



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

SECTION 3.4.1

FLOOD PROTECTION

REVIEW RESPONSIBILITIES

Primary - Auxiliary and Power Conversion Systems Branch (APCSB)

Secondary - Site Analysis Branch (SAB)
Electrical, Instrumentation and Control Systems Branch (EICSB)
Structural Engineering Branch (SEB)

I. AREAS OF REVIEW

The APCSB review of the plant flood protection includes all systems and components whose failure could prevent safe shutdown of the plant or result in uncontrolled release of significant radioactivity. The facility design and equipment arrangements presented in the applicant's safety analysis report (SAR) are reviewed with respect to the following considerations: to identify the safety-related systems and components that must be protected against flooding; to determine the capabilities of structures housing safety-related systems or equipment to withstand a flood, i.e., the relationship between structure elevation and flood elevation as determined by the Section 2.4 Standard Review Plans (SRP); to determine adequacy of the isolation of redundant safety-related systems or equipment subject to flooding; to identify possible leakage sources, such as cracks in structures not designed to withstand seismic events and exterior or access openings or penetrations in structures located at a lower elevation than the flood level. The applicant's proposed technical specifications are reviewed for operating license applications, as they relate to areas covered in this review plan.

The review of flood protection involves secondary evaluations performed by other branches. The conclusions of their evaluations will be used by the APCSB to complete the overall evaluation of the subject area. The Site Analysis Branch verifies the elevations determined for the various conditions of site flooding, including the probable maximum flood and the adequacy of the type of flood protection utilized (SRP for Section 2.4). The Structural Engineering Branch determines the acceptability of the design analyses, procedures, and criteria used for seismic Category I structures that must withstand the effects of natural phenomena such as the safe shutdown earthquake (SSE), the design basis flood, and tornado missiles. The Electrical, Instrumentation and Control Systems Branch will, upon request, verify the adequacy of instrumentation needed for flood protection including

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 Revision 2 of 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. 20545.

adequacy of detectors and alarms necessary to detect rising water levels within structures, and will evaluate the consequences of flooding on other safety-related instrumentation and electrical equipment in affected areas (SRP 7.6).

II. ACCEPTANCE CRITERIA

Acceptability of the flood protection measures described in the SAR, including related portions of Chapter 3 of the SAR, is based on specific general design criteria and regulatory guides and on the reviewer's independent evaluation and calculations with respect to area or component flooding. Listed below are specific criteria as they relate to flooding.

The facility design and equipment locations are acceptable if they are in accordance with General Design Criterion 2, "Design Bases for Protection against Natural Phenomena," as related to systems and components withstanding flood conditions, and Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants." An additional basis for determining the acceptability of the facility will be the degree of similarity to previously approved plants with respect to means of providing flood protection.

III. REVIEW PROCEDURE

The review procedures below are used during the construction permit (CP) review to determine that the design criteria and bases and the preliminary design as set forth in the preliminary safety analysis report meet the acceptance criteria given in Section II of this plan. For the review of operating license (OL) applications the procedures 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 reviewer will select and emphasize material from the paragraphs below as may be appropriate for a particular case.

The general review procedures for OL's include a determination that the content and intent of the technical specifications prepared by the applicant are in agreement with the requirements developed as a result of the staff's review. Where necessary, the review will include requirements for system testing, minimum performance, and surveillance.

The review procedure consists of:

1. A determination from the SAR as to which systems and components are safety-related and should be protected against floods or flooded conditions.
2. An evaluation using the plant arrangement and layout drawings as to the various means to prevent flooding of safety-related systems or components, such as pumping systems, stoplogs, and watertight doors. The measures utilized are reviewed as to their ability to cope with the design basis flood, as established in the SRP for Section 2.4 of the SAR.
3. An assessment of leakage, a determination if liquid-carrying systems could produce flooding, and an evaluation of the measures taken to protect safety-related

equipment. A failure modes and effects analysis may be performed to determine that the flooding consequences resulting from failures of such liquid-carrying systems close to essential equipment will not preclude required functions of safety systems.

4. A review of the SAR to ascertain if safety-related systems or components are capable of normal function while completely or partially flooded.
5. A review of plant arrangement and layout drawings to determine if any safety-related equipment or components are located within individual compartments or cubicles which act as positive barriers against possible means of flooding.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that his evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

"The flood protection review included all systems and components whose failure could prevent safe shutdown of the plant or result in significant uncontrolled release of radioactivity. The scope of the flood protection review for the _____ plant included layout drawings, piping and instrumentation diagrams, and descriptive information for all systems and components that are essential to the safe operation and shutdown of the plant. [The review has included the applicant's proposed design criteria and design bases for safety-related systems, structures and components, the adequacy of those criteria and bases, and the requirements to maintain the capability for a safe plant shutdown during the design basis flood (CP).] [The review has included the applicant's analysis of the manner in which the design of structures, systems and components conforms to the applicable design criteria and bases, and demonstrates the ability to perform a safe plant shutdown during the design basis flood (OL).]

"The staff concludes that the design of the facility for flood protection conforms to the Commission's regulations and to applicable regulatory guides, staff technical positions, and industry standards, and is acceptable."

V. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. Regulatory Guide 1.59, "Design Basis Floods for Nuclear Power Plants."

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