U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

10.4.7 CONDENSATE AND FEEDWATER SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of power conversion systems

Secondary - None

I. AREAS OF REVIEW

The condensate and feedwater system (CFS) provides feedwater at the required temperature, pressure, and flow rate to the reactor for boiling water reactor (BWR) plants and to the steam generators for pressurized water reactor (PWR) plants. Condensate is pumped from the main condenser hotwell by the condensate pumps, passes through the low-pressure feedwater heaters to the feedwater pumps, and then is pumped through the high-pressure feedwater heaters to the nuclear steam supply system.

The primary reviewer reviews the CFS from the condenser outlet, up to and including the nozzle connections with the nuclear steam supply system, the feedwater spargers, and the heater drain system to ensure conformance to General Design Criteria (GDC) 2, 4, 5, 44, 45, and 46. For PWRs, there are also interfaces with the secondary water makeup system and the auxiliary feedwater system. The CFS is used for normal shutdown. The only part of the CFS classified as safety-related, i.e., required for safe shutdown or in the event of postulated accidents, is the feedwater piping from the steam generators for PWRs and from the nuclear steam supply system for BWRs, up to and including the outermost containment isolation valve.

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The specific areas of review are as follows:

1. Review of the characteristics of the CFS with respect to the capability to supply adequate feedwater to the nuclear steam supply system as required for normal operation and shutdown.

2. Determination that an acceptable design has been established for:

   A. The interfaces of the CFS with the auxiliary feedwater system (PWR), the reactor core isolation cooling system (BWR), and the condensate cleanup system with regard to functional design requirements and seismic design classification.

   B. The feedwater system (PWR), including the auxiliary feedwater system piping entering the steam generator, with regard to possible fluid flow instabilities (e.g., water hammer) during normal plant operation as well as during upset or accident conditions.

   C. The detection of major system leaks that could affect the functional performance of safety-related equipment.

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 for flood protection is performed under SRP Section 3.4.1.

2. Review of the protection against internally generated missiles is performed under SRP Section 3.5.1.1.

3. Review of protection against missiles generated by natural phenomena, including tornados, is performed under SRP Section 3.5.1.4.

4. Review of the structures, systems, and components to be protected against externally generated missiles is performed under SRP Section 3.5.2.

5. Review of high- and moderate-energy pipe breaks is performed under SRP Section 3.6.1.

6. Review of the fire protection program is performed under SRP Section 9.5.1.

7. Review of the environmental qualification of mechanical and electrical equipment is performed under SRP Section 3.11.

8. Review of the auxiliary feedwater system (PWR) is performed under SRP Section 10.4.9.

9. Determination that transients resulting from feedwater flow control malfunctions will not violate the primary system pressure boundary integrity criterion are performed under SRP Sections 15.1.1 through 15.1.4.

10. Determination that the loss of normal feedwater flow will not violate the fuel damage criterion or the system pressure boundary integrity criterion is performed under SRP Section 15.2.7.

11. Review of the reactor core isolation cooling system (BWR) is performed under SRP Section 5.4.6.

12. Evaluation of the system power sources with respect to their capability to perform safety-related functions during normal, transient, and accident conditions is performed under SRP Section 8.3.1.

13. Review of the acceptability of 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 are performed under 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.

14. Determination that the components, piping, and structures are designed in accordance with applicable codes and standards is performed under SRP Sections 3.9.1 through 3.9.3. The analysis includes a determination of the acceptability of design analyses, procedures, and criteria used to establish the adequacy of devices or restraints as they may relate to significant water hammers in system piping, and a review of test programs of components that may be affected by water hammers.

15. Determination of the acceptability of seismic and quality group classifications for system components is performed under SRP Section 3.2.1.

16. Review of the adequacy of the inservice testing program of pumps and valves is performed under SRP Section 3.9.6.

17. Verification that preservice inspection requirements are met for system components is performed under SRP Section 6.6.

18. Evaluation of feedwater system materials, including their selection and fabrication, fracture toughness of Class 2 and 3 components, and erosion/corrosion is performed under SRP Section 10.3.6.

