Environmental Assessment of Geological and Seismological Characteristics for Siting and Design of Dry Cask Independent Spent Fuel Storage Installations and Monitored Retrievable Storage Installations

Final Report

U.S. Nuclear Regulatory Commission
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Executive Summary

The Nuclear Regulatory Commission (NRC) is amending its siting and design requirements in 10 CFR Part 72 for dry cask modes of storage of (1) spent nuclear fuel in an independent spent fuel storage installation (ISFSI) and (2) spent nuclear fuel and solid high-level radioactive waste in a monitored retrievable storage installation (MRS). For this document, the term "ISFSI" is used to include both dry cask ISFSI and MRS facilities, as appropriate. The Commission is not revising the 10 CFR Part 72 geological and seismological criteria as they apply to wet modes of storage because applications for this means of storage are not expected and it is not cost-effective to allocate resources to develop the technical bases for such an expansion of the rulemaking. The Commission also is not revising the 10 CFR Part 72 geological and seismological criteria as they apply to dry modes of storage that do not use casks because of the lack of experience in licensing these facilities.

The Commission considered a number of options to change the siting and design requirements in Part 72. This Environmental Assessment (EA) is part of the Commission's analysis of the options considered.

In its proposed rule (67 FR 47745, July 22, 2002), the Commission proposed the following changes:

1. Require a new specific-license applicant for a dry cask storage facility located in either the western U.S. or in areas of known seismic activity in the eastern U.S., and not co-located with a nuclear power plant (NPP), to address uncertainties in the seismic hazard analysis by using appropriate analyses, such as a probabilistic seismic hazard analysis (PSHA) or other suitable sensitivity analyses, for determining the design earthquake ground motion (DE). All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use a PSHA or other suitable sensitivity analyses to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation.

2. Allow new ISFSI applicants to use a DE appropriate for and commensurate with the risk associated with an ISFSI (§ 72.103). Regulatory Guide 3.73 (RG 3.73, draft was DG-3021), "Site Evaluations and Design Earthquake Ground Motion for Dry Cask Independent Spent Fuel Storage and Monitored Retrievable Storage Installations," accompanying the final rule, recommends a DE with a mean annual probability of exceedance of 5E-4, which is lower than the current level for the safe shutdown earthquake (SSE) of an NPP, for ISFSI applications.

3. Require general licensees to evaluate that the designs of cask storage pads and areas adequately account for dynamic loads, in addition to static loads (§ 72.212).

The Commission intends to leave present § 72.102 in place to preserve the licensing basis of present ISFSIs. The new provisions would be added as a new § 72.103, which would provide the requirements that would be utilized for new specific-license applicants.

The changes are consistent with the Commission's strategic goals in that:

– The rule would increase NRC's effectiveness and efficiency by reducing the number of exemption requests that would need to be submitted by the applicants and reviewed by NRC.

– This rule would maintain safety by selecting the DE level to be commensurate with the risk associated with an ISFSI.

– The changes to the DE level are considered risk-informed, consistent with NRC policy to develop risk-informed regulations.

– This rule would increase realism by enabling ISFSI applicants to use a state-of-the-art approach (PSHA or suitable sensitivity analyses) to more accurately characterize the seismicity of a site as opposed to the current deterministic approach which does not account for uncertainties in seismic data and interpretations.

The Commission considered four options for this rulemaking:

Option 1.

No Action. The siting requirements for new dry cask ISFSIs would continue to conform to the existing requirements of §§ 72.102.

Option 1, the no-action alternative, would not result in any change to current seismic design criteria, nor would it affect the DE for ISFSI SSCs.

Option 2.

Require new Part 72 specific-license applicants to conform to § 100.23 in lieu of Appendix A to Part 100.

No adverse environmental impacts are expected under Option 2. Under this option, certain applicants would be required to address uncertainties in seismic hazard analysis by using appropriate analyses, such as a PSHA or suitable sensitivity analyses, for developing the DE for ISFSIs. The use of PSHA or suitable sensitivity analyses for derivation of the DE would be more risk-informed than the deterministic approach. Under this option, all ISFSIs would still meet the radiological protection standards in §§ 72.104(a) and 72.106(b), and thus the degree of protection of the public health would not be compromised.

Option 3.

Require new Part 72 specific-license applicants to conform to § 100.23 in lieu of Appendix A to Part 100, and also give them the option to use a graded approach to seismic design of the ISFSI SSCs.

No adverse environmental impacts are expected under Option 3. As under Option 2, derivation of DEs for ISFSIs using a risk-informed PSHA or suitable sensitivity analyses would be required for certain specific-license applicants, and would be protective. Under the graded approach to

developing design criteria for ISFSIs, the DE for SSCs important to safety designed for Category 2 events would still be the SSE for an NPP. For these SSCs, there is therefore no change in risk of radiological exposure. SSCs could be designed to withstand less stringent criteria (Category 1 events) only if the applicant's analysis provides reasonable assurance that the failure of the SSC would not cause the facility to exceed the radiological protection requirements of § 72.104(a) under normal operations. If the specific-license applicant's analysis cannot support this conclusion, the SSC would have to be designed such that the facility can withstand more stringent criteria without impairing the ISFSI's capability to perform safety functions and not exceed the radiological protection requirements of §§ 72.104(a) and 72.106(b). Thus, no additional risk to the public would be incurred.

Option 4.

(1) Require a new specific-license applicant for a dry cask storage facility located in either the western U.S. or in areas of known seismic activity in the eastern U.S., and not co-located with a nuclear power plant, to address uncertainties in the seismic hazard analysis by using appropriate analyses, such as a PSHA or other suitable sensitivity analyses, for determining the DE. All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use a PSHA or other suitable sensitivity analyses to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation.

(2) Maintain the present Part 72 requirement of using a single-level DE, but allow for the use of a lower DE that is commensurate with the level of risk associated with an ISFSI. RG 3.73, accompanying the final rule, recommends a DE with a mean annual probability of exceedance of 5E-4 for ISFSI applications. This recommended level is lower than the present level of approximately 1E-4 (equivalent to the SSE for an NPP).

Option 4 is similar to Options 2 and 3 in that it requires certain specific-license applicants to address uncertainties in seismic hazard analysis to use a risk-informed PSHA or suitable sensitivity analyses for deriving the DE for ISFSIs. Thus, there would be no adverse effect associated with that aspect of this option. Option 4 is different from 3 in that specific licensees would not be required to design any SSCs to withstand a DE as high as the SSE of an NPP.

Options Summary.

Overall, no adverse environmental impacts will result from any of the options identified. Dry storage casks used at an ISFSI are passive systems with natural cooling sufficient to maintain safe temperatures and a robustness or structural integrity to withstand external forces. The cask walls provide adequate shielding and no radioactive products are released under any credible accident conditions. Other systems, structures, and components (SSCs) will also be designed to standards affording a high degree of environmental protection under normal operations and credible accident conditions. In addition, none of the changes considered will significantly affect the construction or operation of an ISFSI facility.

