U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

10.4.5 CIRCULATING WATER SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of power conversion systems

Secondary - None

I. AREAS OF REVIEW

The circulating water system (CWS) provides a continuous supply of cooling water to the main condenser to remove the heat rejected by the turbine cycle and auxiliary systems.

The specific areas of review are as follows:

1. Review of the performance of the CWS with respect to its functional requirements and the effects of adverse environmental occurrences, anticipated operational occurrences, or accident conditions such as loss of offsite power.

2. Review of the CWS and its interfaces with other systems to determine that a malfunction, failure of a component, or failure of a circulating water pipe, including the failure of an expansion joint, do not have unacceptable adverse effects on the functional performance capabilities of safety-related systems located in the immediate area.

3. Review of the design of the circulating water system with respect to the following:

   A. The capability to prevent or detect and control flooding of safety-related areas so that the intended safety function of a safety system or component will not be precluded due to circulating water system leakage.

   B. Provisions to annunciate abnormal and unsafe operating conditions.

4. Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this SRP section in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this SRP section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.

5. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).

   For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

Review Interfaces

Other SRP sections interface with this section as follows:

1. Review of high- and moderate-energy pipe breaks is performed under SRP Section 3.6.1. SRP Section 3.6.1 identifies the circulating water system as a moderate-energy system included in the scope of review.

2. Determination of whether liquid-carrying systems could produce flooding and evaluation of the measures taken to protect safety-related equipment from internal flooding is performed under SRP Section 3.4.1.

3. Review of the compatibility of the methods proposed for control of water chemistry and of long-term corrosion and organic fouling with system components and piping materials, and assurance that agents used for the control of water chemistry, corrosion, and organic fouling are compatible with the materials of the system is performed (upon request from the primary reviewer) by the organization responsible for reviewing the control of water chemistry, long-term corrosion, and organic fouling in system components and piping materials.

4. Review of the classification of systems quality groups is performed under SRP Section 3.2.2.

5. Review of the instrumentation and controls, as they may relate to operations that could affect safety-related systems or components is performed under SRP Section 7.1 and 7.6.

6. Review of the electrical power systems, as they may relate to operations that could affect safety-related systems or components is performed under SRP Sections 8.3.1 and 8.3.2.

7. Review of the potential for low water conditions (e.g., those associated with drought) that may affect the CWS design is performed under SRP Section 2.4.11.

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.

1. General Design Criterion 4 (GDC 4), "Environmental and Dynamic Effects Design Bases," as it relates to design provisions provided to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS.

2. 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;

3. 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 the review described in 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. The requirements of GDC 4 are met when the circulating water system design includes provisions to accommodate the effects of discharging water that may result from a failure of a component or piping in the CWS. Acceptance is based on meeting the following:

    A. Means should be provided to prevent or detect and control flooding of safety-related areas so that the intended safety function of a system or component will not be precluded due to leakage from the CWS.

    B. Malfunction or a failure of a component or piping of the CWS, including an expansion joint, should not have unacceptable adverse effects on the functional performance capabilities of safety-related systems or components.

Technical Rationale

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

1. GDC 4 requires that structures, systems, and components important to safety shall be designed to accommodate the effects and be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents.

   Although the circulating water system is not safety related, GDC 4 establishes CWS design limits that will minimize the potential for creating adverse environmental conditions (e.g., flooding of systems and components important to safety).

   Meeting the requirements of this criterion provides a level of assurance that systems and components important to safety will perform their intended safety functions.

III. REVIEW PROCEDURES

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

These review procedures are based on the identified SRP acceptance criteria. For deviations from these acceptance criteria, the staff should review the applicant's evaluation of how the proposed alternatives provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

The procedures below are used during the construction permit (CP) reviews 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 the review of operating license (OL) or combined license applications, the procedures are used 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 (FSAR).

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

1. Although the circulating water system is not safety related, a failure of this system, or any of its components, may affect a safety-related component or system. Since large quantities of water flow through the CWS, a leak or break in a component or pipe or expansion joint failure could cause severe and unacceptable flooding of adjacent areas. The reviewer verifies that the design includes provisions to minimize hydraulic transients and their effect upon the functional capability and the integrity of system components.

   In evaluating the effects of the failure of an expansion joint, the reviewer assumes that the butterfly valve(s) are not available to isolate CWS flow out of the failed expansion joint unless the valve(s) have been designed to safety-grade requirements. The reviewer analyzes the descriptions and drawings in the SAR and determines that provisions are incorporated in the design to prevent unacceptable flooding of areas containing safety-related equipment or to mitigate the consequences of flooding.

2. The reviewer analyzes the CWS to verify the capability to detect leaks and to secure the system quickly and effectively.

3. Based on the information contained in the SAR, the reviewer verifies that the applicant's proposed methods for control of water chemistry and of long-term corrosion and organic fouling, and the chemical agents used for these purposes, are compatible with the system materials.

For review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the final safety analysis report (FSAR) meets the acceptance criteria. DCs have referred to the FSAR as the design control document (DCD). The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR.

For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report).

For review of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

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. The reviewer also states the bases for those conclusions.

The circulating water system includes all components and equipment necessary to provide the main condenser with a continuous supply of cooling water. The system is designed to nonnuclear safety, Quality Group D, requirements since it is not necessary for safe shutdown, accident prevention, or accident mitigation. Based on the review of the applicant's proposed design criteria and bases for the circulating water system, the staff concludes that the design of the circulating water system is acceptable and meets the requirements of General Design Criterion 4. This conclusion is based on the following:

> The applicant has met the requirements of General Design Criterion 4 with respect to the effects of discharging water that may result from a failure of a component or piping in the CWS. Acceptance is based on provisions of the design that prevent flooding of safety-related areas so that the intended safety function of a system or component will not be precluded due to leakage from the CWS; or provisions of the design that detect and control flooding of safety-related areas so that the intended safety function of a system or component will not be precluded due to leakage from the CWS; or provisions of the design such that malfunction of a component or piping of the CWS, including an expansion joint, will not have unacceptable adverse effects on the functional performance capabilities of safety-related systems or components.

For DC and COL reviews, the findings will also summarize the staff’s evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this SRP section.

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

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 submitted 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, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases."

2. 10 CFR 52.47, "Contents of applications."

3. 10 CFR 52.80(a), "Issuance of combined licenses."