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DRAFT REGULATORY GUIDE

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(Proposed Revision 2 of Regulatory Guide 1.13, dated December 1975)

SPENT FUEL STORAGE FACILITY DESIGN BASIS

A. INTRODUCTION

The U.S. Nuclear Regulatory Commission (NRC) is issuing this draft regulatory guide to provide current guidance regarding the design basis for spent fuel storage facilities. This regulatory guide endorses (with certain additions, clarifications, and exceptions) "Design Objectives for Light-Water Spent Fuel Storage Facilities at Nuclear Power Plants," which the American National Standards Institute/American Nuclear Society issued as ANSI Standard N210-1976/ANS-57.2-1983.

General Design Criterion (GDC) 61, "Fuel Storage and Handling and Radioactivity Control," set forth in Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10, Part 50, of the *Code of Federal Regulations* (10 CFR Part 50), "Domestic Licensing of Production and Utilization Facilities," requires that fuel storage and handling systems be designed to ensure adequate safety under anticipated operating and accident conditions. Specifically, GDC 61 requires (1) periodic inspections; (2) suitable radiation shielding; (3) appropriate containment, confinement, and filtering systems; (4) residual heat removal capability consistent with its importance to safety; and (5) prevention of significant reduction in fuel storage inventory under accident conditions.

To augment those requirements, the spent fuel pool design basis is also covered by GDC 2, "Design Bases for Protection Against Natural Phenomena"; GDC 4, "Environmental and Dynamic Effects Design Bases"; and GDC 63, "Monitoring Fuel and Waste Storage." In addition, Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," and Regulatory Guide 1.29, "Seismic Design Classification," respectively detail the quality groups and seismic categories, which are referenced in this guide.

The NRC issues regulatory guides to describe to the public methods that the staff considers acceptable for use in implementing specific parts of the agency's regulations, to explain techniques that the staff uses in evaluating specific problems or postulated accidents, and to provide guidance to applicants. Regulatory guides are not substitutes for regulations, and compliance with regulatory guides is not required. The NRC issues regulatory guides in draft form to solicit public comment and involve the public in developing the agency's regulatory positions. Draft regulatory guides have not received complete staff review and, therefore, they do not represent official NRC staff positions.

This regulatory guide contains information collections that are covered by the requirements of 10 CFR Part 50 which the Office of Management and Budget (OMB) approved under OMB control number 3150-0011. The NRC may neither conduct nor sponsor, and a person is not required to respond to, an information collection request or requirement unless the requesting document displays a currently valid OMB control number.

B. DISCUSSION

Background

This revision of Regulatory Guide 1.13 addresses guidelines for conformance with the GDCs that are relevant to the design of spent fuel storage facilities. Since the NRC issued Revision 1 of the guide in 1975, the staff has added considerations regarding inspections, radiation shielding by adequate water levels, coolant cleanup systems, and residual heat removal capability, including provisions for adequate natural circulation through the storage racks. In addition, this guide addresses the impact of high-burnup fuel, updated earthquake engineering criteria, and updated limits on potential offsite exposure.

It is important that the spent fuel storage pool structures, systems, and components be designed to accomplish the following:

- prevent loss of water from the fuel pool that would lead to water levels that are inadequate for cooling or shielding
- protect the fuel from mechanical damage
- provide the capability to limit potential offsite exposures in the event of a significant release of radioactivity from the fuel or significant leakage of pool coolant
- provide adequate cooling to the spent fuel to remove residual heat

If spent fuel storage facilities are not designed to the above considerations, radioactive materials could be released to the environs, or personnel could be exposed to unacceptable radiation fields. The specific measures discussed in the following sections address the above design considerations.

Loss of Water from the Storage Pool

Unless protective measures are taken, loss of water from a storage pool could cause the spent fuel to overheat, resulting in damage to fuel cladding integrity and, possibly, a release of radioactive materials to the environment. Natural events, such as earthquakes or high winds, could damage the fuel pool either directly or by generating airborne missiles. Designing the facility to withstand these occurrences without significant loss of watertight integrity is necessary to protect the spent fuel. Furthermore, adequate water levels above the top of the spent fuel assemblies should always be maintained because the water serves as a radiation shield for personnel. Provisions for maintaining adequate water levels are important not only for fuel cooling, but also for this shielding effect.

