U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

10.3 MAIN STEAM SUPPLY SYSTEM

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of power conversion systems

Secondary - None

I. AREAS OF REVIEW

The main steam supply system (MSSS) for both boiling-water reactor (BWR) and pressurized-water reactor (PWR) plants transports steam from the nuclear steam supply system to the power conversion system and various safety-related and nonsafety-related auxiliaries. Portions of the MSSS may be used as a part of the heat sink to remove heat from the reactor facility during certain operations and may also be used to supply steam to drive engineered safety feature (ESF) pumps. The MSSS may also include provisions for secondary system pressure relief in PWR plants.

The MSSS for the BWR direct-cycle plant extends from the outermost containment isolation valves up to and including the turbine stop valves and includes connected piping that is 6.4 centimeters (2.5 inches) in nominal diameter and larger, up to and including the first valve that is either normally closed or is capable of automatic closure during all modes of reactor operation. The MSSS for the PWR indirect-cycle plant extends from the connections to the secondary sides of the steam generators, up to and including the turbine stop valves, and includes the containment isolation valves, safety and relief valves, connected piping that is 6.4 centimeters (2.5 inches) in nominal diameter and larger, up to and including the first valve that

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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is either normally closed or capable of automatic closure during all modes of operation, and the steamline to the auxiliary feedwater (AFW) pump turbine.

The review of the MSSS extends from the containment up to the turbine stop valve.

The specific areas of review are as follows:

1. The review should verify that portions of the MSSS that are essential for safe shutdown of the reactor or for preventing or mitigating the consequences of accidents are evaluated to determine the following:

   A. A single malfunction or failure of an active component would not preclude safety-related portions of the system from functioning as required during normal operations, adverse environmental occurrences, and accident conditions, including loss of offsite power.

   B. Appropriate quality group and seismic design classifications are met for safety-related portions of the system.

   C. The system is capable of performing multiple functions, such as transporting steam to the power conversion system, providing heat sink capacity or pressure relief capability, or supplying steam to drive safety system pumps (e.g., turbine-driven AFW pumps), as may be specified for a particular design.

   D. The MSSS design includes the capability to operate the atmospheric dump valves remotely from the control room following a safe-shutdown earthquake (SSE) coincident with the loss of offsite power so that a cold shutdown can be achieved by depending only on safety-grade components.

2. The MSSS review should include measures that limit blowdown of the system if a steamline were to break.

3. The review includes the design of the MSSS with respect to the following:

   A. Functional capability of the system to transport steam from the nuclear steam supply system as required during all operating conditions.

   B. Capability to detect and control system leakage and to isolate portions of the system in case of excessive leakage or component malfunctions.

   C. Capability to preclude accidental releases to the environment.

   D. Provisions for functional testing of safety-related portions of 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. Acceptability of the seismic and quality group classifications for system components is reviewed under SRP Sections 3.2.1 and 3.2.2.

2. Acceptability of the 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 SSE, probable maximum flood, and tornado missiles is reviewed 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.

3. Review for flood protection is performed under SRP Section 3.4.1.

4. Review of the protection against internally generated missiles outside containment is performed under SRP Section 3.5.1.1.

5. Review of the protection against internally generated missiles inside containment is performed under SRP Section 3.5.1.2.

6. Review of the SSCs to be protected against externally generated missiles is performed under SRP Section 3.5.2.

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

8. Review to determine whether piping, mechanical components, and support structures are designed in accordance with applicable codes and standards is performed under SRP Sections 3.9.1 through 3.9.3.

9. Review of the system design capability to withstand the adverse dynamic loads, such as water or steam hammer resulting from rapid valve closure and relief valve fluid discharge loads is performed under SRP Section 3.9.3.

10. Review of the adequacy of the inservice testing program of the system valves is performed under SRP Section 3.9.6.

11. Review of the seismic qualification of components is performed as part of the primary review responsibility for SRP Section 3.10.

