



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

9.3.3 EQUIPMENT AND FLOOR DRAINAGE SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of cooling water systems associated with the balance of plant

Secondary - None

I. AREAS OF REVIEW

The equipment and floor drainage system (EFDS) is designed to ensure that waste liquids, valve and pump leak-offs, and tank drains are directed to proper areas for processing or disposal, and that excessive water accumulation and flooding is prevented in accordance with plant design basis. Review of the EFDS includes design features that are necessary for collecting, routing, and disposing of liquid effluents outside containment. This includes piping and pumps from equipment or floor drains to the sumps, drain tanks, devices that are credited with preventing reverse flow, and any additional equipment necessary to route effluents to the drain tanks and then to the liquid waste management system or other points of discharge.

The specific areas of review are as follows:

1. Leakage detection capability that is relied upon for identifying conditions that are adverse to safety, such as excessive leakage that could compromise the capability of structures, systems or components (SSCs) to perform safety functions or could result in uncontrolled release of radioactive material to the environment.

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USNRC STANDARD REVIEW PLAN

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission staff responsible for the review of applications to construct and operate nuclear power plants intends to use in evaluating whether an applicant/licensee meets the NRC's regulations. The Standard Review Plan is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide an acceptable method of complying with the NRC regulations.

The standard review plan sections are numbered in accordance with corresponding sections in the Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of the standard format have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) will be based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)," until the SRP itself is updated.

These documents are made available to the public as part of the NRC's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Individual sections of NUREG-0800 will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience. Comments may be submitted electronically by email to NRR_SRP@nrc.gov.

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2. System features that are relied upon to prevent flooding due to drain backflow that may result from malfunction of active components, blockage, or the probable maximum flood, which could affect a SSC that is important to safety.
3. System features that are relied upon to prevent an inadvertent transfer of contaminated fluids to non-contaminated drainage systems or to otherwise prevent uncontrolled releases of radioactive material to the environment.
4. System features, a failure or malfunction of which could result in adverse effects on an SSC important to safety, or could result in uncontrolled release of radioactive material to the environment.
5. Inspection, Test, Analysis, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the applicant's proposed information on the ITAAC associated with the structures, systems, and components (SSCs) related to this Standard Review Plan (SRP) section is reviewed in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria - Design Certification." The staff recognizes that the review of ITAAC is performed after review of the rest of this portion of the application against acceptance criteria contained in this SRP section. Furthermore, the ITAAC are reviewed to assure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.
6. COL Action Items and Certification Requirements and Restrictions. COL action items may be identified in the NRC staff's final safety evaluation report (FSER) for each certified design to identify information that COL applicants must address in the application. Additionally, DCs contain requirements and restrictions (e.g., interface requirements) that COL applicants must address in the application. For COL applications referencing a DC, the review performed under this SRP section includes information provided in response to COL action items and certification requirements and restrictions pertaining to this SRP section, as identified in the FSER for the referenced certified design.

Review Interfaces

The listed SRP sections interface with this section as follows:

1. Sections 3.2.1 and 3.2.2: review to determine the acceptability of the seismic and quality group classifications for system components.
2. Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5: review to determine the acceptability of the design analyses, procedures, and criteria establishing the ability of seismic Category I structures housing the system and supporting systems to withstand the effects of such natural phenomena as the safe shutdown earthquake (SSE), the probable maximum flood, and tornado missiles.
3. Section 3.4.1: review of flood protection.
4. Sections 3.5.1.1, 3.5.1.2 and 3.5.1.3: review of the protection against internally-generated missiles.

