

ENCLOSURE

**SUMMARY HIGHLIGHTS OF THE
U.S. DEPARTMENT OF ENERGY/U.S. NUCLEAR REGULATORY COMMISSION
TECHNICAL EXCHANGE ON RISK INFORMATION
MAY 15, 2003
U.S. NUCLEAR REGULATORY COMMISSION
ROCKVILLE, MD**

Introduction

On Thursday, May 15, 2003, the U.S. Department of Energy (DOE) and U.S. Nuclear Regulatory Commission (NRC) staff conducted a Technical Exchange in Rockville, Maryland, in which the DOE presented its current approach on the use of risk information to resolve key technical issue (KTI) agreements as it applies to the proposed geological repository at Yucca Mountain. Two hundred ninety-three agreements were generated during previous preclicensing interactions between NRC and DOE on a variety of topics. The DOE has proposed to resolve a subset of the technical agreements by submitting risk information in lieu of the originally agreed upon information. The technical agreements cover information that NRC staff expects would be needed during the review of a license application (if submitted) to dispose of high-level radioactive waste at Yucca Mountain, Nevada, in accordance with the requirements of 10 CFR Part 63. The NRC goal of issue resolution during the pre-licensing period is to assure that the DOE has assembled enough information on a given issue for NRC to accept a license application for review.

The detailed agenda for this meeting can be found in Attachment 1. The Technical Exchange included a video conference connection between NRC in Rockville, Maryland, the Center for Nuclear Waste Regulatory Analyses (CNWRA) in San Antonio, Texas and DOE facilities located in Las Vegas, Nevada. An additional audio connection permitted the remote participation of other interested parties. In addition to staff from DOE, NRC, the CNWRA and DOE's contractors, the meeting was attended by representatives from the State of Nevada; Clark County, Nevada; the Nevada Nuclear Waste Task Force; the Electric Power Research Institute (EPRI); the Advisory Committee on Nuclear Waste (ACNW); and the public. Attachment 2 contains the list of attendees who were present at the conference locations.

Opening Remarks

The meeting commenced with opening remarks by DOE and NRC. The DOE indicated that the purpose of this technical exchange was to present their approach to resolving KTI agreements through the use of risk information and to get clarification of NRC comments provided in recent letters to DOE. In particular, the DOE wanted to get clarification of what the NRC meant by the combined effect analysis, the regulatory basis for this analysis, and how the NRC would use the results of the analysis. The DOE has been encouraged by recent communications with the NRC and looked forward to a productive interaction. The NRC stated that they were interested in building understanding of the issues and in supplying any clarification to recent communication provided to the DOE [January 27, 2003 and February 26, 2003, letters from Schlueter (NRC) to Ziegler (DOE)]. The NRC stated that they were interested in seeking necessary and sufficient information to make risk-informed regulatory decisions. Consistent with the detailed agenda found in Attachment 1, the DOE presented their overview of the use of risk to address KTI agreements. The NRC presented their comments on the DOE approach.

In addition, the NRC presented their perspective on the propagation of uncertainty (combined effect of uncertainty) with respect to agreements resolved with risk information. These presentations can be found in Attachment 3.

Presentations and Discussion

DOE presented its approach to the use of risk information to address KTI agreements. The following points regarding the use of risk information were made by the DOE:

- 1) The DOE's use of risk information is based on 10 CFR 63.303 which states that compliance shall be based on the mean of calculated doses, and on 10 CFR 63.304(4), which provides that performance assessments focus on "the full range of defensible and reasonable parameter distributions rather than only upon extreme physical situations and parameter values."
- 2) Sensitivity analyses conducted by the DOE have demonstrated that overall repository performance is insensitive to uncertainties in the current technical basis of certain performance assessment model components. Even the assumption of extreme values in these cases results in insignificant effects on the assessment of compliance with regulatory requirements for individual and groundwater protection and barrier capability as used in these assessments.
- 3) With respect to the combined effect analysis, the DOE emphasized that the probability of the simultaneous occurrence of low probability tails of parameter distributions is extremely small. For example, the probability of occurrence of 95th percentile values (or worse) in 9 independent models is $(0.05)^9$, or 2×10^{-12} .
- 4) The DOE emphasized that the sensitivity analyses provided in the Risk Prioritization Report¹ are extremely conservative and are not realistic. The realistic treatment of uncertainty that is appropriate to compare to regulatory limits will be provided in the full probabilistic analyses completed with the Total System Performance Assessment for License Application (TSPA-LA).
- 5) The DOE has identified approximately 20 applicable KTI agreements for which, based on sensitivity analyses, it proposes to use risk information in lieu of additional technical work to resolve the agreements. None of these issues is specific to waste package performance.

