

**ATTACHMENT 1**

NRC/DOE Technical Exchange on Yucca Mountain Pre-Licensing Issues  
Las Vegas, Nevada  
April 25-26, 2000

The U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) held a technical exchange on April 25-26, 2000, at the Yucca Mountain Site Characterization Project (YMP) office in Las Vegas, Nevada. The purpose of this meeting was to review Key Technical Issue (KTI) status, discuss and identify the path forward for resolution of subissues at the staff level, and discuss the objective of the NRC sufficiency review of the DOE Site Recommendation.

The attendee list is attached. Also attached are the agenda and the briefing materials presented at the meeting. Below is the summary of the most important points and discussions from the meeting.

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W. Reamer (NRC) presented a summary of the NRC strategy for resolving KTIs. Mr. Reamer stated that the NRC goal is to develop the schedule for KTI resolution by September 2000 and resolution of issues before DOE submits any License Application (LA). He added that DOE must comply with proposed 10 CFR 63, but alternatives to strict compliance may be presented by DOE. The alternatives would be considered as a means for meeting the regulation. Mr. Reamer also indicated that the NRC plans to complete the Yucca Mountain Review Plan by September 2000, and will tailor it to focus staff review. Mr. Reamer emphasized the importance of maintaining schedule and that the NRC would take a risk-informed approach to the safety review.

S. Brocoum (DOE) presented the DOE process for completing the Site Recommendation Consideration Report. Dr. Brocoum pointed out that the Process Model Reports (PMRs) would be revised only if the Total System Performance Assessment (TSPA) results changed significantly as a result of a change to the process models described in the respective PMRs; otherwise Interim Change Notices (ICNs) would be issued. Dr. Brocoum indicated that the DOE would revise the AMRs to incorporate ICNs to support the LA. Dr. Brocoum stated that the target date for submitting the TSPA-Site Recommendation (TSPA-SR) to the NRC is June 1, 2000. Dr. Brocoum stated that the Analysis and Model Reports (AMRs), the PMRs, and the System Description Documents (SDDs) form the foundation for the DOE safety case.

J. Bailey (M&O) presented the status of the Repository Safety Strategy (RSS). Mr. Bailey pointed out that the waste package (WP) design is the principal contributor with regard to overall repository system performance. D. Brooks (NRC) stated that the AMRs were not discussed and that they form the basis for the PMRs. A representative of the CNWRA also commented that a sufficient technical basis for removal of issues from consideration has not yet been developed.

Total System Performance Assessment and Integration (TSPAI)

J. Firth (NRC) presented the status of the TSPAI KTI from the NRC perspective. Mr. Firth placed emphasis on the importance of the transparency and traceability of data sources to the analysis results. He stated that the NRC should be able to go up or down the hierarchy of information such that the linkages between various levels of information are clear and traceable. He added that the TSPA-Viability Assessment (TSPA-VA) was lacking in this regard. Mr. Firth emphasized the importance of ensuring that the features, events, and processes (FEPs) list is complete and that the process for screening FEPs out was sound. He stated further that the potential for underestimating the effects based on the elimination of a FEP should not result in overestimating the performance capability of the repository. He added that the NRC needed to gain an understanding of the process for identifying FEPs and that the DOE's basis for concluding the model is acceptable for event screening.

A. Van Luik (DOE) indicated that Revision 2 of the TSPAI issue resolution status report (IRSR) should be available by June 1, 2000. Mr. Van Luik presented an example of traceability of data back to the source in the GoldSim software package. The NRC participants indicated that they were very interested in obtaining the GoldSim software for use in their review.

