

January 24, 2006

Mr. Mark H. Williams, Director
Office of License Application and Strategy
Office of Repository Development
U.S. Department of Energy
1551 Hillshire Drive
North Las Vegas, NV 89134-6321

SUBJECT: PRECLOSURE SEISMIC DESIGN METHODOLOGY AND PERFORMANCE
DEMONSTRATION

Dear Mr. Williams:

The purpose of this letter is to provide staff feedback on the U.S. Department of Energy's (DOE's) proposed preclosure seismic design methodology (see References 1 and 2). These two references provide details of DOE's proposed technical approach to comply with 10 CFR Part 63, regarding preclosure seismic design and performance.

DOE's proposed approach for demonstrating compliance with 10 CFR Part 63 includes a combination of seismic design bases and performance analyses. DOE's seismic design bases are consistent with the recently revised design requirements for independent spent fuel storage installations as defined in 10 CFR Part 72, whereas the performance analyses are based on a Seismic Margin Assessment (SMA)¹.

DOE's approach is based on the premise that the risk at the Yucca Mountain Geologic Repository Operations Area (GROA) is similar to that of other facilities, such as the proposed Private Fuel Storage Facility in Utah. DOE proposes a 2,000-year return period ground motion as the design basis for structures, systems, and components (SSCs) important to safety (ITS), as a starting point to comply with the performance objectives defined in § 63.111(b)(2). Additionally, for Category 2 event sequences, a Review Level Earthquake (RLE) with a 10,000-year return period ground motion (approximately twice the design basis ground motion) is proposed for the performance analyses. In DOE's (see Reference 1 and 2) documents, RLE is referred to as Beyond Design Basis Ground Motion. DOE concludes that this approach complies with the performance requirements of 10 CFR Part 63 based on precedents adopted for nuclear facilities with comparable or higher radiological risks [§ 63.102(f)].

The staff has reviewed DOE's documentation and provides the following feedback.

- (1) The design basis ground motion, coupled with the proposed design criteria and the codes and standards, appears consistent with the regulatory requirements of § 63.112(f)(2).

¹The SMA approach was used in the Individual Plant Examination of External Events program to evaluate seismic safety and identify vulnerabilities in nuclear power plants.

- (2) The SMA approach may be useful for establishing the design margins of SSCs ITS against failures during a seismic event. However, the SMA approach is not a substitute for demonstrating compliance with the performance objectives in § 63.111(b)(2).
- (3) Preclosure safety analysis must consider the probability of occurrence of an initiating event to determine whether an event sequence meets the definition of a category 2 event sequence, as defined in § 63.2. In contrast, the traditional seismic hazard curve provides the probability of exceedance of the ground motion, which then can be used to derive the probability of occurrence of the ground motion. Because the RLE is a single point on the probability of exceedance seismic hazard curve, it cannot be considered as an initiating event in a seismic event sequence.
- (4) Based on the reasons delineated above, the staff concludes that DOE should consider performing the following supporting analyses to satisfy the performance objectives for Category 2 event sequences, as defined in § 63.111(b)(2) and § 63.111(c).
 - (a) The probability of occurrence of event sequences leading to the unacceptable performances of individual SSCs ITS could be obtained by convolution of the seismic hazard curve at the GROA with the SSCs ITS fragility curves. A methodology similar to the one outlined in American Society of Civil Engineers Standard 43-05 (Section C 2.0), or as used for the mixed oxide fuel fabrication facility at the Savannah River Site in South Carolina (USNRC NUREG-1821, section 5.1.6.1) may be used for estimating the probability of occurrence of unacceptable performance of SSCs ITS. The preclosure safety analysis requirements are met if the calculated probability of unacceptable seismic performance values of individual SSCs ITS is less than 1 in 10,000 over the preclosure period, as defined in § 63.111(b)(2).
 - (b) If the probability of occurrence of unacceptable seismic performance of individual SSCs ITS calculated in step (a) is greater than or equal to 1 in 10,000 over the preclosure period, DOE may demonstrate compliance with § 63.111(b)(2) by: (i) showing that the dose consequence is within 5 rems; or (ii) showing that the probability of the complete event sequence is less than 1 in 10,000 over the preclosure period; or (iii) modifying the design.

In summary, the DOE's proposed seismic design methodology, consisting of design bases and seismic margins assessment, requires additional supporting analyses to demonstrate compliance with 10 CFR Part 63. The staff is prepared to discuss its feedback in detail at a future technical exchange. Please note that the topics of seismic design and preclosure safety analysis are among those proposed for technical exchanges (see References 3 and 4).

M. Williams

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If you have any questions about this matter, please contact Dr. Mysore Nataraja at (301) 415-6695, or by e-mail, at msn1@nrc.gov.

Sincerely,

/RA/

Lawrence E. Kokajko, Deputy Director
Division of High-Level Waste Repository Safety
Office of Nuclear Material Safety
and Safeguards

References:

1. Preclosure Seismic Design Methodology for a Geologic Repository at Yucca Mountain, YMP/TR-003-NP, Revision 03, October 2004.
2. Letter from Joseph D. Ziegler, U. S. Department of Energy, to the U.S. Nuclear Regulatory Commission, August 25, 2005.
3. Letter from the U.S. Nuclear Regulatory Commission, to W. John Arthur III, U.S. Department of Energy, September 9, 2005.
4. Letter from W. John Arthur III, U. S. Department of Energy, to the U.S. Nuclear Regulatory Commission, October 24, 2005.

Letter to M. H. Williams from L. E. Kokajko dated: January 24, 2006

cc:

A. Kalt, Churchill County, NV	A. Elzeftawy, Las Vegas Paiute Tribe
R. Massey, Churchill/Lander County, NV	J. Treichel, Nuclear Waste Task Force
I. Navis, Clark County, NV	W. Briggs, Ross, Dixon & Bell
E. von Tiesenhausen, Clark County, NV	R. Murray, DOE/ORD
G. McCorkell, Esmeralda County, NV	G. Runkle, DOE/Washington, D.C.
R. Damele, Eureka County, NV	C. Einberg, DOE/Washington, D.C.
L. Marshall, Eureka County, NV	S. Gomberg, DOE/Washington, D.C.
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J. Donnell, DOE/ORD	A. Gil, DOE/ORD
M. Baughman, Lincoln County, NV	W. Boyle, DOE/ORD
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D. Swanson, Nye County, NV	S.A. Wade,, DOE/ORD
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R. Clark, EPA	R. Arnold, Pahrump Paiute Tribe
R. Anderson, NEI	J. Birchim, Yomba Shoshone Tribe

cc: (Continued)

R. McCullum, NEI

S. Kraft, NEI

J. Kessler, EPRI

D. Duncan, USGS

R. Craig, USGS

W. Booth, Engineering Svcs, LTD

C. Marden, BNFL Inc.

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P. Thompson, Duckwater Shoshone Tribe

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D. Feehan, GAO

E. Hiruo, Platts Nuclear Publications

G. Hernandez, Las Vegas Paiute Tribe

K. Finrock, NV Congressional Delegation

P. Johnson, Citizen Alert

M. Williams, DOE/ORD

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G. Hellstrom, DOE

S. Joya, Sen. Ensign's Office

J. Saldarini, BSC

M. Williams

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If you have any questions about this matter, please contact Dr. Mysore Nataraja at (301) 415-6695, or by e-mail, at msn1@nrc.gov.

Sincerely,

/RA/

Lawrence E. Kokajko, Deputy Director
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References:

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