SECY-98-071

April 8, 1998

FOR: The Commissioners

FROM: L. Joseph Callan /s/
Executive Director for Operations

SUBJECT: EXEMPTION TO 10 CFR 72.102(f)(1) SEISMIC DESIGN REQUIREMENT FOR THREE MILE ISLAND UNIT 2 INDEPENDENT SPENT FUEL STORAGE INSTALLATION

PURPOSE:

To request, by negative consent, Commission approval of the staff's intent to inform the U.S. Department of Energy, Idaho Operations Office (DOE-ID) of its finding that an adequate safety basis supports granting an exemption to the 10 CFR Part 72 seismic design requirement for the independent spent fuel storage installation (ISFSI) to store Three Mile Island Unit 2 (TMI-2) fuel debris.

BACKGROUND:

On October 31, 1996, DOE-ID submitted an application to the U.S. Nuclear Regulatory Commission to operate an ISFSI at the Idaho National Engineering and Environmental Laboratory (INEEL) for storing TMI-2 core debris. The core debris is presently stored in small canisters in a spent fuel pool at the Test Area North facility at INEEL. The ISFSI will be constructed within the Idaho Chemical Processing Plant (ICPP) site at INEEL. The ISFSI will use a modified version of the NUHOMS system technology, with the canisters housed horizontally in concrete modules. The safety and environmental reviews of the DOE-ID application are ongoing. DOE-ID is party to a settlement agreement with the State of Idaho, requiring construction of the ISFSI by December 31, 1998. Although the Commission is not a party to this agreement, the staff has committed to review the application as expeditiously as possible, to assist DOE-ID in meeting this schedule.

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On September 15, 1997, DOE-ID requested an exemption to the 10 CFR 72.102(f)(1) seismic design requirement for the TMI-2 ISFSI. Section 72.102(f)(1) requires sites west of the Rocky Mountain front to use a design earthquake (DE) ground motion equivalent to that of a safe shutdown earthquake (SSE) for a nuclear power plant (NPP), as evaluated by the methods of Appendix A of 10 CFR Part 100. Following the methods of Appendix A, DOE-ID determined that the design earthquake at the ICPP site would be a peak ground acceleration (PGA) of 0.56 g, with an appropriate response spectrum. However, DOE-ID proposes a design earthquake with a 0.36 g peak ground acceleration as an adequately conservative seismic design for the ISFSI.

DISCUSSION:

When Part 72 was first promulgated in 1980, ISFSIs were largely envisioned to be spent fuel pools or single, massive dry storage structures. A seismic design requirement equivalent to a nuclear power plant (Appendix A of Part 100) seemed appropriate for these types of facilities, given the potential accident scenarios. NRC recognized that a major seismic event at an ISFSI storing spent fuel in dry casks or canisters would have minor radiological consequences compared with a nuclear power plant, spent fuel pool, or single massive storage structure. NRC stated in the Part 72 "Statements of Consideration" that the design earthquake for cask and canister technology need not be as high as a nuclear power plant safe shutdown earthquake: "For ISFSIs which do not involve massive structures, such as dry storage casks and canisters, the required design earthquake will be determined on a case-by-case basis until more experience is gained with licensing these types of units" (45 FR 74697).

The staff is developing, for Commission approval, a plan to modify the Part 72 seismic requirement to better reflect robust cask and canister designs, as well as recent amendments to seismic siting criteria in other regulations. The existing Part 72 requires the use of Appendix A of Part 100, a deterministic method, in calculating the design earthquake at western sites. The seismic requirements in 10 CFR Parts 50 and 100, effective January 10, 1997, and 10 CFR Part 60, effective January 3, 1997, are based on probabilistic seismic hazard assessment (PSHA) techniques. Parts 50 and 100 allow PSHA methods to address uncertainties inherent in determining an safe shutdown earthquake value for a nuclear power plant. The Part 60 change, also known as the Design Basis Event (DBE) rulemaking, allows probabilistic methods in designing for hazards (including seismic) at a geologic repository, and allows two design levels based on risk. The staff will consider PSHA and relative risk in developing the new Part 72 seismic requirement.