The design should also consider the possibility of dropping a heavy load, such as a 100-ton fuel cask. Heavy-load-handling systems should be designed to preclude the positioning of heavy loads over the spent fuel pool to avoid direct damage to the pool in the event that the load-handling system was to fail. This capability can be provided either by interlocks and stops or, preferably, by arranging the handling system to preclude positioning a load over the pool. However, the spent fuel casks must still be handled in the fuel-cask-loading area adjacent to the storage pool, creating a potential for damaging the watertight integrity of the pool. Therefore, the design of the pool structure should consider the possibility of dropping the fuel cask in this critical area. Regulatory Position 5 (in Section C of this guide) further discusses this measure.

Other potential paths for loss of coolant inventory involve storage pool wall penetrations (e.g., piping) and gates that separate the pool from other fuel-handling areas. Locating all piping penetrations above the minimum pool water levels and using devices to prevent siphon flow (such as siphon breakers and check valves) greatly reduces the possibility of a significant loss of coolant. Moreover, the bottoms of gated openings should be well above the top of the fuel seated in the storage racks, and the areas that are separated from the pool by a single gate should be small enough to prevent significant loss of coolant into these areas, assuming that the areas are initially drained and the gate's seals fail.

Even if the measures described above are followed, leakage through the pool liner or evaporation of coolant following loss of the forced cooling system may result in a continuing loss of coolant inventory. Therefore, a permanent fuel-pool-coolant makeup system is important to maintain adequate coolant levels during an accident. An appropriate backup system is also important to ensure reliability of the makeup function and, depending on the design of the cooling system, the backup system may or may not need to be permanently installed. (See Regulatory Position 8 in Section C of this guide.)

Detecting and containing spent fuel pool leaks is important to maintain adequate coolant levels and reduce radiation exposures to personnel. Radiation monitors and pool water level monitors designed to alarm both locally and in a permanently staffed location (e.g., control room) allow for leak detection, while proper drainage and sumps allow for containment of leaks.

Mechanical Damage to Fuel

The release of radioactive material from fuel may occur during the fuel-handling process as a result of fuel-cladding failures or mechanical damage caused by dropping the fuel elements or dropping objects onto them.

Externally or internally generated missiles (e.g., from tornadoes or turbine failures) can be a potential cause of mechanical damage to spent fuel. Designing the fuel storage facility to protect against such missiles is an important consideration. Generally, the spent fuel pool walls and adequate water levels above the fuel assemblies can provide protection from these missiles.

The burnup of fuel has been increasing in U.S. nuclear power plants as utilities have been extending the length of operating cycles. The mechanical properties of fuel may change with longer operating cycles. For instance, high-burnup fuel may become more brittle (i.e., possess lower ductility and fracture toughness) and, therefore, be more vulnerable to failure. In order to protect high-burnup fuel from mechanical damage, this potential vulnerability should be considered in the design of spent fuel handling and storage facilities.

Limiting Offsite Release of Radioactivity

Since a relatively small amount of mechanical damage to the fuel could cause significant radiation doses to personnel and releases to the environment, radiation monitors and confinement structures should be provided. A controlled leakage building with appropriate ventilation systems can provide necessary confinement, while a safety-grade filtration system may also be necessary to limit offsite dose consequences.

Filtering and cleanup systems for the spent fuel pool coolant are important to maintain pool coolant radioactivity as low as reasonably achievable. Proper removal and disposal of corrosion products, radioactive materials, and other impurities from the coolant minimizes exposures to radiation. Segmented leak channels, proper drainage, and sumps for collecting and containing leakage from the pool liner should be used to limit offsite release of radioactivity in the coolant.

Spent Fuel Cooling

Removal of decay heat from the spent fuel pool is an important safety consideration required by GDC 61. Providing a forced cooling and circulation system maintains the pool water at acceptable temperatures for spent fuel handling during all heat load conditions, including full-core offloads during refueling.

The design of the spent fuel racks should consider the ability of the coolant to naturally circulate through these racks. Improper design of the racks could prevent some fuel assemblies from receiving adequate coolant flow under certain conditions, resulting in overheating and possible cladding failures. Adequate coolant circulation ensures protection of the fuel from thermal damage, provided that the fuel remains covered by water.