#### Unsaturated and Saturated Flow under Isothermal Conditions

N. Coleman (NRC) presented the status of this KTI. Mr. Coleman stated that the data from drill holes NC-EWDP-22S, NC-EWDP-23S, and NC-EWDP-4PA/PB are key in resolving this issue. He pointed out that seepage testing in sealed-off portions of the East-West drift has been affected by alteration of the natural environment due to heating from lights and a power transformer on the tunnel boring machine. DOE needs to measure heat and mass losses through the bulkhead in the drift-scale test to adequately characterize the thermal effects. Mr. Coleman pointed out that about 5 percent of the repository footprint underlying Solitario Canyon has no PTn cover (Paintbrush non-welded tuff), so this area could be exposed to additional percolation without the damping effect of the PTn, resulting in accelerated chemical interaction with the waste package (WP). He also suggested that the presence of calcite in the bottom of lithophysal cavities needs to be explained if no seepage is assumed, and he added that chlorine-36 data suggest seepage. The use of carbon-14 dating of organic carbon in groundwater (method of J. Thomas, USGS/Carson City) should be considered.

R. Patterson (DOE) explained the measures that were being taken to restore a more natural environment to the sealed-off section of the test drift. He added that drip cloths will also be installed.

In response to a question from the State of Nevada (L. Lehman), DOE indicated that temperature measurements are not required to determine thermal conductivity values, as the thermal conductivities for the materials in question can be obtained in existing literature. DOE stated that they would consider using temperature data from drill holes as a tracer.

#### Container Life and Source Term

T. Ahn (NRC) presented NRC's status on this KTI. He discussed the need for the NRC to have detailed information on the materials being used for construction and the manufacturing techniques that will be used to fabricate the drip shield and the waste packages. He stated that the NRC is not yet convinced that the DOE has adequately evaluated the effects of in-package criticality on waste package and engineered barrier performance.

P. Russell (DOE) discussed the projected failure rates of the waste package. The values of  $10^{-4}$  vs.  $10^{-3}$  are in question based on NRC feedback. Further discussion is needed to determine acceptable technical basis for any failure rate. Ms. Russell pointed out that an issue regarding verification of fuel burnup had been raised in the past, and that NRC has agreed to consider DOE's proposal for use of a statistically accurate random sampling if possible.

In response to a question from Clark County (E. Tiesenhausen) DOE indicated that J-13 water is representative of water that may seep into the emplacement drifts. However, they have considered a wide range of chemistry in performing the analysis.

#### Evolution of the Near-Field Environment

B. Leslie (NRC) presented the NRC status on this KTI. Four of the five subissues for this KTI remain open. Mr. Leslie continued to emphasize the need for DOE to provide the NRC with a sound technical basis for excluded FEPs (15–20 percent still require additional basis). A key point was the concern that the neglect of some THC processes will result in underestimating dose. NRC needs to understand the disparity in pH values, predicted 7, measured fluids 4, and why use of an incorrect value may result in overestimating repository performance (underestimate negative effects of process on system performance). With regard to THC modeling there is a concern as to whether kinetics had been factored into the modeling. NRC needs to understand how the THC processes can be decoupled, evaluated separately, then relinked.

D. Barr (DOE) presented DOE's perspective on this KTI. Based on the NRC's questions, she stated that adequate assessment and evaluation of the drift environment are considered essential for putting together a sound safety case for the repository. The NRC is focused on these analyses, and would like to receive more detail regarding the methodologies used to evaluate the analysis of the drift conditions and the effects drift conditions have on the WP over time.

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#### Repository Design and Thermal-Mechanical Effects

M. Nataraja (NRC) presented NRC's status on this KTI. Subissue 1 is closed; Subissues 2 and 4 are closed pending confirmatory information. NRC will be evaluating the DOE implementation of the design control process (Subissue 1) through audit observations and will reopen the related subissue, if needed. Dr. Nataraja suggested the need for more input data that are consistent with the seismic design methodology and the PA methodology (Subissue 2). He expressed concern that STR-3 was not scheduled to be completed until November 2001, perhaps too late to support review in time for LA approval, and that options other than the topical report approach are available. He stated that Seismic Topical Report-3 (STR-3) should discuss inputs to the PA in addition to the design. He expressed the need for additional data and analysis related to the thermal-mechanical (TM) effects on the underground facility design/performance (Subissue 3). Consideration of TM effects in estimating quantities of seepage and dripping characteristics into emplacement drifts must be well integrated in the KTI assessment. In closing Subissue 4, he indicated that NRC will review the topic of seal design in the overall context of the repository performance.

