December 12, 2000

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Office of Licensing and Regulatory Compliance
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P.O. Box 30307
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SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION/U.S. DEPARTMENT OF ENERGY TECHNICAL EXCHANGE AND MANAGEMENT MEETING ON RADIONUCLIDE TRANSPORT (DECEMBER 5 - 7, 2000)

Dear Mr. Brocoum:

Enclosed are the meeting summary highlights agreed upon during the December 5-7, 2000, Technical Exchange and Management meeting between the staff of the U.S. Nuclear Regulatory Commission and the U.S. Department of Energy. The main purpose of the meeting was to discuss one of the Key Technical Issues, Radionuclide Transport (RT). The meeting was held in Berkeley, California.

If you have any questions regarding this letter, please contact the technical lead for USFIC, Mr. John Bradbury or the Senior Project Manager for issue closure, Mr. James Andersen. Mr. Bradbury can be reached at (301) 415-6597 and Mr. Andersen at (301) 415-5717.

Sincerely,

/ra by K. Stablein for:/

C. William Reamer, Chief
High-Level Waste Branch
Division of Waste Management
Office of Nuclear Material Safety
and Safeguards

Enclosure: Summary Highlights of NRC/DOE Technical Exchange and Management Meeting on Radionuclide Transport

cc: See attached distribution list

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Letter to S. Brocoum from C.W. Reamer dated: December 12, 2000

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Summary Highlights of NRC/DOE Technical Exchange and Management Meeting on Radionuclide Transport

December 5-7, 2000
Berkeley, California

Introduction and Objectives

This Technical Exchange and Management Meeting on Radionuclide Transport (RT) is one in a series of meetings related to the U.S. Nuclear Regulatory Commission (NRC) key technical issue (KTI) and sufficiency review and the U.S. Department of Energy (DOE) site recommendation decision. Consistent with NRC regulations on prelicensing consultations and a 1992 agreement with DOE, staff-level resolution can be achieved during prelicensing consultation. The purpose of issue resolution is to assure that sufficient information is available on an issue to enable the NRC to docket a proposed license application. Resolution at the staff level does not preclude an issue being raised and considered during the licensing proceedings, nor does it prejudge what the NRC staff evaluation of that issue will be after its licensing review. Issue resolution at the staff level, during prelicensing, is achieved when the staff has no further questions or comments at a point in time regarding how the DOE is addressing an issue. The discussions recorded here reflect NRC's current understanding of aspects of radionuclide transport most important to repository performance. This understanding is based on all information available to date which includes limited, focused, risk-informed reviews of selected portions of recently provided DOE documents (e.g., Analysis and Model Reports (AMRs) and Process Model Reports (PMRs)). Pertinent additional information could raise new questions or comments regarding a previously resolved issue.

Issues are "closed' if the DOE approach and available information acceptably address staff questions such that no information beyond what is currently available will likely be required for regulatory decision making at the time of any initial license application. Issues are "closed-pending' if the NRC staff has confidence that the DOE proposed approach, together with the DOE agreement to provide the NRC with additional information (through specified testing, analysis, etc.) acceptably addresses the NRC's questions such that no information beyond that provided, or agreed to, will likely be required at time of initial license application. Issues are "open' if the NRC has identified questions regarding the DOE approach or information, and the DOE has not yet acceptably addressed the questions or agreed to provide the necessary additional information in a potential license application.

The objective of this meeting is to discuss and review the progress on resolving the RT KTI (see Attachment 1 for the description of Subissues #1, 2, and 3). Subissue #4, "Nuclear Criticality in the Far Field," was discussed during a Technical Exchange on October 22-23, 2000, and was not discussed during this meeting. The quality assurance (QA) aspect of this KTI was determined to be outside the scope of the meeting and is being tracked in NRC's ongoing review of DOE's QA program.

Summary of Meeting

At the close of the Technical Exchange and Management Meeting, the NRC staff stated that Subissues 1, 2, and 3 were "closed-pending." Specific NRC/DOE agreements made at the meeting are provided as Attachment 1. The agenda and the attendance list are provided as Attachments 2 and 3, respectively. Copies of the presenters' slides are provided as Attachment 4. Highlights from the Technical Exchange and Management Meeting are listed below.

