



U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

9.1.1 NEW FUEL STORAGE

REVIEW RESPONSIBILITIES

Primary - Auxiliary Systems Branch (ASB)

Secondary - None

I. AREAS OF REVIEW

Nuclear reactor plants include storage facilities for the storage of new fuel. The quantity of new fuel to be stored varies from plant to plant, depending upon the specific design of the plant and the individual refueling requirements. The ASB verifies that the storage facility maintains the new fuel in a subcritical array during all credible storage conditions in accordance with General Design Criteria 2, 5, 61, and 62. The ASB reviews the new fuel storage facility design including the fuel assembly storage racks and storage vault with respect to the following:

1. The quantity of fuel to be stored.
2. The design and arrangement of the storage racks for maintaining a subcritical array during all storage conditions.
3. The degree of subcriticality, and the supporting analysis and associated assumptions.
4. The effects of external loads and forces on the new fuel storage racks and vault (e.g., safe shutdown earthquake, crane uplift forces).
5. The effects of sharing in multi-unit complexes, and failures of other plant equipment close to the new storage facility.
6. ASB also performs the following reviews under the SRP sections indicated.
 - (a) Review of flood protection is performed under SRP Section 3.4.1,
 - (b) Review of the protection against internally generated missiles is performed under SRP Section 3.5.1.1,

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USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

- (c) Review of structures, systems, and components to be protected against externally generated missiles is performed under SRP Section 3.5.2, and
- (d) Review of high and moderate energy pipe breaks as performed under SRP Section 3.6.1.

Should the design deviate significantly from previously accepted designs, ASB will request for a review by the Core Performance Branch (CPB) to verify the K_{eff} of the loaded storage racks is acceptable.

In addition, ASB will coordinate other branches evaluations that interface with the overall review of the system as follows:

The Structural Engineering Branch (SEB) determines the acceptability of the design analyses, procedures, and criteria used to establish the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), the probable maximum flood (PMF), and tornadoes and tornado missiles as part of its primary review responsibility for SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1, through 3.7.4, 3.8.4, and 3.8.5. The Mechanical Engineering Branch (MEB) determines that the components and structures are designed in accordance with applicable codes and standards as part of its primary review responsibility for SRP Sections 3.9.1 through 3.9.3. The MEB also determines the acceptability of the seismic and quality group classifications for system components as part of their primary review responsibility for SRP Section 3.2.1 and 3.2.2. The Radiological Assessment Branch (RAB) reviews the adequacy of the radiation monitoring system as part of its primary review responsibility for SRP Section 12.3-12.4. The Equipment Qualification Branch (EQB) reviews the adequacy of the equipment qualification as part of their review responsibility for SRP Section 3.11. The Materials Engineering Branch (MTEB) verifies that inservice inspection requirements are met for system components as part of its primary review responsibility for SRP Section 6.6 and, upon request, verifies the compatibility of the materials of construction with services conditions. The review for Fire Protection, Technical Specifications, and Quality Assurance are coordinated and performed by the Chemical Engineering Branch, Licensing Guidance Branch and Quality Assurance Branch as part of their primary review responsibility for SRP Sections 9.5.1, 16.0, and 17.0, respectively.

For those areas of review identified above as being the responsibility of other branches, the acceptance criteria and their methods of application are contained in the SRP sections corresponding to those branches.

II. ACCEPTANCE CRITERIA

Acceptability of the new fuel storage facility design as described in the applicant's analysis report (SAR) is based on specific general design criteria, regulatory guides, industry standards, and on independent calculations and staff judgments with respect to facility functions and component selection. The design of the new fuel storage facility is acceptable if the integrated design is in accordance with the following criteria:

1. General Design Criterion 2, as it relates to the ability of structures housing the facility and the facility components to withstand the effects of

earthquakes. Acceptance is based on meeting the guidance of Regulatory Guide 1.29, position C.1.1, as it relates to seismic classification of facility components.

2. General Design Criterion 5, as it relates to shared structures, systems and components important to safety being capable of performing required safety functions.
3. General Design Criterion 61, as it relates to the facility design for fuel storage.
4. General Design Criterion 62, as it relates to the prevention of criticality by physical systems or processes utilizing geometrically safe configurations.

Specific criteria necessary to meet the requirements of General Design Criteria 61 and 62 are ANS 57.1, "Design Requirements for LWR Fuel Handling Systems," and ANS 57.3, "Design Requirements for New LWR Fuel Storage Facilities" (proposed), as they relate to the prevention of criticality and to the aspects of the radiological design.

III. REVIEW PROCEDURES

The procedures below are used during the construction permit (CP) application review to determine that the applicant's design criteria and bases and the preliminary design meet the acceptance criteria given in subsection II of this SRP section. For operating license (OL) applications, the review procedures and acceptance criteria are utilized to verify that the initial design criteria and bases have been appropriately implemented in the final design as set forth in the final safety analysis report. The review procedures given are for a typical storage system. Any variance of the review, to adjust to a proposed unique design, is such as to assure that the facility design conforms to the criteria in subsection II of this SRP section. The reviewer selects and emphasizes material from this SRP section as may be appropriate for a particular case.

On those occasions where the design deviates significantly from previously approved designs ASB will request the coordinating review branches to provide input for the areas of review stated in subsection I of this SRP section. The ASB will incorporate such input as required to assure that this review procedure is complete.