19. Review of technical specifications is performed under SRP Chapter 16.0.

20. Review of quality assurance programs is performed under SRP Chapter 17.0.

21. Review of the seismic qualification of Category I instrumentation and electrical equipment is performed under SRP Section 3.10.

22. Review of the instrumentation and controls associated with the feedwater control system (BWR) or steam generator level control system (PWR) is performed under SRP Section 7.7 upon request of the primary reviewer.

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 2 (GDC 2), "Design Bases for Protection Against Natural Phenomena," as related to the system being capable of withstanding the effects of earthquakes.

2. General Design Criterion 4 (GDC 4), "Environmental and Dynamic Effects Design Bases," as related to the dynamic effects associated with possible fluid flow instabilities (e.g., water hammers) during normal plant operation as well as during upset or accident conditions.

3. General Design Criterion 5 (GDC 5), "Sharing of Structures, Systems, and Components," as related to the capability of shared systems and components important to safety to perform required safety functions.

4. General Design Criterion 44 (GDC 44), "Cooling Water," as it relates to:

    A. The capability to transfer heat loads from the reactor system to a heat sink under both normal operating and accident conditions.

    B. Redundancy of components so that under accident conditions the safety function can be performed assuming a single active component failure. (This may be coincident with the loss of offsite power for certain events.)

    C. The capability to isolate components, subsystems, or piping if required so that the system safety function will be maintained.

5. General Design Criterion 45 (GDC 45), "Inspection of Cooling Water System," as related to design provisions to permit periodic inservice inspection of system components and equipment.

6. General Design Criterion 46 (GDC 46), "Testing of Cooling Water System," as related to design provisions to permit appropriate functional testing of the system and components to ensure structural integrity and leak-tightness, operability and performance of active components, and capability of the integrated system to function as intended during normal, shutdown, and accident conditions.

7. 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;

8. 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. Seismic Events. The requirements of GDC 2 are met by demonstrating that structures, systems, and components important to safety will be designed to withstand the effects of natural phenomena such as earthquakes. Acceptance is based on meeting the guidance of Regulatory Guide 1.29, Position C.1 for safety-related portions and Position C.2 for nonsafety-related portions.

2. Fluid Instabilitites. The requirements of GDC 4 as related to protecting structures, systems and components against the dynamic effects associated with possible fluid flow instabilities (e.g., water hammers) during normal plant operation as well as during upset or accident conditions are met by:

   A. Meeting the guidance contained in the Branch Technical Position 10-2, "Design Guidelines for Avoiding Water Hammers in Steam Generators," for reducing the potential for water hammers in steam generators; and

B. Meeting the guidance related to feedwater-control-induced water hammer. Guidance for water hammer prevention and mitigation is found in NUREG-0927, Revision 1.

3. Sharing of Structures, Systems, and Components. The requirements of GDC 5 are met by demonstrating the capability of important to safety components in the CFS which are shared by multiple units to perform their required safety functions.

4. Heat Removal Capability. The requirements of GDC 44, as related to the capability to transfer heat from structures, systems and components important to safety to an ultimate heat sink are met by demonstrating that the CFS is capable of providing heat removal under both normal operating and accident conditions. Sufficient redundancy of components is demonstrated so that under accident conditions the safety function can be performed assuming a single active component failure (which may be coincident with the loss of offsite power for certain events.) The system demonstrates capability to isolate components, subsystems, or piping if required so that the system safety function will be maintained.

5. Inspection. The requirements of GDC 45 are met by demonstrating that the design contains provisions to permit periodic inservice inspection of system components and equipment.

6. Testing. The requirements of GDC 46 are met by demonstrating that the design contains provisions to permit appropriate functional testing of the system and components to ensure structural integrity and leak-tightness, operability and performance of active components, and capability of the integrated system to function as intended during normal, shutdown, and accident conditions.

7. Flow Accelerated Corrosion. Piping system designs, including material standards and inspection programs, shall incorporate adequate considerations to avoid erosion and corrosion. Guidance for acceptable inspection programs is found in Generic Letter 89-08 and in EPRI NP-3944, "Erosion/Corrosion in Nuclear Plant Steam Piping: Causes and Inspection Guidelines."