Highlights

1) Opening Comments

DOE stated that the intent of the meeting is to reach agreement on the current status and path forward for each of the RT subissues (see "Radionuclide Transport" presentation given by Eric Smistad). In the RT Issue Resolution Status Report (IRSR), the NRC stated that RT Subissues 1, 2, and 3 are "open." During this meeting, DOE stated that its presentation would focus on confirmatory and additional information, data, and analyses identified by the NRC in the IRSR and subsequent discussions. DOE stated that it felt that the details provided during the current meeting would be the basis for NRC to list Subissues 1, 2, and 3 as "closed-pending."

2) Total System Performance Assessment

DOE provided an overview of how radionuclide transport is being incorporated into the Total System Performance Assessment (TSPA) for both the unsaturated zone (UZ) from the repository to the top of the water table and for the saturated zone (SZ) from the top of the water table beneath the repository to the 20 kilometer boundary.

Radionuclide transport processes parameters were implemented into the TSPA code using a particle tracking technique. Three-dimensional dual-continuum (fracture and matrix) flow fields (steady state flux) from the unsaturated and saturate zone process-level flow models were imported into TSPA code. The TSPA transport model incorporates probabilistically defined transport parameters in the unsaturated and saturated zone. In addition to these transport parameters, the TSPA code also varies the effective porosity of the alluvial material and the location of the alluvial boundary. The DOE provided clarifying information on the use of retardation and filtration expressions for modeling colloid transport. The DOE stated that colloid transport parameters were not as well constrained as other types of parameters.

3) Technical Discussions - Subissue #1, Radionuclide Transport Through Porous Rock

A summary of the current status of resolution was presented (see "Radionuclide Transport Key Technical Issue, Subissue 1, Radionuclide Transport in Porous Rock" presentation given by Jim Houseworth and Arend Meijer). The DOE identified the NRC information needs from Revision 2 of the RT IRSR and subsequent NRC/DOE discussions. The DOE stated that the presentations would provide the basis for going to "closed" or "closed-pending" for each of the acceptance criteria and, therefore, that it believed Subissue #1 should be listed as "closed-pending." For transport in porous rock, the DOE considers various transport processes including hydrodynamic dispersion, matrix diffusion, sorption (solutes), filtration (colloids), and radioactive decay important to performance.

The DOE stated that all the acceptance criteria are considered "closed" with the exception of criteria 2b, 2c, and 5. The DOE stated that it believed these criteria are "closed-pending." Additional testing is needed for Criterion 2b titled "Demonstrate evaluation of R_f" and for Criterion 2c titled "Demonstrate assumptions for K_d approach are valid." For Criterion 2b additional sensitivity studies and review of available data need to be done to evaluate the adequacy of sorption parameters derived from laboratory experiments. Experiments for plutonium have shown kinetic effects that make the high flow rates used for the column tests non-representative. Additional sensitivity studies and a review of available data will be used to evaluate the adequacy of the data. The sensitivity of performance assessment results to protactinium sorption will be investigated to evaluate if additional tests are needed. If protactinium is important to performance and the existing data are inadequate, additional batch sorption tests using site-specific materials will be considered. The criterion to confirm the K_d for plutonium determined in static tests that are appropriate for calculating retardation in dynamic systems has not been met. To evaluate the adequacy of the data, the DOE stated that the effect of plutonium sorption on performance will be investigated in sensitivity studies and external information on plutonium sorption will be reviewed.

For Criterion 2c, NRC staff had previously commented that batch and column experiments with plutonium indicate that retardation reactions are not instantaneous in the time scale of the experiments. The DOE plans to consider the effects of plutonium sorption on performance in sensitivity studies and will also review external information concerning plutonium sorption. These experiments will be used to evaluate the need for additional experiments with plutonium.

The NRC stated that additional documentation for Criterion 4, titled "Expert judgement/elicitation," is needed to enable a thorough evaluation of the use of expert judgement to obtain ranges and probabilities for transport parameters used in the TSPA code. The NRC staff expressed the concern that retardation (K_d) distributions were obtained from inadequately documented expert judgments. For transport parameters derived from expert judgements, the judgements should be conducted and documented in accordance with the guidance in NUREG-1563, as applicable. For those species for which K_ds were measured or referenced, the selected ranges of K_ds used to model transport of chemical species either through porous rock or fractures should be technically supported. The DOE plans to provide additional documentation to explain how transport parameters obtained from expert judgments and used for performance assessment were derived.