During the DOE presentation, the NRC asked the DOE to explain what modifications they make to the TSPA model when they perform a neutralization analysis. The DOE stated that they do not attempt to build a new model when they perform a neutralization analysis, rather they perform a stylized analysis with their current model recognizing the limitations imposed by the changes made for the analysis. The NRC stated during the DOE presentation that they do not intend for the DOE to evaluate very unlikely scenarios that may result from the combination of unlikely parameter distributions. The NRC commented that implicit in the DOE's argument that

¹ BSC (Bechtel SAIC Company) 2002. Risk Information to Support Prioritization of Performance Assessment Models, TDR-WIS-PA-000009 Rev. 01 ICN 01, Las Vegas, NV

the evaluation of the combination of uncertainties is very unlikely, is that the KTI agreement items are all dealing with the tails of probability distributions, when in fact, many agreement items may be addressing the support for the model or parameter representation. The NRC stated that in general, the staff did not seek to develop key technical agreements on issues that were believed to be very unlikely.

The first NRC presentation provided an overview of NRC's perspective on the use of risk to address KTI agreements. The NRC reiterated that they encourage the use of risk assessments and sensitivity analyses to help identify data, models, and barriers that are most important to repository performance and to focus available resources on those items. The NRC emphasized five main elements to the use of risk to address KTI agreements:

- 1) Technical basis to support quantitative analysis.
- 2) Adequate documentation of the analysis.
- 3) Consideration and representation of uncertainties.
- 4) Understanding and explanation of the quantitative results.
- 5) Confirmatory analyses with a qualified TSPA model.

All of the main elements of the use of risk to address KTI agreements are derived from the 10 CFR Part 63 requirements for performance assessment (§63.114). The NRC stated that the amount of technical basis provided for an analysis should be commensurate with the uncertainty, risk-significance, and the amount of pessimism introduced into the analysis. An analysis that is very pessimistic (e.g., a neutralization of a barrier's capabilities) would require limited technical basis. The NRC conveyed the expectation that the DOE should provide a reasoned argument why the analysis appropriately represents the uncertainty under consideration or is sufficiently bounding. The NRC noted that adequate documentation of the analysis should be provided because models and assumptions within the TSPA model may not be integrated such that changes in one model are automatically reflected in other associated models. The NRC stated that demonstration of an understanding of the model and results is essential to developing confidence in the conclusions. Simple physical arguments and presentation of intermediate outputs can enhance confidence in the results of the sensitivity analysis.

On the first NRC presentation, the DOE stated that they had general agreement with all major elements of the presentation except the conclusion that the combined effect analysis performed by the DOE in the Risk Prioritization Report needs to be updated.

The second NRC presentation addressed the combined effects of uncertainties. As of 9/21/02, the DOE had proposed that 31 agreements be resolved with risk information (termed Bin 3) in lieu of the originally agreed upon information. The NRC summarized that the proposed risk-informed agreements covered some aspects of: infiltration, seepage, unsaturated zone flow and transport, drip shield performance, in-drift chemistry, in-package chemistry, cladding performance, thermo-hydro-chemical effects on seepage, and thermo-hydro-mechanical effects on permeability. The NRC highlighted the information that has been provided by the DOE and stated that it did not adequately address the propagation of uncertainty in a system-model such as the DOE's performance assessment (TSPA). The NRC provided examples of uncertainty propagation to communicate the basis for their request that DOE perform a combined effects analysis of the uncertainty associated with the KTI agreements to be addressed with risk

information. Illustrative examples were provided using insights from the NRC's performance assessment code (TPA) as well as a hypothetical example developed with the GoldSim software package. The NRC stated that typically the propagation of uncertainty (combined effects) drives the risk in a performance assessment model. The NRC emphasized that it is not necessary for key parameters to be at the extremes of their uncertainty distributions in order for there to be a meaningful contribution to risk. The NRC stated that extremely pessimistic analyses for individual uncertainties are neither required nor preferred by the NRC. However, DOE's documentation should provide adequate basis for the analysis and the technical analysis should appropriately consider the system-nature of the performance assessment model. For example, uncertainty in the drip shield performance (in addition to water flow to the waste package) may influence the magnitude of mechanical loads the waste package experiences and the environmental conditions for waste package corrosion.

During the second NRC presentation, the DOE stated that they were in agreement with the importance of the use of sensitivity and uncertainty analysis to provide insights and understanding. The DOE noted that the simple example of uncertainty propagation provided in the NRC presentation was not a completely appropriate parallel to the DOE's use of sensitivity analysis. The DOE believed that some of the results from the simple analysis performed by the NRC would have been considered to be significant and associated agreements would not have been selected to be resolved in a risk-informed manner. The NRC stated that it was important to understand how DOE has propagated the uncertainty through their model. The NRC noted that multiple barriers and dose must be considered when evaluating agreements. Some of the uncertainties the NRC is concerned about deal with potential changes in specific aspects of the model itself (e.g., corrosion models) and not just the parameter values. The NRC also inquired about DOE's approach on the use of unqualified data, unverified software, and unvalidated models for sensitivity analysis. The DOE stated, that while they have confidence in the current results of their analysis, that they will perform a confirmatory analysis with their final, fully-qualified performance assessment model used to support a license application (TSPA-LA).

