



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

9.3.3 EQUIPMENT AND FLOOR DRAINAGE SYSTEM

REVIEW RESPONSIBILITIES

Primary - Auxiliary Systems Branch (ASB)

Secondary - None

I. AREAS OF REVIEW

The equipment and floor drainage system (EFDS) is designed to assure that waste liquids, valve and pump leakoffs, and tank drains are directed to the proper area for processing or disposal. The ASB reviews the equipment and floor drainage system, including the collection and disposal of liquid effluents outside containment. This includes piping and pumps from equipment or floor drains to the sumps, and any additional equipment that may be necessary to route effluents to the drain tanks and then to the radwaste system.

1. The ASB reviews the EFDS capability to collect and dispose of all waste liquid effluents so that they will be processed in a controlled and safe manner. ASB will determine that:
 - a. The system is capable of handling the volume of leakage expected, including the capacities of the sumps, drain tanks, and sump pumps.
 - b. The system is capable of preventing a backflow of water that might result from maximum flood levels to areas of the plant containing safety-related equipment.
 - c. There is no potential for inadvertent transfer of contaminated fluids to a non-contaminated drainage system.
2. ASB also performs the following reviews under the SRP section indicated:
 - a. Review of flood protection is performed under SRP Section 3.4.1,

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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.

- b. Review of the protection against internally generated missiles is performed under SRP Section 3.5.1.1,
- c. Review of the 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 is performed under SRP Section 3.6.1.

In addition, the ASB will coordinate with other branch evaluations that interface with the overall review of the system as follows. The Effluent Treatment Systems Branch (ETSB) will provide verification that the radwaste system is capable of collecting, sampling, analyzing, and processing the effluents from the EFDS consistent with the requirements for disposal of radwaste material as part of its primary review responsibility for SRP Section 11.2. The Containment Systems Branch (CSB) will verify that portions of the drain system penetrating the containment barrier are designed with acceptable isolation features to maintain containment integrity for all operating conditions including accidents as part of its primary review responsibility for SRP Section 6.2.4. The Radiological Assessment Branch (RAB) will verify that the system will meet occupational radiation protection criteria as part of its primary review responsibility for SRP Section 12.3. The Power Systems Branch (PSB) verifies that power supplies for safety-related portions of the EFDS meet criteria appropriate to its safety function as part of its primary review responsibility for SRP Section 8.3.1.

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 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, piping, 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 its primary review responsibility for SRP Sections 3.2.1 and 3.2.2. The MEB also reviews the adequacy of the inservice testing program of pumps and valves as part of its primary review responsibility for SRP Section 3.9.6. 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 identified as the primary review responsibility of those branches.

II. ACCEPTANCE CRITERIA

Acceptability of the design of the equipment and floor drainage system, as described in the applicant's safety analysis report (SAR) is based on the system meeting the following criteria:

1. General Design Criterion 2 as related to safety-related portions of the system being capable of withstanding the effects of earthquakes. Acceptance is based on meeting the guidance of Regulatory Guide 1.29, Position C-1, if any portion is deemed to be safety related, and Position C-2, for nonsafety-related functions. The ASB uses the following to determine if portions of the EFDS are safety related:
 - a. If the system is capable of detecting leaks in safety systems that utilize the drainage system sumps, and is the only means for such leakage detection, it is considered safety related in this regard.
 - b. If the system can cause the inundation of safety-related areas due to drain backflow that may result from malfunction of active components, blockage or the probable maximum flood, it is considered safety related in this area.
 - c. If the system is connected so that an inadvertent transfer of contaminated fluids to noncontaminated drainage systems can occur, it is considered safety related in this area.
 - d. If a failure or malfunction in a portion of the system could result in adverse effects on essential systems or components (i.e., necessary for safe shutdown, accident prevention, or accident mitigation) it is considered safety related in this area.

If none of the above safety-related criteria apply, then the EFDS need not meet General Design Criterion 2.

2. General Design Criterion 4 with respect to the capability of withstanding the effects of and to be compatible with the environmental conditions (flooding) associated with normal operation, maintenance, testing, and postulated accidents (pipe break, tank ruptures). Acceptance is based on the system being designed to prevent flooding which could result in adverse effects on essential systems or components (i.e., necessary for safe shutdown, accident prevention, or accident mitigation).
3. General Design Criterion 60 as related to providing a means to control suitably the release of radioactive materials in liquid effluent, including anticipated operational occurrences. This criterion applies since the EFDS usually consists of two subsystems, radioactive and nonradioactive and the inadvertent transfer of radioactive wastes to the nonradioactive portion of the system could result in radioactive releases to the environs. Acceptance is based on the system being designed to prevent the inadvertent transfer of contaminated fluids to a noncontaminated drainage system for disposal.

III. REVIEW PROCEDURES

The 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 subsection II. For 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.

Upon request from the primary reviewer, the coordinating review branches will provide input for the areas of review stated in subsection I. The primary reviewer obtains and uses such input as required to assure that this review procedure is complete.

The reviewer will select and emphasize material from this SRP section, as may be appropriate for a particular case.