As a result of additional discussions, the NRC and DOE reached five agreements for Subissue #1 (see Attachment 1). With these five agreements, the NRC stated that Subissue #1 could be listed as "closed-pending".

4) Technical Discussions - Subissue #3, Radionuclide Transport Through Fractured Rock

A summary of the current status of resolution was presented (see "Radionuclide Transport Key Technical Issue, Subissue 3, Radionuclide Transport in Fractured Rock" presentation given by Al Aziz Eddebbarh, Bo Bodvarsson, George Moridis, Paul Reimus, and Edward Kwicklis). DOE identified the NRC information needs from Revision 2 of the RT IRSR and subsequent NRC/DOE discussions. The DOE stated that the presentations would provide the basis for going to "closed" or "closed-pending" for each of the acceptance criteria and, therefore, that it believed Subissue #3 should be listed as "closed-pending."

The DOE stated that for the unsaturated zone, the path lengths through the various units are generally the shortest distance between the potential repository and the water table. The only case where this is not true is where there is lateral diversion when downward flowing water encounters lower permeability rock such as bedded zeolitized tuff units or basal vitrophyres. The DOE stated that transport behavior in the unsaturated zone is not highly sensitive to alternative transport pathways, consistent with the data and known flow processes. Fractures are the main pathways of radionuclide transport in most units of the unsaturated zone. Diffusion from the fractures into the matrix and sorption in the matrix are the main retardation processes in radionuclide transport.

Sorption onto the matrix retards the migration of sorbing radionuclides. Flow and transport in the Calico Hills nonwelded hydrogeologic unit are strongly dependent on the spatial variability of the distribution of the vitric and zeolitic layers.

Recent unsaturated zone modeling at Yucca Mountain indicates that Topopah Spring welded units appear to be the most important for early arrival at the water table, while bedded tuff zeolitic units are more important for later arrival. In terms of relative importance to arrival times at the water table, the Topopah Spring is more important than bedded tuff zeolitic units, which in turn are more important than bedded vitric tuff units.

As discussed above, the DOE believes that all acceptance criteria for this subissue are considered "closed" or not applicable, with the exception of criteria 2a and 2b. These criteria are considered to be "closed-pending." Criterion 1c is considered to be closed by the DOE, because for the saturated zone, the uncertainty related to the lengths of flow paths in the tuff and in the alluvium was discussed at the October 31-November 2, 2000, Saturated Zone Technical Exchange. However, the DOE agreed at that technical exchange to provide additional information, including Nye County data, to

further justify the uncertainty distribution of the flow path in alluvium in updates to the Uncertainty Distribution Stochastic Parameters AMR. Additional information was presented at this meeting to show how water chemistry and isotopic data are being used by the DOE to better define groundwater flow paths in the saturated zone.

Criterion 2a is titled "Demonstrate ability to predict breakthrough curves". Breakthrough curves of reactive, non-reactive, and colloidal tracers have been developed from field tests. These breakthrough curves are documented in the Saturated Zone Process Model Report, the planned C-well testing report, and the Unsaturated Zone Process Model Report. The DOE has developed breakthrough curves for nonsorbing tracer transport in fractured, welded tuff based on Alcove 1 data. Additional tests are being conducted in Alcove8/Niche 3 ,which will include nonsorbing and moderately sorbing tracers. The DOE is developing predictive models for the Alcove 8/Niche 3 tests as was discussed at the October 11-13, 2000, Structural Deformation and Seismicity Technical Exchange. This was the subject of an agreement made at that exchange. DOE considers this criterion "closed-pending" pending results from Alcove 8/Niche 3 testing and predictive modeling.

The NRC previously commented on the test plans for Alcove 8/Niche 3 and recommended that slots be cut into the walls of Niche 3. The NRC stated that this would allow the capture of most of the water percolating down from infiltration beds in Alcove 8. The DOE showed simulations that suggest percolation could occur well beyond where slots can be cut, making it unlikely to achieve a full water balance. The DOE also indicated that full recovery of percolation is not necessary to interpret the Alcove 8/Niche 3 tests. As an alternative, the DOE proposed to cut slots in Niche 5 to capture the bypass flow from seepage experiments. The injection of fluid will occur only a few meters above Niche 5, making it possible to capture all flow diverted around the niche.