DOE-ID has developed design earthquake values for the ISFSI site both deterministically (Appendix A of Part 100) and through a PSHA (10 CFR 100.23). To comply with the 10 CFR 72.102(f)(1) requirement, DOE-ID calculated a deterministic design earthquake of 0.56 g peak ground acceleration, with an appropriate response spectrum. Based on 10 CFR 100.23 requirements, as described in Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," a future nuclear power plant in the western United States can use as a safe shutdown earthquake the 10,000-year return period mean ground motion. DOE-ID derived 0.47 g peak ground acceleration as the 10,000-year return period mean ground motion for the ISFSI site. Likewise, DOE-ID derived 0.30 g peak ground acceleration as the 2000-year return period mean ground motion. DOE-ID proposes to use 0.36 g peak ground acceleration, with an appropriate response spectrum, as the design value for the ISFSI. DOE-ID selected this value based on consistency with its own site-specific design standard, which would also require a 0.36 g peak

ground acceleration design value for a power reactor at this site. This standard relies on a detailed geologic investigation similar to that required by Appendix A of Part 100, but without the benefit of some more recent geologic data. DOE-ID further justifies 0.36 g peak ground acceleration with a site-

specific radiological risk analysis.

In reviewing DOE-ID's exemption request, the staff considered foremost the public health and safety consequence of a major seismic event at a cask or canister ISFSI. At an ISFSI using the NUHOMS system technology, the consequences are bounded by a canister drop onto the concrete pad. Although this would occur only at a ground motion well above the proposed design earthquake of 0.36 g peak ground acceleration, the canisters are designed to withstand such drops with no release of radioactive material. DOE-ID estimates that should a storage canister fail and one of the 12 inner core debris canisters release its contents (although the staff has not identified a credible mechanism for such a failure), the radiological consequences would be a dose of about 0.75 mSv (75 mrem) to a member of the public. This is well below the 0.05 Sv (5 rem) siting evaluation factor of 10 CFR 72.106(b).

The staff also considered the relative risk posed by the ISFSI. The staff examined relative risk by referring to DOE Standard 1020, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities." This standard takes a graded approach to designing critical facilities, requiring facilities with greater accident consequences to use higher design requirements for phenomena such as earthquakes and tornadoes. Standard 1020 defines four performance categories (PCS) for structures, systems, and components (SSCs) important to safety, with PC 4 facilities being those with potential accident consequences similar to a commercial nuclear power plant. Such facilities must have a design earthquake equal to the mean seismic ground motion with a 10,000-year return period. Dry spent fuel storage facilities such as the TMI-2 ISFSI, are PC 3 and must have a design earthquake equal to the mean ground motion with a 2000-year return period. Considering the minor radiological consequences from a canister failure, and the lack of a credible mechanism to cause a failure, the staff finds that the DOE approach of using the 2000-year return period mean ground motion as the design earthquake for dry storage facilities is adequately conservative. The design earthquake proposed by DOE-ID for the ISFSI exceeds the peak ground acceleration value of the mean 2000-year return period ground motion.

With the Part 60 Design basis event rulemaking, NRC adopted a graded approach similar to DOE Standard 1020 for natural hazard characterization and design. The Design basis event rulemaking defined a framework for two SSC design categories for repository surface facilities. For seismic events, the staff has accepted DOE's approach of designing SSCs with failure consequences within the public dose limit of 10 CFR 20.1302(a)(1), 1 mSv (100 mrem), to withstand the 1000-year return period mean ground motion. Meanwhile, SSCs with higher potential accident doses must be designed to withstand the 10,000-year return period mean ground motion.

In summary, the staff finds that the design earthquake proposed by DOE-ID for the TMI-2 ISFSI (0.36 g peak ground acceleration with an appropriate response spectrum) adequately protects public health and safety. The design earthquake is above the 0.30 g peak ground acceleration 2000-year return period mean ground motion obtained from the PSHA. The analysis provided by DOE-ID relies on widely accepted PSHA techniques that are consistent with the newer seismic design requirements in Parts 50, 60, and 100. In addition, the relative risk of the facility warrants a design earthquake below the Part 100 Appendix A value. The use of probabilistic techniques and a risk-graded approach are compatible with the direction provided by the Commission on Direction Setting Issue 12, "Risk-Informed, Performance-Based Regulation."

Since the rulemaking to revise the Part 72 seismic requirement for ISFSIs is unlikely to be completed before issuance of the TMI-2 ISFSI license, the staff intends to grant the exemption as requested if the Environmental Assessment (EA) is favorable. A final decision on granting the exemption will be made when the staff completes an EA on the exemption request. If the exemption is granted, staff intends to formally issue the exemption at the time the license is issued.

