August 16, 2002

Joseph D. Ziegler, Acting Assistant Manager
Office of Licensing and Regulatory Compliance
U.S. Department of Energy
Yucca Mountain Site Characterization Office
P.O. Box 364629
North Las Vegas, NV 89036-8629

SUBJECT: RADIONUCLIDE TRANSPORT AGREEMENT 3.08

Dear Mr. Ziegler:

During a Technical Exchange and Management Meeting held on December 5-7, 2000, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) reached agreement on a number of issues within the Radionuclide Transport (RT) Key Technical Issue (KTI). By letter dated April 26, 2002, DOE provided information pertaining to RT Agreement 3.08. The NRC staff has reviewed this information as it relates to the agreement and the results of the staff's review are enclosed.

In summary, the NRC staff believes that additional information is needed for RT Agreement 3.08. Specifically, DOE needs to provide a stronger technical basis and adequate experimental evidence to indicate that carboxylate-modified latex microspheres can be used as analogs for colloids in alluvium. Therefore, RT Agreement 3.08 is listed as "need additional information." In addition, the DOE response to this agreement did not address General Agreement 1.01 (#45), as discussed during the September 18-19, 2001, technical exchange on the range of operating temperatures. Therefore, DOE should address the concern in its response to RT Agreement 3.08 or some other correspondence. If you have any questions regarding this matter, please contact Mr. James Andersen of my staff. He can be reached at (301) 415-5717.

Sincerely,
/RA/

Janet Schlueter, Chief
High-Level Waste Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: As stated
cc: See attached distribution list

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Letter to J. Ziegler from J. Schlueter dated August 16, 2002

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**NRC Review of DOE Documents Pertaining to Key Technical Issue Agreements**

The U.S. Nuclear Regulatory Commission (NRC) goal of issue resolution during the pre-licensing period is to assure that the U.S. Department of Energy (DOE) has assembled enough information on a given issue for NRC to accept a license application for review. Resolution by the NRC staff during pre-licensing does not prevent anyone from raising any issue for NRC consideration during the licensing proceedings. Also, and just as important, resolution by the NRC staff during pre-licensing does not prejudge what the NRC staff evaluation of that issue will be after its licensing review. Issues are resolved by the NRC staff during pre-licensing when the staff has no further questions or comments about how DOE is addressing an issue. Pertinent new information could raise new questions or comments on a previously resolved issue.

This enclosure addresses one NRC/DOE agreement made during the December 5-7, 2000, Radionuclide Transport (RT) Technical Exchange and Management Meeting (see NRC letter dated December 12, 2000, which summarized the meeting). By letter received April 26, 2002, DOE submitted information to address RT Agreement 3.08. However, the DOE response did not address General Agreement 1.01 (#45). The DOE information submitted and both agreements are discussed below.

**Radionuclide Transport Agreement 3.08**

Wording of the Agreement: 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 [Analysis and Model Report] 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.

**General Agreement 1.01 (#45)**

Wording of Issue:

NRC Comment: In discussing preliminary microsphere transport tests at the Alluvial Testing Complex, it is mentioned that flow transients can remobilize microspheres. Is such a process possible in the repository system? If so, how can it be accommodated in the models? These questions may be addressed under agreement RT.3.08, although that agreement specifically discusses fractured rock rather than alluvium.

DOE Response: Flow transients are likely to occur, but it is unlikely that they will be as rapid or extreme as transients associated with stopping or starting the pump at ATC [Alluvial Testing Complex] during single-well testing. However, it may be important to incorporate sudden transients associated with seismicity into models (it is well known that earthquakes can turn water turbid for a while). Transients in water chemistry could also result in some remobilization of colloids. This issue is related to KTI [Key Technical Issue] agreement RT.3.08 and will address both fractured rock and alluvium.

