FINAL SUMMARY OF THE
U.S. DEPARTMENT OF ENERGY/U.S. NUCLEAR REGULATORY COMMISSION
TECHNICAL EXCHANGE ON THE DESIGN OF THE SURFACE AND SUBSURFACE
FACILITIES AT YUCCA MOUNTAIN, NEVADA
SEPTEMBER 14-15, 2004
LAS VEGAS, NEVADA

INTRODUCTION

On September 14-15, 2004, the U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) held a public Technical Exchange (TE) to discuss the proposed design of the surface and subsurface facilities for Yucca Mountain, Nevada. The meeting was held at the DOE offices in Las Vegas, Nevada. The agenda for this meeting can be found in Attachment 1.

To support staff and stakeholder interactions, the TE included video connections at NRC offices in Rockville, Maryland, and at the Center for Nuclear Waste Regulatory Analyses in San Antonio, Texas. Teleconference connections were also made available to interested stakeholders.

Participants included representatives of the NRC, DOE, state of Nevada, Affected Units of Local Government, Naval Nuclear Propulsion Program, Nuclear Waste Technical Review Board, Nuclear Energy Institute and other industry representatives, and members of the public. Attachment 2 contains the list of attendees who were present at the above noted locations and Attachment 3 contains the slides presented by DOE and NRC.

OPENING REMARKS

The NRC stated that this TE was a follow-up meeting to TEs conducted in February and May 2004 regarding the level of detail in the potential license application (LA) and the classification of items important to safety (ITS). The NRC stated that it will base its licensing decision on whether DOE has demonstrated compliance with the requirements of 10 CFR 63.

The DOE stated that it was in the final stages of developing the LA and that there had been considerable progress made in the design since the last TE in May 2004. The DOE cautioned that some information discussed during this TE may be modified before the submittal of the LA, however, no major changes were anticipated.

PRESENTATIONS AND DISCUSSION

Surface Facilities Concept of Operations

The DOE presented an overview of the implementation of the Preclosure Safety Analysis (PCSA). In designing the surface facilities, wherever possible, DOE implemented a strategy to prevent initiating events. In cases where design features cannot be used to prevent initiating events, mitigation features such as heating, ventilation, and air conditioning (HVAC) systems are relied on to mitigate the consequences of an event sequence (e.g., the spread of radioactive material).

In the identification of event sequences, DOE considers equipment reliability data as part of the determination of event sequence probabilities. Category 1 event sequences are driven by the handling of large numbers of individual commercial spent fuel assemblies (approximately 221,000) which may be handled up to four times each. Category 2 event sequences are driven by the handling of transportation casks, site-specific casks, and waste packages.

The DOE stated that the surface facilities will be constructed in stages to facilitate the receipt of high-level waste (HLW); however, all of the ITS surface facilities that will be operated at the site will be contained in the license application. The Fuel Handling Facility (FHF) and Central Control Center Facility (CCCF) will be constructed first and scheduled for operation in 2010. Then the Canister Handling Facility (CHF) and later two Dry Transfer Facilities (DTF) would be constructed and operated. The CCCF would provide the means to monitor and terminate onsite operations and to control subsurface waste emplacement operations, but would not provide means to perform operations in the FHF, CHF, or DTFs.

The FHF would be designed to receive and transfer both commercial spent fuel assemblies, and DOE canistered fuel and HLW, except multipurpose canister overpacks, from transportation casks into either a waste package or a site-specific cask. The spent fuel assemblies would be individually removed from the transportation cask and placed in either the waste package or site-specific cask. The sealed DOE canisters would be placed either directly into waste packages or site-specific casks. The waste package would then be emplaced in the subsurface repository and the site-specific cask would be placed on an Aging Pad for thermal aging. The FHF would be designed to have capacity to process up to 40 waste packages per year.

The CHF would be used to receive and transfer DOE and commercial canistered fuel into waste packages and site-specific casks. No bare spent fuel movements would be made in the CHF. The CHF would be designed to have a capacity to process up to 180 waste packages per year.

The DOE intends that the DTFs will be the last facilities to be constructed and operated. The DTF would have the capability to process all waste forms and have a capacity to process up to 180 waste packages per year. In addition, the DTF would have both dry and wet remediation areas to handle damaged waste forms and waste packages. Two DTFs would be built in phases at the repository site.

The Cask and Waste Package Receipt Building (CWPRB) would be constructed and operated on approximately the same schedule as the CHF. The CWPRB would receive transportation casks and transfer them to a site rail transfer cart for movement into the CHF and DTF. The impact limiters will not be removed until the transportation cask reaches the CHF unless needed for cask transfer. In addition, DOE stated that a portion of the CWPRB would not be ITS. In this area, the empty site-specific casks and the empty waste packages would be received, receipt inspected, and transferred to the other facilities for use.

