U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

10.4.6 CONDENSATE CLEANUP SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of chemical engineering issues

Secondary - None

I. AREAS OF REVIEW

The condensate cleanup system (CCS) removes dissolved and suspended impurities resulting from corrosion caused by condenser or steam generator leaks that could be introduced into the CCS by carryover from the main steam system. The CCS is not necessary for safe shutdown or mitigation of postulated accidents, but it is important in maintaining the primary coolant quality in direct cycle plants or the secondary coolant quality in indirect cycle plants.

The specific areas of review are as follows:

1. The staff will review the design of the condenser to ensure that chloride and other contaminant concentrations are limited to allowable values until the condensate and feedwater systems can be isolated in the event of condenser tube leaks.

2. The staff will review provisions to ensure that the water purity criteria are maintained.

3. The staff will review the compatibility of the materials of construction with the service conditions in the system.

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 the adequacy of the design with respect to breaks and cracks in high- and moderate-energy system piping is performed under SRP Section 3.6.1.

2. Review of the functional design criteria and seismic design classification for the connection between the CCS and the condensate and feedwater system is performed under SRP Section 10.4.7.

3. Review of the effect of CCS on fission and corrosion product concentrations and the effect of the quantity of spent resin and regenerant solution on radwaste system requirements is performed under SRP Sections 11.2, 11.3, and 11.4.

4. Review of the shielding design of the condensate demineralized system is performed under SRP Section 12.2.

5. Review of the technical specifications is performed under SRP Section 16.0.

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 (GDC) 14 found in Appendix A to 10 CFR Part 50, as it relates to the reactor coolant pressure boundary being designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

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.

Specific criteria acceptable to meet the requirements of GDC 14 are as follows:

1. For direct cycle (boiling-water reactor (BWR)) plants, SRP Section 5.4.8 provides the criteria for acceptable water purity. SRP Section 5.4.8 refers to the guidelines provided in the latest version in the Electric Power Research Institute (EPRI) report series, "BWR Water Chemistry Guidelines," and the technical specifications for the water chemistry of BWR reactor coolant systems.

2. For indirect cycle (pressurized-water reactor (PWR)) plants, SRP Section 5.4.2.1 provides the criteria for acceptable secondary water chemistry. SRP Section 5.4.2.1 refers to the guidelines provided in the latest version in the EPRI report series, "PWR Secondary Water Chemistry Guidelines."

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 paragraph:

GDC 14 requires that the reactor coolant pressure boundary be designed, fabricated, erected, and tested to ensure an extremely low probability of abnormal leakage, rapidly propagating failure, and gross rupture. GDC 14 applies to SRP Section 10.4.6 because the CCS maintains water quality to avoid corrosion-induced failure of the reactor pressure boundary.

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 reviewer will evaluate the system design information and drawings. Using engineering judgement, operational experience, and performance characteristics of similar, previously approved systems, the reviewer will verify the following:

1. The system meets the criteria for the condensate cleanup capacity, provides effluent of the necessary purity, and contains adequate instrumentation to monitor the effectiveness of the system.

2. The system is connected to radioactive waste disposal systems to allow disposal of spent resin or regenerant solutions when necessary.

3. The materials of construction are compatible with the service environment.

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 condensate cleanup system includes all components and equipment necessary for the removal of dissolved and suspended impurities that may be present in the condensate. Based on the staff's review of the applicant's proposed design criteria and design bases for the condensate cleanup system and the criteria for operation of the system, the staff concludes that the design of the condensate cleanup system and supporting systems is acceptable and meets the applicable reactor coolant pressure boundary integrity requirements of GDC 14. This conclusion is based on the applicant having met the guidelines in the latest version in the EPRI report series, "BWR Water Chemistry Guidelines" and the "PWR Secondary Water Chemistry Guidelines," with respect to maintaining acceptable chemistry control [BWR reactor coolant and for PWR secondary coolant] during normal operation and anticipated operational occurrences by reducing corrosion [BWR reactor system components and of PWR steam generator tubes and materials], thereby reducing the likelihood and magnitude of reactor piping failures and of primary-to-secondary coolant leakage.

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, Appendix A, General Design Criterion 14, “Reactor Coolant Pressure Boundary.”

2. 10 CFR 52.47, “Contents of Applications.”

3. 10 CFR 52.80, “Contents of Applications; additional technical information.”

4. Electric Power Research Institute Report Series, “BWR Water Chemistry Guidelines.”

5. Electric Power Research Institute Report Series, “PWR Secondary Water Chemistry Guidelines.”