL_R1_S1.OUT** in CMS library **LIBCRA14_NUTR1S1** for the CRA-2014 BL PA calculations. Consequently, we have followed the procedure used in the previous CRA for determining releases of the five lumped radionuclides tracked by NUTS (^{241}Am, ^{239}Pu, ^{238}Pu, ^{234}U, and ^{230}Th) (Garner 2003 and Ismail 2008a). The calculations were carried out by running the **PA_NUTS_ISO_CONC.COM**, which is stored in the directory **PAWORK:[SHARED.SUNKIM.CRA14.SEC51_52.2014PA.CRA14-BL]**. Under this directory the script runs ALGEBRACDB with the input file **PA_NUTS_ISO_S1_CONC.INP** and **NUT_ISO_CRA14BL_R1_S1_V053.CDB** (which is copied from CMS library **LIBCRA14_NUTR1S1** for the CRA-2014 PA), producing an output file **PA_NUTS_ISO_CRA14BL_R1_S1_CONC_V053.CDB** which is then analyzed using SUMMARIZE with script **PA_NUT_ISO_S1_CONC.SMZ**. The resulting output file **PA_NUTS_ISO_S1_CONC.TBL** is then processed by MBCON.EXE to determine the maximum

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concentration of each radionuclide during 10,000-year which is stored in **PA_NUTS_ISO_CONC_RESULTS.DAT**.

Table 1. Maximum Concentrations of Radionuclides at the Land Withdrawal Boundary

Radionuclide	Maximum Concentration at LWB (Ci/L)					
	CRA-2004 PA*	CRA-2004 PABC	CRA-2009 PA	CRA-2009 PABC	CRA-2014 PA BL	CRA-2014 PA
Vector	Replicate 1, Vector 82	Replicate 1, Vector 53	Replicate 1, Vector 53	Replicate 1, Vector 53	Replicate 1, Vector 53	No vector pass the NUTS screen-out for Marker Bed.
^{241}Am	2.45E-21	9.61E-21	1.71E-18	1.45E-18	3.55E-31	
^{239}Pu	2.53E-18	1.45E-15	3.83E-13	2.33E-13	2.15E-23	
^{238}Pu	3.51E-35	3.56E-31	1.51E-28	4.79E-29	0.00E+00	
^{234}U	1.98E-20	4.31E-18	1.14E-15	4.44E-15	5.72E-26	
^{230}Th	2.36e-21	6.99E-19	1.83E-16	6.58E-16	8.79E-27	

* In reference (Ismail 2008a) vector 83 in replicate 1 in the CRA-2004 PA releases more than 1.0×10^{-7} kg/m^3 of a tracer component to the Marker Beds. However, **SUM_NUT_CRA1_SCN_R1_S1.DAT** in CMS library **LIBCRA1_SUM** for the CRA-2004 PA calculations shows that vector 82 has 1.02×10^{-7} kg/m^3 of a tracer component to the Marker Beds. Vector 83 in replicate 1 in the CRA-2004 PA in Table 1 in reference (Ismail 2008a) should be changed to vector 82.

The maximum concentrations in curies per liter of the various radionuclides for the CRA-2004 PA, CRA-2004 PABC, CRA-2009 PA, CRA-2009 PABC and CRA-2014 PA BL are listed in Table 1. For the CRA-2014 PA BL calculations very small concentrations of radionuclides are released at the LWB. For ^{238}Pu no release is predicted.

When we incorporate all changes included in the CRA-2014 PA, however, **SCREEN_NUT_SCN_CRA14_R1_S1.OUT** in CMS library **LIBCRA14_NUTR1S1** shows that no vector in Scenario 1 transports more than 1.0×10^{-7} kg/m^3 of a tracer component to the Marker Beds at the LWB. Changes included in the CRA-2014 PA result in an overall reduction in the cumulative volume of brine reaching the LWB through the Marker Beds for undisturbed repository conditions. Total cumulative brine flows reaching the LWB through the Marker Beds calculated in BRAGFLO scenario S1-BF for replicate 1, vector 53 of the CRA-2009 PABC and the CRA-2014 PA are plotted together in Fig. 1.

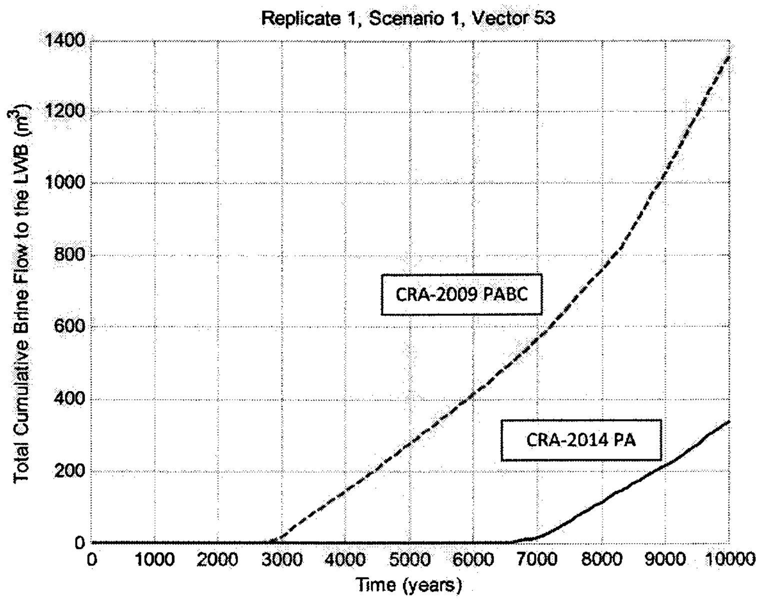

Fig.1. Comparison of total cumulative brine flow to the LWB between CRA-2009 PABC and CRA-2014 PA.

Quantities shown in Fig. 1 are defined in files ALG2_BF_PABC09.INP and ALG2_BF_CRA14.INP located in CMS library LIBPABC09_BF and LIBCRA14_BF, respectively.

The statutory requirements of 40 CFR 194.55 require that DOE determine the maximum total radioactivity level for ^{226}Ra and ^{228}Ra in any underground source of drinking water for 10,000 years after decommissioning (Ismail 2008b). For the CRA-2014 PA calculations, we discovered that no vector results in a tracer component release exceeding the NUTS screening limit 1.0×10^{-7} kg/m^3. Consequently, we do not need to calculate Radium concentration in the CRA-2014 PA (DOE 2009).

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