

April 10, 2003

Joseph D. Ziegler, Acting Director  
Office of License Application and Strategy  
U.S. Department of Energy  
Office of Repository Development  
P.O. Box 364629  
North Las Vegas, NV 89036-8629

SUBJECT: TOTAL SYSTEM PERFORMANCE ASSESSMENT AND INTEGRATION  
(TSPAI) AGREEMENTS 1.01 AND 4.03; STATUS: TSPAI 1.01 COMPLETE,  
TSPAI 4.03 PARTLY RECEIVED

Dear Mr. Ziegler:

The enclosure to this letter addresses two agreements made between the U.S. Department of Energy (DOE) and the U.S. Nuclear Regulatory Commission (NRC) during the TSPAI Technical Exchange and Management Meeting held from August 6-10, 2001. In a letter dated October 29, 2002, DOE submitted information to address TSPAI Agreement 1.01 and TSPAI Agreement 4.03. The information was provided in a document entitled "Total System Performance Assessment — License Application Methods and Approach" (herein referred to as the "Methods and Approach Document"). In the transmittal letter, DOE stated that it considered TSPAI Agreement 1.01 to be fully addressed and TSPAI Agreement 4.03 to be partially addressed by the Methods and Approach Document. The letter, dated October 29, 2002, noted that the Methods and Approach Document is equivalent to the Total System Performance Assessment to support the potential License Application Methods and Assumptions document referred to in the wording of the agreements. The NRC staff review of the Methods and Approach Document, as it pertains to the two agreements above, is discussed in the attachment to this letter.

By providing the Methods and Approach Document, DOE has satisfied the intent of Agreement TSPAI.1.01. NRC staff will evaluate the implementation of this approach as it follows DOE's progress towards satisfying TSPAI Agreement 1.02. TSPAI Agreement 1.01 is listed as "complete." By addressing, in the Methods and Approach Document, the statistical measures that DOE intends to use to support its arguments for stability and by starting to describe the components of a potential method, DOE has provided some of the information requested by TSPAI Agreement 4.03.

J. Ziegler

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NRC staff will continue to evaluate DOE's progress in providing the information requested by this agreement as more information becomes available. TSPAI Agreement 4.03 is listed as "partly received."

If there are any questions regarding this letter please contact Daniel S. Rom at 301-415-6704, or by e-mail at [dsr@nrc.gov](mailto:dsr@nrc.gov).

Sincerely,

**/RA/**

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

Enclosure: NRC review of DOE letter  
pertaining to TSPAI  
Key Technical Issue  
Agreements 1.01 and 4.03

cc: See attached distribution list

J. Ziegler

-2-

NRC staff will continue to evaluate DOE's progress in providing the information requested by this agreement as more information becomes available. TSPA Agreement 4.03 is listed as "partly received."

If there are any questions regarding this letter please contact Daniel S. Rom at 301-415-6704, or by e-mail at [dsr@nrc.gov](mailto:dsr@nrc.gov).

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Janet R. Schlueter, Chief  
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Division of Waste Management  
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Enclosure: NRC review of DOE letter  
pertaining to TSPA  
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Agreements 1.01 and 4.03

cc: See attached distribution list

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Letter to J. Ziegler from J. Schlueter, dated: April 10, 2003

cc:

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J. Pegues, City of Las Vegas, NV	B. Helmer, Timbisha Shoshone Tribe
M. Murphy, Nye County, NV	R. Arnold, Pahrump Paiute Tribe

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cc: (Continued)

R. Clark, EPA

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D. Duncan, USGS

R. Craig, USGS

W. Booth, Engineering Svcs, LTD

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S. Echols, ESQ

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R. Mike, Duckwater Shoshone Tribe

