

**SUMMARY OF  
U.S. NUCLEAR REGULATORY COMMISSION/U.S. DEPARTMENT OF ENERGY  
TECHNICAL EXCHANGE AND MANAGEMENT MEETING ON  
TOTAL SYSTEM PERFORMANCE ASSESSMENT  
October 24-25, 2006  
Las Vegas, Nevada**

**INTRODUCTION**

On October 24 and 25, 2006, U.S. Nuclear Regulatory Commission (NRC) and Department of Energy (DOE) met in Las Vegas, Nevada, to discuss "DOE's Total System Performance Assessment (TSPA)." The meeting was held at the NRC Las Vegas Hearing Facility, and was open to the public.

To support staff and stakeholder interactions, the meeting included video connection to NRC offices in Rockville, Maryland, and the Center for Nuclear Waste Regulatory Analyses (CNWRA) in San Antonio, Texas. Teleconference connections were also available to interested stakeholders. Participants included representatives of the NRC, DOE, State of Nevada, Affected Units of Local Government, Nuclear Energy Institute, other industry representatives, and members of the public.

The meeting agenda, list of attendees, and presentations by NRC and DOE are available with the interim meeting summary on the NRC web site, at <http://www.nrc.gov/waste/hlw-disposal/public-involvement.html> (in ADAMS, ML063050222).

**PURPOSE OF THE MEETING**

The purpose of this meeting was to discuss the DOE's performance assessment for a potential geologic high-level waste repository at Yucca Mountain, Nevada, and for the NRC to present some perspectives on the regulatory information that it will consider in its review of a potential license application. Performance assessment is the systematic analysis of features, events, and processes (FEPs) that may affect the performance of a repository, including a quantitative estimate of possible dose due to release of waste.

**TOPICS OF DISCUSSION**

NRC presented its perspective on the use of risk information and on total system issues. The presentation covered areas discussed in NRC's letter to DOE dated October 5, 2006 (in ADAMS, ML062690190). NRC staff discussed how risk information obtained from both the DOE demonstration of barrier capability and the NRC risk insights would be used in a review process. Staff also highlighted topics for DOE to consider while developing and documenting their performance assessment, including the demonstration of barrier capability, scenario analysis, treatment of uncertainty, quality assurance and model support, and design and use of TSPA analyses. The discussion following the presentation centered on the distinction between the potential capability of a barrier and the computed performance of that barrier.

DOE provided an overview of their efforts in developing the Total System Performance Assessment for a license application (TSPA-LA). The presentations covered both completed work that has been documented in publically available reports and potential work that may be

implemented in the TSPA-LA. DOE presentations covered the schedule, process, and procedures for developing the TSPA-LA, as well as the basic structure of and information flow between the computational models supporting the TSPA-LA. In response to NRC questions regarding the schedule for the TSPA, DOE clarified that the milestone dates indicated during the presentation are for delivery by the lead laboratory (Sandia National Laboratories) to DOE. The related reports would not be publically available until after DOE had completed its internal review and public release process. DOE also indicated that it does not plan to update its TSPA methods and approach document from December 2003, and therefore the approaches are expected to remain substantially similar. Following a presentation on the DOE process for scenario analysis, DOE clarified that a single document compiling all of the FEPs will replace the individual FEP Analysis Model Reports (AMR) that had been provided in the past. DOE estimated that the documentation of FEP screening arguments would be completed concurrent with the TSPA. NRC and DOE also discussed methods for maintaining traceability between FEPs, the TSPA model, the supporting documentation, and the underlying data.

DOE then provided presentations to address several of the key topics identified by the NRC, including the demonstration of barrier capability, the treatment of uncertainty and variability, and the design and use of TSPA analyses. NRC commented that care should be taken in the demonstration of barrier capability so that barrier capabilities are not inadvertently hidden by upstream barrier performance, but also emphasized that the requirements for the demonstration of multiple barriers were not intended to require additional analyses beyond those conducted for the demonstration of compliance with the postclosure standards. DOE acknowledged that the distinction between performance and capability would be made, but that demonstration of barrier capability may be more qualitative, whereas barrier performance would be quantitatively based on TSPA. In response to NRC questions about the rationale for performing different types of analyses, DOE indicated that analyses documented in the TSPA model report may support more than just the demonstration of compliance for a license application. NRC pointed out that the license application should include only the information DOE will use to make its safety case as required in the regulations. Finally, DOE presented an overview of the potential impacts of the transport, aging, and disposal (TAD) canister concept on the TSPA, indicating that it has a systematic process for examining FEPs that may be impacted by the TAD canister.