The DOE stated the surface facilities would include an Aging Facility to stage commercial spent fuel while the fuel cools to the state at which it may be disposed of in the repository. The fuel would be placed into site-specific casks or possibly commercially available NRC certified casks within either the FHF, CHF, or DTF. Once the fuel has been thermally aged, the cask would be returned to one of the facilities in order to transfer its contents into a waste package for disposal. The NRC staff raised a concern that DOE has not completed its design of the

site-specific casks nor performed an analysis to determine whether one or more previously certified NRC casks could be used at the repository for thermal aging purposes.

Surface Facilities Design and Operation - Waste Transfer Operations

The DOE discussed the various surface facility waste handling operations that would take place at the repository. The first handling operations would involve the transportation casks which DOE considered ITS because they have to withstand various load combinations associated with drops and tip-overs. To prevent handling accidents at the various waste transfer facilities, DOE plans to procure 200-ton capacity gantry cranes that would provide a probability of a drop that is $<1 \times 10^{-5}$. In addition, the lifting yokes and cask/waste package movement trolleys would also be considered ITS. The transportation casks, waste packages and site-specific casks would be moved throughout the facilities using a trolley system. The trolleys would be designed to prevent tip-over.

In this, and subsequent discussions, DOE stated that the LA will include discussions on the sources of applicable failure rates and reliability data used in the analyses and determinations of systems, structures, and components (SSCs) ITS. Furthermore, the LA would contain a discussion of the design criteria, design basis, general arrangements, and system block diagrams, for both the cranes and the trolleys, however, the final design will not be completed until after the LA is submitted.

The waste package would be designed to prevent the release of radioactive materials during preclosure handling, seismic, internal missile, and rock fall events and would be considered ITS. The waste package would also have several design features that provide functions that are important to waste isolation (ITWI).

The HVAC primary confinement system (the portion of the HVAC system in FHF and DTF that services the fuel assembly transfer area) is designated ITS to mitigate the release of radioactive materials after a commercial spent fuel handling event (i.e., drop or collision). As such, DOE stated that the electrical power supply to the HVAC primary confinement system would also be designated ITS. In describing the extent of which items within a system such as these are ITS the LA would contain block diagrams to identify the boundaries of the ITS designation.

The NRC staff expressed concern that, as of the date of the TE, DOE had not established the preferred power source for the ITS portion of the electrical system. The DOE proposed two potential options exist: (1) designate one or more of the on-site diesel generators as ITS; or (2) depend on the reliability of the off-site electrical grid to be available during a fuel handling event.

Stakeholder Comments and Questions

Frank Rahn, Electric Power Research Institute, questioned whether the loss of off-site power was an initiating event for the surface or subsurface facilities because off-site power supplies present a unique set of failure modes such as transmission lines shorting out due to birds nesting and taking flight near these lines. The DOE responded that loss of off-site power as an initiating event does not result in radiological exposures and, therefore, is not considered a credible Category 1 or Category 2 event sequence.

Surface Facilities Design and Operation - Design Criteria and Facility Descriptions

The design methodologies for the FHF, CHF, and DTF are substantially the same. The DOE stated that the facilities are designed to withstand natural phenomena, maintain moderator control, control door and trolley travel speeds, preclude tip-over of casks, and provide shielding after a Category 1 event sequence, and maintain rail system integrity during Design Basis Ground Motion-2 (DBGM-2) 2000-year return period events. The DOE described some of the various codes, standards, and regulatory guides that it has incorporated in the design of the surface facilities. The DOE stated that the LA will include a complete listing of codes and standards and regulatory guides, and describe the extent of compliance to these documents. The NRC staff noted that the potential LA would need to provide clear information on how the facility SSCs would maintain their functionality during and after site-specific seismic events. For example, the LA should demonstrate that PCSA design basis for ITS structures will meet the 10 CFR 63.111 performance objectives (i.e., precluding a structure from collapsing during a beyond DBGM-2 event sequence). The DOE noted that a seismic margins analysis will be prepared to demonstrate, using the design methodologies put forth in the forthcoming Seismic Topical Report Number 2, that ITS structures designed to DBGM-2 would have a high probability of acceptable performance during a beyond DBGM (10,000-year return period seismic event) the repository would likely meet 10 CFR 63.111 performance objectives. The NRC requested that DOE be clear in defining performance criteria in the potential LA, for example, the term "collapse" indicates a degree of structural failure that greatly exceeds "Limit State C," which appears to be the criterion used by DOE.