Additional Change

The Commission also proposed a change to § 72.212(b)(2)(i)(B) to require that general licensees evaluate dynamic loads (in addition to static loads) in the design of cask storage pads and areas. This change is an additional modification, separate from the changes considered in the options above.

NRC would change § 72.212(b)(2)(i)(B) to require written evaluations, prior to use, establishing that cask storage pads and areas have been evaluated for the static and dynamic loads of the stored casks. No adverse environmental impacts are expected to result from the proposed change to evaluate dynamic as well as static loads in the design of ISFSI storage pads and areas. The proposed changes are intended to require that general licensees perform appropriate analyses to ensure that the seismic design bases for the casks are met and that casks are not placed in an unanalyzed condition. Therefore, these proposed changes are necessary to assure adequate protection to occupational and public health and safety. The proposed changes to § 72.212 would not actually impose new burden on the general licensees because they currently need to consider dynamic loads to meet the requirements in § 72.212(b)(2)(i)(A). Since the general licensees currently evaluate dynamic loads for evaluating the cask pads and areas, the proposed changes to § 72.212(b)(2)(i)(B) would not actually require any present general licensees operating an ISFSI to re-perform any written evaluations previously undertaken.

1.0 Introduction

The NRC is amending its siting and design requirements in 10 CFR Part 72 for dry cask modes of storage of (1) spent nuclear fuel in an ISFSI and (2) spent nuclear fuel in solid high-level radioactive waste in a MRS. For this document, the term "ISFSI" is used to include both ISFSI and MRS facilities, as appropriate. The Commission is not revising the 10 CFR Part 72 geological and seismological criteria as they apply to wet modes of storage because applications for this means of storage are not expected and it is not cost-effective to allocate resources to develop the technical bases for such an expansion of the rulemaking. The Commission also is not revising the 10 CFR Part 72 geological and seismological criteria as they apply to dry modes of storage that do not use casks because of the lack of experience gained in licensing these facilities.

The Commission considered four options to change the siting and design requirements in Part 72. In its proposed rule (67 FR 47745) NRC proposed to adopt Option 4 (described in detail in sections 3.1.4 and 4.4 of this document). The purpose of this EA is to evaluate the potential environmental impacts associated with the regulatory changes as required by the National Environmental Policy Act (NEPA). This document presents background material, describes the purpose and need for the proposed action, outlines the proposed action and alternatives being considered, and evaluates the environmental consequences of the proposed action and alternatives.

1.1 Background

In 1980, the Commission added 10 CFR Part 72 to its regulations to establish licensing requirements for the storage of spent fuel in an ISFSI (45 FR 74693, November 12, 1980). Subpart E of Part 72 contains siting evaluation factors that must be investigated and assessed with respect to the siting of an ISFSI, including a requirement for evaluation of geological and seismological characteristics. The original regulations envisioned these facilities as spent fuel pools or single, massive dry storage structures. The regulations required seismic evaluations equivalent to those for an NPP when the ISFSI is located in the western U.S. (approximately 104^0 west longitude) or in areas of known seismic activity in the eastern U.S. A seismic design requirement, equivalent to the requirements for an NPP (Appendix A to 10 CFR Part 100) seemed appropriate for these types of facilities, given the potential accident scenarios. For those sites located in the eastern U.S., and not in areas of known seismic activity, the regulations allowed for less stringent alternatives.

For other types of ISFSI designs, the regulation required a site-specific investigation to establish site suitability commensurate with the specific requirements of the proposed ISFSI. The Commission explained that for ISFSIs which do not involve massive structures, such as dry storage casks and canisters, the required DE will be determined on a case-by-case basis until more experience is gained with the licensing of these types of units. (45 FR 74697)
For sites located in either the western U.S. or in areas of known seismic activity in the eastern U.S., the regulations in Part 72 require the use of the procedures in Appendix A to Part 100 for determining the design basis vibratory ground motion at a site. Appendix A requires the use of "deterministic" approaches in the development of a single set of earthquake sources. The applicant develops for each source a postulated earthquake to be used to determine the ground motion that can affect the site, locates the postulated earthquake according to prescribed rules,

and then calculates ground motions at the site. Because the deterministic approach does not explicitly recognize uncertainties in geoscience parameters, PSHA methods were developed that allow explicit expressions for the uncertainty in ground motion estimates and provide a means for assessing sensitivity to various parameters. Yet Appendix A to Part 100 does not allow this application.

Advances in the sciences of seismology and geology, along with the occurrence of some licensing issues not foreseen in the development of Appendix A to Part 100, have caused a number of difficulties in the application of this regulation. Specific problematic areas include the following:

– The limitations in data and geologic and seismic analyses and the rapid accumulation of knowledge in the geosciences have required considerable latitude in judgment. The inclusion of detailed geoscience assessments in Appendix A has caused difficulties for applicants and the Commission by inhibiting the use of needed judgment and flexibility in applying basic principles to new situations.

– Various sections of Appendix A are subject to different interpretations. For ISFSI applications, some sections in the Appendix do not provide sufficient information for implementation. As a result, the Appendix has been the source of licensing delays and debate.

In 1996, the Commission amended 10 CFR Parts 50 and 100 to update the criteria used in decisions regarding NPP siting, including geologic and seismic engineering considerations for future NPPs (61 FR 65157, December 11, 1996). The amendments placed a new § 100.23 in the regulations requiring that the uncertainties in seismic hazard analysis in determining the SSE be addressed through appropriate analyses, such as a PSHA or suitable sensitivity analyses in lieu of Appendix A. This approach takes into account the shortcomings in the earlier siting requirements and is based on developments in the field over the past two decades. Further, regulatory guides have been used to address implementation issues. For example, the Commission provided guidance for nuclear power plant license applicants in Regulatory Guide 1.165, “Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion,” and Standard Review Plan-NUREG 0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Reactors.” However, the Commission left Appendix A to Part 100 in place to preserve the licensing basis for existing plants and confined the applicability of § 100.23 to new NPPs.

The NRC is amending the seismological and geological requirements of 10 CFR Part 72 for siting and design of a dry cask ISFSI or MRS. The proposed rule and the announcement on the availability of the draft Regulatory Guide, DG-3021, were published for public comment on July 22, 2002 (Ref. 4.2). The amendments to the regulations include the use of PSHA or other suitable sensitivity analyses in evaluating the hazards to the ISFSI or MRS facility due to an earthquake, instead of the deterministic methods of 10 CFR 100 Appendix A of the current Part 72 regulations.

Unlike the regulations for a new NPP, the Part 72 amendments include limited use of the PSHA or suitable sensitivity analyses in evaluating the ISFSI or MRS facility hazards due to an earthquake. Only a specific-license applicant for a dry cask storage ISFSI or MRS facility at a

site not co-located with an NPP, in either the western U.S., or in areas of known seismic activity in the eastern U.S. must use the PSHA or suitable sensitivity analyses, to address uncertainties in determining the DE. For all other specific-license applicants for a dry cask storage ISFSI or MRS facility the use of the PSHA or suitable sensitivity analyses is optional. The applicant can use the design criteria for the most recent NPP (if applicable), or the current regulations applicable to locations in the eastern U.S. of a standardized DE described by an appropriate response spectrum anchored at 0.25 g. Thus, the amendments related to the use of the PSHA or suitable sensitivity analyses would apply only to a few sites in the western U.S. The amendments are not applicable to licensees operating an ISFSI under a Part 72 general license anywhere in the U.S.