8. Feedwater Nozzle Design. For BWRs, feedwater nozzle design, inspection, and testing procedures, and CFS operating procedures are adequate to minimize nozzle cracking at low feedwater flow. The review criteria for this issue are stated in NUREG-0619 and in associated Generic Letters 80-95 and 81-11.

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 2 requires that structures, systems, and components important to safety shall be designed to withstand the effects of natural phenomena such as earthquakes.

   This criterion applies to SRP Section 10.4.7 because the review identifies CFS components important to safety and determines that they are designed to withstand the

effects of earthquakes and other natural phenomena. Regulatory Guide 1.29, Positions C.1 and C.2, provide guidance for determining compliance with this criterion.

Meeting the requirements of this criterion provides a level of assurance that the capability to shut down the reactor safety will be maintained during the most severe expected earthquake or other natural phenomena.

2. GDC 4 requires that structures, systems, and components important to safety shall be appropriately protected against dynamic effects that may result from equipment failures and from events and conditions outside the nuclear power unit.

   GDC 4 applies to SRP Section 10.4.7 because the review verifies that CFS components important to safety are protected against the effects of high-energy pipe ruptures. This review also considers the dynamic consequences of flow instabilities (specifically, water hammer) resulting from normal operation and during anticipated operational occurrences.

   Meeting the requirements of this criterion provides further assurance that the integrity of the feedwater piping inside the containment structure will be maintained, thereby minimizing the likelihood of a loss-of-coolant accident that could cause fuel damage.

3. GDC 5 requires that structures, systems, and components important to safety shall not be shared by nuclear power units, unless it can be shown that such sharing will not significantly impair the ability to perform safety functions, including an orderly shutdown and cooldown of remaining units in the event of an accident in one unit.

   GDC 5 applies to SRP Section 10.4.7 because the review determines whether CFS components important to safety are shared and, if so, evaluates the impact of that sharing on safety functions.

   Meeting the requirements of this criterion provides further assurance that all reactors at a multiple-unit site will be capable of completing normal shutdown in the event of a component failure in one reactor.

4. GDC 44 requires that a system be provided to transfer heat from structures, systems, and components important to safety to an ultimate heat sink. The safety function of this system shall be to transfer the specified combined heat load under normal operating and accident conditions. Suitable redundancy in components and features, as well as suitable interconnections, leak detection, and isolation capabilities, shall be provided to ensure that the system safety function can be accomplished for loss of either onsite or offsite power assuming a single failure.

   GDC 44 applies to SRP Section 10.4.7 because the review establishes that the CFS is capable of providing heat removal from the reactor system during normal conditions. For PWRs, the auxiliary feedwater system provides heat removal during accident conditions involving loss of normal feedwater. (The auxiliary feedwater system is evaluated under SRP Section 10.4.9.) For BWRs, the reactor core isolation cooling system provides heat removal during accident conditions involving loss of normal feedwater. (The reactor core isolation cooling system is evaluated under SRP Section 5.4.6.) Review of the CFS is coordinated with those of alternate feedwater systems and

addresses redundancy, interconnections, leak detection, and isolation capabilities to establish that containment isolation can be accomplished during accidents that occur concurrently with loss of onsite or offsite power and a single failure.

Meeting the requirements of this criterion provides a level of assurance that the capability for heat removal from the reactor will be retained during normal and accident conditions, thus protecting fuel cladding from elevated temperatures.

5. GDC 45 requires that the cooling water system shall be designed to permit appropriate periodic inspection of important components (e.g., heat exchangers and piping) to ensure the integrity and capability of the system.

   GDC 45 applies to SRP Section 10.4.7 because the CFS provides cooling water to the reactor or steam generators and because the CFS is isolated in the event of certain accidents. This review verifies that the feedwater system design facilitates inspection.

   Meeting the requirements of this criterion provides a level of assurance that the CFS will be able to perform its safety function in the event of an accident.