M. Smurr, BNFL, Inc.

T. Kingham, GAO

D. Feehan, GAO

E. Hiruo, Platts Nuclear Publications

G. Hernandez, Las Vegas Paiute Tribe

R. Boland, Timbisha Shoshone Tribe

J. Birchim, Yomba Shoshone Tribe

C. Meyers, Moapa Paiute Indian Tribe

R. Wilder, Fort Independence Indian Tribe

D. Vega, Bishop Paiute Indian Tribe

J. Egan, Egan & Associates, PLLC

J. Leeds, Las Vegas Indian Center

R. M. Saulque, Benton Paiute Indian Tribe

C. Bradley, Kaibab Band of Southern Paiutes

R. Joseph, Lone Pine Paiute-Shoshone Tribe

L. Tom, Paiute Indian Tribes of Utah

E. Smith, Chemehuevi Indian Tribe

V. McQueen, Sr., Ely Shoshone Tribe

D. Crawford, Inter-Tribal Council of NV

R. Quintero, Inter-Tribal Council of NV  
(Chairman, Walker River Paiute Tribe)

D. Eddy, Jr., Colorado River Indian Tribes

H. Jackson, Public Citizen

J. Wells, Western Shoshone National Council

R. Henning, BSC

I. Zabarte, Western Shoshone National Council

K. Finrock, NV Congressional Delegation

NRC On-Site Representatives

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## **U.S. Nuclear Regulatory Commission Staff Review of U.S. Department of Energy 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. Furthermore, 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 issues.

This enclosure addresses two agreements made between DOE and NRC during the Total System Performance Assessment and Integration (TSPAI) Technical Exchange and Management Meeting.<sup>1</sup> By a letter dated October 29, 2002, DOE submitted information to address TSPAI Agreement 1.01 and TSPAI Agreement 4.03. The scope of information that DOE would provide in response to TSPAI Agreements 1.01 and 1.02 was discussed at the April 15-16, 2002, Technical Exchange and Management Meeting on DOE's Key Technical Issue Agreement Planning Strategy and Discussion of Fiscal Year (FY) 2002 Agreements.<sup>2</sup> The information was provided in a document entitled "Total System Performance Assessment — License Application Methods and Approach" (herein referred to as the "Methods and Approach Document"). In the transmittal letter, it was indicated that DOE considers TSPAI Agreement 1.01 to be fully addressed and TSPAI Agreement 4.03 to be partially addressed by the Methods and Approach Document. The letter, dated October 29, 2002, noted that the Methods and Approach Document is equivalent to the Total System Performance Assessment (TSPA) to support the potential License Application (LA) Methods and Assumptions document referred to in the wording of the agreements. The NRC staff review of the Methods and Approach Document, as it pertains to the two agreements above, is discussed below.

### **Total System Performance Assessment and Integration Agreement 1.01**

#### **Wording of the Agreement:**

Provide enhanced descriptive treatment for presenting barrier capabilities in their final approach for demonstrating multiple barriers. Provide discussion of the capabilities of individual barriers, in light of existing parameter uncertainty (e.g., in barrier and system characteristics) and model uncertainty. DOE will provide enhanced descriptive treatment for presenting barrier capabilities in the final approach for demonstrating multiple barriers. DOE will also provide discussion of

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<sup>1</sup>Reamer, C.W. "U.S. Nuclear Regulatory Commission/U.S. Department of Energy Technical Exchange and Management Meeting on Total System Performance Assessment and Integration (August 6–10, 2001)." Letter (August 23) to S. Brocoum, DOE.

<sup>2</sup>Schlueter, J. "U.S. Nuclear Regulatory Commission/U.S. Department of Energy Technical Exchange and Management Meeting on Key Technical Issue Agreements (April 15-16, 2002)." Letter (April 15-16, 2002) to S. Brocoum, DOE.

the capabilities of individual barriers, in light of existing parameter uncertainty (e.g., in barrier and system characteristics) and model uncertainty. The information will be documented in TSPA Methods and Assumptions document, expected to be available to NRC in FY 2002, for any potential LA.

NRC Review:

During its review of the information pertaining to the TSPA for Site Recommendation (SR), the NRC staff identified a need for more information on the DOE approach for demonstrating the presence of multiple barriers. Demonstration of multiple barriers is required under 10 CFR 63.113(a) and 63.115. TSPA Agreement 1.01 addresses the approach that DOE will use to demonstrate multiple barriers. The implementation of the DOE demonstration of multiple barriers is addressed by TSPA Agreement 1.02, which requires that the documentation will discuss: (i) parameter uncertainty, (ii) model uncertainty, (iii) spatial and temporal variability in the performance of the barriers, (iv) independent and interdependent capabilities of the barriers (e.g., differentiation of capabilities for barriers performing similar functions), and (v) barrier effectiveness with regard to individual radionuclides.