As an additional minor change, NRC would amend § 72.212(b)(2)(i)(B) to require that general licensees evaluate dynamic loads, in addition to static loads, in the design of cask storage pads and areas for ISFSIs, to ensure that casks are not placed in unanalyzed conditions. Accounting for dynamic loads in the analysis of ISFSI pads and areas will ensure that pads continue to support the casks during seismic events. General licensees currently evaluate dynamic loads for evaluating the casks, pads and areas, to meet the cask design bases in the Certificate of Compliance, as required by § 72.212(b)(2)(i)(A). Therefore, the rule changes would not actually require any general licensees operating an ISFSI to re-perform any written evaluations previously undertaken. Specific licensees are currently required, under § 72.122(b)(2), to design ISFSIs to withstand the effects of dynamic loads, such as earthquakes and tornados.

2.0 Purpose and Need for Proposed Action

Part 72 currently requires siting and design of ISFSI facilities in accordance with requirements that were established for the licensing of NPPs. The changes to Part 72 are intended to (1) provide benefit from the experience gained in applying the existing regulation and from research, (2) provide needed regulatory flexibility to incorporate state-of-the-art improvements in the geosciences and earthquake engineering, and (3) make the regulations more risk-informed.

The objectives of this rule are to:

1. Require a new specific-license applicant for a dry cask storage facility located in either the western U.S. or in areas of known seismic activity in the eastern U.S., and not co-located with a nuclear power plant, to address uncertainties in the seismic hazard analysis by using appropriate analyses, such as a PSHA or other suitable sensitivity analyses, for determining the DE. All other new specific-license applicants for dry cask storage facilities will have the option of complying with the requirement to use a PSHA or other suitable sensitivity analyses to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation (§ 72.103).

2. Allow ISFSI applicants to use a DE appropriate for and commensurate with the risk associated with an ISFSI.

3. Require general licensees to ensure that the designs of cask storage pads and areas adequately account for dynamic loads, in addition to static loads (§ 72.212).

NRC considered three changes to its seismological and geological siting and design regulations for ISFSI applications.

(1) The first change considered the plausibility of requiring new applicants for sites located in either the western U.S. or in the eastern U.S. in areas of known seismic activity, and not co-located with an NPP, to address uncertainties in the seismic hazard analysis by using appropriate analyses, such as a PSHA or other suitable sensitivity analyses, for determining the DE. All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use a PSHA or other suitable sensitivity analyses to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation.

The existing approach for determining a DE for an ISFSI, embodied in Appendix A to Part 100, relies on a "deterministic" approach. Using this deterministic approach, an applicant develops a single set of earthquake sources, develops for each source a postulated earthquake to be used as the source of ground motion that can affect the site, locates the postulated earthquake according to prescribed rules, and then calculates ground motions at the site.

Although this approach has worked reasonably well for the past several decades, in the sense that safe shutdown earthquake ground motions for NPPs sited with this approach are judged to be suitably conservative, the approach has not explicitly recognized uncertainties in geosciences parameters. Because so little is known about earthquake phenomena (especially in the eastern U.S.), there have often been differences of opinion and differing interpretations

among experts as to the largest earthquakes to be considered and ground-motion models to be used.

Probabilistic methods that have been developed in the past 15 to 20 years for evaluation of seismic safety of nuclear facilities allow explicit incorporation of different models for zonation, earthquake size, ground motion, and other parameters. The advantage of using these probabilistic methods is their ability to incorporate different models and data sets, thereby providing an explicit expression for the uncertainty in the ground motion estimates and a means of assessing sensitivity to various input parameters. The western and eastern U.S. have fundamentally different tectonic environments and histories of tectonic deformation. Consequently, application of these probabilistic methodologies has revealed the need to vary the fundamental PSHA methodology depending on the tectonic environment of the site.

In 1996, when the Commission accepted the use of a PSHA methodology or suitable sensitivity analyses in §100.23, it recognized that the uncertainties in seismological and geological information must be formally evaluated and appropriately accommodated in the determination of the SSE for seismic design of NPPs. The Commission further recognized that the nature of uncertainty and the appropriate approach to account for it depends on the tectonic environment of the site and on properly characterizing parameters input to the PSHA or suitable sensitivity analyses. Consequently, methods other than probabilistic methods such as sensitivity analyses may be adequate for some sites to account for uncertainties. The Commission believes that certain new applicants for ISFSI specific licenses, as described in section 3.2, must also account for these uncertainties instead of using the Appendix A to Part 100.

NRC staff will review the application using all available data including insights and information from previous licensing experience. Thus, the approach requires thorough regional and site-specific geoscience investigations. Results of the regional and site-specific investigations must be considered in application of the probabilistic method. Two current probabilistic methods are the NRC- sponsored study conducted by Lawrence Livermore National Laboratory and the Electric Power Research Institute's seismic hazard study. These are regional studies without detailed information on any specific location. The regional and site-specific investigations provide detailed information to update the database of the hazard methodology to make the probabilistic analysis site-specific.

Applicants also must incorporate local site geological factors such as stratigraphy and topography and account for site-specific geotechnical properties in establishing the DE. In order to incorporate local site factors and advances in ground motion attenuation models, ground motion estimates are determined using the procedures outlined in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Reactors", Section 2.5.2, "Vibratory Ground Motion."

(2) The second change would allow applicants to use a DE appropriate for and commensurate with the risk associated with an ISFSI.

The present DE for ISFSIs is based on the requirements contained in 10 CFR Part 100 for NPPs. In the Statement of Consideration accompanying the initial Part 72 rulemaking, the Commission recognized that the design peak horizontal acceleration for SSCs need not be as high as for a nuclear power reactor, and should be determined on a "case-by-case" basis until more experience is gained with licensing of these types of units (45 FR 74697, November 12, 1980). The present ISFSI DE (equivalent to the SSE for an NPP) has a mean annual probability of exceedance of approximately 1E-4 (i.e., in any one year, the probability is one in ten thousand that the DE established for the site will be exceeded). Factors that result in lower radiological risk at an ISFSI or MRS compared to a nuclear power plant include the following:

- In comparison with an NPP, an operating ISFSI or MRS is a relatively simple facility in which the primary activities are waste receipt, handling, and storage. An ISFSI or MRS does not have the variety and complexity of active systems necessary to support an operating nuclear power plant. After the spent fuel is in place, an ISFSI or MRS is essentially a static operation.

