U.S. NUCLEAR REGULATORY COMMISSION

DESIGN-SPECIFIC REVIEW STANDARD FOR mPOWER™ iPWR DESIGN

9.2.6 CONDENSATE STORAGE FACILITIES

REVIEW RESPONSIBILITIES

Primary - Organization responsible for the review of cooling water systems

Secondary - None

I. AREAS OF REVIEW

The condensate storage facility (CSF) serves as a receiver for excess water generated by other systems such as the main condenser hotwell, liquid radioactive waste system low-activity reprocessed condensate, and the makeup water treatment system. The CSF also functions as the water supply or makeup source for various auxiliary systems that require water during normal and emergency operations.

The CSF may be designed either as a safety-related or as nonsafety-related structure, system, or component (SSC), depending on the plant. The safety-related function performed by the CSF is to ensure an adequate supply of water if it is required for the safe shutdown of the reactor. Normal plant system functions performed by the CSF, such as supplying makeup water to the condenser hotwells and other auxiliary systems of the plant, are reviewed to verify that any failure will not adversely affect the safety-related or risk-significant functions of SSCs in other systems.

In accordance with the guidance in NUREG – 0800 *"Introduction Part 2*, an SSC may be classified as:

(1) Safety-related risk-significant
(2) Safety-related nonrisk-significant
(3) Nonsafety-related risk-significant, or
(4) Nonsafety-related non-risk significant

The classification of SSCs, a list of risk-significant SSCs, and a list of regulatory treatment of non-safety systems (RTNSS) will be provided by the applicant. Based on this information, the staff will review according to Design Specific Review Standard (DSRS) Section 3.2, and Standard Review Plan (SRP) Sections 17.4 and 19.3 to confirm the determination of the safety-related and risk-significant SSCs. For the purpose of brevity in this section the first three categories above will be designated as "safety-related or risk-significant."

The review performed by the responsible organization includes the CSF from the condensate storage tank up to the connections or interfaces with other systems to ensure conformance with the requirements of 10 CFR Part 50, Appendix A, General Design Criteria (GDC) 2, 5, 44, 45, 46, and 60 and with 10 CFR 20.1406 and 10 CFR 50.63.

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The specific areas of review are as follows:

1. The responsible organization reviews the CSF to determine if the system is safety-related or risk-significant.

2. The responsible organization reviews the capability of the CSF to supply water to various auxiliary systems and to receive return water from other systems.

3. The responsible organization reviews the CSF to verify the following:

   A. Failures of CSF components do not adversely affect safety-related or risk-significant SCCs either directly as a result of system connections, or indirectly as a result of structural failure or flooding resulting from structural or system failure.

   B. The portions of the CSF that are identified as safety-related, or risk-significant are protected from the effects of natural phenomena including cold weather, tornadoes, and flooding such that the events will not have an adverse affect on the system's ability to perform its safety-related or risk-significant functions.

   C. The safety-related and risk-significant portions of the CSF possess the component redundancy necessary to ensure the performance of CSF safety or risk-significant functions.

   D. System components meet design code requirements consistent with the component quality group and seismic design classifications.

   E. Provisions for mitigating the environmental effects of system leakage or storage tank failure are furnished.

   F. Provisions for the safe handling of storage tank overflow, the associated instrumentation necessary to detect high or low water levels, and a means of isolation are supplied.

   G. Provisions for automatic transfer from a normal water supply that is non-safety related to an assured seismic Category I source, if required, are furnished.

   H. The CSF system is designed with adequate design features and provisions that, when supplemented by adequate operating procedures will provide reasonable assurance that the potential for release of radioactive material to the facility, site and environment will be minimized.

3. For plants in which the design relies on the CSF in response to a station blackout (SBO), the responsible organization reviews the CSF design to verify that the CSF capacity is adequate for the plant SBO event coping period, and that the required flow path from the CSF to SSC's required for SBO coping, can be established and maintained independent of normal class 1E power supplies.

4. Inspections, Tests, Analyses, and Acceptance Criteria. For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) associated with the SSCs related to

this DSRS section in accordance with SRP Section 14.3, ITAAC. 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 SRP Section 14.3 and DSRS Section 14.3.7.