The Methods and Approach Document provides an overview of the approaches that DOE plans to use in their TSPA model. Section 8.3 of the Methods and Approach Document presents the DOE approach to support the multiple barrier analyses. The Methods and Approach Document identifies four potential natural barriers and five potential engineered barriers. DOE indicated that the level of information provided to describe a barrier would be commensurate with the relative importance of the barrier in complying with the individual protection requirement of 10 CFR 63.113(b).

For barriers important to waste isolation, the description will focus on their capabilities to limit the movement of water or radionuclides. The description will include discussions of model and parameter uncertainty as well as temporal and spatial variability. Quantitative analyses would be incorporated into the description of multiple barriers, when appropriate. By using the quantitative results directly from the TSPA-LA (not from any hypothetical extreme scenario or degraded barrier simulation), DOE asserts that they can account for the uncertainty in barrier characteristics and barrier interdependence. The Methods and Approach Document discusses two types of quantitative analyses, intermediate performance analyses and pinch-point analyses. Examples of intermediate performance measures and pinch-point metrics considered the movement of water and transport of radionuclides. The approach also included a figure depicting barrier effectiveness for a single radionuclide at two different times.

In Section 8.3.1, there are quotations provided that relate to the definitions of "barrier" and "important to waste isolation" in 10 CFR Part 63. There are errors in the quotations associated with each of these definitions. Excerpts from the definitions, with emphasis added for those sections not included correctly when quoted in Section 8.3.1 of the Methods and Approach Document, are provided below.

*Barrier* means any material, structure, or feature that, **for a period to be determined by NRC**, prevents or substantially reduces the rate of movement of water or radionuclides from **the Yucca Mountain repository** to the accessible

environment, or prevents the release or substantially reduces the release rate of radionuclides from the waste.

*Important to waste isolation*, with reference to design of the engineered barrier system and characterization of natural barriers, means those engineered and natural barriers whose function is to provide a reasonable expectation that high-level waste can be disposed of without exceeding the requirements of **§ 63.113(b) and (c)**.

A number of observations that could affect how the approach outlined in the Methods and Approach Document is implemented to develop information identified in TSPAI Agreement 1.02 are provided below.

- On page 134 of the Methods and Approach Document, pinch-point analyses are described. The information provided by this approach may not indicate whether a feature prevents or substantially reduces the rate of movement of water or radionuclides and additional information supporting such an assertion may be needed. One example is the accounting of material entering a feature near the end of the calculation. This material would be identified as being “retained” by a barrier even if it enters the feature during the last time step and it would not be clear that the feature is substantially affecting its movement. As DOE seeks to address the effectiveness of particular barriers using pinch-point analyses, as described in the Methods and Approach Document, DOE should consider and address appropriately artifacts of the modeling or the display of information.
- The independent and interdependent capabilities of barriers should be clearly differentiated within the description and discussion.
- Discussions of barrier effectiveness should be thorough with regard to individual radionuclides. Barrier capabilities should be presented for most, if not all, of the radionuclides and should not be limited only to those radionuclides that contribute significantly to the calculated dose to the reasonably maximally exposed individual. Radionuclides that contribute significantly to the calculated dose tend to have some unfavorable combination of properties (e.g., moderate to large values for half-life, initial inventory, solubility, transport affinity, or biosphere dose conversion factor), which results in reduced barrier effectiveness. In principle, the radionuclides for which at least one barrier is highly effective may not contribute significantly to the calculated dose. Discussions that address the range of barrier effectiveness for different radionuclides (from minimally to highly effective) are important for understanding the capability of each barrier to isolate waste.
- The effect of a barrier on radionuclide transport can be used to describe the capability of barriers below the repository horizon, but cannot be used directly for barriers above the repository horizon. Instead, the effect of a barrier on water movement will be used in the description of the capability of barriers that reside above the repository horizon. Water movement can influence radionuclide release and radionuclide transport. To help clarify the capabilities of specific barriers, it may be necessary to discuss the

relationship between water movement (e.g., how it was affected by barriers above the repository horizon) and radionuclide release and transport.