Criterion 2b, titled "Demonstrate tracers are appropriate homologues for radionuclides," states that if credit is to be taken for radionuclide attenuation in fractured rock, then the DOE should have demonstrated nonradioactive tracers used in field tests are appropriate homologues for radioelements. The DOE expects to show that non-radioactive tracers used in field tests are appropriate homologues for radioelements. Ongoing testing at Alcove 8/Niche 3 will provide transport data using a suite of tracers representative of conservative and weakly sorbing radionuclides. The DOE has completed tests at the C-well complex using pentafluorobenzoic acid, bromide, lithium, and microspheres . The DOE considers these tests to be representative of transport of conservative radionuclides, sorbing radionuclides, and colloids. For dissolved radionuclides, the DOE is using these results as a means of demonstrating the appropriateness of conceptual models rather than as a source of transport parameters for TSPA. The DOE considers this criterion "closed-pending" pending documentation of Busted Butte and C-wells data.

As a result of additional discussions, the NRC and DOE reached 10 agreements for Subissue #3 (see Attachment 1). With these 10 agreements, the NRC stated that Subissue #3 could be listed as "closed-pending".

5) Technical Discussion - Subissue #2, Radionuclide Transport Through Alluvium

A summary of the current status of resolution was presented (see "Radionuclide Transport Key Technical Issue, Subissue 2, Radionuclide Transport Through Alluvium" presentation given by Al Aziz Eddebbarh, Paul Reimus, and Arend Meijer). The DOE identified the NRC information needs from Revision 2 of the RT IRSR and subsequent NRC/DOE discussions. The DOE stated that the presentations would provide the bases for going to "closed" or "closed-pending" for Subissue #2 acceptance criteria and, therefore, that it believed Subissue #2 should be listed as "closed-pending."

Through performance assessment the DOE has determined that for the alluvium, transport processes such as sorption, radioactive decay, and colloidal filtration are important to repository performance. On-going and planned testing at the Alluvium Testing Complex will help confirm the applicability of laboratory determined transport parameters. Testing at the Alluvium Testing Complex will also confirm whether the alluvial aquifer can be considered a single continuum porous medium.

Future TSPA analyses will be revised to better incorporate the effects of heterogeneity in the alluvium. Heterogeneity in the alluvial aquifer will be incorporated into TSPA analyses by the use of effective porosity distributions. The DOE indicated that gravimeter logs will be run in addition to Nye County wells to obtain further estimates of average formation porosity.

The DOE believes that all acceptance criteria are considered "closed" with the exception of criteria 2a, 2b, 2c, and 4. These criteria are considered to be "closed-pending."

Criterion 2a stated that for the valid application of the constant K_d approach, the DOE should demonstrate that the flow path acts as a single continuum porous medium. If the flow cannot be shown to be a single continuum porous medium, then the acceptance criteria for radionuclide transport in fractured rock apply. Evidence that the alluvium can be modeled as a single continuum porous medium will be obtained by testing at the Alluvium Testing Complex. The DOE considers this criterion "closed-pending" completion of these tests.

Criterion 2b states that for the valid application of the constant K_d approach, the DOE should demonstrate that appropriate sorption values have been adequately considered (e.g., experimentally determined or measured). The DOE is using preliminary transport parameter values derived from lab measurements in performance assessment analyses. The DOE will refine and confirm these parameter values after multiple well tracer testing of radionuclide surrogates at the Alluvium Testing Complex and after laboratory batch and column radionuclide transport studies. The DOE considers this criterion "closed-pending" the completion of the testing at the Alluvium Testing Complex to obtain hydraulic and transport parameters for the alluvium.

The DOE considers Criterion 2c "closed-pending." The DOE cited as a basis for "closed-pending" that the following tests of alluvial aquifer samples are planned: (1) batch and column testing of alluvial aquifer material for technetium and neptunium under reducing conditions; (2) column testing to address the assumption of fast desorption kinetics; and (3) laboratory testing under reducing conditions to address the assumption of bulk chemistry.