1. The SAR is reviewed to see that the EFDS description section, layout drawings, and piping and instrumentation diagrams (P&IDs) show the EFDS layout and equipment, including pumps and valves necessary for routing effluents, the minimum drain tank capacity system flow requirements, connections to areas containing safety-related equipment or to non-contaminated drain systems, and any use made of the EFDS for leakage detection for safety-related systems. The reviewer determines which portions of the EFDS have safety functions or can adversely affect safety-related systems, using the criteria of subsection II, above. These "essential" portions of the EFDS are then reviewed on the basis of the criteria of subsection II, as is described in the paragraphs that follow.
2. The EFDS performance requirements section of the SAR is reviewed to confirm that it describes component allowable operational degradation (e.g., drain blockage, sump pump leakage, or failures) for safety-related portions of the system and describes the procedures that will be followed to detect and correct these conditions if they become excessive. The reviewer determines that essential portions of the system can sustain the loss of any active component and meet minimum system requirements. The system P&IDs, layout drawings, and component descriptions and characteristics are then reviewed for the following points:
 - a. Essential portions of the EFDS are correctly identified and are isolable from the nonessential portions of the system to the extent required by system performance requirements.
 - b. Essential portions of the EFDS are classified Quality Group C or higher and seismic Category I. Components and system descriptions in the SAR are reviewed by ASB to verify that the seismic and safety classifications have been included, and that the P&IDs indicate any points of change in piping quality group classification. The review for seismic design is performed by the SEB and the review for seismic and quality classification is performed by the MEB as indicated in subsection I of this SRP section.
3. The reviewer verifies that the system safety functions will be maintained, as required, in the event of adverse environmental phenomena such as earthquakes, or in the event of certain pipe breaks. The reviewer evaluates

the system, using engineering judgment, failure modes and effects analyses, and the results of reviews performed under other SRP sections, to determine that:

- a. Failure of nonessential portions of the system, or of other systems not designed to seismic Category I Standards and located close to essential portions of the system, or of nonseismic Category I structures that house, support, or are close to essential portions of the EFDS, will not preclude operation of the essential portions of the EFDS. Reference to SAR Chapter 2 (which describes site features) and the general arrangement and layout drawings will be necessary. Statements in the SAR to the effect that the above conditions are met are acceptable.
 - b. System capability to prevent drain or flood water from backing up in the drainage system into areas housing safety-related equipment has been incorporated. Statements in the SAR that this capability is provided are acceptable.
 - c. Provisions are made in the system to control and direct the flow of radioactive waste fluids to the radwaste area. It will be acceptable if the system P&IDs and design criteria show that the potential for inadvertent transfer of contaminated fluids to noncontaminated drainage system for disposal has been precluded.
 - d. Essential portions of the system are protected from the effects of high and moderate energy line breaks. Layout drawings are reviewed to assure that no high or moderate energy piping systems are close to essential portions of the EFDS, or that protection from the effects of failure will be provided. The means of providing such protection will be given in Section 3.6 of the SAR, and the procedures for reviewing this information are given in the corresponding SRP sections.
4. The descriptive information, P&IDs, EFDS drawings, and failure modes and effects analyses in the SAR are reviewed to assure that essential portions of the system can function as required following design basis accidents, assuming a concurrent failure of a single active component. The reviewer evaluates the analyses presented in the SAR to assure function of required components, traces the availability of these components on system drawings, and checks that the SAR contains verification that minimum system flow requirements are met for each accident situation for the required time spans. For each case, the design will be acceptable if minimum system requirements are met.

IV. EVALUATION FINDINGS

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

The equipment and floor drainage system includes all piping from equipment or floor drains to the sump, the sump pumps, and the associated pumps and piping network necessary to route effluents to the drain tanks and then to the radwaste system. Portions of the EFDS which are safety related as determined by the following criteria are classified Seismic I and Quality Group C.

- a. If the system is capable of detecting leaks in safety systems that utilize the drainage system sumps, and is the only means for such leakage detection, it is considered safety related in this regard.
- b. If the system can cause the inundation of safety-related areas due to drain back flow that may result from malfunction of active components, blockage or the probable maximum flood, it is considered safety related in this area.
- c. If the system is connected so that an inadvertent transfer of contaminated fluids to noncontaminated drainage can occur, it is considered safety related in this area.
- d. If a failure or malfunction in a portion of the system could result in adverse effects on essential systems or components (i.e., necessary for safe shutdown, accident prevention or accident mitigation) it is considered safety related in this area.

The basis for acceptance in the staff review has been conformance of the applicant's designs and design criteria for the essential portions of the equipment and floor drainage system and necessary auxiliary supporting systems to the Commission's regulations as set forth in the general design criteria, and to applicable regulatory guides, staff technical positions, and industry standards.

The staff concludes that the design of the equipment and floor drainage system is acceptable and conforms to the requirements of General Design Criteria 2, 4, and 60 with respect to seismic design, environmental conditions, and control release of radioactive materials. This conclusion is based on the following:

1. The applicant has met the requirements of General Design Criterion 2 with respect to seismic design by
 - a. meeting regulatory Position C-1 or C-2 in Regulatory Guide 1.29 or
 - b. providing and meeting an alternative method to the regulatory Position C-1 or C-2 in Regulatory Guide 1.29 that the staff has reviewed and found to be acceptable.
2. The applicant has met the requirements of General Design Criterion 4 with respect to environmental conditions by preventing flooding which could result in adverse effects on essential systems or components.
3. The applicant has met the requirements of General Design Criterion 60 with respect to controlling release of radioactive materials by preventing the inadvertent transfer of contaminated fluids to portions of the systems for noncontaminated drainage.

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 guide.

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 4, "Environmental and Missile Design Bases."
3. 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment."
4. Regulatory Guide 1.29, "Seismic Design Classification."