DOE then described the status of its TSPA, with presentations on nominal and disruptive scenario classes. DOE indicated that the treatment of the seismic scenario class could change significantly from the previous TSPA version, including the possibility of multiple damaging seismic events in a single realization and inclusion of an abstraction that could account for seismic events under a variety of initial drift and waste package conditions. Following the presentation on the igneous scenario class, NRC requested clarification on how DOE would consider updated probability models. The DOE stated that its 1996 Probabilistic Volcanic Hazard Assessment (PVHA) would remain the basis for assigning probabilities for the license application.

The second day of the technical exchange focused on the individual model abstractions within the TSPA. The presentations provided information on what was included in each abstraction and how each links to other abstractions; major assumptions; a brief description of the technical basis and supporting information for the abstraction; primary references documenting the abstraction; and potential changes that have been made since the TSPA for site recommendation (TSPA-SR), or changes that may be made prior to submittal of a license

application.

For the unsaturated zone flow abstraction, the major anticipated changes from TSPA-SR relate to updated modeling of infiltration as the upper boundary condition for flow in the unsaturated zone, and strengthening of the technical bases for the flow model. The ambient seepage abstraction presented uses generally the same conceptual model and approach for evaluating uncertainties as was used in TSPA-SR with updated percolation flux distributions. For the thermal hydrology model, anticipated changes include a multiscale methodology to interpolate flux and stratigraphic effects from a library of calculation results. For near-field and in-drift chemistry, anticipated changes include revised selection of starting water chemistries based on available data, revised abstraction methodology for the thermal hydrology process model, and possible development of a reaction-path model for seepage composition that would eliminate the need to bin water chemistries. NRC asked several clarifying questions regarding flow patterns and asked whether issues related to chlorine-36 observations made in studies by Los Alamos National Laboratory and the U.S. Geological Survey had been resolved. DOE responded that a study done through a cooperative agreement with the Nevada state university consortium was unable to resolve those issues.

The abstractions for waste package and drip shield degradation, the radionuclide source term, and transport inside the engineered barrier system have all undergone significant revision relative to TSPA-SR. In particular, changes to the source term model are expected to include the fraction of initially failed cladding, treatment of uncertainty and degradation rate model coefficients, in-package chemistry functionality and range, and the solubility model. Changes to the engineered barrier transport model are expected to include a revised treatment of transport below the invert, addition of a corrosion-products domain for transport through the waste packages, the addition of kinetic sorption of plutonium and americium on colloids, and a revised water flux-splitting algorithm for flow through the drip shield and waste package. NRC asked several clarifying questions regarding the credit taken for cladding, and DOE indicated that initial cladding defects, seismicity, and igneous events are expected to be the dominant mechanisms for cladding damage in the abstraction. NRC also asked clarifying questions regarding the approaches used to estimate the amount of water entering a failed waste package and the modeling of flow and transport through the invert.

The abstractions for radionuclide transport in the unsaturated and saturated zones were also presented. Anticipated changes to the unsaturated zone transport model since the TSPA-SR include a revised fracture-matrix submodel for matrix diffusion that more accurately reflects transport in a dual-permeability system, a method for partitioning releases from the engineered barrier system between the fractures and matrix of the underlying unsaturated zone, revised sorption and diffusion parameters, and inclusion of water table rise for future climates as an uncertain parameter. NRC asked several clarifying questions about the treatment of the invert-unsaturated zone interface, the significance of matrix diffusion in retarding radionuclide movement, and the treatment of colloids. DOE also indicated that development of a "colloid diversity" model was under consideration, in which colloids are assumed to be characterized by a distribution of transport characteristics. They also expect to revise the saturated zone flow and transport model from the TSPA-SR approach. Anticipated and potential changes include an updated hydrogeologic framework model (HFM), a recalibration of the flow model to include recent water level measurements from Nye County wells, and the potential deterministic representation of the tuff-alluvium contact. Other potential changes under consideration include a new "colloid diversity" model similar to that being contemplated for the unsaturated zone, and

the addition of reducing zones in the saturated zone. Finally, DOE discussed the updated model for biosphere transport, and indicated that the Environmental Radiation Model for Yucca Mountain, Nevada (ERMYN), implemented in GoldSim, represents a substantial change to modeling of biosphere transport relative to the approach used in the TSPA-SR. Anticipated changes include incorporation of new requirements for the receptor, incorporation of additional pathways, and more comprehensive treatment of uncertainties. NRC asked several clarifying questions regarding the implementation of the microenvironmental models.