P. Harrington (DOE) stated that the DOE has addressed the one concern related to design control (Subissue 1) identified in the IRSR. The DOE has investigated the extent of the problem, issued lessons learned, performed a self-assessment, provided to the NRC the status of subissue resolution in recent DOE comment letters on the IRSRs, and closed the associated deficiency report. Mr. Harrington discussed the divergence of opinion between the NRC and the DOE concerning the predicted rock mass friction angles used as input to predicting rockfall. He indicated that the NRC and DOE approach to assessing rock mass friction angle was the same. However, the stress ranges were different. NRC's S. Hsiung expressed the opinion that DOE has neglected the degradation of strength (50-70 percent) with time under elevated temperatures.

Mr. Harrington addressed a concern from the November 1999 Appendix 7 meeting during which NRC expressed a concern about additional dynamic analyses to validate the existing approach. He indicated that DOE has performed a new calculation, currently under review, which includes revised block sizes based on new emplacement drift alignment and excluding backfill. Planning is in progress for performing a revised drift degradation analysis to include the current drift alignment, exclusion of backfill, and consideration of additional dynamic analyses for seismic effects on rockfall. He noted that the seismic cases analyzed did not produce a significantly greater expected number of key blocks per drift unit length over the static case. He also indicated that the DOE and NRC do not agree on the need for repository-scale modeling, as discussed in the IRSR. He stated that this issue is a good candidate for upcoming Appendix 7 meetings.

Mr. Harrington noted that the NRC has not yet included acceptance criteria for seals in its IRSR. Based on work completed to date, he indicated that no factors associated with this issue have been demonstrated to be important to waste isolation in the RSS. The seals have been classified CQ (Conventional Quality) and are not subject to the Quality Assurance (QA) program, but this classification is exclusively based on considerations of moisture infiltration. Work is continuing regarding evaluation of other aspects of seal performance.

#### Thermal Effects On Flow

J. Pohle presented the status of resolution of the Thermal Effects on Flow (TEF) KTI. He indicated that the three subissues currently remain open.

Generally, Mr. Pohle indicated that the DOE is focusing on the identified principal factors, while the NRC is focusing on why issues become "downgraded" from the principal factors. He indicated further that a key NRC interest is understanding the background and basis for identification of those processes that could have an impact on seepage, those that don't, and the corresponding justification. He stated that it appears to be a design objective to control water flow and send the flow down the pillars. He stated that the NRC needed to know if the analysis is considering heat and orientation of the drifts, effects of fractures, etc., and how these characteristics might be coupled to impact flow. T. McCartin (NRC) added that the NRC wanted to ensure that the interactions between these characteristics are adequately understood and addressed in the waste package corrosion performance analysis.

D. Barr (DOE) summarized, from a DOE perspective, the three subissues associated with TEF, and she described recent and near-term future key activities. She indicated that there were several areas of disagreement between the DOE and the NRC that require resolution. She said that a number of NRC requirements appear to be more prescriptive than DOE's understanding of the intent of proposed 10 CFR 63, which provides performance-based acceptance criteria. She stated further that some of the acceptance criteria inappropriately call for conservatism. Finally, she indicated that DOE does not consider it necessary to directly measure all heat and mass loss through the bulkhead in the drift scale test to adequately characterize the thermal effects.

#### Radionuclide Transport

J. Bradbury described and provided the status of the four subissues associated with radionuclide transport (RT) KTI. For RT through fractured rock, he indicated that the model was acceptable for the  $K_d = 0$  approach. However, the NRC needed additional information concerning effective porosity, demonstration that the  $K_d = 0$  doesn't underestimate dose, and justification of the length of the pathway to which these fracture transport conditions apply.

J. Houseworth (M&O) indicated that for Subissues 1-3, the focus was on one acceptance criterion. He discussed areas of potential disagreement between the NRC and DOE, as discussed in a March 22, 2000, letter from S. Brocoum to B. Reamer. These included DOE's position that homogeneity of porous rock and alluvium only needs to be demonstrated at the level assumed in the models. Regarding the concern that "bounding" future water chemistry cannot be identified, "reasonable" future water chemistry should be adequate.