6. GDC 46 requires that the cooling water system shall be designed to facilitate periodic pressure and functional testing that will ensure (a) the structural and leaktight integrity of cooling water system components, (b) the operability and the periodic performance of the system's active components, and (c) the operability of the system as a whole. The criterion further requires that the testing ensure, under conditions as close to design as practical, the performance of the full operational sequence that brings the system into operation for reactor shutdown and for loss-of-coolant accidents, including operation of applicable portions of the protection system and the transfer between normal and emergency power sources.

   GDC 46 applies to SRP 10.4.7 because the CFS provides the proper cooling water inventory for PWR steam generators or BWR reactor pressure vessels during normal operation. The CFS is isolated after a loss-of-feedwater accident has occurred. During such conditions, the CFS feedwater piping inside the containment is used as the conduit for feedwater flow from alternate systems. This review determines that the CFS is designed to accommodate testing the system and its components.

   Meeting the requirements of this criterion provides a level of assurance that the CFS will be able to perform reliably under normal operating conditions and will perform its safety function in the event of an accident.

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.

The SAR is reviewed to determine that the system description and diagrams delineate the function of the condensate and feedwater system under normal and abnormal conditions. The reviewer verifies the following:

1. The system has been designed to function as required for all modes of operation. The results of failure modes and effects analyses presented in the SAR, if any, are used in making this determination.

2. The system piping is designed to preclude hydraulic instabilities from occurring in the piping for all modes of operation. As appropriate, the reviewer evaluates the results of model tests and analyses that are relied on to verify that water hammer will not occur, or proposed tests of the installed system that are intended to verify design adequacy. Steam generators are reviewed in accordance with Branch Technical Position 10-2.

   The feedwater control valve and controller design shall be verified to be stable and to be compatible with system(s) under imposed operating conditions (e.g., control functions required, range of control and pressure drop characteristics, valve stroke, trim, etc.). Test data or operating experience data shall be used where available. In addition, the applicant has committed to review plant operating and maintenance procedures to ensure that precautions for avoidance of steam/water hammer and water hammer occurrences have been provided.

   Guidance for water hammer prevention and mitigation is found in NUREG-0927.

3. The outermost containment isolation valves and all downstream piping to the nuclear steam supply system are designed in accordance with seismic Category I requirements. The review for seismic design and the review for seismic and quality group classification are performed as indicated in subsection I of this SRP section.

4. The CFS design is such that the plant can be safely shut down using the auxiliary feedwater system (PWR) or the reactor core isolation cooling system (BWR), if required.

5. The CFS design, or other plant systems, provide the capability to detect and control leakage from the system, including leakage from spargers.

6. The essential portion of the system has been designed so that system function will be maintained as required in the event of adverse environmental phenomena or loss of offsite power. The review for protection against natural phenomena is performed in the Chapter 3 SRP sections. The reviewer evaluates the system, using engineering

judgment and the results of failure modes and effects analyses, to determine that the 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), will not preclude operation of the essential portions of the CFS. The reviewer shall also ensure that failure of nonseismic Category I structures that house, support, or are close to essential portions of the CFS will not preclude operation of the essential portions of the CFS.

7. Piping system designs, including material standards and inspection programs, incorporate adequate considerations to avoid erosion and corrosion. Guidance for acceptable inspection programs is found in Generic Letter 89-08 and in EPRI NP-3944, "Erosion/Corrosion in Nuclear Plant Steam Piping: Causes and Inspection Guidelines."

8. For BWRs, feedwater nozzle design, inspection, and testing procedures, and CFS operating procedures are adequate to minimize nozzle cracking at low feedwater flow. The review criteria for this issue are stated in NUREG-0619 and in associated Generic Letters 80-95 and 81-11.

9. For multiple-unit sites, sharing of any CFS structure, system, or component important to safety will not impair its ability to perform its intended safety function.

