U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

10.4.8 STEAM GENERATOR BLOWDOWN SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of chemical engineering issues

Secondary - Organization responsible for the review of instrumentation and controls

I. AREAS OF REVIEW

The specific areas of review are as follows:

1. Ability of the system to remove particulate and dissolved impurities from the steam generator secondary side, thus assisting in maintaining optimum secondary-side water chemistry in steam generators during normal operation, including anticipated operational occurrences (main condenser inleakage and primary-to-secondary leakage).

2. Consideration in the design basis of expected and design flows for all modes of operation (process and process bypass), process design parameters and equipment design capacities, expected and design temperatures for temperature sensitive treatment processes (demineralization and reverse osmosis), and process instrumentation and controls for maintaining operations within established parameter ranges.

Revision 3 - March 2007

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 Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

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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3. 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.

4. 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 process sampling capabilities under SRP Section 9.3.2.

2. Review of the secondary coolant chemistry for steam generator blowdown samples under Branch Technical Position (BTP) 5-3, “Monitoring of Secondary Side Water Chemistry in PWR Steam Generators.”

3. Review of the resistance to flow-accelerated corrosion under SRP Section 10.3.6.

4. Review of the system’s seismic design and quality group classification under SRP Sections 3.2.1 and 3.2.2, respectively.

5. Determination of the acceptability of the design analysis, 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, under SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1, 3.7.2, 3.7.3, 3.7.4, 3.8.4, and 3.8.5.

6. Review of the liquid, gaseous, and solid waste treatment aspects of the Steam Generator Blowdown System (SGBS) under SRP Sections 11.2, 11.3, and 11.4, and review of the liquid and gaseous process and effluent radiological monitoring under SRP Section 11.5.

7. Evaluation under SRP Section 3.6.1 of the effect of high- and moderate-energy system piping failures to ensure that safety-related equipment will not be made inoperable.

8. Evaluation of the capabilities of the high-energy portion of the SGBS to withstand the effects of internally generated missiles, both outside containment under SRP Section 3.5.1.1, and inside containment under SRP Section 3.5.1.2.

9. Determination that the blowdown lines penetrating primary containment are isolated on a containment isolation signal, and evaluation of containment isolation dependability (10 CFR 50.34(f)(2)(xiv) and NUREG-0737 Task II.E.4.2) under SRP Section 6.2.4.

10. Review of the quality assurance program under SRP Chapter 17.

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

II. ACCEPTANCE CRITERIA

Acceptance criteria are based on meeting the relevant requirements of the following Commission regulations:

1. General Design Criterion 1 (GDC 1) as it relates to system components being designed, fabricated, erected, and tested for quality standards.

2. General Design Criterion 2 (GDC 2) as it relates to system components designed to seismic Category 1 requirements.

3. General Design Criterion 13 (GDC 13) as it relates to monitoring system variables that can affect the reactor coolant pressure boundary and maintaining them within prescribed operating ranges.

4. General Design Criterion 14 (GDC 14) as it relates to secondary water chemistry control to maintain the integrity of the primary coolant pressure boundary.

5. 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.

6. 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 1 and GDC 2 are met when the design of the SGBS includes the following:

   A. The design is seismic Category I and Quality Group B, from its connection to the steam generator inside primary containment up to and including the first isolation valve outside containment.

   B. The design is in accordance with the provisions of Regulatory Guide 1.143, Position C.1.1 downstream of the outer containment isolation valves.

2. The requirements of GDC 13 are met when the SGBS design includes provisions to monitor system parameters and maintain them within a range that allows the system to perform its impurity removal function and thereby assist in maintaining the integrity of the reactor coolant pressure boundary.

3. The requirements of GDC 14 are met when the SGBS design includes provisions to control secondary water chemistry to maintain the integrity of the primary coolant boundary. Acceptance is based on meeting the following:

   A. The SGBS is sized to accommodate the design blowdown flow needed to maintain secondary coolant chemistry for normal operation, including anticipated operational occurrences.

   B. Equipment capacities are based on design blowdown flow rates and are such that temperature limits for heat-sensitive processes are not exceeded.

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. Meeting the requirements of GDC 1 provides assurance that failure of any component in the SGBS will not result in loss of reactor coolant and subsequent fuel damage. Compliance with GDC 1 further ensures that the reactor coolant pressure boundary will not be degraded by adverse secondary water chemistry conditions.

