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October 22, 2002

Secretary
U.S. Nuclear Regulatory Commission
Washington, DC 20555-0001

ATTENTION: Rulemaking and Adjudications Staff

SUBJECT: Review Comments on Proposed 10CFR Part 72 Changes and Draft Regulatory Guide DG-3021 Requirements for Determination of Design Earthquake (DE) Ground Motion for Independent Spent Fuel Storage Installations (ISFSI)

The Nuclear Regulatory Commission (NRC) is proposing to amend its licensing requirements for dry cask modes of storage of spent nuclear fuel and high-level radioactive waste in an independent spent fuel storage installation (ISFSI) or in a U.S. Department of Energy (DOE) monitored retrievable storage (MRS) installation. These amendments would update the seismic siting and design criteria, including geologic, seismic, and earthquake engineering considerations. The proposed rule would reportedly allow the NRC and its licensees to benefit from experience gained in the licensing of existing facilities and to incorporate rapid advancements in the earth sciences and earthquake engineering. The proposed amendments would make the Part 72 regulations compatible with the 1996 revision to Part 100 that addressed uncertainties in seismic hazard analysis, and would be commensurate with the risk associated with an ISFSI or MRS.

The NRC is requesting public comment on these proposed regulatory changes. The industry and EPRI have reviewed both the proposed 10CFR Part 72 changes, as well as the draft of Regulatory Guide DG-3021, "Site Evaluations and Determination of Design Earthquake Ground Motion for Seismic Design of Independent Spent Fuel Storage Installations", and is in general agreement with both of these draft documents. Three summary comments on these documents are presented below and represent an executive summary of this review.

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1. The criteria presented for establishing the Design Earthquake (DE) for ISFSI and MRS sites at existing nuclear power plants allow for the use of the existing NPP SSE as one alternative. This alternative is key to ensuring that significant new probabilistic ground motion studies (these studies could represent a significant level of resources) are not required (although generating a new probabilistic seismic hazard analysis, PSHA, is still an option for this class of sites and could potentially result in a lower DE) at existing NPP sites.

2. The proposed regulation would require new dry cask storage applicants at some locations (e.g., Western U.S. or in areas of known seismic activity in the Eastern U.S., and not co-located with an NPP) to address uncertainties in seismic hazard analysis by using appropriate analyses (such as probabilistic seismic hazard analysis, PSHA) for determining the DE. The Commission believes that the seismically induced risk from the operation of an ISFSI or MRS is less than an operating NPP and, thus, is recommending a mean annual probability of exceedance value of 5.0E-4 (i.e., 2000 year return period earthquake) as an appropriate risk-informed value for the seismic design of dry cask storage facilities. Thus, the DE required for a Dry Cask ISFSI is less than the SSE that would be established by Regulatory Guide 1.165 (Ref. 3) for a new NPP at the same site. The Commission is soliciting comments on what the appropriate mean annual probability of exceedance value should be for the subject dry cask storage designs. The industry strongly endorses lowering the seismic design level to the proposed 5x10-4 mean annual probability of exceedance and provides a justification for this probability level in an Appendix to this write-up.

3. The Commission is proposing to modify 10CFR Part 72 to require that licensees evaluate dynamic loads (in addition to the static loads currently stipulated) in the design of dry cask and storage pad systems. During a seismic event, the cask and storage pad systems experience dynamic loads and interactions between the casks, the concrete pads, and the supporting soil profiles. The proposed revision requires consideration of potential amplification of the earthquake through soil-structure interaction and the potential for soil liquefaction and other soil instability effects. While these evaluations for dynamic loads may require more analytical effort than the static load evaluations that some licensees (through their ISFSI vendors) had attempted to utilize in the past for ISFSI designs, these requirements are felt to be technically correct. EPRI supports the concept that the seismic evaluation of dry cask storage systems should be conducted using state-of-the-art structural dynamics principals, which include the

consideration of dynamic loads and appropriate structural dynamics effects (e.g., soil structure interaction).

The enclosure provides further supporting information for industry's three primary comments.

The industry appreciates the NRC's efforts to revise the rule. If you have any questions please contact Alan Nelson at (202) 739-8110 or by e-mail (apn@nei.org).