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 DSRS or SRP sections interface with this section as follows:

1. Review of flood protection under DSRS Section 3.4.1

2. Review of the protection against internally generated missiles under DSRS Section 3.5.1.1

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

4. Review of high- and moderate-energy pipe breaks under SRP Section 3.6.1

5. Evaluation of the radioactivity concentrations in the CSF as part of its primary review responsibility under DSRS Section 11.1

6. Review of electrical systems required to provide risk-significant functions of the CSF under DSRS Sections 8.3.1, 8.3.2, and 8.4

7. Review of the assured supply of water to ultimate heat sink storage tanks under DSRS Section 9.2.5

8. Review of the assured supply of water to the spent fuel pool cooling and cleanup system under DSRS Section 9.1.3

9. Review of fire protection under SRP Section 9.5.1

10. Review of the condensate and feedwater system under DSRS Section 10.4.7.

11. Review of initial tests, and system inspection, test, analyses and acceptance criteria under DSRS Section 14.2 and SRP Section 14.3.

12. Review of risk significance of CSF SSCs required availabilities and failure modes and effects under SRP Chapter 19.0.

In addition, the lead organization will coordinate other organization evaluations that interface with the overall review of the system as follows:

1. As a part of its primary review responsibility under DSRS Section 6.3, the organization responsible for reactor systems will identify safety-related or risk significant portions of the facilities that must function during normal operations and accident conditions and will assist in establishing the basis for the minimum condensate storage capacity.

2. As part of its review responsibility under DSRS Sections 3.9.1, 3.9.2, and SRP section 3.9.3, the organization responsible for mechanical engineering will determine that components, piping, and structures are designed in accordance with applicable codes and standards. As part of its primary review responsibility under DSRS Sections 3.2.1 and 3.2.2, this organization will also determine the acceptability of the seismic and quality group classifications for system components. The review will address the adequacy of the inservice testing program for pumps and valves under DSRS Section 3.9.6.

3. As part of the reviews performed under DSRS Sections 3.3.1, 3.3.2, 3.5.3, and 3.7.2, and SRP Sections 3.7.4, 3.7.1, 3.7.3, 3.8.4 and 3.8.5, the organizations responsible for structural engineering and/or geosciences will determine the 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 safe-shutdown earthquake, probable maximum flood, and tornado-generated missiles. As part of its review responsibility, the organization responsible for reviews under DSRS Section 6.6 will verify that the inservice inspection requirements are met for system components.

4. As part of its primary review responsibility under DSRS Section 6.1.1, the organization responsible for materials and chemical engineering will verify the compatibility of the materials of construction with the service conditions.

5. As part of its primary review responsibilities under DSRS Sections 8.3.1 and 8.3.2, the organization responsible for electrical engineering will verify the adequacy of the design, installation, inspection, and testing of all electrical systems (sensing, control, and power) required for proper operation. As part of its responsibility, the responsible organization also will review the plant with respect to SBO requirements and will coordinate with the reviewer for DSRS Section 9.2.6 with respect to the capacity and capability of the CSF during an SBO.

6. As part of its review responsibilities under DSRS Chapter 7, the organization responsible for instrumentation and controls will verify the adequacy of the design, installation, inspection, and testing of all instrumentation and control systems (sensing, control, and power) required for proper operation.

7. As part of its primary review responsibility under DSRS Section 12.1, the organization responsible for radiation protection will review the facility design to ensure that radiation exposure for personnel will be maintained as low as is reasonably achievable.

8. As part of its review responsibility under DSRS Section 16.0, the organization responsible for technical specifications will coordinate and perform the review for technical specifications.

9. As part of its review responsibility under SRP Chapter 17, the organization responsible for quality assurance will perform the review for quality assurance.

10. As part of its review responsibility under SRP Chapter 19, the organization responsible for probabilistic risk assessment will perform the review to identify any risk significant aspects of the CSF SSCs in affecting the frequency or consequence of accidents that result in core damage.