By providing the Methods and Approach Document, DOE has satisfied the intent of agreement TSPA.1.01. NRC staff will evaluate the implementation of this approach as it follows DOE's progress towards satisfying agreement TSPA.1.02.

Additional Information Needed: None.

Status of Agreement: TSPA Agreement.1.01 is listed as "complete."

### **Total System Performance Assessment and Integration Agreement 4.03**

Wording of the Agreement:

DOE will document the method that will be used to demonstrate that the overall results of the TSPA are stable. DOE will provide documentation that submodels (including submodels used to develop input parameters and transfer functions) are also numerically stable. DOE will address in the method the stability of the results with respect to the number of realizations. DOE will describe in the method the statistical measures that will be used to support the argument of stability. The method will be documented in TSPA LA Methods and Assumptions Document in FY02. The results of the analyses will be provided in the TSPA (or other appropriate documentation) for any potential license application in FY 2003.

NRC Review:

During its review of the information pertaining to the TSPA-SR, the NRC staff identified a need for more information on how the DOE will demonstrate that the overall TSPA results are stable. Stability of the results from the total system performance assessment code is explicitly addressed by two acceptance criteria of the Yucca Mountain Review Plan (Section 4.2.1.4.1.3 and 4.2.1.4.2.3, U.S. Nuclear Regulatory Commission, NUREG-1804, Revision 2, Draft Report for Comment, March 2002), which pertain to the post-closure performance objectives at 10 CFR 63.113(b), 63.113(c), and 63.113(d). TSPA Agreement 4.03 addresses both the method and its implementation for demonstrating that the results of the total system performance assessment are stable.

The Methods and Approach Document provides a general description and overview of method and approaches to be used in model development and analysis for the TSPA. In Section 7.3, DOE indicates that the approach to be used to assess the stability and reliability of the TSPA-LA model has not been decided upon. Several techniques are described for the TSPA model. In its October 29, 2002, letter transmitting the Methods and Approach Document, DOE acknowledged that the results of the analyses demonstrating stability will be provided later. In addition, the portion of TSPA Agreement 4.03 that addresses stability of submodels, including those submodels used to develop input parameters and transfer functions, has not been addressed.

Section 7.3 of the Methods and Approach Document presents several tests for demonstrating the stability and reliability of the results from the TSPA. The Methods and Approach Document presents three techniques under consideration for testing stability: (i) graphical comparison of model output for different sample sizes, (ii) statistical significance testing using the difference in the mean dose for different samples, and (iii) statistical significance testing using distributions of dose. While an overview has been provided on these three tests, an insufficient level of detail and structure has been provided to discern the method that DOE will use to demonstrate stability. Two of the three tests address the statistical measures that will be used to support the argument of stability. Therefore, the eventual approach that DOE will follow is not clear. Consequently, it is ambiguous whether DOE's eventual approach will result in the NRC's questions being addressed to the point where it is unlikely that no information beyond that provided, or agreed to, will be required at the time of initial LA (i.e., one of the requirements for a subissue to be characterized as "closed pending").

By addressing, in the Methods and Approach Document, the statistical measures that DOE intends to use to support its arguments for stability and by starting to describe the components of a potential method, DOE has provided some of the information requested by TSPAI Agreement 4.03. NRC staff will continue to evaluate DOE's progress in providing the information requested by this agreement as more information becomes available.

Additional Information Needed: In addition to the information that DOE has already acknowledged that it needs to provide in response to this agreement — i.e., the results of the analyses (used to demonstrate stability), which are to be provided in the TSPA to support the potential LA (or any other appropriate documentation) — the following information is needed from DOE.

- 1) A description of the method that will be used to demonstrate stability in the TSPA to support the potential LA. As indicated in the Methods and Approach Document, DOE has not yet decided on its approach.
- 2) Documentation that submodels (including submodels used to develop input parameters and transfer functions) are numerically stable, as requested in the original agreement.

Status of Agreement: TSPAI Agreement 4.03 is listed as "partly received."