- During normal operations, the conditions required for the release and dispersal of significant quantities of radioactive materials are not present. There are no components carrying fluids at high temperatures or pressures during normal operations or under design basis accident conditions to cause the release and dispersal of radioactive materials. This is primarily due to the low heat-generation rate of spent fuel that has undergone more than one year of decay before storage in an ISFSI or MRS, and to the low inventory of volatile radioactive materials readily available for release to the environment.

- The long-lived nuclides present in spent fuel are tightly bound in the fuel materials and are not readily dispersible. Short-lived volatile nuclides, such as I-131, are no longer present in aged spent fuel. Furthermore, even if the short-lived nuclides were present during a fuel assembly rupture, the canister surrounding the fuel assemblies would confine these nuclides. Therefore, the Commission believes that the seismically induced radiological risk associated with an ISFSI or MRS is significantly less than the risk associated with a nuclear power plant.

(3) The third change would require that the design of cask storage pads and areas at ISFSIs adequately account for dynamic loads in addition to static loads.

The Commission proposed a change to clarify that 10 CFR Part 72 general licensees must perform both static and dynamic analyses for new ISFSIs after the effective date of the rule to ensure that casks are not placed in an unanalyzed condition. The change would state that the design of cask storage pads and areas must adequately account for dynamic loads (in addition to static loads). For example, dynamic effects can cause soil-structure interactions that could amplify ground motion to the point that the acceleration on the casks is greater than the DE acceleration, or soil liquefaction could cause unacceptable pad and foundation settlement. Accounting for dynamic loads in the analysis of ISFSI pads and areas would ensure that the pad continues to support the casks during seismic events.

3.0 Proposed Action and Alternatives

The specific options considered were:

Option 1. No Action. The siting requirements for new dry casks ISFSIs would continue to conform to the existing requirements of § 72.102.

Option 2. Require new Part 72 specific-license applicants, for sites located in either the western U.S., or in the eastern U.S. in areas of known seismic activity, to comply with the requirements of § 100.23 in lieu of § 72.102(f) which requires the use of Appendix A to Part 100. All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use § 100.23 to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation Appendix A to Part 100.

Option 3. Require new Part 72 specific-license applicants, for sites located in either the western U.S., or in the eastern U.S. in areas of known seismic activity, to comply with the requirements of § 100.23 in lieu of § 72.102(f) which requires the use of Appendix A to Part 100. All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use § 100.23 to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation Appendix A to Part 100. This option further requires the use of a graded approach to seismic design of the ISFSI SSCs.

Option 4. (1) Require a new specific-license applicant for a dry cask storage facility located in either the western U.S. or in areas of known seismic activity in the eastern U.S., and not co-located with a nuclear power plant, to address uncertainties in the seismic hazard analysis by using appropriate analyses, such as a PSHA or other suitable sensitivity analyses, for determining the DE. All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use a PSHA or other suitable sensitivity analyses to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation (§ 72.103).

(2) Maintain the present Part 72 requirement of using a single-level DE, but with a lower DE that is commensurate with the lower level of risk associated with the potential accident scenarios for ISFSIs. RG 3.73, accompanying the final rule, recommends a DE with a mean annual probability of exceedance of 5E-4, which is lower than the current level for the SSE of an NPP, for ISFSI applications.

Option 4 is the only option that considers whether a site is located with an NPP in determining applicability of the proposed requirements (see Table 3-1 below). Options 2 and 3 do not make this distinction.

Table 3-1. Summary of Applicability

DE for ISFSI or MRS Specific-license Applicants for Dry Cask Modes of Storage on or after the Effective Date of the Final Rule	
Site Condition	Specific-license[1]
Western U.S., or areas of known seismic activity in the eastern U.S., **not** co-located with NPP	Must use PSHA or suitable sensitivity analyses to account for uncertainties in seismic hazards evaluations[2]
Western U.S., or areas of known seismic activity in the eastern U.S., **and** co-located with NPP	PSHA or suitable sensitivity analyses to account for uncertainties in seismic hazards evaluations[2], **or** existing NPP design criteria (multi-unit sites - use the most recent criteria)
Eastern U.S., and not in areas of known seismic activity	PSHA or suitable sensitivity analyses to account for uncertainties in seismic hazards evaluations[2], **or** existing NPP design criteria, if applicable (multi-unit sites - use the most recent criteria), **or** an appropriate response spectrum anchored at 0.25g (subject to the conditions in proposed § 72.103(a)(1)).

1. Proposed § 72.103 does not apply to general licensees. General licensees must satisfy the conditions given in 10 CFR 72.212.
2. Regardless of the results of the investigations, anywhere in the continental U.S., the DE must have a value for the horizontal ground motion of no less than 0.10 g with the appropriate response spectrum.

Additional Proposed Change. The Commission also proposed a change to § 72.212(b)(2)(i)(B) that would require general licensees to evaluate both static and dynamic loads for new ISFSIs. This proposed change is an additional modification, separate from the changes proposed in the options above.

3.1 Comparison of Options

This section compares the requirements of the proposed options. These options differ with regard to seismological and geological siting criteria and estimation of the DE for ISFSIs, and whether single-level DEs will be used in evaluating the design of ISFSI SSCs. As noted above, requirements for consideration of dynamic loads in the design of cask storage pads and areas may be promulgated along with any option. A summary of the requirements of the considered options is provided in Table 3-2.

Table 3-2. Comparison of Requirements Under Considered Options

Option	Seismic Siting Criteria, DE Definition	DE for Systems, Structures, and Components (SSCs)
1. (No Action)	Current § 72.102. Sites in the western U.S. do seismic analysis as required by Appendix A to Part 100. In the eastern U.S., use Appendix A analysis or DE with response spectrum anchored at 0.25g ground motion. If Appendix A is used at any site, DE is defined as the SSE for an NPP.	Current § 72.102.
2	Applicant must conform to § 100.23, requiring PSHA or suitable sensitivity analyses in lieu of Appendix A to Part 100, or other options compatible with the existing regulation.	Current § 72.102.
3	Applicant must conform to § 100.23, requiring PSHA or suitable sensitivity analyses in lieu of Appendix A to Part 100, or other options compatible with the existing regulation.	Require applicants to use graded approach to seismic design of SSCs. Similar to Parts 60 and 63; Category 1 event annual probability = 1E-3, Category 2 event annual probability = 1E-4.
4	Applicant must comply with new § 72.103 requiring use of PSHA or suitable sensitivity analyses in lieu of Appendix A to Part 100, or other options compatible with the existing regulation.	Single level DE for SSCs or other options compatible with the existing regulation.

3.1.1 Option 1: No-Action Alternative

Under Option 1, new specific-license applicants for dry cask ISFSIs would continue to meet the existing requirements of § 72.102. As noted in section 1, currently, ISFSI applicants at sites in the western U.S. or in areas of known seismic activity in the eastern U.S. must perform deterministic site seismic evaluations as prescribed in Appendix A to Part 100. ISFSIs located in the eastern U.S. and not in areas of known seismic activity may use a standardized DE (peak ground acceleration of 0.25 g) if justified by sufficient geological investigations and literature review. For any application in which the methods in Appendix A are used, the DE for the ISFSI must be no less than the SSE for an NPP. Under the No-Action alternative the current requirement for static analysis of cask storage pads would also be retained. This approach does not consider uncertainties in the seismic hazard assessment, is not risk-informed, and may not be cost effective.

