U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER^{TM} iPWR DESIGN

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) transports steam from the steam generator to the power conversion system and various auxiliaries during normal plant operation. Portions of the MSSS may be used as part of the heat sink to remove heat from the reactor facility during certain operations. The MSSS may also include provisions for seconday system pressure relief.

The MSSS extends from the connections to the secondary side 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 is either normally closed or capable of automatic closure during all modes of operation.

For the mPower^{TM} design, the safety-related portions of the MSSS include the piping and valves associated with the containment and main steam isolation functions and the main steam safety relief valves. Unlike existing large pressurized-water reactors (PWRs), the mPower MSSS does not supply steam to drive safety-related engineered safety feature (ESF) pumps such as auxiliary feedwater pumps.

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 or risk-significant 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 or risk-significant 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 for normal operations and shutdown, system isolation, or pressure relief capability.

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D. The MSSS is designed to minimize the potential for, and to provide protection against, the effect of adverse dynamic loads such as water (steam) hammer resulting fron rapid valve closure and relief valve fluid discharge loads.

E. Failures of nonseismic Category I equipment or structures, or cracks and breaks in moderate and high energy piping will not impact safety-related, or risk-significant structures, systems, and components (SSCs).

F. 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

mPower is a passive plant design. Because of the functional limitations of the passive plant designs, the Commission, in a staff requirements memorandum (SRM), dated June 30, 1994, approved the position in SECY-94-084, “Policy and Technical Issues Associated with the Regulatory Treatment of Non-safety systems in Passive Plant Designs,” dated March 28, 1994. This position accepts a value of 215.6 degrees C (420 degrees F) or lower (rather than the cold shutdown specified in Regulatory Guide (RG) 1.139, “Guidance for Residual Heat Removal,” issued for comment in May 1978) as the safe, stable condition that the passive systems must be capable of achieving and maintaining following events other than loss-of-coolant accidents (LOCAs).

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 SSCs related to this design-specific review standard (DSRS) section in accordance with Standard Review Plan (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 DSRS 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 DSRS Sections 14.2 and 14.3.7.

5. Review should include – Inspection and Tests as appropriate in accordance with DSRS Section 14.2:

A. Pre-operational and startup test program for valve testing, system testing, and pipe testing.

B. Inservice Test Program.

C. Chemistry Control and Flow Accelerated Corrosion (FAC) Program.

6. 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 DSRS and SRP sections interface with this section as follows:

1. Acceptability of the seismic and quality group classifications for system components is reviewed under DSRS 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 DSRS Sections 3.3.1, 3.3.2, 3.5.3, 3.7.2, and SRP Sections 3.7.1, 3.7.3, 3.7.4, 3.8.4, and 3.8.5.

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

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

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

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

7. Review of high- and moderate-energy pipe breaks is performed under DSRS 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 DSRS Section 3.9.1, and SRP Sections 3.9.2 and 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 DSRS Section 3.9.6.

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

12. Review of the environmental qualification of components is performed under DSRS 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 DSRS Section 5.2.2.

14. Review of the compatibility of the materials of construction with service conditions is performed under DSRS 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 DSRS 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 DSRS Sections 6.2.4 and 6.2.6.

17. 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 DSRS Chapter 7.

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

19. 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 DSRS Section 8.4.

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

21. Review of the proper operation of the turbine steam admission valves, including extraction steam non-return valves, is performed under DSRS Section 10.2.

22. Acceptability of the preoperational and startup tests and is performed under DSRS Section 14.2.

23. Review of technical specifications is performed under DSRS Section 16.0.

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

25. Review of the probabilistic risk assessment is performed under SRP Chapter 19.

For those areas of review identified above as part of the primary review responsibility of other staff, the acceptance criteria necessary for the review and their methods of application are contained in the referenced DSRS and SRP sections of the corresponding primary reviewers.

II. ACCEPTANCE CRITERIA

Requirements

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

1. General Design Criterion (GDC) 2, as it relates to the capability of the system to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, and floods.