12. Review of the environmental qualification of components is performed under SRP Section 3.11.

13. Review to identify essential components (associated with the portion of the MSSS inside the primary containment) that are required for normal operations and accident conditions, to establish shutdown cooling load requirements versus time, and to verify the design transient used in establishing the flow capacity and setpoints of steam generator relief and safety valves is performed under SRP Section 5.2.2.

14. Review of the compatibility of the materials of construction with service conditions is performed under SRP Sections 5.2.3 and 10.3.6.

15. Review of the design margins for decay heat removal during various accident conditions, including a comparison of system flow rates, heat loads, maximum temperatures, and heat removal capabilities to those of similarly designed systems for previously reviewed plants, is performed under SRP Section 5.4.7.

16. Review to assess the adequacy of the containment isolation system and the acceptability of the containment leakage testing program, is performed under SRP Sections Section 6.2.4 and 6.2.6.

17. Review of the main steam isolation valve leakage control system (MSIVLCS) is performed under SRP Section 6.7.

18. Review of portions of the MSSS with respect to the adequacy of design, installation, inspection, and testing of essential components necessary for instrumentation and control functions is performed under SRP Sections 7.1, 7.4, 7.5, and 7.7.

19. Review of the adequacy of the design, installation, inspection, and testing of all electrical systems required for proper operations is performed under SRP Section 8.3.1.

20. Review of the plant's capability to cope with a station blackout (SBO), including evaluation of required systems and their capabilities to support the overall determination of compliance with SBO requirements, is performed under SRP Section 8.4.

21. Review of fire protection is performed under SRP Section 9.5.1.

22. Review of the proper operation of the turbine stop valves is performed under SRP Section 10.2.

23. Acceptability of the preoperational and startup tests and is performed under SRP Section 14.2.

24. Review of technical specifications is performed under SRP Section 16.0.

25. Review of quality assurance is performed under SRP Chapter 17.

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

II. ACCEPTANCE CRITERIA

Requirements

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

1. GDC 2, as it relates to safety-related portions of the system being capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods.

2. GDC 4, with respect to safety-related portions of the system being capable of withstanding the effects of external missiles and internally generated missiles, pipe whip, and jet impingement forces associated with pipe breaks.

3. GDC 5, as it relates to the capability of shared systems and components important to safety to perform required safety functions.

4. GDC 34, as it relates to the system function of transferring residual and sensible heat from the reactor system in indirect-cycle plants.

5. 10 CFR 50.63, as it relates to the ability of a plant to withstand for a specified duration and then recover from an SBO.

6. 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;

7. 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. Acceptance of GDC 2 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. Acceptance of GDC 4 is based on the guidance of Regulatory Guide 1.115, Position C.1, as it relates to the protection of SSCs important to safety from the effects of turbine missiles.

   In addition, the system design should adequately consider water (steam) hammer and relief valve discharge loads to assure that system safety functions can be performed and should assure that operating and maintenance procedures include adequate precautions

to prevent water (steam) hammer and relief valve discharge loads. The system design should also include protection against water entrainment.

3. Compliance with 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 their ability to perform their intended safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units. Meeting the requirements of GDC 5 provides assurance that the main steam system and its associated components will continue performing their required safety functions even if they are shared by multiple nuclear power units.

4. Acceptance of GDC 34 is based on the following:

   A. The positions in Branch Technical Position 5-4, as they relate to the design requirements for residual heat removal (RHR)

   B. Issue Number 1 of NUREG-0138, as it relates to credit being taken for all valves downstream of the main steam isolation valves (MSIVs) to limit blowdown of a second steam generator if a steamline were to break upstream of the MSIV

5. Acceptance of 10 CFR 50.63 is based on meeting Regulatory Guide 1.155 as it relates to the MSSS design.

6. Regulatory Guide 1.29, Positions C.1.a, C.1.e, C.1.f, C.2 and C.3, as it relates to the seismic design classification of system components.

7. Regulatory Guide 1.117, Appendix Position 2 and 4, as it relates to the protection of SSCs important to safety from the effects of tornado missiles.