For Criterion 4, "Expert Elicitation," the DOE stated that it did not use expert elicitation for development of K_ds for the alluvium. Additional documentation will be provided to explain how sorption coefficient distributions used for performance assessment were derived. The DOE considers this criterion "closed-pending" additional documentation of expert judgement.

As a result of additional discussions, the NRC and DOE reached 11 agreements for Subissue #2 (see Attachment 1). With these 11 agreements, the NRC stated that Subissue #2 could be listed as "closed-pending".

6) Features, Events, and Processes

The DOE presented Features, Events, and Processes (FEPs) for unsaturated zone and saturated zone transport (see "Features, Events, and Processes for Unsaturated Zone and Saturated Zone Transport" presentation given by Jim Houseworth). The objective of the presentation was to describe the upcoming revision to the FEPs AMRs.

Out of 128 features, events, and processes important to performance in the unsaturated and saturated zone, the DOE stated that 35 are related to unperturbed radionuclide transport. Of these, 28 are included and 7 are excluded. Included FEPs are those that are modeled in the TSPA either directly or indirectly. Excluded FEPs are not included in the TSPA. The seven excluded features, events, and processes were excluded based on low consequence.

The DOE stated that it was updating the unsaturated and saturated zone flow and transport FEPs AMRs, and that the AMRs will be provided in NRC upon completion.

7) Public Comments

The State of Nevada (Ms. Linda Lehman) provided written comments at the meeting which were read at the end of the meeting. The comments were as follows:

1) There may be a disconnect between unsaturated zone and saturated zone structures important to transport. For example, the Ghost Dance Fault Splay seems to be important in the unsaturated zone, but may not be explicitly gridded in the saturated zone.

2) Distribution of recharge in the unsaturated zone is still problematic, for example on the western slope and especially where Paintbrush Tuff non-welded is absent. (This may also be relevant to the unsaturated zone FEP AMR - infiltration and recharge).

3) Flow paths in the saturated zone are still of concern.

4) Much more work must go into defining paths and chemistry thru alluvium.

5) There is concern about correlated variables and their use in Monte Carlo methods for performance assessment.

6) The State of Nevada has a problem with the boundary conditions used for diffusion, especially in Topapah Springs.

7) The State of Nevada has a problem with boundary conditions with respect to saturated zone dispersion stratigraphically and laterally.

C. William Reamer	Dennis R. Williams
Deputy Director	Deputy Assistant Manager
Division of Waste Management	Office of Licensing & Regulatory Compliance
Nuclear Regulatory Commission	Department of Energy

Summary of the Resolution of the Key Technical Issue on Radionuclide Transport

Subissue #	Subissue Title	Status	NRC/DOE Agreements
1	Radionuclide Transport Through Porous Rock	Closed-Pending	1) Provide the basis for the proportion of fracture flow through the Calico Hills non-welded vitric. DOE will revise the AMR *UZ Flow Models and Submodels* and the AMR *Calibrated Properties Model* to provide the technical basis for the proportion of fracture flow through the Calico Hills Nonwelded Vitric. These reports will be available to the NRC in FY 2002. In addition, the field data description will be documented in the AMR *In Situ Field Testing of Processes* in FY 2002. 2) Provide analog radionuclide data from the tracer tests for Calico Hills at Busted Butte and from similar analog and radionuclide data (if available) from test blocks from Busted Butte. DOE will provide data from tracers used at Busted Butte and data from (AECL) test blocks from Busted Butte in an update to the AMR *In Situ Field Testing of Processes* in FY 2002. 3) 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.