ANSI Standard N210-1976/ANS 57.2-1983

This regulatory guide endorses ANSI Standard N210-1976/ANS-57.2-1983, with the following additions, clarifications, and exceptions.

Additions

- This guide directly considers a thermal-hydraulic analysis of coolant flow through the spent fuel storage racks and the prevention of nucleate boiling under all anticipated operating conditions.
- This guide provides considerations for extreme winds and missiles generated by those winds, as well as low-trajectory turbine missiles.
- This guide offers an option of preventing cask drops by using a single-failure-proof, heavy-load-handling system rather than demonstrating that dropping the fuel cask in the fuel-cask-loading area will not damage the watertight integrity of the pool.
- This guide points out the need to consider the potential impact of high-burnup fuel for the design of spent fuel handling and storage facilities.

Clarifications

- This guide provides more specific criteria for the makeup water system and its backup, including additional details concerning when the backup system must be Seismic Category I and the necessary makeup rates.
- This guide presents details on how to prevent the cask crane from passing over the spent fuel (e.g., by using stops and interlocks or, preferably, by design).
- This guide presents the conditions necessary to allow coolant boiling, including the ability of the pool structure and liner to withstand coolant boiling and the ability of the ventilation system to keep safety-related components safe from the effects of high temperatures and moisture.
- This guide specifies the temperature conditions for a safety-related cooling system; specifically, the pool water during accident conditions should remain below the lesser of (1) the pool and structure design temperatures, or (2) 93 °C (200 °F).

Exceptions

- ANSI/ANS-57.2-1983 states that spent fuel pool water should be maintained below 66 °C (150 °F) during normal operating conditions. By contrast, this regulatory guide specifies that pool water should be maintained below 60 °C (140 °F) for all heat load conditions, including full-core offloads during refueling.
- ANSI/ANS-57.2-1983 states that water shielding should limit the maximum radiation dose to 2.5 millirem per hour for personnel. Instead of a dose rate, this guide specifies that the minimum pool depth for shielding should be 3 meters (10 feet) above the top of the stored fuel assemblies.
- ANSI/ANS-57.2-1983 states that a high-radiation-level alarm should actuate the engineered safety feature filtration system. By contrast, this regulatory guide states that either the high-radiation-level alarm should adjust the ventilation system to contain the radiation, or the air should be filtered if the spent fuel storage facility is equipped with a filtration system designed to the guidelines of Regulatory Guide 1.52, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants."
- When the term "potential offsite exposures"appears in paragraphs 3, 5.(3), 5.(4), 5.5.4, and 6.5.2.3 of ANSI/ANS-57.2-1983, the phrase "the Code of Federal Regulations, Title 10, 'Energy,' Part 100" should be replaced by "the Code of Federal Regulations, Title 10, 'Energy,' Paragraphs 50.34(a)(1), 50.67(b)(2), or 100.11, as applicable."
- Sections 20.106 and 20.3 of 10 CFR Part 20, quoted in paragraph 5, "Facility Performance Requirement," of ANSI/ANS 57.2-1983, are no longer in the 2006 edition of 10 CFR. Rather, those two sections have been replaced by Sections 20.1206 and 20.1003, respectively, in the 2006 edition of the 10 CFR.

- The guidelines described in Section 6.4.2.14, "Design for Seismic Loading," and Appendix B to ANSI/ANS 57.2-1983 should be replaced by NRC Regulatory Guide 1.92, Revision 2, "Combining Modal Responses and Spatial Components in Seismic Response Analysis" (July 2006).

- The definitions of "operating basis earthquake (OBE)" and "safe shutdown earthquake (SSE)" in ANSI/ANS 57.2-1983 should be replaced by those in Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," to 10 CFR Part 50. This is true for applicants for design certification or a combined license pursuant to 10 CFR Part 52, or a construction permit or operating license pursuant to 10 CFR Part 50, on or after January 10, 1997. The new definitions reflect the current NRC and industry thinking, and are in line with the definitions of OBE and SSE in the proposed new versions of ANS Standards 2.2, 2.10, 2.23, and 57.2. However, for an operating license applicant or holder whose construction permit was issued prior to January 10, 1997, the earthquake engineering criteria in Section VI of Appendix A to 10 CFR Part 100, "Reactor Site Criteria" (i.e., the definitions of OBE and SSE in ANSI/ANS 57.2-1983) continue to apply.

