

November 25, 1996

MEMORANDUM TO: Michael J. Bell, Chief  
ENGB/DWM/NMSS

FROM: Mysore Nataraja, Sr. Geotechnical Engineer  
ENGB/DWM/NMSS  
/S/

SUBJECT: STATUS OF THE U.S. DEPARTMENT OF ENERGY'S SEISMIC DESIGN

The attached paper summarizes the status of the U.S. Department of Energy's seismic design of the Exploratory Studies Facility and the Geologic Repository Operations Area at the Yucca Mountain site. This memorandum is prepared in response to your E-mail request of November 1, 1996.

If you have further questions regarding the contents of the paper, I would be happy to discuss them with you at your convenience.

Attachment: As stated

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**STATUS OF CURRENT U.S. DEPARTMENT OF ENERGY'S SEISMIC DESIGN APPROACH  
FOR A HIGH-LEVEL WASTE  
REPOSITORY AT THE YUCCA MOUNTAIN SITE**

**Exploratory Studies Facility (ESF) Design**

Design inputs for the ESF are based on the results of a U.S. Department of Energy study documented in the report "Seismic Design Inputs for the Exploratory Studies Facility at Yucca Mountain" (prepared for the Office of Civilian Radioactive Waste Management by the Management and Operating [M&O] Contractor, dated April 29, 1994). Some details regarding the design inputs and assumptions from the above document are summarized in the following paragraphs.

**ESF Temporary Items**

**Surface:** Seismic design of ESF temporary surface facilities conforms to requirements specified in the Uniform Building Code for Zone 3. (Peak horizontal ground acceleration of 0.3g.)

**Subsurface:** For the design of temporary ESF subsurface facilities, the above peak horizontal ground acceleration of 0.3g is attenuated with depth (zero reduction up to 100 feet and 50 percent reduction for depths greater than 400 feet).

**ESF Permanent Items**

**Surface:** No items are considered permanent.

**Subsurface:** For the permanent items, a mean peak horizontal acceleration at the surface equal to 0.37g is attenuated with depth as described above under temporary items. This acceleration value corresponds to a hazard exceedance level of  $5 \times 10^{-4}$  and is associated with performance category 3 of DOE Standard-1020-94.

In addition, the subsurface permanent items are designed assuming that some upgrades and replacements may be required at a later date. Also, the design and construction of the permanent items are carried out under quality assurance procedures that will allow the incorporation of the item into a future repository (if the site becomes acceptable).

There are no ESF items classified as "permanent" other than the roof support system, and even the concrete inverts that provide the base for the rails and are very much a part of the roof support system are considered 'removable' and 'replaceable.' (The staff has raised some concerns on this issue during an in-field verification. DOE's response to these concerns is currently being evaluated.)

## Geologic Repository Operations Area (GROA) Design

The Advanced Conceptual Design Report (ACDR) dated March 1996 is the most important DOE reference where the topic of seismic design is discussed. The ACDR references the DOE Topical Reports (TRs) as the bases for seismic design of the GROA.

The first TR in the series, "Methodology to Assess Fault Displacement and Vibratory Ground Motion Hazards at Yucca Mountain," describes the proposed probabilistic methodology to define the hazard at the site. This TR has been reviewed and accepted by the staff.

The second TR "Seismic Design Methodology for a Geologic Repository at Yucca Mountain" (Rev. 0) was submitted by DOE in FY 95 and the staff, after a detailed review, recommended extensive revisions to the contents of the TR. Rev. 0 was based on DOE Standard 1020-94, which consists of classifying the structures, systems and components into four safety categories and assigning appropriate performance goals. The TR methodology, in addition to being too cumbersome, was incompatible with the U.S. Nuclear Regulatory Commission's proposed Design Basis Events (DBE) rulemaking. Therefore, the staff recommended revisions, which were accepted by DOE, and a revised TR (Rev. 1) was submitted by DOE in October 1996. The revised TR is currently under staff review.

A third and final TR will document DOE's design inputs that will be used for the design of the GROA. In the interim, DOE has committed to use all available NRC guidance on this issue.

DOE has proposed to adopt the Category-1 and Category-2 DBEs from the NRC proposed rulemaking. The vibratory ground motion hazard exceedance levels corresponding to the frequencies of these two category events would be the mean annual probabilities of  $10^{-3}$  and  $10^{-4}$  respectively. The design acceleration values proposed in the ACDR are not final at this stage and are based on the preliminary probabilistic seismic hazard assessment (PSHA) performed during the design of the ESF. The four horizontal peak ground accelerations (0.19g, 0.27g, 0.37g, and 0.66g) proposed by DOE in the ACDR correspond to the four performance categories found in TR-2 (Rev. 0) and DOE Standard 1020-94. As a result of the staff review, however, DOE has agreed to propose two design basis accelerations in its TR-3 corresponding to the two DBE categories. Although these acceleration values are likely to be close to 0.27g and 0.66g for the NRC proposed two DBE categories, they are yet to be confirmed by the final PSHA results, which are expected to be available before the end of FY 97.

### Summary

The seismic design of the ESF was based on the results of a preliminary PSHA conducted by DOE's M&O contractor, and the construction of the ESF is nearing completion. The GROA design, on the other hand, is continuously evolving making the current ACDR out of date. At the present time, there is agreement between NRC and DOE on the hazard assessment methodology for the Yucca

Mountain site based on the review of DOE TR-1. There is a tentative agreement between NRC and DOE on the seismic design methodology for the GROA in that DOE TR-2 (currently under review) has adopted the definitions and principles from the DBE rulemaking and proposes to use applicable acceptance criteria from NUREG-0800 for the GROA surface facilities design. However, the final agreement between NRC and DOE comes only after DOE submits TR-3 (which includes the actual values of design inputs), and the staff reviews it and adopts the three TRs as acceptable references to the repository license application. DOE is kept informed of the staff's positions on the issue of seismic design through regular technical exchanges and letters summarizing the staff's concerns on the TRs.