1	Radionuclide Transport Through Porous Rock - Cont.		4) Provide sensitivity studies on K_d for plutonium, uranium, and protactinium to evaluate the adequacy of the data. DOE will analyze column test data to determine whether, under the flow rates pertinent to the Yucca Mountain flow system, plutonium sorption kinetics are important to performance. If they are found to be important, DOE will also perform sensitivity analyses for uranium, protactinium, and plutonium to evaluate the adequacy of K_D data. The results of this work will be documented in an update to the AMR *Unsaturated Zone and Saturated Zone Transport Properties* available to the NRC in FY 2002. 5) Provide additional documentation to explain how transport parameters used for performance assessment were derived in a manner consistent with NUREG-1563, as applicable. Consistent with the less structured approach for informal expert judgment acknowledged in NUREG-1563 guidance and consistent with DOE procedure AP-3.10Q, DOE will document how it derived the transport parameter distributions for performance assessment, in a report expected to be available in FY 2002.
2	Radionuclide Transport Through Alluvium	Closed-Pending	1) Provide further justification for the range of effective porosity in alluvium, considering possible effects of contrasts in hydrologic properties of layers observed in wells along potential flow paths. DOE will use data obtained from the Nye County Drilling Program, available geophysical data, aeromagnetic data, and results from the Alluvium Testing Complex testing to justify the range of effective porosity in alluvium, considering possible effects of contrasts in hydrologic properties of layers observed in wells along potential flowpaths. The justification will be provided in the *Alluvial Testing Complex* AMR due in FY 2003. 2) The DOE should demonstrate that TSPA captures the spatial variability of parameters affecting radionuclide transport in alluvium. DOE will demonstrate that TSPA captures the variability of parameters affecting radionuclide transport in alluvium. This information will be provided in the TSPA-LA document due in FY 2003.

2	Radionuclide Transport Through Alluvium - Cont.		3) Provide a detailed testing plan for alluvial testing (the ATC and Nye County Drilling Program) to reduce uncertainty (for example, the plan should give details about hydraulic and tracer tests at the well 19 complex and it should also identify locations for alluvium complex testing wells and tests and logging to be performed). NRC will review the plan and provide comments, if any, for DOE's consideration. In support and preparation for the October/November 2000 Saturated Zone meeting, DOE provided work plans for the Alluvium Testing Complex and the Nye County Drilling Program (FWP-SBD-99-002, Alluvial Tracer Testing Field Work Package, and FWP-SBD-99-001, Nye County Early Warning Drilling Program, Phase II and Alluvial Testing Complex Drilling). DOE will provide test plans of the style of the Alcove 8 plan as they become available. The plan will be amended to include laboratory testing. In addition, the NRC On Site Representative attends DOE/Nye County planning meetings and is made aware of all plans and updates to plans as they are made. 4) The NRC needs DOE to document the pre-test predictions for the ATC. DOE will document pretest predictions for the Alluvial Testing Complex in the *SZ In Situ Testing* AMR available in October 2001. 5) Provide the laboratory testing plan for laboratory radionuclide transport studies. NRC will review the plan and provide comments, if any, for DOE's consideration. In support and preparation for the October/November 2000 Saturated Zone meeting, DOE provided work plans for the Alluvium Testing Complex and the Nye County Drilling Program (FWP-SBD-99-002, Alluvial Tracer Testing Field Work Package, and FWP-SBD-99-001, Nye County Early Warning Drilling Program, Phase II and Alluvial Testing Complex Drilling). DOE will provide test plans of the style of the Alcove 8 plan as they become available. The plan will be amended to include laboratory testing. In addition, the NRC On Site Representative attends DOE/Nye County planning meetings and is made aware of all plans and updates to plans as they are made.

2	Radionuclide Transport Through Alluvium - Cont.		6) If credit is taken for retardation in alluvium, the DOE should conduct K_d testing for radionuclides important to performance using alluvium samples and water compositions that are representative of the full range of lithologies and water chemistries present within the expected flow paths (or consider alternatives such as testing with less disturbed samples, use of samples from more accessible analog sites (e.g., 40-mile Wash), detailed process level modeling, or other means). DOE will conduct K_d experiments on alluvium using samples from the suite of samples obtained from the existing drilling program; or, DOE will consider supplementing the samples available for testing from the alternatives presented by the NRC. This information will be documented in an update to the *SZ In Situ Testing* AMR, available in FY 2003. K_d parameter distributions for TSPA will consider the uncertainties that arise from the experimental methods and measurements. 7) Provide the testing results for the alluvial and laboratory testing. DOE will provide testing results for the alluvial field and laboratory testing in an update to the *SZ In Situ Testing* AMR available in FY 2003. 8) Provide additional information to further justify the uncertainty distribution of flow path lengths in the alluvium. This information currently resides in the *Uncertainty Distribution for Stochastic Parameters* AMR. DOE will provide additional information, to include Nye County data as available, to further justify the uncertainty distribution of flowpath lengths in alluvium in updates to the *Uncertainty Distribution for Stochastic Parameters* AMR and to the *Saturated Zone Flow and Transport* PMR, both expected to be available in FY 2002. 9) Provide the hydro-stratigraphic cross-sections that include the Nye County data. DOE will provide the hydrostratigraphic cross sections in an update to the *Hydrogeologic Framework Model for The Saturated Zone Site-Scale Flow and Transport Model* AMR expected to be available during FY 2002, subject to availability of Nye County data.