C. REGULATORY POSITION

1. Seismic Design

The spent fuel storage facility, including all structures and equipment necessary to maintain minimum water levels necessary for radiation shielding, should be designed to Seismic Category I requirements. Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants" to Title 10, Part 50, of the *Code of Federal Regulations* (10 CFR Part 50), "Domestic Licensing of Production and Utilization Facilities," applies to applicants for a design certification or combined license pursuant to 10 CFR Part 52, or a construction permit or operating license pursuant to 10 CFR Part 50 issued on or after January 10, 1997. However, for an operating license applicant or holder whose construction permit was issued prior to January 10, 1997, the earthquake engineering criteria in Section VI of Appendix A to 10 CFR Part 100, "Reactor Site Criteria," continue to apply. In addition, Regulatory Guide 1.92, Revision 2, "Combining Modal Responses and Spatial Components in Seismic Response Analysis" (July 2006), provides licensees and applicants with updated and improved guidance for the seismic response analysis of nuclear power plant structures, systems, and components that are important to safety, which include spent fuel handling and storage facilities.

2. Protection Against Extreme Winds

The spent fuel storage facility should be designed to (a) keep extreme winds and missiles generated by those winds from causing significant loss of watertight integrity of the fuel storage pool, and (b) keep missiles generated by extreme winds from contacting fuel within the pool. For those nuclear plants that are located in areas of the country where tornadoes cause the strongest winds, refer to Regulatory Guide 1.76, "Design Basis Tornado for Nuclear Power Plants," for design-basis tornado characteristics.

3. Protection Against Turbine Missiles

The spent fuel storage facility should be designed to protect the spent fuel from low-trajectory turbine missiles, and the storage pool should retain watertight integrity if struck by such missiles. Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles," provides guidance for appropriate protection against low-trajectory turbine missiles.

4. Confinement and Filtering Systems

A controlled-leakage building should enclose the fuel to limit the potential release of radioactive iodine and other radioactive materials. If necessary to limit offsite dose consequences from a fuel-handling accident or spent fuel pool boiling, the building should include an engineered safety feature filtration system that meets the guidelines outlined in Regulatory Guide 1.52.

5. Control of Heavy Loads

Cranes capable of carrying heavy loads should be prevented, preferably by design rather than by interlocks, from moving over the pool. Furthermore, the spent fuel storage facility design should have at least one of the following provisions with respect to the handling of heavy loads, including the shipping cask:

a. Cranes should be designed to provide single-failure-proof handling of heavy loads, so that a single failure will not result in the crane handling system losing the capability to perform its safety function.

b. The shipping-cask-loading area should be designed to withstand, without significant leakage of the adjacent spent fuel storage, the impact of the heaviest load to be carried by the crane from the maximum height to which it can be lifted.

6. Drainage Prevention

Drains, permanently connected mechanical or hydraulic systems, and other features that (by maloperation or failure) could reduce the coolant inventory to unsafe levels should not be installed or included in the design. No piping penetrations through the storage pool wall should be below the minimum water level required for shielding. Siphon breakers, check valves, and other devices should be used to preclude accidental draining by hydraulic systems. In addition, the spent fuel storage facility should comply with one of the following criteria:

(a) If the spent fuel pool cooling system is designed to Quality Group C, Seismic Category I requirements, drains, piping, or other systems should be unable to reduce the coolant inventory to a level that would prevent the cooling system from maintaining the storage pool below its design temperature limit.

(b) If the spent fuel pool is designed to allow coolant boiling during accident conditions, no drains, piping, or other systems should be installed that would allow coolant levels to drain below adequate shielding depths of approximately 3 meters (10 feet) above the top of the fuel assemblies.

7. Instrumentation

Reliable and frequently tested monitoring equipment should be provided to alarm both locally and in a continuously manned location if the water level in the fuel storage pool falls below a predetermined level, if the water temperature exceeds a predetermined level, or if high local radiation levels are experienced. The high-radiation-level instrumentation should signal automatic ventilation and/or filtration functions that are consistent with the dose consequence evaluation for fuel-handling accidents.