3.1.2 Option 2: Require New Part 72 Specific-license Applicants to Conform to § 100.23 in lieu of Appendix A to Part 100

This option would require specific-license applicants located in either the western U.S., or in the eastern U.S. in areas of known seismic activity, to comply with the requirements of § 100.23 in lieu of § 72.102(f) which requires the use of Appendix A to Part 100. All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use § 100.23 to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation. This would bring the seismic site evaluation requirements for ISFSIs into conformance with the updated requirements for NPPs.

By accepting the use of a PSHA methodology or suitable sensitivity analyses in § 100.23, the Commission has recognized that the uncertainties in seismological and geological information must be formally evaluated and appropriately accommodated in the determination of the SSE for seismic design of NPPs. The Commission, in promulgating § 100.23 further recognized that the nature of uncertainty and the appropriate approach to account for it depends on the tectonic environment of the site and on properly characterizing parameters input to the PSHA or suitable sensitivity analyses such as seismic sources, the recurrence of earthquakes within a seismic source, the maximum magnitude of earthquakes within a seismic source, and engineering estimation of earthquake ground motion.

The Commission notes that while strict adherence to the requirements in Appendix A for determining the DE for the ISFSI (equivalent to an NPP SSE) will be removed, those applicants for ISFSIs, co-located with existing nuclear power plant sites, would be allowed to use all of the geophysical investigation information obtained from the original licensing process (which used the Appendix A requirements), in verifying that all applicable seismic data are considered in determining the design basis. The benefit of this option is that it would be a conforming change to Part 100 for evaluating geological and seismological criteria. It should be noted that under this option, the extent of site investigations and characterization remains the same as required in Part 100. Regulatory Guide 1.165, "Identification and Characterization of Seismic Sources and Determination of Safe Shutdown Earthquake Ground Motion," was developed to provide general guidance on procedures acceptable to the staff for satisfying the requirements of § 100.23 for NPPs. This guidance would be considered acceptable for ISFSIs.

This option retains the § 72.102(f)(1) requirement that the DE for ISFSIs be equivalent to the SSE for an NPP. Thus, while improving the technical requirements for site seismic analysis, this option is still not risk-informed, in that the same DEs are defined for the much less hazardous ISFSIs as for NPPs. Finally, this option requires evaluation of dynamic, as well as static, loads of cask storage pads and areas.

3.1.3. Option 3:

(1) Require New Part 72 Specific-license Applicants to Conform to § 100.23 in lieu of Appendix A to Part 100

(2) Provide new Part 72 applicants the option to use a graded approach to seismic design for ISFSI SSCs.

This option is the same as Option 2, except that it would also require applicants to use a graded approach to developing seismic design criteria for SSCs. The specific approach proposed for dry cask ISFSIs would be comparable to the Parts 60 and 63 graded approach to design ground motion for SSCs of pre-closure facilities (§ 60.2). In general, a graded approach to design requires those SSCs whose failure would result in greater accident consequences to use higher design requirements for phenomena such as earthquakes and tornadoes (Category 2 event). Similarly, those SSCs whose failure would result in lesser consequences due to normal operations would be designed to less stringent requirements (Category 1 event). For seismic design considerations of the Yucca Mountain site, the NRC staff has accepted the approach described in DOE Topical Report YMP/TR-003-NP, Rev. 2, Preclosure Seismic Design Methodology for a Geologic Repository at Yucca Mountain, pertaining to Part 63. In this

approach Category 1 design basis ground motion refers to a mean annual probability of exceedance of 1E-3. Category 2 design basis ground motion refers to a mean annual probability of exceedance of 1E-4.

Individual SSCs that are required to maintain the annual dose within the regulatory limits of 10 CFR Part 20 would be designed to a Frequency Category 1 design earthquake. Other SSCs needed to be functional to prevent the dose limit of 5 rem from being exceeded at the controlled area boundary due to a seismic event, would be designed to a Frequency Category 2 design earthquake. Thus, the seismic design of the SSCs would be commensurate with their importance to safety.

By requiring uncertainties in seismic hazard analysis to be addressed using a PSHA or suitable sensitivity analyses in determining the DE for ISFSIs, and the use of a graded approach to defining seismic criteria for SSCs, Option 3 sets siting and design criteria that are much more risk-informed than Options 1 and 2, and are more flexible than the proposed requirements in Option 2. Although considered suitable for a high-level waste repository at the Yucca Mountain site, this option, would be more complex to implement than Option 2 and, as discussed in Section 4, would not achieve a meaningful risk reduction for ISFSIs compared to the approach defined in Option 4. Finally, like Option 2, this option also requires evaluation of dynamic, as well as static, loads of cask storage pads and areas.

3.1.4 Option 4:

(1) Require a new specific-license applicant for a dry cask storage facility located in either the western U.S. or in areas of known seismic activity in the eastern U.S., and not co-located with a nuclear power plant, to address uncertainties in seismic hazard analysis by using appropriate analyses, such as a PSHA or other suitable sensitivity analyses, for determining the DE. All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use a PSHA or other suitable sensitivity analyses to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation.

(2) Maintain the present Part 72 requirement of using a single-level DE, but with a lower DE that is commensurate with the level of risk associated with an ISFSI. RG 3.73, accompanying the final rule, recommends a DE with a mean annual probability of exceedance of 5E-4, which is lower than the current level of an SSE for an NPP, for ISFSI applications.

Option 4 would require that:

(1) Applicants who apply on or after the effective date of the final rule, for a Part 72 specific license for a dry cask storage ISFSI or MRS, located in either the western U.S. or in areas of known seismic activity in the eastern U.S., and not co-located with an NPP, would be required to address uncertainties in the seismic hazard analysis by using appropriate analyses, such as a PSHA or other suitable sensitivity analyses, for determining the DE.;

(2) Applicants who apply on or after the effective date of the final rule, for a Part 72 specific license for a dry cask storage ISFSI or MRS, located in either the western U.S. or in areas of known seismic activity in eastern U.S., and co-located with an NPP, would have the option of using a PSHA methodology or suitable sensitivity analyses for addressing uncertainties in seismic hazard analysis in determining the DE, or using the existing design criteria for the NPP. When the existing design criteria for the NPP are used for an ISFSI at a site with multiple NPPs, the criteria for the most recent NPP must be used;

(3) Applicants who apply on or after the effective date of the final rule, for a Part 72 specific license for a dry cask storage ISFSI or MRS, located in eastern U.S., except in areas of known seismic activity, would have the option of using a PSHA methodology or suitable sensitivity analyses for addressing uncertainties in seismic hazard analysis in determining the DE, or using the standardized DE described by an appropriate response spectrum anchored at 0.25 g (subject to the conditions in proposed § 72.103(a)(1)), or using the existing design criteria for the most recent NPP (if applicable); and

(4) The proposed changes regarding the use of a PSHA methodology or suitable sensitivity analyses for addressing uncertainties in seismic hazard analysis for determining the DE are not applicable to a general licensee at an existing NPP operating an ISFSI under a Part 72 general license anywhere in the U.S.