II. ACCEPTANCE CRITERIA

Requirements

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

1. GDC 2 as related to the system's capability to withstand the effects of natural phenomena, including earthquakes and tornadoes.

2. GDC 5 as related to the capability of shared systems and components to perform required safety functions.

3. GDC 44 as related to ensuring the following:

   A. Redundancy of components so that, under normal and accident conditions, the safety function can be performed assuming a single active component failure coincident with the loss of offsite power

   B. The capability to isolate components, subsystems, or piping if required so that the system safety function will not be compromised

   C. The capability to provide sufficient makeup water to safety-related or risk-significant cooling systems.

4. GDC 45 as related to design provisions that permit inservice inspection of safety-related components and equipment.

5. GDC 46 as related to design provisions that permit operational functional testing of safety-related systems and components to ensure structural integrity, system leak-tightness, operability and performance of active components, and capability of the

integrated system to function as intended during normal, shutdown, and accident conditions.

6. The CSF must meet GDC 60 as it relates to tanks and systems handling radioactive material in liquids.

7. 10 CFR 20.1406, as it relates to facility design and procedures for operation that will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

8. 10 CFR 50.63 as related to design provisions to support the plant's ability to withstand and recover from a SBO.

9. 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.

10. 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.

DSRS Acceptance Criteria

Specific DSRS acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are set forth below. 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."

1. Protection Against Natural Phenomena. Acceptance for meeting the relevant aspects of GDC 2 is based in part on meeting the guidance of Position C.1 of Regulatory Guide (RG) 1.29 if any portion of the system is deemed to be safety related and the guidance of Position C.2 RG 1.29 for nonsafety-related portions. Also, acceptance is based in part on (1) meeting the guidance of RG 1.117 with respect to identifying portions of the system that should be protected from tornadoes and (2) meeting the guidance of RG 1.102 with respect to identifying portions of the system that should be protected from flooding.

2. Sharing of Structures, Systems, and Components. Information that addresses the requirements of GDC 5 regarding the capability of safety-related or risk-significant shared systems and components important to safety to perform required safety functions will be considered acceptable if the use of the CSF in multiple-unit plants during an accident in one unit does not significantly affect the capability to conduct a safe and orderly shutdown and cool-down in the unaffected unit(s).

3. Condensate Storage Facility. Information that addresses the requirements of GDC 44 regarding consideration of the cooling water system will be considered acceptable if a system to transfer heat from SSCs important to safety to an ultimate heat sink is provided. In addition, the CSF can supply makeup water to these SSCs to transfer the combined heat load of these SSCs under normal operating and accident conditions, assuming loss of offsite power and a single failure, and that system portions can be isolated so the safety-related or risk-significant functions of these SSCs is not compromised.

4. Condensate Storage Facility Inspection. Information that addresses the requirements of GDC 45 regarding the inspection of cooling water systems will be considered acceptable if the design of the CSF permits inservice inspection of safety-related or risk-significant components and equipment and operational functional testing of the system and its components.

5. Condensate Storage Facility Testing. Information that addresses the requirements of GDC 46 regarding the testing of cooling water systems will be considered acceptable if the CSF is designed for testing to detect degradation in performance or in the system pressure boundary so that the CSF will function reliably to provide decay heat removal and essential cooling for safety-related or risk-significant equipment.

6. Control of Radioactive Releases to the Environment. Acceptance for meeting the relevant aspects of GDC 60 is based on meeting the guidance of RG 1.143.

7. The requirements of 10 CFR 20.1406 are met when the design and procedures identify provisions to detect contamination that may enter as in-leakage from other systems, identifies potential collection points such as water treatment systems or system low points, and addresses the long term control of radioactive material in the system. DC/COL-ISG-06 and RG 4.21 relate to acceptable levels of detail and content required to demonstrate compliance with 10 CFR 20.1406.

8. Loss of All Alternating Current Power. Acceptance for meeting the relevant aspects of 10 CFR 50.63 is based on meeting the guidance of RG 1.155.