1. The quantity of new fuel to be stored onsite forms the basis for the design capacity of the vault and the number of storage racks provided. The SAR is reviewed to determine that the facility description includes the storage capacity provided by the design. The SARs for recent light-water reactor applications have stated that the storage space provided is consistent with the number of new fuel assemblies used during the refueling cycle. In general, storage capacity for approximately one-third of a core is usually provided for each unit of a plant (e.g., 1/3 core for single unit design and 2/3 core for a dual unit design).
2. The information provided in the SAR pertaining to criticality safety of the new fuel storage facility is evaluated by CPB upon request. The facility design criteria, safety evaluation, system description, and the layout drawings for the storage vault and racks are reviewed to verify that:

- a. Criticality information (including the associated assumptions and input parameters) in the SAR must show that the spacing between fuel assemblies in the storage racks is sufficient to maintain the array, when fully loaded and flooded with potential moderators such as nonborated water fire extinguishant aerosols, in a subcritical condition, i.e., K_{eff} of less than about 0.95. Furthermore, the design of the new fuel storage racks will be such that the K_{eff} will not exceed 0.98 with fuel of the highest anticipated reactivity in place assuming optimum moderation. Credit may be taken for neutron absorbing materials.
 - b. The design is such that a fuel assembly cannot be inserted anywhere in the racks other than in the design locations and provisions have been made for drainage of the vault design, to prevent the accumulation of a fluid moderator.
 - c. Failures of nonsafety-related systems or structures not designed to seismic Category I criteria that are located in the vicinity of the new fuel storage facility are reviewed to assure that they will not cause an increase in K_{eff} beyond the maximum allowable. The SAR description section, the general arrangement and layout drawings, and the tabulation of seismic design classifications for structures and systems are reviewed and evaluated to assure that this condition is met. A statement in the SAR establishing the above condition as a design criterion is acceptable at the CP review stage.
 - d. Design calculations should show that the storage racks and the anchorages can withstand the maximum uplift forces available from the lifting devices without an increase in K_{eff} . A statement in the SAR that excessive forces cannot be applied due to the design of the lifting devices is acceptable if justification is presented. The evaluation procedures identified in SRP Section 9.1.4 are used to validate this statement.
 - e. The vault and racks have been designed to preclude damage from dropped heavy objects.
 - f. Sharing of a storage facility in multi-unit plants does not result in any added potential for increasing the K_{eff} of the storage array.
3. The reviewer verifies that the safety function of the facility will be maintained, as required, if the facility is subjected to natural phenomena such as earthquakes, tornadoes, hurricanes, and floods. In making this determination, the reviewer considers the following points:
 - a. The facility design basis and criteria, and the component classification tables presented in the SAR are reviewed to verify that the new fuel storage facility, including storage vault and racks, have been classified and will be designed to seismic Category I requirements.
 - b. The essential portions of the new fuel racks and storage vault are reviewed to verify that protection from the effects of floods, hurricanes, tornadoes, and internally or externally generated missiles is provided. Flood protection and missile protection criteria are

discussed in sections of the SRP contained in Chapter 3. The reviewer utilizes the procedures of those SRP sections, as appropriate, to assure that the analyses presented are valid. A statement to the effect that the storage will be located in a seismic Category I structure that is designed to withstand the effects of internally and externally generated missiles and floods is an acceptable commitment at the CP stage. The review for seismic design is performed by SEB and the review for seismic and quality group classification is performed by MEB as indicated in subsection I of this SRP section.

IV. EVALUATION FINDINGS

The reviewer verifies that the information provided and his review support conclusions of the following type to be included in the staff's safety evaluation report:

The new fuel storage facility includes the fuel assembly storage racks, the concrete storage vault that contains the storage racks, and auxiliary components. Based on the review of the applicant's proposed design criteria, design bases, and safety classification for the new fuel storage facility regarding the provisions necessary to maintain a subcritical array.

The staff concludes that the design of the new fuel storage facility and supporting systems is acceptable and meets the requirements of General Design Criteria 2, 5, 61, and 62 with respect to the measures taken to provide protection against the effects of natural phenomena, missiles, environmental conditions, and the sharing of structures, systems, and components. This conclusion is based on the following:

1. The natural phenomena requirements of General Design Criterion 2 regarding earthquakes have been met since it conforms to position C.1.1 of Regulatory Guide 1.29.
2. The shared portions of the new fuel storage facility between nuclear power units meet the requirements of General Design Criterion 5 in that it was demonstrated that such sharing did not impair, under accident conditions, the shared structures, systems, and components ability to perform this safety functions.
3. The fuel storage and handling and radioactivity control aspects of General Design Criterion 61 and the criticality aspects of General Design Criterion 62 have been met based on the new fuel storage system meeting ANS 57.1 and ANS 57.3 as they relate to the prevention of criticality and radiological releases.

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced Regulatory Guides.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."
3. 10 CFR Part 50, Appendix A, General Design Criterion 61, "Fuel Storage and Handling and Radioactivity Control."
4. 10 CFR Part 50, Appendix A, General Design Criterion 62, "Prevention of Criticality in Fuel Storage and Handling."
5. Regulatory Guide 1.29, "Seismic Design Classification."
6. ANS 57.1, "Design Requirements for Light-Water Reactor Fuel Handling Systems."
7. ANS 57.3, "Design Requirements for New LWR Fuel Storage Facilities" (proposed).