RAS 5680   72-22-ISFSI - State Exhibit 209 - Rec'd 6/5/02

Safety Evaluation Report for Systems not Directly Associated With Storage Casks for the Private Fuel Storage Facility, December 15, 1999

PAGES 2-44 to 2-45:

However, the staff has determined that a 2,000-year return value with the PSHA methodology can be acceptable for the following reasons:

- The DOE standard, DOE-STD-1020-94 (U.S. Department of Energy, 1994), defines four performance categories for structures, systems, and components important to safety. The DOE standard requires that performance category-3 facilities be designed for the mean ground motion with a 2,000-year return period. Category-3 facilities in the DOE standard have potential accident consequences similar to a dry spent fuel storage facility.

- The Uniform Building Code and the National Earthquake Hazards Reduction Program (International Conference of Building Officials, 1994; Building Seismic Safety Council, 1995) both recommend using peak ground motion values that have a 90-percent probability of not being exceeded in 50 years for the seismic design of structures. Considering the radiological safety aspects of a dry spent fuel storage facility, conservative peak ground motion values that have a 99 percent likelihood of not being exceeded in the 20-year licensing period of the Facility are considered adequate for its seismic design. This exceedance probability corresponds to a return period of 2,000 years.

- The NRC has accepted a design seismic value that envelops the 50th-percentile deterministic ground motion value and the 2,000-year return period probabilistic ground motion value for the TMI-2 ISFSI facility license.(Nuclear Regulatory Commission, 1998b; Chen and Chowdhury, 1998). The TMI-2 is designed to store spent nuclear fuel in dry storage casks. The applicant's 2,000-year PSHA response spectra generally envelops the 50th-percentile updated DSHA response spectra (Stamatakos et. al., 1999). A lower design value of 50th-percentile design earthquake is adequate because the passive design of the dry cask storage facility is inherently less hazardous and less vulnerable to earthquake-initiated accidents than an operating nuclear power reactor, which requires a 84th-percentile design earthquake (Hossain et al., 1997).

- In its Fault Evaluation Study and Seismic Hazard Assessment Study–Final Report for the site, Geomatrix Consultants, Inc. (1999a) concluded that an appropriate design probability level for both vibratory ground motion and fault displacement for the site is 5 x 10^{-4} (or a 2,000-year return period).

Safety Evaluation Report for the Private Fuel Storage Facility
September 29, 2000

PAGES 2-41 to 2-42:

However, the staff has determined that a 2,000-year return value with the PSHA methodology can be acceptable for the following reasons:

- The radiological hazard posed by a dry cask storage facility is inherently lower and the Facility is less vulnerable to earthquake-induced accidents than operating commercial nuclear power plants (Hossain et al., 1997). In its Statement of Consideration accompanying the rulemaking for 10 CFR Part 72, the NRC recognized the reduced radiological hazard associated with dry cask storage facilities and stated that the seismic design basis ground motions for these facilities need not be as high as for commercial nuclear power plants (45 FR 74697,11/12/80; SECY-98-071; SECY-98-126).

- Seismic design for commercial nuclear power plants is based on a determination of the Safe Shutdown Earthquake ground motion. This ground motion is determined with respect to a reference probability level of 10^{-5} (median annual probability of exceedance) as estimated in a probabilistic seismic hazard analysis (Reference Reg Guide 1.165). The reference probability, which is defined in terms of the median probability of exceedance, corresponds to a mean annual probability of exceedance of 10^{-4} (Murphy et al., 1997). That is, the same design ground motion (which has a median reference probability of 10^{-5}) has a mean annual probability of exceedance of 10^{-4} .

- On the basis of the foregoing, the mean annual probability of exceedance for the PFS Facility may be less than 10^{-4} per year.

- The DOE standard, DOE-TD-1020-94 (U.S. Department of Energy, 1996), defines four performance categories for structures, systems, and components important to safety. The DOE standard requires that performance Category-3 facilities be designed for the ground motion that has a mean recurrence interval of 2000 yrs (equal to a mean annual probability of exceedance of 5×10^{-4}). Category-3 facilities in the DOE standard have a potential accident consequence similar to a dry spent fuel storage facility.

- The NRC has accepted a design seismic value that envelopes the 2000-yr return period probabilistic ground motion value for the TMI-2 ISFSI license (Nuclear Regulatory Commission, 1998b; Chen and Chowdhury, 1998). The TMI-2 ISFSI was designed to store spent nuclear fuel in dry storage casks similar to the PFS Facility.

Consolidated Safety Evaluation Report
Concerning the Private Fuel Storage Facility, Docket No. 72-22
March 2002

PAGES 2-50 to 2-51:

However, the staff has determined that a 2,000-year return value with the PSHA methodology can be acceptable for the following reasons:

- The radiological hazard posed by a dry cask storage facility is inherently lower and the Facility is less vulnerable to earthquake-induced accidents than operating commercial nuclear power plants (Hossain et al., 1997). In its Statement of Consideration accompanying the rulemaking for 10 CFR Part 72, the NRC recognized the reduced radiological hazard associated with dry cask storage facilities and stated that the seismic design basis ground motions for these facilities need not be as high as for commercial nuclear power plants (45 FR 74697, 11/12/80; SECY-98-071; SECY-98-126).