8. Makeup Water

A Quality Group C, Seismic Category I makeup system should be provided to add coolant to the pool. Appropriate redundancy or a backup system for filling the pool from a reliable source, such as a lake, river, or onsite Seismic Category I water-storage facility, should be provided. If the spent fuel pool cooling system is designed to the requirements of Quality Group C, Seismic Category I, the backup to the makeup system need not be permanently installed or designed to Seismic Category I requirements; however, the backup system should still take water from a Seismic Category I source. The makeup system and its backup should have redundant flowpaths for providing water to the storage pool. The capacity of the makeup systems should exceed the larger of (1) the pool leakage rate, assuming spent fuel pool liner perforation resulting from a dropped fuel assembly, or (2) the evaporation rate necessary to remove 0.3 percent of the rated reactor thermal power.

9. Pool Cooling

The spent fuel storage facility should include a system for cooling the pool water in order to maintain a bulk temperature below 60 °C (140 °F) for all heat load conditions, including full-core offloads during refueling. Administrative controls may be used to ensure that this temperature limit is not exceeded. However, the minimum heat removal capacity with the forced-circulation cooling system in operation, the pool at the design temperature of the structure, and the heat sink at its maximum design temperature should exceed 0.3 percent of the reactor rated thermal power. One of the two following conditions should also be satisfied:

(a) The spent fuel pool cooling system is designed to meet Quality Group C, Seismic Category I requirements.

(b) The spent fuel pool cooling system is not designed to meet Quality Group C, Seismic Category I requirements. However, the pool structure and liner are designed to withstand coolant boiling; the pool makeup system and its backup are designed to Quality Group C, Seismic Category I requirements; and the building ventilation system has the capability to vent steam or moisture to the atmosphere to protect safety-related components from high temperatures and moisture levels. If necessary to limit offsite dose consequences from venting steam or moisture during accident conditions, the ventilation system should meet the guidelines of Regulatory Guide 1.52.

10. Gates and Weirs

Gates and weirs that isolate the spent fuel storage pool from the adjacent fuel-handling areas should be designed to prevent the coolant inventory from being drained below the top of the fuel assemblies. The volume of the fuel-handling areas adjacent to the storage pool (e.g., cask-loading area, transfer canal) should be limited so that if the seal(s) of a single gate were to fail and the pool water drained into one of these areas, pool coolant inventory would not be reduced to a level less than 3 meters (10 feet) above the top of the fuel assemblies.

11. Fuel Cooling

The spent fuel storage racks should be designed in a manner that allows for adequate coolant flow to all stored fuel assemblies. A thermal-hydraulic analysis should demonstrate that the racks provide adequate natural circulation to prevent nucleate boiling within the stored assemblies.

12. Leakage Containment

The spent fuel storage pool should include a system for detecting and containing pool liner leaks. Segmented leak channels, proper drainage, and sumps for collecting and containing such leakage should be used.

13. Pool Cleanup

The spent fuel storage facility should be capable of maintaining safe radiation levels for personnel during anticipated operating and accident conditions. To maintain low radiation levels, a filtering system should be provided to remove radioactive materials and other contaminants from the spent fuel pool coolant. This system does not need to be safety-related, but its failure should not impair safety-related systems or cause a significant decrease in the pool coolant inventory.

14. High-Burnup Fuel

The mechanical properties of fuel may change with longer operating cycles. For instance, high-burnup fuel may become more brittle (i.e., possess lower ductility and fracture toughness) and, therefore, be more vulnerable to failure. In order to protect high-burnup fuel from mechanical damage, this potential vulnerability should be considered in the design of spent fuel handling and storage facilities.

D. IMPLEMENTATION

The purpose of this section is to provide information to applicants and licensees regarding the NRC staff's plans for using this draft regulatory guide. No backfitting is intended or approved in connection with its issuance.

The NRC has issued this draft guide to encourage public participation in its development. Except in those cases in which an applicant or licensee proposes or has previously established an acceptable alternative method for complying with specified portions of the NRC's regulations, the methods to be described in the active guide will reflect public comments and will be used in evaluating (1) submittals in connection with applications for construction permits, standard plant design certifications, operating licenses, early site permits, and combined licenses; and (2) submittals from operating reactor licensees who voluntarily propose to initiate system modifications if there is a clear nexus between the proposed modifications and the subject for which guidance is provided herein.