2. GDC 4, with respect to the capability of the system to withstand 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. Title 10 of the *Code of Federal Regulations* (CFR), Section 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 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 facility that incorporates the DC has been constructed and will be operated in conformity with the DC, the provisions of the Atomic Energy Act (AEA), and the U.S. Nuclear Regulatory Commission's (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 be operated in conformity with the COL, the provisions of the AEA, and the NRC's regulations.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are set forth belowas follows for review described in this DSRS section. The DSRS is not a substitute for the NRC's regulations, and compliance with it is not required. Identifying the differences between this DSRS section and the design features, analytical techniques, and procedural measures proposed for the facility, and discussing how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria, is sufficient to meet the intent of 10 CFR 52.47(a)(9), "Contents of applications; technical information." The same approach may be used to meet the requirements of 10 CFR 52.79(a)(41) for COL applications.

1. Acceptance of GDC 2 is based on meeting the guidance of RG 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 RG 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 SSCs 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 (BTP) 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 RG 1.155 as it relates to the MSSS design

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

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

Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this DSRS 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 include steam line isolation, steam generator and MSSS overpressure protection, and termination of main steamline break (MSLB) events. The MSSS must perform its safety functions while withstanding natural phenomena that may reasonably be expected to occur at the plant site. RG 1.29 provides specific guidance for determining those SSCs that should be designated seismic Category I and therefore designed to meet the SSE. RG 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 RG 1.29 and RG 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 include steam line isolation, steam generator and MSSS overpressure protection, and termination of MSLB events. 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. RGuide 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 RG 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 include steam line isolation, steam generator and MSSS overpressure protection, and termination of MSLB events. 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 design of the MSSS 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 and NUREG-0138 ensures that the MSSS can fulfill its safety function 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 steam to the auxiliary condenser, which may be used to provide the decay heat removal capability for core cooling and safe-shutdown (non-design-basis accident (DBA)), during an SBO. Its design capability to operate regardless of alternating current power source availability enables performance of these important functions during an SBO. RG 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 RG 1.155 provides assurance that the MSSS is capable of supporting core cooling and/or safe-shutdown (non-DBA) 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 DSRS 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.

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

1. Programmatic Requirements – In accordance with the guidance in NUREG-0800 "Introduction," Part 2 as applied to this DSRS Section, the staff will review the programs proposed by the applicant to satisfy the following programmatic requirements. If any of the proposed programs satisfies the acceptance criteria described in Subsection II, it can be used to augment or replace some of the review procedures. It should be noted that the wording of "to augment or replace" applies to nonsafety-related risk-significant SSCs, but "to replace" applies to nonsafety-related nonrisk-significant SSCs according to the "graded approach" discussion in NUREG-0800 "Introduction," Part 2. Commission regulations and policy mandate programs applicable to SSCs that include:

   A. Maintenance rule, SRP Section 17.6 (DSRS Section 13.4, Table 13.4, Item 17, RG 1.160, "Monitoring the Effectiveness of Maintenance at Nuclear Power Plants," and RG 1.182, "Assessing and Managing Risk Before Maintenance Activities at Nuclear Power Plants."

   B. Quality Assurance Program, SRP Sections 17.3 and 17.5 (DSRS Section 13.4, Table 13.4, Item 16).

   C. Technical Specifications (DSRS Section 16.0 and SRP Section 16.1) – including brackets value for DC and COL. Brackets are used to identify information or characteristics that are plant specific or are based on preliminary design information.

   D. Reliability Assurance Program (SRP Section 17.4).

   E. Initial Plant Test Program (RG 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," DSRS Section 14.2, and DSRS Section 13.4, Table 13.4, Item 19).

   F. ITAAC (DSRS Chapter 14).

2. In accordance with 10 CFR 52.47(a)(8),(21), and (22), for new reactor license applications submitted under Part 52, the applicant is required to (1) address the proposed technical resolution of unresolved safety issues and medium- and high-priority generic safety issues that are identified in the version of NUREG-0933 current on the date 6 months before application and that are technically relevant to the design; (2) demonstrate how the operating experience insights have been incorporated into the plant design; and, (3) provide information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v). These cross-cutting review areas should be addressed by the reviewer for each technical subsection and relevant conclusions documented in the corresponding safety evaluation report (SER) section.

3. 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. Programmatic requirements are identified that provide verification or confirmation of isolation functions.