If the staff grants the exemption to 10 CFR 72.102(f)(1), this may impact the licensing process for other ISFSIs in the western United States. Until the ISFSI seismic requirement in Part 72 is amended by rulemaking, the staff may receive similar exemption requests for other ISFSIs to be sited west of the Rocky Mountain front.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection.

RECOMMENDATION:

Unless the Commission directs otherwise, the staff intends to issue the attached letter to DOE-ID.

L. Joseph Callan
Executive Director for Operations

Attachment: Draft Ltr C. Haughney, NRC, to J. Wilcynski, DOE-ID

March xx, 1998

Mr. J. M. Wilcynski, Manager
Idaho Operations Office
U.S. Department of Energy
850 Energy Drive
Idaho Falls, ID 83401-1563

SUBJECT: REQUEST FOR EXEMPTION TO 10 CFR 72.102(f)(1) SEISMIC DESIGN REQUIREMENT FOR THREE MILE ISLAND UNIT 2 INDEPENDENT SPENT FUEL STORAGE INSTALLATION (TAC NO. L22283)

Dear Mr. Wilcynski:

This responds to your September 15, 1997, request, pursuant to 10 CFR 72.7, for an exemption to the seismic design requirement of 10 CFR 72.102(f)(1), for the Three Mile Island Unit 2 (TMI-2) Independent Spent Fuel Storage Installation (ISFSI).

After reviewing the probabilistic seismic hazard assessment completed for the TMI-2 ISFSI site, the staff finds an adequate safety basis to grant your requested exemption, allowing a design earthquake of 0.36 g peak ground acceleration, with an appropriate response spectrum. This staff reached this decision after considering the origin of the 10 CFR 72.102(f)(1) seismic design requirement, recent amendments to the seismic and geologic criteria in 10 CFR Parts 60 and 100, and the on-going U.S. Nuclear Regulatory Commission effort to revise the 10 CFR Part 72 seismic design requirements for ISFSIs. A safety evaluation of the exemption request is enclosed. This safety evaluation will be incorporated into the final safety evaluation to be issued with the TMI-2 ISFSI license.

A final decision on granting the exemption cannot be made until the staff completes an Environmental Assessment (EA) on the exemption request. When the EA is completed, the staff will make the determination whether to grant the exemption. If the exemption is granted, staff intends to formally issue the exemption at the time the license is issued.

If you have any questions, please contact Mr. Michael Raddatz of my staff at 301-415-8544.

Sincerely,
Charles J. Haughney, Acting Director
Spent Fuel Project Office
Office of Nuclear Material Safety and Safeguards

Docket 72-20

Enclosure: Safety Evaluation

cc: Service List

DOCKET: 72-20

APPLICANT: U.S. Department of Energy, Idaho Operations Office Three Mile Island Unit 2 Independent Spent Fuel Storage Installation

SUBJECT: EVALUATION OF EXEMPTION REQUEST TO 10 CFR 72.102(f)(1) SEISMIC DESIGN REQUIREMENT

BACKGROUND

By request dated September 15, 1997, the U.S. Department of Energy, Idaho Operations Office (DOE-ID), requested an exemption to the 10 CFR 72.102(f)(1) seismic design requirement for the Three Mile Island Unit 2 (TMI-2) Independent Spent Fuel Storage Installation (ISFSI). The facility will use the NUHOMS system technology with dry, shielded canisters housed horizontally in concrete modules. DOE-ID plans to construct this facility at the Idaho Chemical Processing Plant within the Idaho National Engineering and Environmental Laboratory (INEEL) site. The DOE-ID seismic hazard analysis meeting the requirement of 10 CFR 72.102(f)(1) yields a design earthquake (DE) of 0.56 g peak ground acceleration (PGA), with an appropriate response spectrum, for the ISFSI site. DOE-ID proposes a DE of 0.36 g PGA, with an appropriate response spectrum. DOE-ID justifies this value with a site-specific radiological risk analysis.