REGULATORY ANALYSIS

1. Statement of the Problem

The NRC issued the original version of Regulatory Guide 1.13 in March 1971, followed by Revision 1 in December 1975. The purpose of Regulatory Guide 1.13 is to provide guidance that the staff considers acceptable for the design of spent fuel storage facilities in order to protect the fuel and limit radiation releases. The staff considers the current version of this guide (Revision 1) to be incomplete in its guidance, which focuses primarily on protection from natural phenomena and dropped loads, while providing limited or no guidance with respect to other design considerations included in GDC 61. In addition, the staff has revised certain guidance with regard to the requirements for pool makeup systems and heavy-load-handling equipment since the issuance of Revision 1 of this guide. Therefore, the 1975 version of Regulatory Guide 1.13 provides incomplete and out-of-date information.

2. Objective

The update to Regulatory Guide 1.13 will provide a more complete and accurate source of guidance for applicants and licensees to use in the design of spent fuel storage pools. The update is intended to revise the current guidance and provide additional guidance to make Regulatory Guide 1.13 consistent with the updates to Sections 9.1.2 and 9.1.3 of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," and the applicable regulations and regulatory guides. This update should promote a greater understanding of the design goals that the NRC staff considers acceptable for meeting the related requirements for spent fuel storage (e.g., GDCs 2, 4, 61, and 63).

3. Alternative Approaches

The NRC staff considered the following alternative approaches to the problem of outdated spent fuel storage facility guidance:

(1) Do not update Regulatory Guide 1.13.
(2) Update Regulatory Guide 1.13.

3.1 <u>Alternative 1: Do Not Update Regulatory Guide 1.13</u>

Under this alternative, the NRC would not revise this guidance, and licensees would continue to use the original version of this regulatory guide. This alternative is considered the baseline or "no action" alternative and, as such, involves no value/impact considerations.

3.2 <u>Alternative 2: Update Regulatory Guide 1.13</u>

Under this alternative, the NRC would update Regulatory Guide 1.13 by adding guidance related to maintaining pool water levels, providing appropriate radiation control and shielding, providing proper coolant flow through storage racks, detecting and controlling pool liner leakage, providing adequate residual heat removal, and allowing for appropriate inspections. In addition, the NRC would update the current guidance to reflect changes specific to makeup systems and heavy-load-handling systems.

The benefit of this action would be to provide more complete and accurate guidance for applicants and licensees to use in designing and building a spent fuel storage facility. The improved guidance will reduce the amount of correspondence necessary between the NRC and the involved party, since more complete designs/applications will initially be prepared. Therefore, this action will result in mutual cost and time savings.

The NRC would incur a one-time cost of issuing the revised regulatory guide (which is expected to be relatively small), and applicants and licensees would incur little or no cost.

4. Conclusion

Based on this regulatory analysis, the staff recommends that the NRC revise Regulatory Guide 1.13. The staff concludes that the proposed action will provide more complete and accurate guidance for the industry to use when designing spent fuel storage facilities. This will lead to cost and time savings for the NRC and industry.

BACKFIT ANALYSIS

This draft regulatory guide provides licensees and applicants with new guidance that the NRC staff considers acceptable for use in designing spent fuel storage facilities. The application of this guide is voluntary. Licensees may continue to use the original version of this regulatory guide if they so choose. No backfit, as defined in 10 CFR 50.109, “Backfitting,” is either intended or implied.

REFERENCES

ANSI/ANS 57.2-1983, "Design Objectives for Light-Water Spent Fuel Storage Facilities at Nuclear Power Plants," American National Standards Institute/American Nuclear Society, La Grange Park, Illinois, 1983.[1]

NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants," Section 9.1.2, "Spent Fuel Storage," and Section 9.1.3, "Spent Fuel Pool Cooling and Cleanup System," U.S. Nuclear Regulatory Commission, Washington, DC.[2]

Regulatory Guide 1.13, "Spent Fuel Storage Facility Design Basis," U.S. Nuclear Regulatory Commission, Washington, DC [available through the NRC's Agencywide Documents Access and Management System (ADAMS) under Accession No. ML003739943].[3]

Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC [available through ADAMS under Accession No. ML003739964].