Option 4 would also maintain the present Part 72 requirement of using a single DE for defining ISFSI SSC seismic design criteria, but with a lower ground motion that is commensurate with the level of risk associated with ISFSIs. RG 3.73 , accompanying the final rule, recommends a DE with a mean annual probability of exceedance of 5E-4, which is lower than the current level for the SSE of an NPP, for ISFSI applications. Seismic design criteria for Part 72, when originally issued in 1980, were based on the nuclear plant requirements, and require a DE with a mean annual probability of exceedance of approximately 1E-4. Part 72 regulations classify ISFSI facility SSCs based on their importance to safety. SSCs, whose function is to protect the public health and safety from undue risk, and prevent damage to the spent fuel during handling and storage, are classified as important to safety. These SSCs are evaluated for a single level of DE as an accident condition event only (§ 72.106). For normal operations and anticipated occurrences (§ 72.104), earthquakes are not included.

3.2 Dynamic Loads and Soil Stability

Changes to § 72.212(b)(2)(i)(B) are also needed to communicate that general licensees must evaluate both static and dynamic loads for designing new ISFSIs after the effective date of the rule to ensure that casks are not placed in an unanalyzed condition. This proposed change would be included with any of the Options 2-4. The change would state that the design of cask storage pads and areas must adequately account for dynamic loads (in addition to static loads). For example, dynamic effects can cause soil-structure interactions that could amplify ground motion to the point that the acceleration on the casks is greater than the DE acceleration, or that soil liquefaction could cause unacceptable pad and foundation settlement. Evaluation of dynamic loads of cask pads and areas would ensure that the pad, which may be considered as failed in a seismic event, could continue to support the casks without placing them in an unanalyzed condition.

4.0 Environmental Consequences

Overall, no adverse environmental impacts will result from any of the options identified. Dry storage casks used at ISFSI's are passive systems with natural cooling sufficient to maintain safe temperatures and a robustness or structural integrity to withstand external forces. The cask walls provide adequate shielding and no radioactive products are released under normal and credible accident conditions. Other systems, structures, and components would also be designed to standards affording a high degree of environmental protection under normal and credible accident conditions.

4.1 Environmental Consequences of Option 1: No-Action

The no-action alternative would not result in any change to current seismic design criteria, nor would it affect the DE definition for ISFSI SSCs. No environmental impacts are expected under the current regulation. This conclusion is based on the finding of no significant impact prepared for the previous Part 72 rulemaking (45 FR 74693, November 12, 1980) and NRC's years of experience with licensing ISFSIs.

4.2 Environmental Consequences of Option 2: Require New Part 72 Specific-license Applicants to Conform to § 100.23 in lieu of Appendix A to Part 100

No adverse environmental impacts are expected under Option 2. Under this option, certain specific-license applicants would be required to address uncertainties in seismic hazard analysis by using a PSHA or suitable sensitivity analyses in determining the DE for ISFSIs. This option would require the same site investigation and characterization as under current rules, and would retain the requirement that the DE for the ISFSI be at least as stringent as the SSE for an NPP. The use of a PSHA or suitable sensitivity analyses for addressing uncertainties in seismic hazard analysis for determining the DE for ISFSIs would be more risk-informed than the deterministic approach. Under this option, all ISFSIs would still meet the radiological protections standards in §§ 72.104(a) and 72.106(b), and thus the degree of protection of the environment and public health is maintained.

4.3 Environmental Consequences of Option 3:

(1) Require New Part 72 Specific-license Applicants to Conform to § 100.23 in lieu of Appendix A to Part 100

(2) Provide new Part 72 applicants the option to use a graded approach to seismic design for ISFSI SSCs.

No adverse environmental impacts are expected under Option 3. As under Option 2, use of a PSHA or suitable sensitivity analyses to address uncertainties in seismic hazard analysis for determining the DE for an ISFSI would be protective. Under the graded approach to developing design criteria for ISFSIs, the DE for certain SSCs important to safety would still be the SSE for an NPP. For these SSCs, there is therefore no change in risk of radiological exposure. SSCs could be designed to withstand Frequency Category 1 events (the less stringent criteria) only if the applicant's analysis provides reasonable assurance that the failure of the SSC would not cause the facility to exceed the radiological protection requirements of § 72.104(a) under

normal operations. If the specific-license applicant's analysis cannot support this conclusion, the SSC would have to be designed such that the facility can withstand Frequency Category 2 events without impairing the ISFSI's capability to perform safety functions and not exceed the radiological protection requirements of § 72.106(b). Thus, no additional risk to the environment and public would be incurred.

4.4 Environmental Consequences of Option 4:

(1) Require a new specific-license applicant for a dry cask storage facility located in either the western U.S. or in areas of known seismic activity in the eastern U.S., and not co-located with a nuclear power plant, to address uncertainties in the seismic hazard analysis by using appropriate analyses, such as a PSHA or other suitable sensitivity analyses, for determining the DE. All other new specific-license applicants for dry cask storage facilities would have the option of complying with the proposed requirement to use a PSHA or other suitable sensitivity analyses to address uncertainties in seismic hazard analysis, or other options compatible with the existing regulation.

(2) Maintain the present Part 72 requirement of using a single-level DE, but with a lower DE that is commensurate with the level of risk associated with an ISFSI. RG 3.73, accompanying the final rule, recommends a DE with a mean annual probability of exceedance of 5E-4, which is lower than the current level for the SSE of an NPP, for ISFSI applications.

This option is similar to Options 2 and 3 in that it requires certain specific-license applicants to address uncertainties in the seismic hazard analysis by using appropriate analyses, such as a PSHA or other suitable sensitivity analyses, for determining the DE. Thus, there would be no adverse effect associated with that aspect of this option. Option 4 also maintains the current single design event for ISFSI SSCs, however, specific licensees would not be required to design any SSCs to withstand a DE as high as the SSE of an NPP. The draft regulatory guide accompanying the proposed rule recommended a DE with a mean annual probability of exceedance of 5E-4, for ISFSI applications. NRC staff believe that the use of the less severe design event for all SSCs provides an adequate level of protection from adverse environmental consequences. This recommendation is explained in a report entitled, "Selection of the Design Earthquake Ground Motion Reference Probability." This report may be accessed through the NRC's Public Electronic Reading Room on the Internet at http://www.nrc.gov/reading-rm/adams.html. If you do not have access to ADAMS or if there are problems in accessing the documents located in ADAMS, contact the NRC's PDR reference staff at 1-800-397-4209, 301-415-4737, or by email to pdr@nrc.gov. The general rationale for this finding includes the following considerations:

ISFSIs and MRS facilities have been designed for earthquakes based on the same risk as for an NPP. The current Part 72 regulations for an ISFSI or an MRS facility require that for sites that have been evaluated under the criteria of Appendix A of Part 100, the DE must be equivalent to the SSE for an NPP. Recently, the regulations for NPPs were changed from the deterministic criteria of Appendix A of Part 100 to the probabilistic seismic hazard analysis methods or suitable sensitivity analyses to account for uncertainties in determining the ground

motion used in the seismic design of structures, systems and components (10 CFR 100.23, and Appendix S to 10 CFR Part 50). There is a need, therefore, to change Part 72 to allow the use of the PSHA and make the design earthquake level commensurate with the risk to public health and safety.