- Seismic design for commercial nuclear power plants is based on a determination of the Safe Shutdown Earthquake ground motion. This ground motion is determined with respect to a reference probability level of 10^{-5} (median annual probability of exceedance) as estimated in a probabilistic seismic hazard analysis (Reference Reg Guide 1.165). The reference probability, which is defined in terms of the median probability of exceedance, corresponds to a mean annual probability of exceedance of 10^{-4} (Murphy et al., 1997). That is, the same design ground motion (which has a median reference probability of 10^{-5}) has a mean annual probability of exceedance of 10^{-4} . Further, analyses of nuclear power plants in the western United States show that the estimated average mean annual probability of exceeding the safe shutdown earthquake is 2.0×10^{-4} (U.S. Department of Energy, 1997).

- On the basis of the foregoing, the mean annual probability of exceedance for the PFS Facility may be defined as greater than 10^{-4} per year.

- The DOE standard, DOE-TD-1020-94 (U.S. Department of Energy, 1996), defines four performance categories for structures, systems, and components important to safety. The DOE standard requires that performance Category-3 facilities be designed for the ground motion that has a mean recurrence interval of 2000 yrs (equal to a mean annual probability of exceedance of 5×10^{-4}). Category-3 facilities in the DOE standard have a potential accident consequence similar to a dry spent fuel storage facility.

- The NRC has accepted a design seismic value that envelopes the 2000-yr return period probabilistic ground motion value for the TMI-2 ISFSI license (Nuclear Regulatory Commission, 1998b; Chen and Chowdhury, 1998). The TMI-2 ISFSI was designed to store spent nuclear fuel in dry storage casks similar to the PFS Facility.

Modified Rulemaking Plan, SECY-01-0178
Geological and Seismological Characteristics for the Siting and Design of Dry Cask ISFSIs 10 CFR Part 72
September 26, 2001

PAGES 7-8

The rationale for the proposed mean annual probability of exceedance of 5.0E-04 (return period of 2,000 years) for a design earthquake is based on several points:

- Use of a mean annual probability of exceedance of 5.0E-04 (return period of 2,000 years) for the design earthquake is consistent with the Commission's approval of DOE's request for an exemption from section 72.102(f)(1) for a proposed ISFSI at the INEEL to store spent fuel generated at the Three Mile Island Unit-2 nuclear power plant. Section 72.102(f)(1) requires that for sites that have been evaluated under the criteria of Appendix A of Part 100, the design earthquake must be equivalent to the SSE for an NPP. In its evaluation of the request, NRC staff considered the relative risk posed by the ISFSI. The staff concluded that considering the minor radiological consequences expected from a cask failure resulting from a seismic event, and the lack of a credible mechanism to cause such a failure, the NRC staff believes that the design earthquake using a mean annual probability of exceedance of
5.0E-04 for dry storage facilities at INEEL would be conservative.

- The total probability of exceedance for a design earthquake at an ISFSI facility with an operational period of 20 years (20 years x 5 0E-04 = 1.0E-02) is the same as the total probability of exceedance for an earthquake event at the proposed pre-closure facility at Yucca Mountain with an operational period of 100 years (100 years x 1.0E-04 = 1.0E-02).

- Because SSCs important to safety in an ISFSI are few, relative to those found in an NPP, the use of a graded approach for classifying ISFSI SSCs into one of two different categories for earthquake designs would unnecessarily increase the complexity in applications, without a commensurate improvement to safety. The SSCs important to safety in an ISFSI are associated with the storage cask, and include the canister, the canister handling systems, concrete pad supporting the cask, the transfer building supporting the handling systems, and the transfer cask. Since these SSCs are needed to be functional to prevent the dose limit of 5 rem being exceeded at the controlled area boundary, they would be required to be designed for a Category 2 design basis earthquake. Other SSCs important to safety may include the pressure monitoring system, protective cover, security lock and wire, etc. and can be designed for a lower Category 1 earthquake. However, it would be simpler to design all SSCs for a bounding Category 2 earthquake.

- The critical element for protection against radiation release is the confinement boundary for containing the spent fuel assemblies. Because the casks are rigid and have high natural frequencies, the damage from a drop or tip-over accident is expected to be far greater and more severe than the seismic inertial acceleration loads. Therefore, seismic inertia loads are bounded by other loads. The dry storage cask designs are very rugged and robust, and are expected to have substantial design margins to withstand forces from a seismic event greater than the design earthquake.

- During a seismic event, a cask may slide if lateral seismic forces are greater than friction resistance between the cask and the concrete pad. The sliding and resulting displacements are computed by the applicant to demonstrate that the casks, which are spaced to satisfy thermal requirements, are precluded from impacting other adjacent casks. Furthermore, the staff typically requests, as part of its approval process, that an applicant demonstrate that during a seismic event equal to the proposed design earthquake, the cask will not tip over. However, it follows from the discussion above that even if the casks slide or tip-over and then impact other casks or the pad during a seismic event greater than the proposed design earthquake, the casks have adequate design margins to ensure that they maintain their structural integrity to meet the Part 72 exposure limits for radiological protection.

- The mean annual probability of exceedance of 5.0E-04 for ISFSI facilities is consistent with the design approach used in DOE Standard DOE-STD-1020, "Natural Phenomena Hazards Design Evaluation Criteria for Department of Energy Facilities," for similar type facilities.