8. SECY 93-087, as it applies to BWR plants that do not incorporate an MSIVLCS and for which main steamline fission product holdup and retention are credited in the analysis of design-basis accident radiological consequences as follows:

   A. Seismic Category I is the classification for the main steamlines extending from the outermost containment isolation valve to the seismic interface restraint and connected piping up to the first normally closed valve.

   B. The nonseismic Category I classification can apply to the main steamlines from the seismic interface restraint up to, but not including, the turbine stop valve (including connected piping to the first normally closed valve) if the following criteria are met:

      i. A dynamic seismic analysis method analyzed the lines to demonstrate their structural integrity under SSE loading conditions.

      ii. All pertinent quality assurance requirements of Appendix B to 10 CFR Part 50 are applied.

      iii. For lines used as an MSIV leakage path to the condenser, reliable power sources must be available for control and isolation valves so that a control operator can establish the flowpath, assuming a single active failure.

C. Main steamlines and other main steam system components are assigned a quality group classification in accordance with the criteria of Branch Technical Position 3-1.

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 SSCs important to safety are designed to withstand the effects of postulated local natural phenomena, such as earthquakes, tornadoes, and floods without loss of the capability to perform their safety functions. The MSSS safety functions are specific to plant design and may include steam supply to safety-related auxiliaries and ESF pumps, provision of a heat sink during certain transients and accidents, limiting of reactor coolant system (RCS) pressure during certain transients, steam generator and MSSS overpressure protection, and termination of main steamline break (MSLB) events. The MSSS provides (1) for BWRs, fission product isolation during and following postulated accidents and (2) for BWRs without an MSIVLCS, fission product retention and holdup during and following an accident. The MSSS must perform its safety functions while withstanding natural phenomena that may reasonably be expected to occur at the plant site. Regulatory Guide 1.29 provides specific guidance for determining those SSCs that should be designated seismic Category I and therefore designed to meet the SSE. Regulatory Guide 1.117 includes specific guidance for determining the SSCs that should be designed to withstand the effects of a design-basis tornado. Meeting the requirements of GDC 2 and the positions of Regulatory Guide 1.29 and Regulatory Guide 1.117 will ensure that the MSSS can perform its required safety functions in the event of adverse natural phenomena.

2. GDC 4 requires that SSCs important to safety are designed to withstand potential dynamic effects, such as missile impact, pipe whip, and jet impingement caused by equipment failure or events outside the plant. The MSSS safety functions are specific to plant design and may include steam supply to safety-related auxiliaries and ESF pumps, provision of a heat sink during certain transients and accidents, limiting of RCS pressure during certain transients, steam generator and MSSS overpressure protection, and termination of MSLB events. The MSSS provides (1) for BWRs, fission product isolation during and following postulated accidents and (2) for BWRs without an MSIVLCS, fission product retention and holdup during and following an accident. The MSSS must perform its safety functions while withstanding the harshest effects of postulated plant equipment failures, such as pipe rupture, or potential external events, such as an airplane crash. Regulatory Guide 1.115 provides specific guidance for protecting safety-related SSCs from low-trajectory missiles resulting from turbine failure. Meeting the requirements of GDC 4 and the positions of Regulatory Guide 1.115 will offer assurance that the MSSS is capable of executing its safety functions in the event of adverse conditions caused by equipment failure or events outside the plant.

3. GDC 5 prohibits sharing of SSCs important to safety among nuclear units unless such sharing will not impair the ability of the SSCs to perform design safety functions in their respective units. The MSSS safety functions are specific to plant design and may include steam supply to safety-related auxiliaries and ESF pumps, provision of a heat sink during certain transients and accidents, limiting of RCS pressure during certain transients, steam generator and MSSS overpressure protection, and termination of MSLB events. The MSSS provides (1) for BWRs, fission product isolation during and following postulated accidents and (2) for BWRs without an MSIVLCS, fission product

retention and holdup during and following an accident. For multiple-unit sites, units may cross-connect the MSSSs for startup, maintenance, or other related purposes. For such shared systems, the licensee must show that each MSSS can perform all of its required safety functions for its respective unit. Meeting GDC 5 will ensure that shared MSSSs at multiple-unit sites will execute their respective safety functions regardless of malfunctions in the other units.