Sincerely,

Lynnette Hendricks

Lynnette Hendricks

Enclosure

REVIEW COMMENTS ON PROPOSED 10CFR PART 72 CHANGES AND DRAFT REGULATORY GUIDE DG-3021 REQUIREMENTS FOR DETERMINATION OF DESIGN EARTHQUAKE GROUND MOTION (DE) FOR INDEPENDENT SPENT FUEL STORAGE INSTALLATIONS (ISFSI)

by

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EXECUTIVE SUMMARY

The Nuclear Regulatory Commission (NRC) is proposing to amend its licensing requirements for dry cask modes of storage of spent nuclear fuel, high-level radioactive waste in an independent spent fuel storage installation (ISFSI) or in a U.S. Department of Energy (DOE) monitored retrievable storage installation (MRS). These amendments would update the seismic siting and design criteria, including geologic, seismic, and earthquake engineering considerations. The proposed rule would reportedly allow the NRC and its licensees to benefit from experience gained in the licensing of existing facilities and to incorporate rapid advancements in the earth sciences and earthquake engineering. The proposed amendments would make the Part 72 regulations compatible with the 1996 revision to Part 100 that addressed uncertainties in seismic hazard analysis, and would be commensurate with the risk associated with an ISFSI or MRS.

The NRC is requesting public comment on these proposed regulatory changes. EPRI has reviewed both the proposed 10CFR Part 72 changes, as well as the draft of Regulatory Guide DG-3021 (Site Evaluations and Determination of Design Earthquake Ground Motion for Seismic Design of Independent Spent Fuel Storage Installations), and is in general agreement with both of these draft documents. Three summary comments on these documents are presented below and represent an executive summary of this review.

1. The criteria presented for establishing the Design Earthquake (DE) for ISFSI and MRS sites at existing nuclear power plants allows for the use of the existing NPP SSE as one alternative. This alternative is key to ensuring that significant new probabilistic ground motion studies (these studies could represent a significant level of resources) are not required (although generating a new probabilistic seismic hazard analysis, PSHA, is still an option for this class of sites and could potentially result in a lower DE) at existing NPP sites.

2. The proposed regulation would require new dry cask storage applicants at some locations (i.e., Western U.S. or in areas of known seismic activity in the Eastern U.S., and not co-located with an NPP) to address uncertainties in seismic hazard analysis by using appropriate analyses (such as probabilistic seismic hazard analysis, PSHA) for determining the DE. The Commission believes that the seismically-induced risk from the operation of an ISFSI or MRS is less than an operating NPP and, thus, is recommending a mean annual probability of exceedance value of 5.0E-4 (i.e., 2000 year return period earthquake) as an appropriate risk informed value for the seismic design of dry cask storage facilities. Thus, the DE

required for a Dry Cask ISFSI is less than the SSE that would be established by Regulatory Guide 1.165 (Ref. 3) for a new NPP at the same site. The Commission is soliciting comments on what the appropriate mean annual probability of exceedance value should be for the subject dry cask storage designs. EPRI strongly endorses lowering the seismic design level to the proposed $5x10^{-4}$ mean annual probability of exceedance and provides a justification for this probability level in an Appendix to this write-up.

3. The Commission is proposing to modify 10CFR Part 72 to require that licensees evaluate dynamic loads (in addition to the static loads currently stipulated) in the design of dry cask and storage pad systems. During a seismic event, the cask and storage pad systems experience dynamic loads and interactions between the casks, the concrete pads, and the supporting soil profiles. The proposed revision requires consideration of potential amplification of the earthquake through soil-structure interaction and the potential for soil liquefaction and other soil instability effects. While these evaluations for dynamic loads may require more analytical effort than the static load evaluations that some licensees (through their ISFSI vendors) had attempted to utilize in the past for ISFSI designs, these requirements are felt to be technically correct. EPRI supports the concept that the seismic evaluation of dry cask storage systems should be conducted using state-of-the-art structural dynamics principals, which include the consideration of dynamic loads and appropriate structural dynamics effects (e.g. soil structure interaction).

The remaining comments either amplify the above 3 comments or are more editorial in nature and are documented in the attached set of review comments.

1. BACKGROUND

ISFSI and MRS facilities are designed and constructed for the interim storage of spent nuclear fuel that has aged for at least one year. The original regulations envisioned ISFSI and MRS facilities as spent fuel pools or single, massive dry storage structures. The regulations required seismic evaluations equivalent to those for a nuclear power plant (NPP). Thus, the current 10CFR Part 72 requires Independent Spent Fuel Storage Installations (ISFSI) to use the procedures in 10CFR Part 100 Appendix A for determining the Design Earthquake Ground Motion (DE). However, in 1996, the U.S. Nuclear Regulatory Commission (NRC) amended 10CFR Parts 50 and 100 to update the criteria used to define the DE for future nuclear power plants (NPP). Specifically, this amendment added a new Section 100.23 requiring that uncertainties associated with the determination of the Safe Shutdown Earthquake Ground Motion (SSE) be addressed using a Probabilistic Seismic Hazard Analysis (PSHA) or suitable sensitivity analyses in lieu of the deterministic Appendix A approach.