NRC Review: In response to Radionuclide Transport Agreement 3.08, DOE provided a letter report (Reimus, 2002) titled “The Use of Polystyrene Microspheres As Tracer Surrogates for Inorganic Groundwater Colloids.” The letter report describes a limited number of laboratory experiments in which the transport behavior of carboxylate-modified latex (CML) microspheres was compared to that of silica microspheres and a dissolved inorganic tracer. The experiments were conducted in saturated conditions using fractured volcanic tuff and alluvium-packed columns. The letter report presents arguments for the utility of CML microspheres, chosen for

use in field transport experiments at Yucca Mountain, relative to other possible colloid surrogates. Experimental evidence is presented showing that the microspheres transport conservatively relative to silica colloids (a more realistic surrogate for groundwater colloids) in fractured tuff. This suggests that transport parameters derived from microsphere field tests in fractured tuff may be conservative.

In alluvium column experiments, however, the microspheres were more attenuated than silica colloids in three of four experiments. Therefore, parameters derived from alluvial field tests using CML microspheres as colloid surrogates may underestimate the potential mobility of groundwater colloids. The preliminary interpretation of the report is that deposition of the microspheres in alluvium is enhanced by "inertial interception," an effect that is sensitive to colloid size distribution. It is apparent that there is a physical colloid-size effect that the use of the CML microspheres may neglect. Furthermore, this effect may be even larger relative to natural colloids that may have significant populations smaller than the 100 nm of the silica colloids. At this time, there appears to be insufficient evidence to support the use of a correction factor as proposed in the report. The report promises a more extensive discussion in a revision of the Saturated Zone Colloid-Facilitated Transport Analysis and Model Report.

One factor not mentioned in the report is the ionic strength of the experimental fluids. The values should be reported so it can be established that they are not high enough to destabilize the colloidal suspensions.

The following is a general comment for consideration by DOE:

> Colloidal suspensions are known to be sensitive to the ionic strength of the solution, and results of previous investigations at C-Wells and Busted Butte suggest that ionic strength effects may have played important roles in those studies. The letter report does not provide any discussion on the ionic strength of experimental fluids. Ionic strength effects should be explicitly considered in any studies involving transport of colloids or an explanation of why the exclusion of this effect would not have an adverse impact on performance should be documented.

In summary, the letter report fails to provide sufficient evidence that CML microspheres are appropriate analogs for determination of natural colloid transport characteristics and parameters in alluvium. The proposed use of a correction factor to interpret field test results lacks sufficient technical basis. It is noted, however, that there are plans to use natural colloids labeled with Sm-152 in the cross-hole tracer tests at the Alluvial Testing Complex (Reimus and Umari, 2002). Results of transport experiments with these natural colloids may be sufficient to develop the colloid transport parameters required for performance assessment modeling of the alluvium.

In addition, General Agreement 1.01 (#45) is not mentioned in the cover letter nor is it discussed in the letter report. DOE needs to address this issue or explain why it will not have an adverse impact on performance in its response to this letter, a revision of the Saturated Zone Colloid-Facilitated Transport AMR, or some other correspondence.

<u>Additional Information Needed</u>:

1) Provide a stronger technical basis and adequate experimental evidence to indicate that CML microspheres can be used as analogs for colloids in alluvium.

2) Provide a response to General Agreement 1.01 (#45) to address the potential for remobilization of microspheres and/or colloids.

Status of Agreements: RT Agreement 3.08 is listed as “need additional information.”

References

Reimus, P. “The Use of Polystyrene Microspheres As Tracer Surrogates for Inorganic Groundwater Colloids.” Letter Report Rev 00 *(document number unknown)*. North Las Vegas, NV: Bechtel SAIC. April, 2002.

Reimus, P. and M.J. Umari. “Test Plan for Alluvial Testing Complex—Single-well, Multiple-well, and Laboratory Studies.” SITP-02-SZ-003 REV 01 ICN 1. North Las Vegas, NV: Bechtel SAIC. April, 2002.