4. GDC 34 requires provision of an RHR system to remove decay and residual heat from the reactor and to maintain the fuel and reactor coolant pressure boundary within design limits. GDC 34 further requires that such RHR systems are designed with redundancy so that they can accomplish their safety functions, assuming a single failure in either the onsite or offsite electric power system. The MSSS may be used for safety functions such as removing decay heat or supplying steam to engineered safety feature pumps. The design of such MSSS safety functions must support the meeting of fuel and reactor coolant pressure boundary design limits by providing sufficient cooldown capacity and suitable power supply and redundancy to assure functionality during a loss of offsite power. Meeting GDC 34 ensures that the MSSS can fulfill its safety functions related to decay heat removal and cooling of the reactor.

5. 10 CFR 50.63 imposes explicit requirements on the plant regarding the capability to ensure that the core is cooled in the event of an SBO for a determined duration. The MSSS may supply pumps—for example, AFW or reactor core isolation coolant—and provide the decay heat removal capability necessary for core cooling and safe shutdown (nondesign-basis accident), respectively, during an SBO. Its design capability to operate regardless of alternating current power source availability enables performance of these important functions during an SBO. Regulatory Guide 1.155 identifies methods acceptable for complying with the requirements of 10 CFR 50.63. Meeting the requirements of 10 CFR 50.63 and the positions of Regulatory Guide 1.155 provides assurance that the MSSS is capable of supporting core cooling and/or safe shutdown (nondesign-basis accident) in the event of an SBO.

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 NRC staff uses the procedures below during a construction permit (CP) review to determine whether the design criteria and bases and the preliminary design in the preliminary safety analysis report (SAR) meet the acceptance criteria in Subsection II of this SRP section. For review of operating license (OL) applications, the procedures verify that the initial design criteria and bases have been appropriately implemented in the final design in the final SAR.

The procedures for OL applications include a determination that the content and intent of the applicant's technical specifications agree with the requirements for system testing, minimum performance, and surveillance, developed as a result of the technical specification review, as indicated in Subsection I of this SRP section.

The review procedures below are written for typical MSSSs for both direct- and indirect-cycle plants. The reviewer will select and emphasize material from this SRP section, as appropriate for a particular case.

1. Significant differences distinguish the design of the MSSS for an indirect-cycle (PWR) plant from that for a direct-cycle (BWR) plant. Furthermore, different portions of the MSSS are safety related in different plant designs, although the safety functions of the system are much the same in all PWR and BWR plants. The first step in the review of the MSSS is to determine those portions that are designed to perform a safety function. For this purpose, a system evaluation determines the components and subsystems necessary for achieving safe reactor shutdown under all conditions or for performing accident prevention or mitigation functions.

2. The reviewer determines that essential (safety-related) portions of the MSSS are correctly identified and are isolable, to the extent required, from nonessential portions of the system. Review of the system description and the piping and instrumentation diagrams (P&IDs) verifies that they clearly indicate the physical division between the safety-related and nonessential portions of the system. Review of the system arrangement drawings identifies the means provided for accomplishing system isolation.

3. A review of the seismic design bases and the quality and seismic classification is performed, as indicated in Subsection I of this SRP section. The SAR review verifies that essential portions of the MSSS are designed to Quality Group B and/or seismic Category I requirements and confirms that the design classifications specified satisfy the acceptance criteria specified in Subsection II of this SRP section. In general, the following apply:

   A. Seismic Category I and Quality Group B classifications apply to the main steamlines from the steam generators to the containment isolation valves in PWR plants.

   B. The main steamlines in BWR plants—extending from the outermost containment isolation valve and connected piping, up to and including the first valve that is either normally closed or capable of automatic closure during all modes of normal reactor operations, but not including the turbine stop and bypass valves—are classified as seismic Category I and are assigned a quality group classification in accordance with Branch Technical Position 3-1.

      Alternatively, for BWRs containing a shutoff valve (in addition to the two containment isolation valves) in the MSSS, seismic Category I and a quality group classification in accordance with Branch Technical Position 3-2 should apply to that portion of the MSSS extending from the outermost containment isolation valves, up to and including the shutoff valve.