DISCUSSION

Section 72.102(b) requires ISFSI sites west of the Rocky Mountain front, as is the INEEL site, to have seismicity evaluated by the techniques of Appendix A of 10 CFR Part 100, also known as a deterministic seismic hazard analysis (DSHA). A DSHA calculates, based on site-specific investigations, the largest credible earthquake likely to affect a site, regardless of the probability of this event through time. Section 72.102(f)(1) states, "For sites that have been evaluated under the criteria of Appendix A of 10 CFR Part 100, the design earthquake must be equivalent to the safe shutdown earthquake (SSE) for a nuclear power plant." In this context, "DE" and "SSE" refer to the design peak ground acceleration, with an appropriate response spectrum, caused by the largest credible earthquake. The most recent DSHA for the ISFSI site yields a DE of 0.56 g PGA, with an appropriate response spectrum.

When 10 CFR Part 72 was first promulgated in 1980, ISFSIs were largely envisioned to be spent fuel pools or single, massive dry storage structures. A DE equivalent to a nuclear power plant (NPP) SSE seemed appropriate for these facilities, given the potential accident scenarios. Furthermore, for ISFSIs to be located at an NPP, the DE value was readily available without additional site characterization work, save the geotechnical investigation at the specific ISFSI location. However, an ISFSI storing spent fuel in dry casks or in canisters with horizontal storage modules is inherently less hazardous and less vulnerable to earthquake-initiated accidents than is an operating NPP (e.g., Hossain et al., 1997). The U.S. Nuclear Regulatory Commission recognized this in the initial Part 72 "Statements of Consideration," and stated that the DE for cask and canister technology need not be as high as an NPP SSE: "For ISFSIs which do not involve massive structures, such as dry storage casks and canisters, the required design earthquake will be determined on a case-by-case basis until more experience is gained with licensing these types of units."

The bounding consequences of a major seismic event at an ISFSI using the NUHOMS system technology are limited by a canister drop onto the concrete pad, although this would occur only at a ground motion well above the proposed 0.36 g PGA design value, as detailed in Section 8.2.3.2 of the TMI-2 ISFSI Safety Analysis Report (DOE-ID, 1996a) (SAR). The casks and canisters are designed to withstand such events with no release of radioactive material. The effects of a NUHOMS canister drop are analyzed in Section 8.2.5.2 of the SAR. In addition, analysis of beyond-design basis accidents leading to cask or canister rupture estimate off-site doses well below the 0.05 Sv (5 rem) whole body dose limit of 10 CFR 72.106(b). In a letter dated July 19, 1996 (DOE-ID, 1996b), DOE-ID presented a conservative analysis of off-site doses resulting from a beyond-design basis accident. In this hypothetical accident, for which neither DOE-ID nor the staff has identified a credible mechanism, both a NUHOMS dry shielded canister and one of the 12 inner core debris canisters are assumed to fail, allowing unmitigated dispersal of the contents. The calculated off-site dose from such an accident is 0.75 mSv (75 mrem), well below the 0.05 Sv (5 rem) siting evaluation factor of 10 CFR 72.106(b).

On January 10, 1997, 10 CFR Parts 50 and 100 were revised to allow the use of the probabilistic seismic hazard assessment (PSHA) methodology to address uncertainties inherent in determining NPP seismic design values. These revisions were accomplished through the addition of 10 CFR 100.23 and Part 50, Appendix S. The PSHA method considers the frequency, as well as magnitude, of earthquakes that may affect a site. Rather than base seismic design on the largest ground motion likely to ever affect a site, a PSHA derives a site-specific hazard curve showing ground motion level versus annual probability of exceedence or, inversely, ground motion return period. The present Part 72 seismic siting evaluation factor requires use of methods in Appendix A of Part 100 and does not allow use of the PSHA method. The staff is developing a plan to modify the Part 72 seismic requirement to a level commensurate with the risks of cask and canister ISFSIs. In addition, the new requirement will be based on the PSHA methodology. Options being considered for DE values are the 2000- or 1000-year return period mean ground motion, possibly derived from a U.S. Geological Survey seismic hazard.

In reviewing the DE proposed by DOE-ID for the ISFSI, the staff also considered DOE and NRC precedents. The staff considered DOE Standard 1020, "Natural Phenomena Hazards Design and Evaluation Criteria for Department of Energy Facilities," DOE-STD-1020-94. This standard takes a probabilistic, risk-graded approach to designing critical facilities, requiring facilities with greater accident consequences to use higher design requirements for phenomena such as earthquakes and tornadoes. DOE Standard 1020 defines four performance categories (PCs) for structures, systems, and components (SSCs) important to safety, with PC 4 facilities being those with potential accident consequences similar to a commercial NPP. Such facilities must be designed to withstand the mean seismic ground motion with a 10,000-year return period. As described in Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," a future NPP licensed by NRC in the western United States would be allowed to design to this same level. Dry spent fuel storage facilities, such as the TMI-2 ISFSI at INEEL, are classified PC 3 and must be designed for the mean ground motion with a 2000-year return period. The DE proposed by DOE-ID for the ISFSI (0.36g PGA) exceeds that of the 2000-year mean ground motion (0.30 g PGA) derived from the site-specific PSHA. As a comparison, the U.S. Geological Survey hazard maps yield, for the ISFSI general vicinity, PGA values of 0.30 g for a 2500-year return period; 0.20 g for 1000-year; and 0.15 g for a 500-year return period.