The proposed changes to 10CFR Part 72 (Ref. 1) accomplishes three principal goals of the NRC: (1) to bring Part 72 in line with the 1996 changes to Parts 50 and 100, (2) to establish the requirement to address dynamic loads within the seismic design process, and (3) to allow the ISFSI or MRS applicants to use a design earthquake ground motion commensurate with the associated risk of the spent fuel storage system.

Specifically, with regard to goal number 1, a new Section 72.103 is added that requires a new specific license applicant for a Dry Cask Mode of Storage ISFSI located in areas of known seismic activity and not co-located with a NPP to address uncertainties in seismic hazard analysis by appropriate analyses such as a PSHA. If co-located with a NPP the applicant would have the option of using the existing design criteria for the NPP for determining the DE. Furthermore, an applicant for a Dry Cask ISFSI located not in areas of known seismic activity has the option of establishing the DE by an appropriate response spectrum anchored at 0.25g.

The Commission is proposing to require that licensees evaluate dynamic loads (goal number 2), in addition to static loads, in the design of storage cask and pad systems for ISFSIs to ensure that casks are not placed in unanalyzed conditions. The dynamic loads are required to consider the interaction of the casks, cask storage pads, and areas. The proposed revision would also require consideration of potential amplification of earthquakes through soil-structure interaction, and soil liquefaction potential or other soil instability due to vibratory ground motion.

Relative to the third NRC goal, the proposed changes to 10CFR Part 72 allows Dry Cask ISFSI applicants to use a DE appropriate for and commensurate with the risk associated with an ISFSI. An acceptable method for implementing this provision is described in

Draft Regulatory Guide DG-3021 (Ref. 2). DG-3021 basically utilizes for the Dry Cask ISFSI the ground motion determination guidance given in Regulatory Guide 1.165 (Ref. 3) for a NPP. However, DG-3021 follows a graded risk approach and allows the DE for a Dry Cask ISFSI to be defined at the mean 5.0E-4 annual frequency of exceedance level, as opposed to approximately mean 1.0E-4 annual exceedance frequency level used to establish the SSE for a new NPP.

2. REVIEW COMMENTS

When coupled with Draft Regulatory Guide DG-3021 (Ref. 2), the majority of the proposed changes to 10CFR Part 72 (Ref. 1) are excellent. In our opinion the changes should be endorsed. Specific comments are provided below.

Design Earthquake Ground Motion Requirements

The requirements defined in Appendix A to Part 100 for establishing the Design Earthquake Ground Motion (DE) are outdated. Application of its provisions requires considerable latitude in judgment and is a source of very differing interpretations, which has made the licensing process more difficult than necessary. The proposed changes to 10CFR Part 72 (Ref. 1) replace the requirement to use Appendix A to Part 100 and allows the use of a Probabilistic Seismic Hazard Analysis (PSHA). Thus, this proposed change brings Part 72 into agreement with the 1996 changes to Part 50 and Part 100.

In recognition that the seismically induced radiological risk associated with a Dry Cask ISFSI is significantly less than the risk associated with a NPP, DG-3021 establishes the DE for a Dry Cask ISFSI at a mean 5.0E-4 annual frequency of exceedance level. Thus, the DE required for a Dry Cask ISFSI is less than the SSE that would be established by Regulatory Guide 1.165 (Ref. 3) for a new NPP at the same site. This level of relief in establishing the DE for a Dry Cask ISFSI is completely consistent with the NRC risk-informed regulation policy and is an excellent example of the application of that policy.

At least two Dry Cask ISFSI applicants have had to go through the extensive paperwork burden of applying for an exemption to the current 10CFR 72 requirement to establish the DE in accordance with Appendix A of Part 100. These exemptions were for the Three Mile Island Unit 2 fuel debris ISFSI at Idaho National Laboratory (INEEL), and the Private Fuel Storage Facility in Utah. In both cases, the exemption was to establish the DE in terms of the mean 5.0E-4 annual exceedance frequency level. The proposed change to 10CFR Part 72, coupled with DG-3021, eliminates the need for applying for this exemption on a case-by-case basis.

In addition, the proposed change to 10CFR Part 72 imposes no new burdens on establishing the DE for an ISFSI over those in the current 10CFR Part 72. For an ISFSI co-located with an NPP, the applicant retains the option of defining the DE at the NPP SSE

level. Also, for ISFSI locations not in areas of known seismic activity, the applicant retains the option of defining the DE by an appropriate response spectrum anchored at 0.25g.