4. A review of the seismic design bases and the quality and seismic classification is performed, as indicated in Subsection I of this DSRS section. The 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 DSRS section. In general, seismic Category I and Quality Group B classifications apply to the main steamlines from the steam generators to the containment isolation valves (i.e.,first anchor after the second MSIV).

5. The review assures that design provisions permit appropriate functional testing of system components important to safety. It is acceptable if the safety analysis report (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.

6. Review of the system description, safety evaluation, component table, P&IDs, and the implementation of the programmatic requirements identified in the acceptance criteria of this DSRS section, verifies that the system has been designed for the following functions:

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

   B. The review verifies the design capability of the atmospheric dump valves to support a controlled cooldown to conditions that allow actuation of the RHR system.

   C. 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.

   D. 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

E. In the event of a main steamline break, terminate steam flow from all systems identified in Item D 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.

F. 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 BTP 5-4).

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7. 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 DSRS Chapter 3. 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.

8. 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.

9. 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.

10. 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 RG 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 DSRS 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, DSRS 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 staff's technical review and analysis support conclusions of the following type to be included in the staff's SER. The reviewer also states the bases for those conclusions.

The MSSS includes all components and piping from the steam generator connection up to and including the turbine stop valves. The essential portions of the MSSS are designed to Quality Group B, from the steam generator to the outermost containment isolation valve as well as 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 operation. 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 the GDCs 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, 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 RG 1.29, Positions C.1.f, C.2, and C.3; RG 1.115, Position C.1; and RG 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. 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 BTP 5-4 and in Issue 1 of NUREG-0138.

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 DSRS 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 acceptance criteria, as applicable.

V. IMPLEMENTATION

The staff will use this DSRS section in performing safety evaluations of mPower^{TM}-specific DC, or COL applications submitted by applicants pursuant to 10 CFR Part 52. The staff will use the method described herein to evaluate conformance with Commission regulations.

Because of the numerous design differences between the mPower^{TM} and large light-water nuclear reactor power plants, and in accordance with the direction given by the Commission in SRM-COMGBJ-10-0004/COMGEA-10-0001, "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews," dated August 31, 2010 (Agencywide Documents Access and Management System Accession No. ML102510405), to develop risk-informed licensing review plans for each of the small modular reactor reviews, including the associated pre-application activities, the staff has developed the content of this DSRS section as an alternative method for mPower^{TM} -specific DC, COL, or ESP applications submitted pursuant to 10 CFR Part 52 to comply with 10 CFR 52.47(a)(9), "Contents of applications; technical information."

This regulation states, in part, that the application must contain "an evaluation of the standard plant design against the Standard Review Plan (SRP) revision in effect 6 months before the docket date of the application." The content of this DSRS section has been accepted as an alternative method for complying with 10 CFR 52.47(a)(9), as long as the mPower^{TM} DCD FSAR does not deviate significantly from the design assumptions made by the NRC staff while preparing this DSRS section. The application must identify and describe all differences between the standard plant design and this DSRS section, and discuss how the proposed alternative provides an acceptable method of complying with the regulations that underlie the DSRS acceptance criteria. If the design assumptions in the DC application deviate significantly

from the DSRS, the staff will use the SRP as specified in 10 CFR 52.47 (a)(9). Alternatively, the staff may supplement the DSRS section by adding the appropriate criteria in order to address new design assumptions. The same approach may be used to meet the requirements of 10 CFR 52.79 (a)(41), for COL applications.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, GDC 2, “Design Bases for Protection Against Natural Phenomena.”

2. 10 CFR Part 50, Appendix A, GDC 4, “Environmental and Dynamic Effects Design Bases.”

3. 10 CFR Part 50, Appendix A, GDC 5, “Sharing of Structures, Systems, and Components.”

4. 10 CFR Part 50, Appendix A, GDC 34, “Residual Heat Removal.”

5. RG 1.29, “Seismic Design Classification.”

6. RG 1.115, “Protection Against Low-Trajectory Turbine Missiles.”

7. RG 1.117, “Tornado Design Classification.”

8. NRC, “Staff Discussion of Fifteen Technical Issues Listed in Attachment to November 3, 1976, Memorandum from Director NRR to NRR Staff,” NUREG-0138, Washington, D.C.