There was opportunity for questions and open discussion during the presentations as well as at the completion of formal presentations. Overall, most of the discussion focused on the combined effects of uncertainty. The DOE maintained that because they were being very pessimistic in their evaluation of individual uncertainties associated with agreements being resolved with risk information, that a combined effect of uncertainty analysis was not useful. It was noted by DOE that by the very nature of TSPA analyses, the combined effect of uncertainty would be performed with their TSPA-LA model. The NRC stated that they did not require the DOE to be very pessimistic in their evaluation of individual uncertainties, and that DOE's choice to be pessimistic did not alleviate the need to consider the combined effect of uncertainty because the TSPA is a system model and many agreements are being addressed via sensitivity analysis by the DOE. The NRC stated that each individual agreement resolved with risk information could, if the information was collected, potentially result in a change to the current base case TSPA model. The NRC is concerned that the local evaluation of uncertainty by the DOE may not capture the aggregate influence of agreements resolved with risk information.


Closing Remarks

In closing, the DOE stated that the list of KTI agreements it plans to address with risk information is being revisited, and it expects the number of agreements in this group will be reduced from the original 31 to approximately 20 agreements. DOE recognized that the existing sensitivity analyses may not be fully sufficient to close all of the original 31 (Bin 3) agreements, using their risk-informed approach, but stated that should not prevent them from using the existing analysis to close other agreements. For those agreement items that the DOE proposes to address with risk information, the DOE would provide additional documentation regarding traceability and transparency of the existing analyses and information regarding the variability in the distribution of results, as requested in the NRC letter of January 27, 2003. The DOE did not propose to conduct additional sensitivity analyses to address these items, and noted that the existing analyses, including the existing combined effects analysis in Section 3.4 of the Risk Prioritization Report, should be sufficient to close the agreements. Although the final list of agreement items that the DOE will address with risk information is still under consideration, the DOE stated that it does not plan at this time to include agreement items related to waste package performance and the environmental conditions associated with waste package corrosion. The DOE agreed with the NRC regarding the importance of uncertainty analysis in providing understanding of combined effects, and plans to document appropriate analyses in the TSPA-LA to provide the level of insight the NRC is requesting. Those analyses will include the full range of reasonable and defensible uncertainty in parameters, as provided by 10 CFR 63.304, and will be the appropriate basis for judging the importance of the combined effects of uncertainty on overall performance.

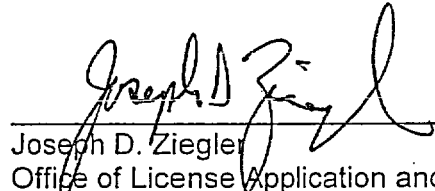
In closing, the NRC noted that they are seeking a sufficient level of information to clearly understand what was done in the DOE sensitivity analysis, and this would include both textual and numerical information (e.g., graphical and tabular) to support the conclusions. The NRC stated that the information provided by DOE for agreement USFIC.3.02 was an example of appropriate technical basis for the amount of uncertainty introduced in the sensitivity analysis. The NRC noted that DOE presented a path forward to the consideration of the combined effect of uncertainty associated with agreements resolved with risk information. The information provided in Section 3.4 of the Risk Prioritization Report was the type of information the NRC was looking for, but that DOE did not provide sufficient documentation of the analysis. The biggest area of concern of the NRC associated with the combined effect of uncertainty was in the area of waste package corrosion and the environmental conditions for corrosion, but that this concern was somewhat alleviated by DOE which stated that it would not use a risk-informed (Bin 3) approach for resolution of issues associated with waste package corrosion and the environmental conditions for waste package corrosion. At the conclusion of the meeting, the NRC reiterated that they support the use of risk information to resolve KTI agreements, however if the NRC does not determine the risk information to be suitable, that they can and will continue to request the original technical information. The NRC stated that they would support a future interaction on the topic of this meeting, if needed.

Public Comments and Final Discussion

Public comments were provided by representatives of the State of Nevada, the Nevada Nuclear Waste Task Force, and EPRI. The representative from the State of Nevada emphasized that the NRC should not go to closure on KTI agreements based on the future availability of information. A representative from the Nevada Nuclear Waste Task Force stated that they were pleased with the NRC addressing the compartmentalization of issues by the DOE. They were also pleased to see that the NRC was interested in developing understanding of issues, that difficult issues should be made understandable to the public, and that NRC decisions should not be influenced by schedule constraints of the DOE. A representative from EPRI stated that he supported the NRC requesting additional information from the DOE if it was clarifying in nature. However, he did not understand what was needed by the NRC beyond that. The NRC responded that they felt it was quite clear what information was needed. The NRC reiterated the previous discussion that each individual agreement resolved with risk information could, if the information was collected, potentially result in a change to the current base case TSPA model. The NRC is concerned that the local evaluation of uncertainty by the DOE may not capture the aggregate influence of the agreements resolved with risk information.

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