In closing remarks, NRC recognized and thanked DOE for the level of effort that had been put into preparation for the technical exchange, and indicated that they had gained a better understanding of the plans for and status of the DOE TSPA. Recognizing that the presentations for this meeting were necessarily at a relatively high level, NRC emphasized the benefit to both parties of future interactions at a more detailed level, and requested a schedule for completion of individual deliverables so that future interactions can be efficiently conducted. DOE thanked the lead laboratory, NRC, and CNWRA for their efforts and reminded all participants that information on planned changes to the TSPA should be considered preliminary and subject to change. DOE acknowledged the usefulness of the key messages letter sent prior to the meeting and the comments provided by NRC during the meeting. DOE also noted that, as a result of its schedule for completing the license application, it would have to consider appropriate timing for additional meetings between the DOE and NRC. Finally, DOE indicated that it is working on developing a schedule for deliverables and that they would discuss that schedule with NRC once it has been completed.

#### PUBLIC COMMENTS

Public comment periods were provided at the end of both days. On the first day, Ms. Judy Treichel of the Nevada Nuclear Waste Task Force noted that the final data feeds reflecting the TAD design are scheduled with aggressive due dates, and questioned whether there would be sufficient time to include all inputs from experts and others and still allow for changes in response to comments on the Supplemental Environmental Impact Statement (SEIS). DOE responded that all comments on the SEIS would be appropriately addressed. Mr. Mike Thorne, consultant to the state of Nevada, asked about the stability of intermediate performance metrics that may be used in demonstrations of barrier capability. DOE indicated that stability would be demonstrated for intermediate metrics, and NRC reiterated that there is no quantitative requirement for barrier performance, but that the models must be consistent with the description of barrier capability. Mr. Leon Reiter, a consultant to the Nuclear Waste Technical Review Board, asked about the applicability of the 1996 PVHA to an extended (million-year) time frame, and DOE indicated that they were aware of the issue and were working on it. Mr. Marty Malsch, representing the state of Nevada, suggested that if the updated PVHA was completed at the same time as LA submittal and if the LA relied on the 1996 PVHA, then the LA would not make use of all available information. DOE elected to take this as a comment.

On the second day, Mr. Thomas Buqo, representing Nye County, offered several comments related to the increasing water usage in Nye County, the assumption that the saturated zone is at a steady state, the effect of paleoclimate on the current groundwater table, and the potential for inhalation exposure to dairy cattle as a potential pathway of agricultural product contamination. Ms. Judy Treichel of the Nevada Nuclear Waste Task Force questioned the use of one model to validate another. Mr. Marty Malsch, representing the state of Nevada, raised several questions about the relative schedules for data development for the safety analysis

report and the EIS and questioned the potential validation status of data for the EIS, and asked whether DOE would identify the documents in the Licensing Support Network (LSN) that it intended to rely on in the LA. DOE responded that they would comply with the relevant regulations. Mr. Malsch then asked clarifying questions about the demonstration of multiple barriers, to which NRC reiterated that there were no quantitative criteria, but that DOE must describe the barrier capability. Finally, he questioned DOE regarding the proposed revised standard from the U.S. Environmental Protection Agency (EPA), and DOE responded that they have provided their comments on the proposed rule to the EPA. Mr. Steve Frishman, representing the state of Nevada, asked several clarifying questions about the technical basis for assuming that only a small percentage of the colloids move quickly, and about the modeling of climate past 10,000 years. DOE responded that C-wells test data were used to construct the colloid transport, and that they are following the proposed rule that prescribes a deep percolation rate for post-10,000 year time. Finally, Mr. Mike Thorne, consultant to the state of Nevada, asked about the treatment of alternative conceptual models in TSPA, and potential weighting of model output to account for alternative conceptual models. NRC acknowledged the comment and will consider it within its review of model uncertainty.

ACTION ITEMS / COMMITMENTS

None.

 Date 12/11/06

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