Radiological risks to the public result from a release of radioactive materials and their dispersal to the environment. To protect the public from the radiological risk, Part 72 requires that the SSCs in an ISFSI or MRS facility be classified as important to safety, if they have the function of protecting public health and safety from undue risk and preventing damage to the spent fuel during handling and storage.

The Dry Cask Storage Systems (DCSSs) for ISFSIs or MRSs, approved under Part 72 regulations, are typically self-contained massive concrete or steel structures, weighing approximately 100 to 180 tons when fully loaded. There are very few, if any, moving parts. The dry cask storage systems consist of free-standing vertical casks with a diameter ranging from 88 inches to 132 inches and a height to diameter ratio of 1.6 to 2.1, or a concrete Vault/Module type (NUHOMS cask storage systems). The spent-fuel is contained in a steel sealed canister for both types of storage systems.

The critical element for protection against radiation release is the sealed canister containing the spent fuel assemblies. The requirements in Part 72 in Subparts E, Siting Evaluation Factors, and F, General Design Criteria, ensure that the dry cask storage designs are very rugged and robust. The dry cask storage system design dimensions, such as thickness of various members are governed by radiological shielding, thermal, and potential drop accidents during handling of the cask. Effects of natural phenomena such as earthquakes, tornadoes, floods etc. are insignificant contributors to the stresses in various cask components, but are required to be considered for the cask stability. The cask stability parameters are the rigid body displacements and the rotations about the cask base on the pad. Cask rigid body displacements and rotations are calculated to evaluate the potential for a cask tip-over event, and a cask-to-cask impact. Even if it is demonstrated that a cask would not tip-over, the effects of a cask tip-over event on the cask's structural integrity are evaluated to meet the requirements of § 72.106(b) for limiting the radioactive release dose to 5 rem to protect public health and safety. If a cask-to-cask impact is likely to occur, the cask structural integrity is evaluated to meet the § 72.106(b) requirements.

To evaluate dry cask storage systems behavior during an earthquake, typical storage systems (one a cylindrical cask, HI-STORM 100, the other a concrete module type, NUHOMS) were

analyzed using coupled non-linear finite-element analyses for a range of earthquakes.[1, 2, 3, 4] Site specific properties at three ISFSI facilities, two on the West coast, and one on the East coast were considered in the analyses. The analyses were performed for artificial earthquakes to match the DE for a plant and Regulatory Guide 1.60 spectra, and real earthquake records with maximum peak ground acceleration varying from 0.15 g to 1.5 g. The purpose of the studies was to determine the stability of the free-standing dry cask storage systems during an earthquake.

Based on the results of the analyses, NRC has concluded that a free-standing dry storage cask remains stable and will not tip-over, or would not slide and impact the adjacent casks during an earthquake, approximately equal to the magnitude of a SSE for an NPP, defined as the mean probability of exceedance level of 1E-4. Additionally, the parametric studies indicated that the dry cask storage systems have significant margins against the tip-over and sliding, to withstand an earthquake significantly higher in magnitude than the SSE for an NPP, without releasing radioactivity. Further, a cask is analyzed for a non-mechanistic tip-over event during an earthquake, to verify that the cask and MPC would remain structurally integral, and radioactivity from spent fuel would not be released to the environment.

In addition to the dry casks containing the spent fuel, the ISFSI or MRS facility includes a reinforced concrete building. The building is generally referred to as the Canister Transfer Building, and is considered as important to safety because the building is used for transferring the multi-purpose steel sealed canister (MPC), containing the spent fuel assemblies, from the transfer cask to the storage cask. The building is designed using the same load combinations, acceptance criteria, and design code, as for NPP safety related seismic Category I buildings. The considered amendments do not change the load combinations or the acceptance criteria for the design of the building. As a result of using these criteria, a building designed to DE can withstand a greater level earthquake without failing to perform its function. Using a minimum margin of safety of 1.5 and using the Hazard Curves for spectral acceleration at 0.1 second period, the building designed for a DE with a mean annual probability of exceedance of 5E-4, as proposed in RG 3.73, can withstand an earthquake with a return period of approximately 4,000 years in New York City, and 25,000 years in San Francisco, CA.

Consequences of a failure of the Canister Transfer Building during an earthquake magnitude greater than the DE, were analytically evaluated to determine if the failure of the crane and the handling system, and resulting drop of the cask and the crane, would damage the MPC of the

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[1] "Seismic Analysis of HI-STORM 100 Casks at Private Fuel Storage Facility, Rev. 1," Luk, V. et al., Sandia National Laboratories, Albuquerque, NM, June 28, 2001.

[2] "Seismic Analysis of Three Module Rectangular Trans-Nuclear West Module/cask," Luk, V. et al., Sandia National Laboratories, Albuquerque, NM, December 21, 2001.

[3] "Seismic Analysis Report on HI-STORM 100 Casks at Private Fuel Storage Facility, Rev. 1," Luk, V. et al., Sandia National Laboratories, Albuquerque, NM, March 31, 2001.

[4] "Dynamic Soil-Structure Interaction Analysis of a Storage-Cask Foundation Design," Ofoegbu, G. I., Gute, G. D., Center for Nuclear Waste Regulatory Analyses, San Antonio, TX, October, 2002.

HI-STORM 100 system.[5] Based on the evaluation, NRC concluded that the MPC would not be damaged and release radioactivity to the environment.

Additionally, for the Canister Transfer Building, the combined probability of the occurrence of a seismic event and operational failure that leads to a radiological release is much smaller than the individual probabilities of either of these events. This is because the handling building and crane are used for only a fraction of the licensed period of an ISFSI or MRS and for only a few casks at a time. Moreover, dry cask ISFSIs are expected to handle only sealed casks and not individual fuel assemblies. Therefore, the potential risk of a release of radioactivity caused by failure of the cask handling or crane during a seismic event is small.

Based on the above, the staff has concluded that the dry cask storage systems for an ISFSI or MRS facility are inherently robust structures because of the design requirements other than for an earthquake and that there is no potential for release of radioactivity at an ISFSI site with a DE at a magnitude equal to the SSE for a NPP or greater.

