HLWYM HEmails

From: William L Dam [WLD@nrc.gov]
Sent: Thursday, April 25, 2002 9:15 AM
To: David Brooks; David Pickett; John Bradbury
Subject: Re: colloid agreements
Attachments: RT colloids agreements.wpd

David, John, and Dave:
Attached is my updated basis for agreement RT3.08 on microspheres. I found on the ymp.gov website "new information" on the latest results (updated March 2002) for the UZ (Appendix B to a White Paper):
http://www.ymp.gov:80/documents/tuilr_c/appx_b.htm
and SZ (Appendix G to a White Paper):
http://www.ymp.gov:80/documents/tuilr_c/appx_g.htm
On the attachment, I pulled out some of the colloid results from these documents.

We will meet Phil Reed at 2pm in my office. Also, (John/Dave) can we call DOE today to request a telecon for next week? THANKS!
Bill

>>> David Pickett 04/24/02 03:17PM >>>
John and Bill,

Attached are tables of colloid-related ENFE and RT agreements, with a "basis" written for the agreement. Dave Brooks had asked Bill for such information before proceeding with contacting DOE. For several agreements (marked with *), I took the "basis" discussion straight from the recent agreements letters that contained my reviews of DOE responses. I hope that is the kind of infomation Dave was after for ENFE; if not, let me know. (May be a little too long in some cases.) Similar language is in the Integrated IRSR, but I don't have access to that document.

I wrote a quicky basis for ENFE.4.03, but I left the following blank:

RT.3.08 - microspheres
ENFE.1.06 and 4.04 - entrained

If I remember correctly, the first originated with Bill, and the other two with John. If that's correct, I would appreciate it if you could each write a short basis for your respective agreements. I can put it all together.

David

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Recipients:
"David Brooks" <David.Brooks@nrc.gov>
Tracking Status: None
"David Pickett" <DXP1@nrc.gov>
Tracking Status: None
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Radionuclide Transport Colloids Agreements

Number	NRC/DOE Agreements	Basis
1.03*	Provide the screening criteria for the radionuclides selected for PA. Provide the technical basis for selection of the radionuclides that are transported via colloids in the TSPA. The screening criteria for radionuclides selected for TSPA are contained in the AMR Inventory Abstraction. DOE is documenting identification of radionuclides transported via colloids for TSPA in the AMR Waste Form Colloid-Associated Concentration Limits: Abstraction and Summary, in the TSPA-SR Technical Report, and in the TSPA-SR Model Document. These documents will be available to the NRC in January 2001.	The NRC staff reviewed four documents pertaining to this agreement, Inventory Abstraction (ANL-WIS-MD-000006, Rev 00, ICN 01); Waste Form Colloid-Associated Concentration Limits: Abstraction and Summary (ANL-WIS-MD-000012, Rev 00, ICN 01); TSPA Model for Site Recommendation (MDL-WIS-PA-000002, Rev 00, ICN 00); and TSPA for the Site Recommendation (TDR-WIS-PA-000001, Rev 00, ICN 01). The analysis and model report on Inventory Abstraction (ANL-WIS-MD-000006, Rev 00, ICN 01) identifies radionuclides for the total system performance assessment model abstraction based on contribution to dose, inventory, and mobility considerations. The NRC staff considers the part of this agreement concerning screening criteria for the radionuclides selected for performance assessment fulfilled. However, to the technical basis for selecting radionuclides for transport modeling via reversible and irreversible colloid attachment is not transparent and traceable in all cases. Discussions in the waste form analysis and model report (ANL-WIS-MD-000012, Rev 00) and TSPA-SR documents (MDL-WIS-PA-000002, Rev 00, ICN 00; TDR-WIS-PA-000001, Rev 00, ICN 01) do not fully consider the possibility that waste form colloids could significantly transport radioelements other than plutonium and americium or the potential contribution of reversible colloid attachment to transport of less sorbing elements such as neptunium and uranium. It is not clear if analyses have been conducted showing that the effect of colloidal attachment on transport of these other radionuclides is insignificant. For example, it may be possible that transport of moderately sorbing radioelements would be significantly enhanced by reversible sorption onto colloids. In addition, there still exists, among the cited reports, confusion about the disposition of specific radioelements in colloid modeling. For example, the Total System Performance Assessment–Site Recommendation model report lists U-234 and Np-237 as radionuclides irreversibly attached to colloids, but the main Total System Performance Assessment–Site Recommendation report states that neptunium and uranium isotopes are not included in colloid transport models.