Lastly, in Ref. 4, the NRC has requested Public Comment on what is the appropriate mean annual probability of exceedance value to be used for the seismic design of an ISFSI and what is the justification for this probability. This request indicates that the establishment in DG-3021 of a mean 5.0E-4 annual frequency of exceedance for the DE for a Dry Cask ISFSI remains open. Our recommendation for endorsement of DG-3021 is strongly conditional on retaining the mean 5.0E-4 annual frequency of exceedance for the DE for a Dry Cask ISFSI. Further discussion on this topic is given in the Appendix to these comments.

<u>Probabilistic Seismic Hazard Analysis (PSHA) Requirements</u>

The PSHA requirements within the draft 10CFR Part 72 and draft Regulatory Guide are generally in conformance with the guidance provided in Regulatory Guide 1.165 (Ref. 3). One change that is noted (lines 356-360 within the proposed Regulatory Guide) consists of using 1 Hz and 10 Hz spectral values for both data de-aggregation and spectral scaling purposes instead of the averages of the 1 and 2.5 Hz values and the average of the 5 and 10 Hz spectral values which RG 1.165 stipulates. While our judgment is that this change will not result in significant changes to the resulting DE, it nonetheless sets a different method into the regulations without clearly defining the reason for the change.

With regard to the use of existing seismic hazard studies, there seems to be some conflicting guidance given within the draft RG-3021. The regulatory guide states, *"To determine the DE in the CEUS, an accepted PSHA methodology with a range of credible alternative input interpretations should be used. For sites in the CEUS, the seismic hazard methods, the data developed, and seismic sources identified by Lawrence Livermore National Laboratory and the Electric Power Research Institute (EPRI) have been reviewed and are acceptable to the staff."*

This statement indicates that not only are the EPRI and LLNL PSHA methodologies acceptable (for sites in the CEUS), but so are their data and seismic sources. However, discussion that comes later qualifies this by saying that new studies need to be done, and the EPRI and LLNL seismic sources and databases possibly modified based as a result of these new studies. For example, lines 159-163 and lines 211-215 indicate that new investigations should be used to determine whether there are "any new data or interpretations" not included in the current PSHA databases. The discussion within the draft Regulatory Guide needs to be reviewed to ensure that a consistent message is delivered with regard to the use of data and results from existing (LLNL and EPRI) seismic hazard studies.

The discussion within lines 894-896 contains the suggestion that an "alternate" (meaning smaller, we would presume) reference probability might have to be developed for sites in active plate margin regions or where a single tectonic structure dominates the hazard. This suggestion, if it becomes a requirement, could potentially be detrimental. These conditions, we presume, would apply for most of the West Coast of the U.S. and for active portions of the EUS. We don't see the technical reason for this alternate reference probability. It would seem that a seismic probability is a seismic probability, and the target level should not change as a function of the location. Being in a more active area only means that the target ground motions are higher for the same probability level. The same reference probability should be acceptable as long as there is an adequate assessment of uncertainty.

The last comment concerns a statement made in the Discussion section of draft DG-3021 (lines 84-88). This statement reads, *"For ISFSI sites that are co-located with existing nuclear power generating stations, the level of effort will depend on the availability and quality of existing evaluations. In performing this evaluation, the applicant should evaluate whether new data require re-evaluation of previously accepted seismic sources and potential adverse impact on the existing seismic design bases of the nuclear power plant."*

This seems to indicate that new information discovered while satisfying the criteria for an ISFSI at an existing NPP site could potentially impact the seismic design basis of that NPP. This would seem to be a disincentive to do additional seismic hazard investigation work at existing NPP sites. We recommend that the word "adverse" be taken out of this sentence, and the statement be modified to reflect the fact that the licensee maintains the option of using the existing seismic design bases (e.g. the DE) for these co-located situations.

References

1. Proposed Rulemaking Changes to 10CFR Part 72, *Geological and Seismological Characteristics for Siting and Design of Dry Cask Independent Spent Fuel Storage Installations and Monitored Retrievable Storage Installations,* U.S. Nuclear Regulatory Commission, July 22, 2002.

2. Draft Regulatory Guide DG-3021, *Site Evaluations and Determination of Design Earthquake Ground Motion for Seismic Design of Independent Spent Fuel Storage Installations and Monitored Retrievable Storage Installations,* U.S. Nuclear Regulatory Commission, July 2002.