   C. Main steamlines and other main steam system components in BWR plants that do not incorporate an MSIVLCS and that take credit for fission product holdup and retention in the main steamlines are reviewed for compliance with the criteria of II.8.

      Details of the quality group and seismic classification of main steamlines for BWRs without an MSIVLCS are addressed in Table A-1 and Figure A-1 of Branch Technical Position 3-1.

4. Review of the SAR assures that design provisions permit appropriate functional testing of system components important to safety. It is acceptable if the SAR delineates a testing and inspection program and the system drawings show any test recirculation loops or special connections around isolation valves that this program would require.

5. Review of the system description, safety evaluation, component table, and P&IDs verifies that the system has been designed for the following functions:

   A. Provide the necessary quantity of steam to any turbine-driven safety system pumps. The reviewer verifies that the design is capable of furnishing the required steam flow to the turbine so that an adequate supply of water can be pumped.

   B. Assure safe plant operation by including appropriate design margins for pressure relief capacity and setpoints for the secondary system.

   C. For PWRs, the design review verifies the design capability of the atmospheric dump valves supporting a controlled cooldown to about 177 °C (350 °F) to allow actuation of the RHR system.

   D. Provide a means to detect steam leakage from the system if a steamline were to break. Temperature or pressure sensors are an acceptable means for initiating signals to close the main steamline isolation valves and/or turbine stop valves to limit the release of steam during a steamline break accident.

   E. Assure that, in the event of a postulated break in a main steamline in a PWR plant, the design will preclude the blowdown of more than one steam generator, assuming a concurrent single active component failure. In this regard, all main steam shutoff valves downstream of the MSIVs, the turbine stop valves, and the control valves are considered to be functional. The reviewer should verify that the MSIVs, shutoff valves in connected piping, turbine stop valves, and bypass valves can close against maximum steam flow. The reviewer verifies that the SAR provides a tabulation and descriptive text of all flowpaths that branch off the main steamlines between the MSIVs and the turbine stop valves. The descriptive information should include the following for each flowpath:

      i. System identification

      ii. Maximum steam flow in pounds per hour (kilograms per second)

      iii. Type of shutoff valves

      iv. Size of valves

      v. Quality of the valves

      vi. Design code of the valves

      vii. Closure time of the valves

viii. Actuation mechanism of the valves (i.e., solenoid-operated, motor-operated, air-operated diaphragm, and the like)

ix. Motive or power source for the valve actuating mechanism

F. In the event of a main steamline break, terminate steam flow from all systems identified in item E above, except those that can be used for mitigation of the accident, as required to bring the reactor to a safe cold shutdown. For these systems, the reviewer verifies that the SAR describes the design features that have been incorporated to assure closure of the steam shutoff valves as well as any required operator actions. If the systems that can be used to mitigate the accident were not available, or if the decision were to be made to use other means to shut down the reactor, the reviewer verifies that the SAR describes the securing of these systems to assure positive steam shutoff as well as any required operator actions.

G. Assure that, in the event of a postulated SSE in a PWR plant, the design includes the capability to operate atmospheric dump valves remotely from the control room so that cold shutdown can be achieved by using only safety-grade components, assuming a concurrent loss of offsite power (refer to Branch Technical Position 5-4).

H. If (N-1) loop operation is anticipated, assure that the MSSS has been evaluated for the effects of (N-1) loop operation on the supply of steam to turbine-driven safety system pumps.

6. The reviewer verifies that the system is designed so that essential functions will be maintained, as required, in the event of adverse environmental phenomena, certain pipe breaks, or loss of offsite power. The reviewer uses engineering judgment and the results of failure modes and effect analyses to determine the following:

A. Failure of nonseismic Category I portions of the MSSS or of other systems located close to essential portions of the system—or of nonseismic Category I structures that house, support, or are close to essential portions of the MSSS—does not preclude operation of the essential portions of the MSSS. Reference to SAR sections describing site features and the general arrangement and layout drawings will be necessary, as well as the SAR tabulation of seismic design classifications for structures and systems. Statements in the SAR that confirm that the above conditions are met are acceptable.