#### Igneous Activity

J. Trapp stated that the two Subissues, "Probability of Igneous Activity" and "Consequence of Igneous Activity," remain open. Mr. Trapp pointed out that there are several differences between the DOE assessment of the Yucca Mountain region and the NRC assessment of the region. He emphasized the need to meet and discuss these issues at the technical level to obtain resolution.

E. Smistad summarized, from DOE's perspective, the current status of resolution of this KTI, and he described recent and future key activities. He indicated that estimates of volcanic hazard were determined based on expert elicitation results as described in the Probabilistic Volcanic Hazard Analysis (PVHA) report, and the probability (estimated at  $1.6 \times 10^{-8}$ ) is given in the TSPA-SR. He stated further that DOE's position is that definitions of igneous events are used consistently and that probabilities of intrusive and extrusive events should be estimated separately. Documentation of these analyses will be presented in the associated AMRs and PMRs.

Smistad indicated that it is also DOE's position that a full range of annual frequencies of igneous intersection should be used in lieu of a single value preferred by the NRC. DOE believes that use of a single value is overly conservative and does not represent the appropriate range of interpretations and uncertainties. He added that the analyses in the AMRs should be responsive to NRC's remaining concerns concerning the consequences of igneous activity.

## Structural Deformation and Seismicity (SDS)

D. Ferrill presented the NRC's position on this KTI. He stated that the objective of this issue is to ensure that the seismotectonics FEPs that may significantly affect repository design or performance are adequately identified and characterized, sufficiently understood and considered, and consistently used to assess design and performance.

T. Sullivan (DOE) presented the DOE's position on the SDS KTI. He summarized the related issues and described the key activities performed recently and planned for the near future.

## Closing Remarks

W. Reamer provided the NRC's closing remarks. He stressed the need for organizational focus, at both the management and technical levels, on NRC open issues. He stated that it would be beneficial if DOE assisted NRC in locating the sources of technical analyses and data to support NRC's informational needs. Timely NRC access to the preliminary AMRs will foster timely resolution of the KTIs at the staff level. Prompt transmittal of design changes to NRC will enhance effective coordination with DOE and allow NRC to properly focus resources. He expressed the need to obtain a copy of the GoldSim code to support its review of the SRCR and the LA.

Mr. Reamer also indicated that NRC and DOE should be actively looking for strategies to foster issue resolution in concert with the SR work. For example, for issues closed, pending further information or review, he encouraged aggressive pursuit of complete closure. He added that, when DOE has ruled out a FEP from further consideration, DOE needs to clearly understand that the NRC has to have sufficient technical basis in order to close out the issue.

He stated that the KTI tables in the DOE presentations were beneficial. That information, coupled with the discussions, has enabled NRC to close (pending receipt of information) seven subissues as an outcome of the meeting. These include four subissues (mechanical failure, rate of release/spent fuel, rate of release/glass and alternative designs identified) under the Container Life and Source Term KTI. The other three subissues identified under Repository Design and Thermal-Mechanical effects KTI are design control process, design for seismic/fault disruption, and design of repository seals.

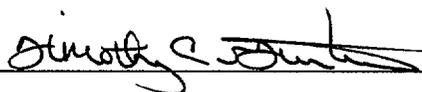
As part of a risk-informed, performance-based approach, NRC can suggest how to resolve issues, but the ultimate responsibility rests with DOE. DOE needs to provide sufficient information for NRC to perform its review and evaluation of the LA and prelicensing documents.

A. Brownstein (DOE) provided closing remarks for the DOE. He indicated that he felt significant progress had been made in the last two days and was pleased with the apparent agreement between DOE's work plans and NRC's expectations. He added that he believes licensing in a risk-informed means will be an efficient way of doing business. However, he indicated that it is critical that expectations for licensing do not become de facto requirements for SR.

Mr. Greeves concluded by stating that receipt of AMRs/PMRs is crucial to of NRC completing its review, and also requested DOE to expedite transmittal of the GoldSim code.



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