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

4. Federal Register, Vol. 67, No. 140, July 22, 2002, pp 47745-47755.

5. DOE-STD-1020-94, *Natural Phenomena Hazards Design Evaluation Criteria for Department of Energy Facilities,* U.S. Dept. of Energy, April 1994.

6. DOE-STD-1020-2002, *Natural Phenomena Hazards Design Evaluation Criteria for Department of Energy Facilities,* U.S. Dept. of Energy, January 2002.

APPENDIX

ESTABLISHING APPROPRIATE MEAN ANNUAL FREQUENCY OF EXCEEDANCE FOR DESIGN GROUND MOTION FOR A DRY CASK ISFSI

Section B.3.2 of Appendix B of DG-3021 provides an excellent discussion of the basis for establishing the DE for a Dry Cask ISFSI at a mean annual probability of exceedance of 5.0E-4. The following is intended to amplify upon and support the discussion given in Appendix B of DG-3021.

The philosophy of applying a graded approach to the seismic design requirements for facilities of differing risks has been in existence for more than 30 years. For example, compare the seismic design requirements imposed on nuclear power plants by the NRC with those imposed by various standard building codes for most other facilities. In recent years, the philosophy of applying a graded approach has become more formalized. For example, in the late 1980's the Department of Energy (DOE) recognized the need for a gradation in the seismic design requirements for their facilities, which spanned a wide range of potential risks. This graded approach for seismic design was formally adopted by issuance of DOE-STD-1020-94 (Ref. 5) in 1994. This standard provided seismic design requirements for facilities divided into four Performance Categories ranging from PC#1 (conventional facilities) to PC#4 (facilities with radiological risks similar to those for nuclear power plants (NPP)) . Most facilities with larger quantities of radioactive materials, but without a high-energy pressure or steam environment capable of widely dispersing these materials have been assigned to PC#3.

The Design Earthquake Ground Motion (DBE) mean annual frequencies of exceedance assigned in DOE-STD-1020-94 for PC#3 and PC#4 facilities are:

Performance Category	Mean Annual Frequency of Exceedance
PC#3	5.0E-4
PC#4	1.0E-4

A revised DOE-STD-1020-2002 (Ref. 6) was published in 2002. This revision established the DE for PC#3 at 90% of the 4.0E-4 mean annual frequency of exceedance level. This revision in the DE for PC#3 was made to enable USGS seismic hazard maps to be used. These maps define the ground motion at the 4.0E-4 annual frequency of exceedance. The 90% factor brings the DE for PC#3 back to approximately the 5.0E-4 level. No change was made for PC#4.

The amount of radioactive material stored in a large Dry Cask ISFSI would result in assigning such a facility to PC#3. However, considering the minor radiological consequences from a single canister failure and the lack of a credible mechanism to cause such a failure from a seismic event suggest that PC#3 seismic design criteria is more than adequately conservative for a Dry Cask ISFSI.

It would be a clear violation of the philosophy of a graded approach to seismic design as well as the NRC policy to use risk-informed approaches to regulations to establish the DE for a Dry Cask ISFSI at a mean annual frequency of exceedance of 1.0E-4 appropriate for a NPP.

Someone might argue that establishing the DE for a Dry Cask ISFSI at a mean annual frequency of exceedance of 5.0E-4 is too liberal since modern conventional building code requirements establish their DE at 67% of the 4.0E-4 annual frequency of exceedance level. Furthermore, essential or hazardous facilities have their seismic design forces increased by an Importance Factor of 1.5. However, the annual frequency of unacceptable seismic performance is a function of both:

1. The annual frequency of exceedance of the Design Earthquake Ground Motion, and

2. The degree of rigor in the seismic evaluation criteria and the degree of conservatism in the seismic design requirements

The rigor of the seismic evaluation criteria and the conservatism of the seismic design requirements established by the NRC Standard Review Plans (NUREG-1536 and NUREG-0800) significantly exceed those in modern conventional building codes. Therefore, it is not sufficient to only compare the annual frequencies of exceedance for the DE for different type facilities, but one must also compare the seismic evaluation and design requirements given the specified DE. The annual probability of unacceptable seismic performance for a Dry Cask ISFSI designed to a DE established at a 5.0E-4 mean annual frequency of exceedance will be substantially less than that of an essential or hazardous facility (Importance Factor of 1.5) designed to a modern conventional building code for which the DE was established at 67% of the 4.0E-4 annual frequency of exceedance level.

Within the full spectrum of graded approaches for seismic design, establishing the DE for a Dry Cask ISFSI at a 5.0E-4 mean annual frequency of exceedance is both reasonable and adequately conservative.