5. Section 3.5.2: review of the SSCs to be protected against externally-generated missiles.
6. Sections 3.6.1 and 3.6.2: review of high- and moderate-energy pipe breaks.
7. Sections 3.9.1 through 3.9.3: review for whether components, piping, and structures are designed in accordance with applicable codes and standards.
8. Section 3.9.6: review of the adequacy of the inservice testing program of pumps and valves.
9. Section 6.2.4: review for whether 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.
10. Section 6.6: review for whether inservice inspection requirements are met for system components.
11. Sections 8.3.1 and 8.3.2: review for whether power supplies for EFDS safety-related portions meet criteria appropriate to its safety function.
12. Section 9.5.1: review for fire protection, including drain system design features (A) to accommodate actuation of installed fire suppression systems (gas and water), (B) to accommodate fire-fighting water, and (C) to prevent backflow of combustible liquids to safety-related areas.
13. Section 11.2: review of the liquid radioactive waste collection system for verification whether the radwaste system can collect, sample, analyze, and process EFDS effluents consistently with the requirements for disposal of radwaste material.
14. Section 12.3: review for whether the system meets occupational radiation protection criteria.
15. Section 16: review for technical specifications.
16. Chapter 17: review for quality assurance.
17. Section 19.1: for new plant applicants, the EFDS may be included in the systematic assessment of shutdown risks as a feature that can minimize the risk of flooding during shutdown conditions.

The specific acceptance criteria and review procedures are contained in the referenced SRP sections.

II. ACCEPTANCE CRITERIA

Requirements

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations. 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. GDC 2 as to safety-related system portions capable of withstanding the effects of natural phenomena.
2. GDC 4 as to capability to withstand the effects of and to be compatible with the environmental conditions (flooding) of normal operation, maintenance, testing, and postulated accidents (pipe break, tank ruptures).
3. GDC 60 as to suitable control of the release of radioactive materials in liquid effluent, including anticipated operational occurrences. This criterion applies as the EFDS usually consists of two subsystems, radioactive and nonradioactive. The inadvertent transfer of radioactive wastes to the nonradioactive portion of the system could result in radioactive releases to the environs.
4. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations;
5. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for review described in Subsection I of this SRP section. The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, an applicant is required to identify differences between the design features, analytical techniques, and procedural measures proposed for its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

1. Protection Against Natural Phenomena

Information that addresses the requirements of GDC 2 regarding the capability of safety-related system portions of the EFDS to withstand the effects of natural phenomena. Comprehensive compliance with GDC 2 is reviewed under other SRP sections as specified in subsection I of this SRP section. If no portion is safety-related, the EFDS need not meet GDC 2.

2. Environmental and Dynamic Effects

Information that addresses the requirements of GDC 4 regarding the capability to withstand the effects of and to be compatible with the environmental conditions (flooding) of normal operation, maintenance, testing, and postulated accidents (pipe break, tank ruptures) will be considered acceptable if the EFDS is designed to prevent flooding that could affect SSCs important to safety (i.e., necessary for safe shutdown, accident prevention, or accident mitigation) adversely.

3. Control of Releases of Radioactive Material to the Environment

Information that addresses the requirements of GDC 60 regarding the suitable control of the release of radioactive materials in liquid effluent, including anticipated operational occurrences will be considered acceptable if the EFDS is designed to prevent the inadvertent transfer of contaminated fluids to a noncontaminated drainage system for disposal.

Technical Rationale

The technical rationale for application of these requirements and/or SRP acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. GDC 2 requires that SSCs important to safety be designed to withstand the effects of natural phenomena like earthquakes, tornadoes, hurricanes, and floods without loss of capability to perform safety functions. EFDS safety-related functions have both active and passive aspects (e.g., flood prevention by such components as check valves, adequate drainage capacity to accommodate unplanned water intrusion in plant areas with SSCs important to safety). Both direct and indirect safety impacts are attributed to EFDS performance during a safe shutdown earthquake. By adequate drainage capacity EFDS must avert direct effects on safety-related equipment from inundation. Nonsafety-related equipment must be protected if its failure could reduce the functional reliability of safety-related equipment to unacceptable safety levels, or result in incapacitating injury to control room occupants or render the control room uninhabitable.

GDC 2 assures that all EFDS safety-related portions will continue to provide adequate drainage capacity during and following **natural phenomena** to accommodate postulated flooding events without water accumulation where it could jeopardize continued operability of safety-related equipment. In addition, these regulatory requirements assure that no system component failures will jeopardize the integrity of the reactor coolant pressure boundary, the capability to shut the reactor down and maintain it in a safe shutdown condition, or the capability to prevent or mitigate the consequences of accidents that could result in offsite radiation exposures.