In addition, the staff considered the seismic design philosophy in 10 CFR Part 60 for high-level waste repository surface facilities. On January 3, 1997, the definition of design basis event in Part 60 was revised to allow a probabilistic, risk-graded methodology, similar to that in DOE-STD-1020-94, in designing for hazards (including seismic) at a geologic repository. This set an NRC precedent by accepting a risk-graded approach in licensing a facility quite similar to an ISFSI in terms of radioactive material present and possible accident scenarios. For seismic events, the staff has accepted DOE's two-tier approach toward designing Part 60 SSCs. Those SSCs with potential failure consequences less than the public dose limit of 10 CFR 20.1302(a)(1), 1 mSv (100 mrem), must withstand the 1000-year return period mean ground motion. SSCs with higher potential failure consequences must withstand the 10,000-year return period mean ground motion, while maintaining doses in unrestricted areas below the 0.05 Sv (5 rem) total effective dose equivalent limit of 10 CFR 60.136(b).

CONCLUSIONS

DOE-ID has completed both a DSHA (Appendix A of Part 100) and PSHA (10 CFR 100.23) for the ISFSI site. The staff has evaluated these analyses and finds the resultant values acceptable: 0.56 g PGA for an SSE by the deterministic method and 0.30 g PGA mean ground motion with a 2000-year return period by the probabilistic method. Considering the lack of radiological consequences from credible accidents and the minor consequences from beyond-design basis accidents, the staff finds the present Part 72 requirement for an ISFSI DE to be an unnecessary regulatory burden. The staff finds acceptable the risk-graded approach to seismic hazard characterization and design in DOE Standard 1020, which is similar to the risk-graded approach to design basis events in Part 60. Given the absence of radiological consequences from any credible seismic event, the staff finds that the DOE Standard 1020 risk-graded approach of using the 2000-year return period mean ground motion as the DE is adequately conservative. Moreover, the expected life span of the ISFSI, 20 years with the possibility of renewal, per 10 CFR 72.42, justifies use of this ground motion as the DE. The DE proposed by DOE-ID for the ISFSI, 0.36 g PGA with an appropriate response spectrum, exceeds the 0.30 g PGA value for the 2000-year return period mean ground motion. Therefore, the staff concludes that granting the requested exemption from 10 CFR 72.102(f)(1) will maintain an adequate design margin for seismic events and will not be inimical to public health and safety.

This safety evaluation does not represent final approval of the TMI-2 ISFSI design. This evaluation approves a DE value other than that required by 10 CFR 72.102(f)(1); it does not evaluate DOE-ID's analysis of how this new requirement will be implemented. The staff evaluation of the design will be contained in the safety evaluation report provided with the TMI-2 ISFSI license.

REFERENCES

Hossain, Q.A., A.H. Chowdhury, M.P. Hardy, K.S. Mark, J.E. O'Rourke, W.J. Silva, J.C. Stepp, and F.H. Swan, III, "Seismic and Dynamic Analysis and Design Considerations for High-Level Nuclear Waste Repositories," J.C. Stepp, ed., American Society of Civil Engineers, New York, New York, 1997.

U.S. Department of Energy, Idaho Operations Office, "Safety Analysis Report for the INEL TMI-2 Independent Spent Fuel Storage Installation," Revision 0, October 1996a.

U.S. Department of Energy, Idaho Operations Office, Letter from J. Hagers (DOE-ID) to M. G. Raddatz (NRC), Subject: "License Application for the Three Mile Island Unit 2 Interim Storage System as an Independent Spent Fuel Storage Installation under 10 CFR Part 72 - Seismic Design Basis," July 19, 1996b.

U.S. Nuclear Regulatory Commission, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," Regulatory Guide 1.165, March 1997.