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 and feedwater system includes all components and equipment from the condenser outlet to the connection with the nuclear steam supply system and to the heater drain system (plus secondary makeup system and auxiliary feedwater system interfaces for PWRs). Based on the review of the applicants proposed design criteria, the design bases, and safety classification for the safety-related portions of the condensate and feedwater system and the requirements for system performance for all conditions of plant operation, the staff concludes that the design of the condensate and feedwater system and supporting systems is

in conformance with the Commission regulations as set forth in General Design Criteria 2, 4, 5, 44, 45, and 46. This conclusion is based on the following:

1. The applicant has met the requirements of General Design Criterion 2 with respect to safety-related portions of the system being capable of withstanding the effects of earthquakes by meeting Regulatory Guide 1.29, Position C.1 for the safety-related portions and Position C.2 for the nonsafety-related portions.

2. The applicant has met the requirements of General Design Criterion 4 with respect to the dynamic effects associated with possible fluid flow instabilities (e.g., water hammers) by having the feedwater system designed in accordance with the guidance contained in Branch Technical Position 10-2 and thereby eliminating or reducing the possibility of water hammers in steam generators (PWRs only).

   The applicant has adequately addressed feedwater control valve and controller designs with respect to water hammer potential and the applicant has committed to review operating and maintenance procedures to ensure that precautions taken will minimize, or avoid, water hammers.

3. The applicant has met the requirements of General Design Criterion 5 with respect to the capability of shared systems and components important to safety to perform required safety functions. The interconnections of the CFS between each unit are designed so that the capability to mitigate the consequences of an accident in either unit and to achieve safe shutdown in that unit is retained without reducing the capability of the other unit to achieve safe shutdown.

4. The applicant has met the requirements of General Design Criterion 44 with respect to cooling water by providing a redundant and isolable system capable of transferring heat loads from the reactor system to a heat sink under both normal operating and accident conditions. The applicant has demonstrated that the condensate and feedwater system can provide sufficient cooling water to transfer the heat load of the reactor system under normal operating conditions. The applicant has also demonstrated that portions of the system can be isolated during accidents that occur concurrently with loss of onsite or offsite power and a single failure so that the safety function of the system will not be compromised.

5. The applicant has met the requirements of General Design Criterion 45 with respect to inspection of cooling water systems by providing a feedwater system design that permits inservice inspection of safety-related components and equipment, including inspection of piping systems for erosion and corrosion, and inspection of feedwater nozzles for fatigue.

6. The applicant has met the requirements of General Design Criterion 46 with respect to testing of cooling water systems by providing a feedwater system design that permits operational functional testing of the system and its components. Functional testing ensures structural integrity and leaktightness, operability, and performance of active components during normal, shutdown, and accident conditions.

The staff concludes that the design of the CFS conforms to all applicable GDCs and positions of the regulatory guide cited and is, therefore, acceptable.

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 2, "Design Bases for Protection Against Natural Phenomena."

2. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Dynamic Effects Design Bases."

3. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."

4. 10 CFR Part 50, Appendix A, General Design Criterion 44, "Cooling Water."

5. 10 CFR Part 50, Appendix A, General Design Criterion 45, "Inspection of Cooling Water System."

6. 10 CFR Part 50, Appendix A, General Design Criterion 46, "Testing of Cooling Water System."

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

8. Branch Technical Position 10-2, "Design Guidelines for Avoiding Water Hammer in Steam Generators."

9. Generic Letter 80-95, "Final Edition of NUREG-0619, 'BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking.'"

10. Generic Letter 81-11, "BWR Feedwater Nozzle Cracking."

11. Generic Letter 89-08, "Erosion/Corrosion-Induced Pipe Wall Thinning."

12. NUREG-0619, "BWR Feedwater Nozzle and Control Rod Drive Return Line Nozzle Cracking."

13. NUREG-0927, Revision 1, "Evaluation of Water Hammer Occurrences in Nuclear Power Plants," March 1984.

14. EPRI NP-3944, "Erosion/Corrosion in Nuclear Plant Steam Piping: Causes and Inspection Guidelines."

15. 10 CFR 52.47, “Contents of applications.”

16. 10 CFR 52.80(a), “Issuance of combined licenses.”