SUMMARY HIGHLIGHTS OF THE
U.S. NUCLEAR REGULATORY COMMISSION/STATE OF NEVADA
MEETING ON THE
NRC TOTAL-SYSTEM PERFORMANCE ASSESSMENT CODE
JUNE 17, 2003
U.S. NUCLEAR REGULATORY COMMISSION
ROCKVILLE, MARYLAND

Introduction

On Tuesday, June 17, 2003, the U.S. Nuclear Regulatory Commission (NRC) staff conducted a meeting with representatives from the State of Nevada in Rockville, Maryland, during which the NRC presented an overview of its Total-system Performance Assessment (TPA) code. The detailed agenda for this meeting can be found in Attachment 1. Audio conference connections were provided to the Center for Nuclear Waste Regulatory Analyses (CNWRA) in San Antonio, Texas, and to persons in other locations. In addition to staff from NRC, the CNWRA and representatives for the State of Nevada, the meeting was attended by representatives from the U.S. Department of Energy (DOE), DOE contractors, the U.S. Nuclear Waste Technical Review Board and the Advisory Committee on Nuclear Waste. Attachment 2 contains the list of attendees who were present in Rockville, Maryland, and San Antonio, Texas.

Opening Remarks

The NRC staff indicated that the purpose of this meeting was to provide an overview of the TPA code. NRC staff also clarified the NRC's role as an independent regulatory agency to protect public health and safety and the use of the TPA code to assist in pre-licensing activities and the review of a potential DOE license application for Yucca Mountain. Representatives from the State of Nevada expressed appreciation for the installation guidance provided by NRC staff in advance of the meeting as well as their desire to achieve transparency and understanding of the NRC role and its TPA code. The NRC staff introductory presentation is included in Attachment 3.

Presentation and Discussion

NRC staff presented an overview of its TPA Version 4.1j code as well as a summary of the TPA parameters, assumptions, and component models. The overview provided details regarding code architecture and execution, input parameters and sources, as well as outputs. NRC staff also provided a summary of parameters, assumptions, and component models implemented into TPA. The presentation containing both the overview of TPA and the summary of parameters, assumptions and component models is included in Attachment 3.

During the overview of TPA, NRC staff stated the TPA code was developed as an independent tool to support review of both pre-licensing activities and a potential license application. NRC staff explained that the code relies upon available data and approaches that allow for computational efficiency and flexibility, where warranted, to support NRC reviews. The TPA approach includes probabilistic simulations for a set of scenario classes: a nominal case including climate changes and seismic activity, a disruptive case involving faulting, and a disruptive case involving igneous activity. NRC staff highlighted the need to consider the likelihood of occurrence of events for disruptive simulations. NRC staff also discussed the software architecture and execution of the TPA code and concluded the overview portion of the presentation with a discussion of TPA input parameters and sources as well as TPA outputs, cautioning that the reference data set provided with TPA does not constitute regulatory acceptability. In response to questions from the representatives of the State of Nevada, NRC staff explained the role of NRC staff in the development of the TPA code, the public availability of the Fortran source code and software specifications for the upcoming TPA Version 5.0 code, the portability of components of the TPA code, as well as software testing procedures. NRC staff agreed to respond to a written State of Nevada request for software development documentation and source codes. NRC staff also offered to provide the representatives from the State of Nevada a list of previous NRC/DOE technical exchange meetings pertaining to either the DOE Total System Performance Assessment model or the NRC TPA code.

The NRC staff provided a summary of TPA parameters, assumptions, and component models, including descriptions of input data and their associated sources, model abstractions and output. The summary explained the conceptual models underlying the TPA code, namely water movement through the repository, the evolution of the near-field thermal and chemical environments, degradation of the engineered barriers, release and transport of radionuclides out of the engineered system, transport of radionuclides through the unsaturated and saturated zones, exposure pathways, igneous activity, faulting and seismic activity.

NRC staff outlined the TPA abstraction of water movement through the repository including climate and infiltration, vaporization, condensation and refluxing of water due to thermal conditions, as well as flow convergence/divergence processes. NRC staff answered questions from representatives of the State of Nevada regarding the climate change abstraction, the implementation of fracture pathways into the abstraction for flow through the unsaturated zone above the repository, and the role of subareas in TPA.

NRC staff also explained TPA abstractions for thermal modeling and the near-field chemical environment including determination of chloride concentrations due to evaporation and pH. NRC staff responded to questions from the representatives of the State of Nevada regarding variability in thermal modeling output and the bounding of chemical environments.

NRC staff described the conceptual models for degradation of the engineered components including the drip shield, waste package, waste form and cladding. In particular, explanations of the abstractions for engineered component degradation included uniform corrosion, localized corrosion, and stress corrosion cracking processes for the waste packages, spent nuclear fuel dissolution and cladding protection. NRC staff answered questions from representatives of the State of Nevada regarding the drip shield emplacement time, the behavior of engineered materials at elevated temperatures, the use of significant figures within the code and time dependency of cladding protection.

NRC staff explained the TPA conceptualization for release and transport out of the waste package, including a description of the bathtub and flow-through models of advective release of radionuclides from the waste package as well as radionuclide solubility limits and transport of radionuclides through the invert beneath the waste package. NRC staff responded to questions from the representatives of the State of Nevada regarding the use of expert elicitation to develop parameter distributions (e.g., solubility limits).

NRC staff summarized the TPA conceptual model for unsaturated and saturated zone radionuclide transport, detailing the TPA abstraction for flow, matrix diffusion, and retardation in both the unsaturated and saturated zones. NRC staff provided a discussion on the use of subareas to represent variability in hydrostratigraphic layers and the impact of matrix flow through the Calico Hills-nonwelded vitric layer on unretarded travel times in response to questions from representatives of the State of Nevada. NRC staff also responded to questions from the representatives of the State of Nevada regarding the streamtube implementation for the saturated zone flow abstraction.

NRC staff explained the abstraction for TPA exposure pathways. NRC staff answered questions from the representatives of the State of Nevada regarding regulatory requirements and the use of federal guidance for biosphere characteristics and parameters.

Following the description of the nominal case, NRC staff provided a summary of the conceptual models for disruptive events including igneous activity, faulting, and seismic activity. In particular, the explanation included discussion of the abstractions for probabilities and consequences of extrusive and intrusive releases for igneous activity, faulting, and seismic activity. NRC staff responded to questions from the representatives of the State of Nevada regarding leaching of radionuclides from an ash deposit following extrusive release from an igneous event as well as the ability to include additional fault zones for the faulting disruptive event.

Finally, NRC staff outlined TPA review and verification including discussion of the quality assurance program for code development, the peer review of TPA Version 3.2, and past analyses and verification activities of the code.

Closing Remarks

In closing, representatives from the State of Nevada stated their intention to examine the TPA modules with a team of international experts, and expressed a willingness to assist the NRC staff with its review.

Public Comments

A public comment was provided by a representative of the State of Nevada. The representative from the State of Nevada expressed gratitude and emphasized that the meeting was beneficial to aid in understanding the TPA code.