B. Essential portions of the MSSS are protected from the effects of floods, hurricanes, tornadoes, and internally and externally generated missiles. Flood protection and missile protection criteria are evaluated under the SRP Section 3 series. Review of the locations and design of the system and structures determines whether the degree of protection provided is adequate. A statement to the effect that the system is located in a seismic Category I structure that is protected from tornado missiles and floods or that components of the system will be located in individual cubicles or rooms that will withstand the effects of winds, flooding, and tornado missiles is acceptable.

C. Essential components and subsystems necessary for safe shutdown can function as required in the event of loss of offsite power. Review of the SAR verifies that, for each MSSS component or subsystem affected by a loss of offsite power, the

system functional capability meets or exceeds minimum design requirements. Statements in the SAR and results of failure modes and effects analyses are considered in assuring that the system meets these requirements. This approach is an acceptable verification of system functional reliability.

7. Review of the descriptive information, P&IDs, MSSS drawings, and failure modes and effects analyses in the SAR to assure that essential portions of the system will function following design-basis accidents, assuming a concurrent single active component failure. The reviewer evaluates the analyses in the SAR to assure the functionality of required components, traces the availability of these components on system drawings, and checks that the SAR verifies that minimum requirements are met for each accident situation for the required time spans. For each case, the design is acceptable if minimum system requirements are met.

8. Review of the SAR to assure that the applicant has committed to address the potential for water (steam) hammer and relief valve discharge loads and will take adequate action to minimize such occurrences. Drain pots, line slope, and valve operators should be addressed.

9. The reviewer confirms that the MSSS capability is sufficient with respect to the plant's ability to cope with, and recover from, an SBO of a specified duration by determining compliance with Regulatory Guide 1.155, Positions C.3.2, C.3.3, and C.3.5, as they relate to the design of the MSSS. This review is coordinated with the review of the SBO event under SRP Section 8.4.

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 MSSS includes all components and piping from the outermost containment isolation valves for BWRs—and from the steam generator connection for PWRs—up to and including the turbine stop valves. The essential portions of the MSSS are designed to Quality Group B, specifically (1) for PWRs, from the steam generator to the containment isolation valves as well as connected piping up to and including the first valve that is normally closed and (2) for BWRs, from the outermost containment isolation valves and connecting piping up to and including the

first valve that is either normally closed or capable of automatic closure during all modes of normal reactor operation, but not including the turbine stop and bypass valves. Those portions of the MSSS necessary to mitigate the consequences of an accident such as a steamline break are designed to the quality standards commensurate with the importance of their safety functions and are designed to the standards listed below.

The scope of review of the MSSS for this plant included layout drawings, P&IDs, and descriptive information for the system.

The basis for acceptance of the MSSS in this review was the degree to which the applicant's design criteria and bases conform to the Commission's regulations in 10 CFR 50.63 and in the GDC in Appendix A to 10 CFR Part 50. The staff concludes that the plant design is acceptable and meets the requirements of GDC 2, 4, 5, and 34 and of 10 CFR 50.63. This conclusion is based on the following:

1. The applicant has met the requirements of (1) GDC 2 with respect to the capability of structures housing the safety-related portion of the system and the safety-related portions of the system to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods and (2) GDC 4 with respect to the capability of structures housing the safety-related portions of the system and the safety-related portions of the system to withstand the effects of external missiles, internally generated missiles, and pipe whip and jet impingement forces associated with pipe breaks. The essential portions of the MSSS (as identified in the above discussion) are designed to seismic Category I and are housed in a seismic Category I structure that provides protection from the effects of tornadoes, tornado missiles, turbine missiles, and floods. This approach meets Regulatory Guide 1.29, Positions C.1.a, C.1.e, C.2 and C.3 or C.1.f, C.2, and C.3; Regulatory Guide 1.115, Position C.1; and Regulatory Guide 1.117, Appendix Positions 2 and 4.