The DOE described the design basis for the Aging Facility. However, as previously discussed, DOE has not yet designed a site-specific cask to be used with the Aging Facility nor identified a suitable NRC-certified cask that would meet the requirements of 10 CFR 63 that could be used at the facility. The DOE stated that these casks may be required to age the fuel for up to 50 years at the Aging Pad (although operational durations are expected to be 20-40 years). The DOE stated that the LA would specify an Aging Facility capacity of 21,000 metric tons heavy metal (MTHM) but that the hazard analysis would be based on the larger potential capacity of 40,000 MTHM to bound, for example, the potential risk of an aircraft crash.

In general, cranes that are ITS will be designed in accordance with American Society of Mechanical Engineers NOG-1, "Overhead and Gantry Cranes," and NUREG–0554, "Single Failure Proof Cranes." The DOE stated that the LA will describe the specific codes and standards and NRC regulatory guidance applied to crane design and the extent of compliance with these codes and standards and regulatory guidance. In addition, procedural safety controls would be implemented (i.e., load paths) and Chapter 5 of the LA would contain maintenance plans, the concept of operations, and proposed technical specifications.

Operations at both the surface and subsurface facilities would be monitored and controlled, as appropriate, from the CCC which would be manned 24 hours/day. The CCC would be located within the CCCF. The security operations would also be located in the CCCF in a separate room from the CCC. The DOE stated that the CCCF and its SSCs provide no prevention nor mitigation of Category 1 or 2 event sequences and are not ITS.

Overview of Subsurface Facilities

The DOE described the concept of operations of the subsurface facilities. The waste package and emplacement pallet are moved together to the underground turnout in the transporter which is attached to an electric locomotive. The transporter would be shielded to maintain radiation dose to workers as low as reasonably achievable.

When the transporter moves to the transfer dock at the entrance of the emplacement drift it would be released from the locomotive and the emplacement gantry would be moved into place by remote control. The emplacement gantry would then lift the waste package and emplacement pallet and move it into position within the drift by remote control. All emplacement activities would be controlled at the CCC.

The DOE stated the subsurface facilities would have thermal management goals to control the maximum drift wall temperature below 96°C, during the preclosure period. The maximum spent fuel cladding temperature in the subsurface is 350°C to provide a margin to failure as a result of a creep rupture. Cooling within the drifts would be maintained using the subsurface ventilation system. The DOE has not designated the ventilation system as ITS or ITWI because it has calculated that if the system fails, DOE would have at least 30 days to restore the ventilation to the drifts. The NRC observed that in the event the ventilation system could not be restored within 30 days, the elevated temperatures may cause fuel cladding spent fuel matrix damage which could affect the results of the Total System Performance Assessment performed by DOE and the ITWI classification of the fuel cladding. The NRC noted that the LA should clearly demonstrate the effects of the loss of the subsurface ventilation on postclosure safety and justify why the ventilation system is not ITWI.

The DOE stated that the design bases for the locomotive and transporter are to prevent a runaway, collision, tip-over, or ejection of the waste package. The components must also prevent damage to the waste package from rock fall. To meet these design bases, the braking system, couplers, speed limiters, lifting height, interlocking shield doors and bed plate, structural integrity, and lightning arresters would be used. The DOE stated that none of the subsurface ITS SSCs will be used to meet the design bases required electrical power to perform their safety functions, therefore, the subsurface electrical power system is not ITS.

The DOE described some of the codes and standards that will be used to meet the design objectives of the locomotive, transporter, emplacement gantry and rail system. At the time the LA is submitted, the designs of these SSCs will not be final but DOE maintains they will be adequate to support DOE's PCSA. The DOE stated the LA will contain commitments to meet the design bases of SSCs by implementing the appropriate codes and standards, and will contain information and analyses identifying target reliability data and supporting discussions to demonstrate that by meeting these commitments the facility can be operated in compliance with the requirements of 10 CFR 63. Furthermore, DOE stated that it plans to confirm that the design criteria and design bases are met by the as-procured and as-built SSCs.

The NRC asked several questions about the conditions under which ITS equipment would be operated. DOE stated that the LA will describe the equipment environmental qualification (EQ) program that it will commit to implement.

Stakeholder Comments and Questions

Judy Treichel, Nevada Nuclear Waste Task Force, questioned whether every cask that would be used at the Yucca Mountain Aging Facility would be licensed or certified by NRC. The DOE responded yes.

Ms. Treichel noted that the drawings presented during the meeting appeared to show that significantly more than 15 percent of the Aging Pad would contain site-specific casks. The DOE responded that the drawing was not to scale. The DOE added that the 15 percent design specification would be met (the area of the site-specific casks is limited to 15 percent of the entire aging pad surface).