2. GDC 4 requires that SSCs important to safety be designed to accommodate the effects of and be compatible with the environmental conditions of normal operation, maintenance, surveillance testing, and postulated accidents. For the EFDS, the purpose of GDC 4 is to assure the capability to provide the required drainage capacity to accommodate unanticipated flooding from pipe breaks, tank leaks, discharge from fire suppression systems, and other potential flooding sources. GDC 4 thus requires consideration in the design basis of the EFDS of the entire spectrum of flooding events, from relatively minor, operations-related, or testing-related events to postulated

accidents. GDC 4 assures that safety-related equipment functions will not be impacted by undue water accumulations within the plant.

3. GDC 60 requires plants to be designed to control the release of radioactive materials in gaseous and liquid effluents. The EFDS must have sufficient capability and margin to collect and dispose of radioactive and nonradioactive liquid effluents for their controlled and safe processing. As radioactive liquid effluents require a treatment different from that for nonradioactive effluents, the EFDS design typically provides for two separate systems, one for collecting radioactive and the other for collecting non-radioactive effluents. GDC 60 requirements assure containment of radioactive liquid effluents by controlled collection and transfer to appropriate treatment systems.

III. REVIEW PROCEDURES

The reviewer will select and emphasize material from the procedures described below, as may be appropriate for a particular case.

For each area of review specified in subsection I of this SRP section, the review procedure is identified below. These review procedures are based on the identified SRP acceptance criteria. For deviations from these specific acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives to the SRP criteria provide an acceptable method of complying with the relevant NRC requirements identified in subsection II.

1. The SAR is reviewed for whether 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 with safety-related equipment or to noncontaminated drain systems, and any EFDS leakage detection for safety-related systems.

The reviewer uses the following to determine whether EFDS portions 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 safety-related for this purpose.
- B. If the system can result in the inundation of safety-related areas due to drain backflow from malfunction of active components, blockage, or the probable maximum flood, it is 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 safety-related in this area.
- D. If a failure or malfunction in a portion of the system could affect safety-related (i.e., necessary for safe shutdown, accident prevention, or accident mitigation) SSCs adversely, it is safety-related in this area.

The reviewer applies the above criteria to determine which EFDS portions have safety functions or can adversely affect safety-related systems. These EFDS safety-related portions are then reviewed on the basis of the subsection II criteria as described in the following paragraphs

2. The SAR EFDS performance requirements section is reviewed for whether it describes component allowable operational degradation (e.g., drain blockage, sump pump leakage, or failures) for safety-related system portions and the procedures followed to detect and correct these conditions if they become excessive. The reviewer determines whether safety-related system portions 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 whether safety-related EFDS portions are identified correctly and can be isolated from the nonsafety-related portions to the extent required for system performance.
3. The reviewer verifies whether system safety functions will be maintained, as required, in adverse environmental phenomena (e.g., earthquakes) or in certain pipe breaks. The reviewer evaluates the system, using engineering judgment, failure modes and effects analyses, and the results of reviews under other SRP sections, for whether:
 - A. Failure of nonsafety-related portions of the system or of other systems not designed to seismic Category I standards and located close to safety-related portions of the system or of nonseismic Category I structures that house, support, or bound safety-related EFDS portions do not preclude operation of safety-related EFDS portions. Reference to SAR Chapter 2 (which describes site features) and the general arrangement and layout drawings is necessary. SAR statements to the effect that the conditions are met are acceptable.
 - B. System capability and design features to prevent drain or flood water from backing up in the drainage system into areas housing safety-related equipment is incorporated. SAR statements that this capability is provided are acceptable.
 - C. The system controls and directs the flow of radioactive waste fluids to the radwaste area. The design is 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 is precluded.
4. The SAR descriptive information, P&IDs, EFDS drawings, and failure modes and effects analyses are reviewed for whether safety-related system portions 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 for assured function of required components, traces the availability of these components on system drawings, and checks that the SAR verifies whether minimum system flow requirements are met for each accident situation for the required time spans. For each case, the design is acceptable if it meets minimum system requirements.
5. For reviews of DC and COL applications under 10 CFR Part 52, the reviewer should follow the above procedures to verify that the design set forth in the safety analysis report, and, if applicable, site interface requirements meet the acceptance criteria. For DC applications, the reviewer should identify necessary COL action items. With respect to COL applications, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit, or other NRC-approved material, applications, and/or reports.