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 nuclear power plant SSCs important to safety be designed to withstand the effects of seismic events and other natural phenomena without losing the capability to perform their safety functions. The subject SSCs are those necessary to ensure (1) the integrity of the reactor coolant pressure boundary, (2) the capability to shut down the reactor and maintain it in a safe-shutdown condition, or (3) the capability to prevent or mitigate the consequences of accidents that could result in potential offsite exposures comparable to the guideline exposures of 10 CFR Part 100 Subpart B. When the plant design includes the CSF as an essential source of cooling water to prevent or mitigate the consequences of accidents or to shut down the reactor and maintain it in a safe-shutdown condition., those portions of the CSF that perform this essential function must be capable of withstanding the effects of an earthquake. Meeting the requirements of GDC 2 provides assurance that adequate reactor cooling will be available in the event of an earthquake, thus preventing offsite exposures that exceed the guidelines in 10 CFR Part 100, Subpart B, Section 100.21.

   GDC 2 requires that SSCs important to safety shall be designed to withstand the effects of tornadoes. Regulatory Guides 1.76 and 1.117 identify the characteristics of a design-basis tornado (DBT), and the SSCs that should be designed to withstand the effects of such a tornado and still remain functional. The CSF provides makeup water to systems that remove heat from the reactor if normal heat removal methods fail or are unavailable. In the event of a DBT, severe damage may occur to those systems that are not designed to withstand these effects. Compliance with GDC 2 provides assurance that the CSF will perform its safety function in the event of a DBT.

   GDC 2 also requires that SSCs important to safety shall be designed to withstand the effects of floods. Regulatory Guides 1.59 and 1.102 identify the characteristics of a design-basis flood (DBF) and the SSCs that should be designed to withstand the effects of such an event and still remain functional. The CSF provides makeup water to systems that remove heat from the reactor if normal heat removal systems fail or are unavailable. In the event of a DBF, severe damage may occur to those systems that are not designed to withstand these effects. Compliance with GDC 2 provides assurance that the CSF will perform its safety function in the event of a DBF.

2. GDC 5 prohibits the sharing of SSCs among nuclear power plant units unless it can be shown that such sharing will not significantly impair their ability to perform their safety-related or risk-significant functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units. The CSF may provide a source of water for decay heat removal from the reactor core and makeup to the spent fuel pool cooling and cleanup system in those plants for which the design includes this system to support the plant in its response to an accident. Meeting the requirements of GDC 5 provides assurance that the unacceptable effects of equipment failures or other events occurring in one unit of a multiunit site will not propagate to the unaffected units.

3. GDC 44 requires that a system be provided to transfer the combined heat load from SSCs important to safety to an ultimate heat sink. It establishes the requirements to ensure the capability to transfer heat from the reactor to a heat sink under normal operating and accident conditions with sufficient redundancy and isolation capability to accomplish the safety function assuming a single failure of an active component. In

those plants with a design that includes the CSF as a support function for heat transfer from safety-related or risk-significant SSCs, compliance with GDC 44 will ensure that the system will function to provide decay heat removal during normal operations, anticipated operational occurrences, and accident conditions.

4. Compliance with GDC 45 requires that the cooling water system, which provides essential cooling for safety-related equipment, be designed to permit appropriate periodic inspection of important components such as heat exchangers and piping to ensure the integrity and capability of the system. The CSF can be included in the plant design to provide a source of cooling of the reactor core. In plants where the CSF has this role?, the CSF needs to be designed such that the ability to perform safety-related or risk-significant functions can be periodically verified. By allowing for periodic inspection to detect signs of system degradation or incipient failure, GDC 45 provides assurance that the CSF will reliably function to support risk-significant functions.

5. GDC 46 requires that the cooling water system, which provides essential cooling for safety-related equipment, be designed to permit appropriate periodic pressure and functional testing to ensure the structural and leak-tight integrity of its components. The CSF can be included in the plant design to provide a source of cooling of the reactor core . This testing will include the operability and performance of the active components of the system as well as the operability of the system as a whole. By designing the CSF to accommodate testing to detect degradation in performance or the system pressure boundary and complying with GDC 45, the applicant provides assurance that the CSF will reliably function to provide both cooling to safety-related or risk-significant equipment and decay heat removal.