   In addition, the system design includes the capability to accommodate water (steam) hammer dynamic loads resulting from rapid closure of system valves (including turbine bypass and stop valves) and safety/relief valve operation, without compromising required safety functions. Water entrainment considerations include provisions for drain pots, line sloping, and valve operation. The applicant will review operating and maintenance procedures to alert plant personnel to the potential for, and means to minimize, water (steam) hammer occurrences. This commitment is stated in the applicant's SAR.

2. The applicant has met the requirements of GDC 5 with respect to the capability of shared systems and components important to safety to perform required safety functions. The NRC staff has reviewed the interconnections from the MSSS of each unit to. The interconnections are designed so that the capability to mitigate the consequences of an accident in either unit and achieve safe shutdown in that unit is retained, without reducing the capability of the other unit to achieve safe shutdown.

   Alternatively, each unit of the plant has its own MSSS with no interconnections between the safety-related and nonsafety-related portions.

3. The applicant has met the requirements of GDC 34 with respect to the system function of transferring residual and sensible heat from the reactor system in PWR plants. The MSSS can provide heat sink capacity and pressure relief capability and can supply steam to the steam-driven, safety-related pumps necessary for safe shutdown. The MSSS design includes the capability to operate the atmospheric dump valves remotely

from the control room following an SSE coincident with the loss of offsite power so that a cold shutdown can be achieved by depending on only safety-grade components. This approach meets the positions in Branch Technical Position 5-4 and in Issue 1 of NUREG-0138.

4. The applicant has met the requirements of 10 CFR 50.63 with respect to MSSS capacity and capability for responding to an SBO. Acceptance is based on meeting the guidance of Regulatory Guide 1.155, Positions C.3.2, C.3.3, and C.3.5.

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.

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulations, regulatory guides, and NUREGs; implementation of the acceptance criterion in Subsection II.2, associated with water (steam) hammer loads, is as follows:

1. Plants with an OL issued before April 1, 1984, and OL applicants docketed before April 1, 1984, need not comply with the provisions of this item, but may voluntarily do so.

2. OL, CP, DC, and COL applications docketed on or after April 1, 1984, will be reviewed according to the provisions of this item.

The provisions of the specific Acceptance Criterion 1.C apply to reviews of applications for BWRs that do not incorporate an MSIVLCS and for which main steamline fission product holdup and retention are credited in the analysis of design-basis accident radiological consequences.

VI. REFERENCES

1. 10 CFR 50.63, "Loss of All Alternating Current Power."

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 4, "Environmental and Dynamic Effects Design Bases."

4. 10 CFR Part 50, Appendix A, General Design Criterion 5, “Sharing of Structures, Systems, and Components.”

5. 10 CFR Part 50, Appendix A, General Design Criterion 34, “Residual Heat Removal.”

6. Regulatory Guide 1.29, “Seismic Design Classification.”

7. Regulatory Guide 1.115, “Protection Against Low-Trajectory Turbine Missiles.”

8. Regulatory Guide 1.117, “Tornado Design Classification.”

9. Regulatory Guide 1.155, “Station Blackout.”

10 Branch Technical Position 3-1, “Classification of Main Steam Components Other than the Reactor Coolant Pressure Boundary for BWR Plants.”

11. Branch Technical Position 3-2, “Classification of BWR/6 Main Steam and Feedwater Components Other than the Reactor Coolant Pressure Boundary.’

12. Branch Technical Position 5-4, “Design Requirements of the Residual Heat Removal System.”

13. U.S. Nuclear Regulatory Commission. “Staff Discussion of Fifteen Technical Issues Listed in Attachment to November 3, 1976, Memorandum from Director NRR to NRR Staff.” NUREG-0138. Washington, DC.

14. U.S. Nuclear Regulatory Commission. “Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor (ALWR) Designs,” SECY 93-087. Washington, DC. April 2, 1993.

15. NRC Letter to All Licensees of Operating BWRs and PWRs and License Applicants, “Technical Resolution of Generic Issue No. B-59, (N-1) Loop Operation in BWRs and PWRs, (Generic Letter 86-09),” March 31, 1986.

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

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.