After this review, SRP Section 14.3 should be followed for the review of Tier I information for the design, including the postulated site parameters, interface criteria, and ITAAC.

IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions of the following type to be included in the staff's safety evaluation report (SER). The reviewer also states the bases for those conclusions.

1. The EFDS includes all piping from equipment or floor drains to the sump, the sump pumps, and the pumps and piping network necessary to route effluents to the drain tanks and then to the radwaste system.

The basis for acceptance in the staff review is compliance of the applicant's designs and design criteria for the safety-related EFDS portions and necessary auxiliary supporting systems with NRC regulations as set forth in the GDCs and with applicable RGs, staff technical positions, and industry standards.

The staff concludes that the EFDS design is acceptable and complies with the requirements of GDCs 2, 4, and 60 as to seismic design, environmental conditions, and control of release of radioactive materials. This conclusion is based on the following findings:

- A. The applicant meets GDC 2 requirements by providing the capability of safety-related system portions of the EFDS to withstand the effects of natural phenomena.
- B. The applicant meets GDC 4 requirements for environmental conditions by preventing flooding that could affect safety-related SSCs adversely.
- C. The applicant meets GDC 60 requirements for controlling release of radioactive materials by preventing the inadvertent transfer of contaminated fluids to system portions for noncontaminated drainage.

For DC and COL reviews, the findings will also summarize (to the extent that the review is not discussed in other SER sections) the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable, and interface requirements and combined license action items relevant to this SRP section.

V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52. Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed six months or more after the date of issuance of this SRP section, unless superseded by a later revision.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, GDC 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, GDC 4, "Environmental and Dynamic Effects Design Bases."
3. 10 CFR Part 50, Appendix A, GDC 60, "Control of Releases of Radioactive Materials to the Environment."
4. NRC Inspection Manual Chapter IMC-2504, "Construction Inspection Program - Non-ITAAC Inspections," issued April 25, 2006.

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, which were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

PUBLIC PROTECTION NOTIFICATION

The NRC may not conduct or sponsor, and a person is not required to respond to, a request for information or an information collection requirement unless the requesting document displays a currently valid OMB control number.

SRP Section 9.3.3 Description of Changes

This SRP section affirms the technical accuracy and adequacy of the guidance previously provided in Draft Revision 3, dated June 1996, of this SRP section. See ADAMS accession number ML052070535.

In addition, this SRP section was administratively updated in accordance with NRR Office Instruction LIC-200, Revision 1, "Standard Review Plan (SRP) Process." The revision also adds standard paragraphs to extend application of this updated SRP section to prospective applicant submissions pursuant to 10 CFR Part 52.

The technical changes are incorporated in Revision 3, [Month] dated 2007:

Review Responsibilities - Reflects changes in review branches resulting from reorganization and branch consolidation. Change is reflected throughout the SRP.

I. AREAS OF REVIEW

The introduction and specific areas of review were rewritten for clarity to be more inclusive and for consistency with other SRP Sections.

SRP Section 3.5.1.3 was added to Review Interface #4.

SRP Sections 3.5.1.4 to 3.5.1.6 were added to Review Interface #5.

SRP Section 3.6.2 was added to Review Interface #6.

II. ACCEPTANCE CRITERIA

The criteria to determine if portions of the EFDS are "safety-related" have been moved to the "Review Procedures" section.

Specific seismic guidance (Regulatory Guide 1.29) has been removed from GDC 2, because the review as it relates to the EFDS is done in other SRP sections that have been identified as review interfaces (SRP Section 3.2.1, Interface #1).

III. REVIEW PROCEDURES

Specific guidance that is given in other SRP sections identified as review interfaces has been removed. Specifically, quality group classification (SRP Section 3.2.2, interface #1), seismic classification (SRP Section 3.2.1, interface #1), and high and moderate energy line breaks (SRP Sections 3.6.1 and 3.6.2, interface # 6) have been removed.

IV. EVALUATION FINDINGS

Redundant guidance (i.e. seismic classification and quality group classification) has been removed.

V. IMPLEMENTATION

None.

VI. REFERENCES

Reference to RG 1.29 has been removed.