3.07*	Provide sensitivity studies to test the importance of colloid transport parameters and models to performance for UZ and SZ. Consider techniques to test colloid transport in the Alcove 8/Niche 3 test (for example, microspheres). DOE will perform sensitivity studies as the basis for consideration of the importance of colloid transport parameters and models to performance for the unsaturated and saturated zones and will document the results in updates to appropriate AMRs, and in the TSPA-LA document, all to be available in FY 2003. DOE will evaluate techniques to test colloidal transport in Alcove 8 / Niche 3 and provide a response to the NRC in February 2001.	The information reviewed was a status of DOE efforts and was not intended to provide the information required to fully address this agreement. At the RT Technical Exchange conducted on December 5-7, 2001, the NRC staff had expressed concern about the lack of field evidence for colloid transport through fractured rock in the unsaturated zone. More generally, colloid transport models and parameters for both the UZ and SZ are poorly constrained. It was agreed that DOE would consider applying techniques to test colloid transport parameters at Alcove 8 - Niche 3. In a letter dated March 28, 2001, DOE indicated that final test plans for colloids at Alcove 8/Niche 3 have not been developed, and that microsphere testing was still being considered in light of experience at the C-Wells and Busted Butte. As noted in the March 28, 2001, letter, DOE will provide a test plan, detailing the test techniques, as soon as it is developed. Since DOE is still in the process of considering techniques to test colloid transport in the Alcove 8/Niche 3 test and will provide the test plan when developed, the NRC staff considers this part of the agreement fulfilled. The concern described above, however, remains.
3.08	Provide justification that microspheres can be used as analogs for colloids (for example, equivalent ranges in size, charge, etc.). DOE will provide documentation in the C-Wells AMR to provide additional justification that microspheres can be used as analogs for colloids. The C-Wells AMR will be available to the NRC in October 2001.	DOE is using polystyrene microspheres to simulate the behavior of colloid-facilitated radionuclide transport in a variety of Yucca Mountain rock types in lab and field tests. The microspheres are spherical particles of specified sizes as compared to colloids that by definition range in size between 1 nanometer (nm) to 1 micron. The microspheres used in testing by DOE range in about four sizes ranging between 44 nm and 330 nm. Due to instrumental limitations of measuring the microspheres, particles smaller than 44 nm were not used in tests of the unsaturated zone and smaller than 100 nm in C-wells saturated zone tests. DOE testing indicates that smaller sized microspheres can migrate easier through porous or alluvial rock. The NRC's IRSR for Radionuclide Transport states that DOE must demonstrate tracers are appropriate homologues for radionuclides. Therefore, DOE must demonstrate that microspheres are appropriate tracers for colloid-facilitated radionuclides.

*Addressed in agreement status letter to DOE.

ADDITIONAL NEW INFORMATION:

From APPENDIX B. SUMMARY OF RECENT INFORMATION
RELEVANT TO THE UNSATURATED ZONE FLOW AND TRANSPORT PROCESS MODEL. 1.

Colloid transport in the matrix at YM may be limited, due to the small size of the available porosity. Physical filtration is likely to provide a first barrier to colloid transport through the matrix. Mercury porosimetry data (Travis and Nuttall, 1987) shows that most of the pores in the Topopah Spring tuff matrix have an aperture of less than 1.0 µm, and more than 50 percent of the pores have apertures less than 0.1 µm. Porosity is even smaller in the Calico Hills formation, with 50 percent of the pores less than 0.06 µm in diameter, although there are pores up to 4 µm in diameter (Travis and Nuttall, 1987). Chemical filtration through attachment to pore walls is likely to provide an additional barrier to colloid transport through the matrix. Tracer tests at the C-Well complex (UE-25 c#1, c#2, and c#3) indicate that colloid-sized particles (0.36 µm diameter polystyrene microspheres) migrated 31.7 m through the Lower Bullfrog tuff, but were attenuated by filtration, with only about 11 percent recovery after 2,650 hr (Reimus and Turin, 1997). It is much more likely that if colloid transport of radionuclide occurs at YM, it will be limited to fractures. Fracture transport processes, including colloid transport, will be considered in more detail under Section 4.3.

To assess colloid transport in the unsaturated zone, polystyrene microspheres were injected as part of the tracer mixture as surrogate colloids. Microsphere migration has also been analyzed in laboratory cores and in overcore samples. In the laboratory, a mixture of microspheres and LiBr was used. Under saturated conditions in the laboratory, the percent mass recovered for 190 nm microspheres within the Tac samples varied as a function of ionic strength, with 21 percent recovered at 0.01 M LiBr and 36 percent at 0 M. **In contrast, 44 nm microspheres had up to 82 percent recovery in the same material, indicating that the smaller colloids can migrate easier through this material.** Qualitative assessment of in-situ microsphere transport in the overcores taken around and below injection boreholes showed transport of approximately 0.21 m (0.69 ft) below the 50 ml/hr injectors over the 800–day injection period. From these rock analyses, it is not possible to distinguish between the two sizes of microspheres injected.

White Paper Appendix G SUMMARY OF RECENT INFORMATION RELEVANT TO THE SATURATED ZONE FLOW AND TRANSPORT PROCESS MODEL. 1. INTRODUCTION.. March 2002
http://www.ymp.gov:80/documents/tuilr_c/appx_g.htm

Finally, experiments intended to compare the transport behavior of carboxylate-modified latex microspheres and silica colloids were conducted in both fractured tuff cores and alluvium-packed columns during the past year. These experiments were conducted to address whether carboxylate-modified latex microspheres can be considered conservative surrogates for inorganic colloids in field tracer tests. Preliminary results have indicated that the carboxylate-modified latex microspheres tested (330-nm diameter) transport conservatively relative to silica colloids (~100-nm diameter) in fractured tuff.