Regulatory Guide 1.29, "Seismic Design Classification," U.S. Nuclear Regulatory Commission, Washington, DC [available through ADAMS under Accession No. ML003739983].

Regulatory Guide 1.52, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water-Cooled Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC [available through ADAMS under Accession No. ML011710176].

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1 Copies may be obtained from the American Nuclear Society, 555 North Kensington Avenue, La Grange Park, Illinois 60526; telephone (708) 352-6611; fax (708) 352-0499. Purchase information is available through the Web-based ANS store at http://www.ans.org/store/vi-240124.

2 Copies are available at current rates from the U.S. Government Printing Office, P.O. Box 37082, Washington, DC 20402-9328 (telephone 202-512-1800); or from the National Technical Information Service (NTIS) by writing NTIS at 5285 Port Royal Road, Springfield, VA 22161; http://www.ntis.gov; telephone 703-487-4650. Copies are available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555 (telephone: 301-415-4737 or 800-397-4209; fax: 301-415-3548; email: PDR@nrc.gov). NUREG-0800 is also available electronically through the NRC's public Web site at http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/.

3 All regulatory guides listed herein were published by the U.S. Nuclear Regulatory Commission. Where an ADAMS accession number is identified, the specified regulatory guide is available electronically through the NRC's Agencywide Documents Access and Management System (ADAMS) at http://www.nrc.gov/reading-rm/adams.html. All other regulatory guides are available electronically through the Public Electronic Reading Room on the NRC's public Web site, at http://www.nrc.gov/reading-rm/doc-collections/reg-guides/. Single copies of regulatory guides may also be obtained free of charge by writing the Reproduction and Distribution Services Section, ADM, USNRC, Washington, DC 20555-0001, or by fax to (301)415-2289, or by email to DISTRIBUTION@nrc.gov. Active guides may also be purchased from the National Technical Information Service (NTIS)on a standing order basis. Details on this service may be obtained by contacting NTIS at 5285 Port Royal Road, Springfield, Virginia 22161, online at http://www.ntis.gov, or by telephone at (703) 487-4650. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room (PDR), which is located at 11555 Rockville Pike, Rockville, Maryland; the PDR's mailing address is USNRC PDR, Washington, DC 20555-0001. The PDR can also be reached by telephone at (301) 415-4737 or (800) 397-4205, by fax at (301) 415-3548, and by email to PDR@nrc.gov.

Regulatory Guide 1.76, "Design-Basis Tornado for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC [available through ADAMS under Accession No. ML003740273].

Regulatory Guide 1.92, "Combining Modal responses and Spatial Components in Seismic Response Analysis," Revision 2, U.S. Nuclear Regulatory Commission, Washington, DC, July 2006 [available through ADAMS under Accession No. ML053250475].

Regulatory Guide 1.115, "Protection Against Low-Trajectory Turbine Missiles," U.S. Nuclear Regulatory Commission, Washington, DC [available through ADAMS under Accession No. ML003739456].

Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design-Basis Accidents at Nuclear Power Reactors," U.S. Nuclear Regulatory Commission, Washington, DC [available through ADAMS under Accession No. ML003716792].

U.S. Code of Federal Regulations**,** Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix A, "General Design Criteria for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.[4]

U.S. Code of Federal Regulations**,** Title 10, Part 50, "Domestic Licensing of Production and Utilization Facilities," Appendix S, "Earthquake Engineering Criteria for Nuclear Power Plants," U.S. Nuclear Regulatory Commission, Washington, DC.[5]

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4 All NRC regulations listed herein are available electronically through the Public Electronic Reading Room on the NRC's public Web site, at http://www.nrc.gov/reading-rm/doc-collections/cfr/part050. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov.

5 All NRC regulations listed herein are available electronically through the Public Electronic Reading Room on the NRC's public Web site, at http://www.nrc.gov/reading-rm/doc-collections/cfr/part050. Copies are also available for inspection or copying for a fee from the NRC's Public Document Room at 11555 Rockville Pike, Rockville, MD; the PDR's mailing address is USNRC PDR, Washington, DC 20555; telephone (301) 415-4737 or (800) 397-4209; fax (301) 415-3548; email PDR@nrc.gov.