Ms. Treichel asked for information regarding the elevation of the emplacement drifts. DOE provided that information to Ms. Treichel during the meeting.

Update of the Preclosure Safety Analysis

The DOE presented an overview of its process for performing the PCSA and identified numerous documents that may assist the NRC's review of the LA. The presentation included a cross-walk between the PCSA process and the primary documents and products that result from it. In response to an NRC question, DOE stated that the LA will contain a PCSA, which is a summary of the supporting calculations and analyses. This summary would include a description of the methodology, discussion of where preventive and mitigative measures were used, and rationales for selecting preventive versus mitigative measures. Detailed supporting information, data, and analyses would be provided in other sections of the LA and would not be repeated in the PCSA summary. In response to NRC questions, DOE stated that other sections of the LA would present details associated with criticality control, radiation protection, procedural controls, maintenance, and other matters related to worker safety.

Initially, 54 general external hazards, that are broadly considered in the nuclear industry, were evaluated for the facilities. Using its screening process, DOE narrowed the list of external hazards to 11 categories.

Internal hazards were assessed for the various functions of the surface and subsurface facilities. The DOE identified over 700 potential hazards based on its screening methodology. The hazards screening has resulted in the identification of three initiating events: (1) commercial spent nuclear fuel assembly drops and collisions; (2) DOE canister drops; and (3) transportation cask drops.

The DOE provided an overview of its PCSA process in evaluating the above three initiating events. The process reviews: (1) what can happen; (2) where can this likely occur and how likely is it; and (3) what are the consequences? The DOE provided a summary of its review of each of the above initiating events.

The NRC staff raised the following concerns about DOE's PCSA process and related design issues that DOE should consider clarifying in the potential LA:

- The DOE does not have a calculation that evaluates the effect of a loss of HVAC system on the spent fuel cladding and matrix integrity. The fuel cladding and matrix may oxidize at elevated temperatures which could result in a new initiating event.

- It was not clear to the NRC staff whether the event sequences for handling spent fuel assemblies at commercial facilities (i.e., movements in spent fuel pools) provided a reasonable representation of the dry spent fuel movements that would be made at the potential repository. The DOE should consider information reasonably available from the nuclear industry.

- The DOE should consider clarifying the term "defective canister" in its event sequence evaluation of a canister or transportation cask drop. In response to this comment DOE stated that this referred to "canisters with undetected flaws."

- The event trees provided during the presentation appeared to be simplistic. The DOE disagrees with this characterization and believes that the event trees are appropriately constructed and their simplicity is a direct consequence of the facilities being simpler than a reactor.

Project Decision Schedule

The DOE provided an overview of its critical decision process, controls cost schedule and scope, and construction schedule. This presentation was for information only to highlight upcoming milestones that DOE has in its work planning effort to receive high-level waste at the repository by 2010.

Stakeholder Comments and Questions

Judy Treichel, Nevada Nuclear Waste Task Force, stated that the project schedule presented looks hopeful, particularly, in view of recent hearing board decisions. She questioned whether the Final Environmental Impact Statement (FEIS) listed as an upcoming event on the schedule was different from the FEIS that has already been submitted. DOE replied that it is the same FEIS and that an Environmental Report will be submitted with the LA. Ms. Treichel observed that DOE's Durations and Sequencing Timeline did not show a milestone for DOE to request from NRC a License to Receive and Possess High-Level Waste.

SUMMARY AND FOLLOW-UP ACTIONS

This TE was a follow-up to TEs held in February and May of this year. During this TE, DOE better defined the types of technical information that would be provided in the potential LA. DOE provided the design bases and criteria for several SSCs for both the surface and subsurface facilities. In addition, DOE provided examples of how it was applying its methodology for performing the PCSA.

However, the NRC staff has questions concerning the level of design detail relating to: (1) the type of storage cask(s) that will be used at the proposed Aging Facility; and (2) the power source to supply SSCs important to safety during a Category 1 event sequence.

In addition, DOE has not completed its aircraft hazards analysis so it is not yet clear whether a consequence analysis will be required. Furthermore, DOE has not presented NRC with its seismic design methodology to support the final design of the preclosure facilities.

The NRC staff also noted that DOE has not adequately evaluated the failure of the subsurface ventilation system which is not ITS but may be ITWI.

For NRC to better understand how DOE plans to, or is, addressing these last three items DOE agreed to further discussions with NRC. The focus of future discussions would be to ensure that NRC clearly understands DOE's position on these issues so that the staff can better prepare to perform an acceptance review of the potential LA.

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