Since there are no adverse consequences to public health and safety at a dry cask ISFSI or MRS facility during an earthquake of a magnitude equivalent to the NPP SSE or greater, one can conclude that the current Part 72 regulations requiring the DE to be equivalent to the SSE for an NPP are excessive, and not performance-based or risk-informed. Therefore, there is a need to determine an appropriate minimum level of earthquake for a dry cask ISFSI or MRS facility, consistent with the criteria for the design of structures in industrial facilities, to verify cask/foundation stability and the Canister Transfer Building design/stability during an earthquake.

To determine an appropriate reasonable value of the mean annual probability of exceedance of an earthquake (the reference probability), or a mean return period, for a dry cask ISFSI or MRS facility, NRC staff reviewed the current guidelines contained in Regulatory Guide 1.165 for a nuclear power plant, the U. S. Department of Energy (DOE) guidelines in DOE-1020-2002,[6] and the International Building Code-2000,[7] and considered the public comments received in response to the proposed rule.

For the siting of a new nuclear power plant, Regulatory Guide 1.165 recommends the reference probability of 1E-5/yr, as the “median” annual probability of exceeding the SSE. The “median” annual probability of exceedance of 1E-5 is approximately equal to a “mean” annual probability of exceedance for the SSE, at sites in the Continental Eastern United States (CEUS). Because the uncertainty associated with the seismic hazard evaluations at sites in the Western United States (WUS) is less than at CEUS sites, “mean” values normally are closer to “median” values at the WUS sites. Thus, choosing a “mean” annual probability of exceedance of 1E-4 would be consistent with the “mean” hazard level associated with the “mean” hazard levels of nuclear power plants in the CEUS, and but choosing a “median” annual probability of exceedance of

[5] “Analysis of Dry Cask Drop Scenarios onto a Reinforced Concrete Floor,” Braverman, J., et al., Brookhaven National Laboratory, April 24, 2002.

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

[7] “International Building Code 2000,” International Code Council, 2002.

1E-5 would not be. Based on the recent work in NUREG/CR-6728,[8] the staff has determined that the use of a "mean" annual probability of exceedance for the reference probability of the seismic hazard is an appropriate method for the design of an ISFSI or MRS facility.

None of the proposed changes will significantly affect the construction or operation of an ISFSI facility and therefore, there is no increased risk to the environment associated with this option.

4.5 Environmental Consequences of Considering Dynamic Loads

NRC would change § 72.212(b)(2)(i)(B) to require written evaluations, prior to use, establishing that cask storage pads and areas have been evaluated for the static and dynamic loads of the stored casks. No adverse environmental impacts are expected to result from the change to evaluate dynamic as well as static loads in the design of ISFSI storage pads and areas. The considered changes are intended to require that general licensees perform appropriate analyses to ensure that the seismic design bases for the casks are met and that casks are not placed in an unanalyzed condition. Therefore, these considered changes are necessary to assure adequate protection to occupational and public health and safety. The changes to § 72.212 would not actually impose new burden on the general licensees because they currently need to consider dynamic loads to meet the requirements in § 72.212(b)(2)(i)(A). Since the general licensees currently evaluate dynamic loads for evaluating the cask pads and areas, the proposed changes to § 72.212(b)(2)(i)(B) would not actually require any present general licensees operating an ISFSI to re-perform any written evaluations previously undertaken.

4.6 Summary

The purpose of the options under consideration is to enable ISFSI applicants to incorporate state-of-the-art improvements in the geosciences and engineering and require a risk-informed regulation, while maintaining protection against radiological risks. As discussed in sections 3 and 4, NRC staff has concluded that neither the options to use a PSHA or suitable sensitivity analyses to address uncertainties in seismic hazard analysis for determining the DE for ISFSIs, nor the recommendation to reduce the mean annual probability of exceedance for the DE will adversely affect the safety of ISFSI designs. Dry storage casks used at an ISFSI are passive systems with natural cooling sufficient to maintain safe temperatures and a robustness or structural integrity to withstand external forces. The cask walls provide adequate shielding and no radioactive products are released under any credible accident conditions. Other SSCs will also be designed to standards affording a high degree of environmental protection under normal operations and credible accident conditions. In addition, none of the proposed changes will significantly affect the construction or operation of an ISFSI facility.

Under all the options under consideration, ISFSIs will still be able to meet the radiological protection standards of §§ 72.104(a) and 106(b). Thus, there will be no adverse environmental impacts from the proposed rule changes, no matter which option is chosen.

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[8] ""Technical Basis for Revision of Regulatory Guidance on Design Ground Motions: Hazard- and Risk-Consistent Ground Motion Spectra Guidelines," NUREG/CR-6728, October, 2001.

5.0 Finding of No Significant Impact

Based on the foregoing environmental assessment, the Commission has determined under the National Environmental Policy Act of 1969, as amended, and the Commission's regulations in Subpart A of 10 CFR Part 51, not to prepare an environmental impact statement for this proposed rule because the Commission has concluded, based on an Environmental Assessment, that this rule, if adopted, would not be a major Federal action significantly affecting the quality of the human environment.

The Commission concluded that no significant environmental impact would result from this rulemaking. Factors that affect the radiological risk at an ISFSI or MRS compared to a nuclear power plant include the following:

- In comparison with an NPP, an operating ISFSI or MRS is a relatively simple facility in which the primary activities are waste receipt, handling, and storage. An ISFSI or MRS does not have the variety and complexity of active systems necessary to support an operating nuclear power plant. After the spent fuel is in place, an ISFSI or MRS is essentially a static operation.

- During normal operations, the conditions required for the release and dispersal of significant quantities of radioactive materials are not present. There are no components carrying fluids at high temperatures or pressures during normal operations or under design basis accident conditions to cause the release and dispersal of radioactive materials. This is primarily due to the low heat-generation rate of spent fuel that has undergone more than one year of decay before storage in an ISFSI or MRS, and to the low inventory of volatile radioactive materials readily available for release to the environment.

- The long-lived nuclides present in spent fuel are tightly bound in the fuel materials and are not readily dispersible. Short-lived volatile nuclides, such as I-131, are no longer present in aged spent fuel. Furthermore, even if the short-lived nuclides were present during a fuel assembly rupture, the canister surrounding the fuel assemblies would confine these nuclides. Therefore, the Commission believes that the seismically induced radiological risk associated with an ISFSI or MRS is significantly less than the risk associated with a nuclear power plant.

Therefore, the seismically induced radiological risk associated with an ISFSI or MRS is less than the risk associated with an NPP.

The determination of this environmental assessment is that there will be no significant environmental impact due to the proposed changes because the same level of safety would be maintained by the new requirements, taking into account the lesser risk from an ISFSI or MRS.

The Environmental Assessment may be examined at the NRC Public Document Room, O-1F21,11555 Rockville Pike, Rockville, MD. Single copies of the Environmental Assessment are available from Keith K. McDaniel, Office of Nuclear Material Safety and Safeguards, U.S. Nuclear Regulatory Commission, Washington, D.C. 20555-0001, telephone: (301) 415-5252, e-mail: kkm@nrc.gov.

6.0 Agencies and Persons Consulted

No other agencies or persons were consulted in the preparation of this environmental assessment.