2	Radionuclide Transport Through Alluvium - Cont.		10) Provide additional documentation to explain how transport parameters used for PA were derived in a manner consistent with NUREG-1563, as applicable. Consistent with the less structured approach for informal expert judgment acknowledged in NUREG-1563 guidance and consistent with AP-3.10Q, DOE will document how it derived the transport distributions for performance assessment, in a report expected to be available in FY 2002. 11) Provide the updated UZ Flow and Transport and the SZ Flow and Transport FEPs AMRs. DOE will provide updates to the AMRs *Features, Events, and Processes in UZ Flow and Transport* and *Features, Events, and Processes in SZ Flow and Transport*, both available in January 2001.
3	Radionuclide Transport Through Fractured Rock	Closed-Pending	1) For transport through fault zones below the repository, provide the technical basis for parameters/distributions (consider obtaining additional information, for example, the sampling of wells WT-1 and WT-2), or show the parameters are not important to performance. DOE will provide a technical basis for the importance to performance of transport through fault zones below the repository. This information will be provided in an update to the AMR *Radionuclide Transport Models Under Ambient Conditions* available to the NRC in FY 2002. If such transport is found to be important to performance, DOE will provide the technical basis for the parameters/distributions used in FY 2002. DOE will consider obtaining additional information. 2) Provide the analysis of geochemical data used for support of the flow field below the repository. DOE will provide the analysis of geochemical data used for support of the fluid flow patterns in the AMR *UZ Flow Models and Submodels*, available to the NRC in FY 2002.

3	Radionuclide Transport Through Fractured Rock - Cont.		3) Provide additional information to further justify the uncertainty distribution of flow path lengths in the tuff. This information currently resides in the *Uncertainty Distribution for Stochastic Parameters* AMR. DOE will provide additional information, to include Nye County data as available, to further justify the uncertainty distribution of flowpath lengths from the tuff at the water table through the alluvium at the compliance boundary in updates to the *Uncertainty Distribution for Stochastic Parameters* AMR and to the *Saturated Zone Flow and Transport* Process Model Report, both expected to be available in FY 2002. 4) Provide sensitivity studies for the relative importance of the hydrogeological units beneath the repository for transport of radionuclides important to performance. DOE will provide a sensitivity study to fully evaluate the relative importance of the different units below the repository that could be used to prioritize data collection, testing, and analysis. This study will be documented in an update to the AMR *Radionuclide Transport Models Under Ambient Conditions* available to the NRC in FY 2002. 5) Provide the documentation for the Alcove 8/Niche 3 testing and predictive modeling for the unsaturated zone. DOE will provide documentation for the Alcove 8 / Niche 3 testing and predictive modeling for the unsaturated zone in updates to the AMRs *In Situ Field Testing of Processes* and *Radionuclide Transport Models Under Ambient Conditions*, both available to the NRC in FY 2002. 6) The NRC needs DOE to document the pre-test predictions for the Alcove 8/Niche 3 work. DOE responded that pre-test predictions for Alcove 8 Niche 3 work will be provided to NRC via letter report (Brocoum to Greeves) by mid-January 2001.

3	Radionuclide Transport Through Fractured Rock - Cont.		7) 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. 8) 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. 9) Provide the documentation for the C-wells testing. Use the field test data or provide justification that the data from the laboratory tests is consistent with the data from the field tests. DOE will provide the C-Wells test documentation and will either use the test data or provide a justified reconciliation of the lab and field test data in the C-Wells AMR available in October 2001. 10) Provide analog radionuclide data from the tracer tests for Calico Hills at Busted Butte and from similar analog and radionuclide data (if available) from test blocks from Busted Butte. DOE will provide data from analog tracers used at Busted Butte and data from (AECL) test blocks from Busted Butte in an update to the AMR *In Situ Field Testing of Processes* in FY 2002.