2. Meeting the requirements of GDC 2 provides a level of assurance that the reactor coolant pressure boundary will maintain its integrity after a design basis earthquake.

3. Meeting the requirements of GDC 13 provides a level of assurance that the system will operate in a range that maintains the integrity of the reactor coolant pressure boundary.

4. Meeting the requirements of GDC 14 provides a level of assurance that the probability of leakage from or rapidly propagating failure of the reactor coolant pressure boundary does not increase during the operating life of the plant.

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.

1. The reviewer considers the pressure, temperature, flow rate, secondary coolant chemistry, main condenser water inleakage, and primary-to-secondary leakage to determine whether the SGBS design has included the effects of normal operation and anticipated operational occurrences (e.g., main condenser inleakage or primary-to-secondary leakage). The reviewer determines that the design parameters are reasonable. If the proposed system includes processes which are heat-sensitive (e.g., demineralization or reverse osmosis), the reviewer verifies the design includes instrumentation and controls to protect the temperature-sensitive elements. The reviewer ensures that instrumentation and process controls are provided to control flashing, liquid levels, and process flow through the proper components for the radioactivity levels expected. Review of instrumentation and controls is performed consistent with the procedures in SRP Section 7.7.

2. The reviewer examines the proposed piping and instrumentation diagrams (P&IDs) and process flow diagrams, the method of operation, the processing to be provided, and the interfaces between the blowdown system and other plant systems to determine:
(a) whether unusual design conditions exist which could lead to safety problems, and
(b) that the system is capable of performing its intended functions.

3. The reviewer reviews the secondary coolant chemistry program for steam generator blowdown samples in SRP Section 5.4.2.1, (see page 2 reference).

4. The reviewer verifies that the assigned classifications at the boundary interfaces between systems and/or system components are in accordance with the importance of the safety function to be performed and the guidelines of Regulatory Guides 1.26, 1.29, and 1.143.

5. The reviewer determines the seismic design, the seismic design classification, and the quality group classification for the SGBS components.

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.

1. The SGBS controls the concentration of chemical impurities and radioactive materials in the secondary coolant. The scope of the SGBS review included piping and instrumentation diagrams, seismic and quality group classifications, design process parameters, and instrumentation and process controls. The review included the applicant’s evaluation of the proposed system operation and the applicant’s estimate of the controlling process parameters.

2. The SGBS design meets the primary boundary material integrity requirements of GDC 13 as it relates to monitoring variables during normal operation and anticipated operational occurrences, and maintaining these variables within prescribed operating ranges that limit corrosion of steam generator tubes and materials.

3. The SGBS design meets the primary boundary material integrity requirements of GDC 14 as it relates to maintaining acceptable secondary water chemistry control during normal operation and anticipated operational occurrences by limiting corrosion of steam generator tubes and materials, thereby limiting the likelihood and magnitude of primary-to-secondary coolant leakage.

4. The SGBS is seismic Category I and Quality Group B from its connection to the steam generator inside primary containment up to and including the first isolation valve outside containment in accordance with Regulatory Guides 1.26 and 1.29 because this portion of the SGBS is considered an extension of primary containment. The SGBS downstream of the outer containment isolation valves is not seismic Category I and meets the quality standards of Position C.1.1 of Regulatory Guide 1.143 since it is not safety related. Thus, the SGBS meets the quality standards requirements of GDC 1 and seismic requirements of GDC .

   Based on this review, the staff concluded the SGBS is acceptable and meets the requirements of GDC 1, 2, 13, and 14.

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 1, "Quality Standards and Records."

2. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

3. 10 CFR Part 50, Appendix A, General Design Criterion 13, "Instrumentation and Control."

4. 10 CFR Part 50, Appendix A, General Design Criterion 14, "Reactor Coolant Pressure Boundary."

5. 10 CFR 52.47, "Contents of Applications."

6. 10 CFR 52.97, "Issuance of Combined Licenses."

7. Regulatory Guide 1.26, "Quality Group Classifications for Water-, Steam-, and Radioactive-Waste Containing Components of Nuclear Power Plants."

8. Regulatory Guide 1.29, "Seismic Design Classification."

9. Regulatory Guide 1.143, "Design Guidance for Radioactive Waste Management Systems, Structures, and Components in Light-Water-Cooled Nuclear Reactor Power Plants."

10. Branch Technical Position (BTP) 5-3, “Monitoring of Secondary Side Water Chemistry in PWR Steam Generators.”

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, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

PUBLIC PROTECTION NOTIFICATION

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