6. GDC 60 requires that nuclear power unit designs include a means to control the release of radioactive materials in gaseous and liquid effluents produced during normal reactor operation, including anticipated operational occurrences. The criteria in GDC 60 apply to all tanks that are located outside the reactor containment and include radioactive materials in liquids. These tanks have the potential for uncontrolled releases of radioactive materials attributable to spillage. Through its connections with the reactor coolant system (in boiling-water reactors) or secondary coolant system (in pressurized-water reactors), the CSF potentially contains radioactive material. Meeting the requirements of GDC 60 helps to ensure that radiation exposures for operating personnel and the general public are as low as is reasonably achievable. RG 1.143 provides specific guidance for implementing GDC 60. Compliance with this RG provides assurance that the design of the CSF will include features to prevent uncontrolled releases of radioactive material.

7 10 CFR 20.1406 requires the design of a nuclear power unit to address minimization of contamination of the facility and the environment, and ease of eventual decommissioning. 10 CFR 20.1406 applies to this DSRS section because the condensate storage facility could connect with contaminated systems. Final Interim Staff Guidance DC/COL-ISG-06 and RG 4.21 provide guidance to meet 10 CFR 20.1406. Specific guidance to meet 10 CFR 20.1406 is identified in RG 4.21 Positions C.1 through C.4.

8. 10 CFR 50.63 requires the ability to withstand and recover from a SBO, which includes ensuring that the core is cooled in the event of an SBO. The criteria in 10 CFR 50.63 apply to the CSF in those plants for which the plant design includes this system to support the plant in its response to an SBO. In those plants, the CSF provides a source of water for removal of decay heat. The CSF capability (e.g., to serve as a water supply from which flow may be delivered as needed) and capacity must meet the decay heat removal requirements of the plant for the SBO event. Regulatory Guide 1.155 provides specific guidance for meeting the requirements of 10 CFR 50.63. Application of the criteria of 10 CFR 50.63 to the CSF ensures that the CSF has sufficient capacity to ensure that there is adequate condensate water for coping with an SBO of a specified duration, and that the CSF is capable of providing needed functions to support decay heat removal and to ensure adequate core cooling during a SBO.

III. REVIEW PROCEDURES

The reviewer will select material from the numbered 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 to the DSRS criteria provide an acceptable method of complying with the relevant NRC requirements identified in Subsection II.

The procedures below are used to confirm that the design criteria and bases and the preliminary design as specified in the application meet the acceptance criteria in Subsection II.
Upon request from the primary reviewer, the coordinating review organizations will provide input for the areas of review noted in Subsection I. The primary 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 include:

    A. Maintenance Rule SRP Section 17.6 (DSRS Section 13.4, Table 13.4, Item 17, Regulatory Guides 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 (Regulatory Guide 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. The application is reviewed to confirm that the facility and the piping and instrumentation diagrams (P&IDs) delineate the CSF equipment that is used for normal operation, abnormal operation, and accident conditions as follows:

   A. The facility functional requirements and the minimum flow requirements for supplying water to the emergency feedwater system and/or other auxiliary systems, such as the ultimate heat sink tanks, spent fuel pool cooling and cleanup system, feedwater system, or other safety-related or risk-significant systems are described.

   B. Allowable operational degradation of components (e.g., pump leakage) and the procedures that will be followed to detect and correct degraded conditions when they become excessive are described. Using failure modes and effects analyses or independent calculations, the reviewer confirms that the facility is capable of losing any active component and still meeting minimum flow requirements to the safety-related or risk-significant systems.

   C. The use of tank coatings, floating covers, and other passive components to protect the purity and cleanliness of the condensate is described. These components are evaluated to provide assurance that the methods used to prevent degradation and the procedures to detect such degradation would be effective in protecting the safety-related or risk-significant water supply from adverse effects.

3. The system description and schematics/drawings are reviewed to confirm the following:

   A. Safety-related or risk-significant portions of the CSF are correctly identified and are isolable from other portions of the system. The design is reviewed to verify that it clearly indicates the physical division between each portion. The design is also reviewed to verify that it shows the means for accomplishing isolation, and the facility description is reviewed to identify minimum performance requirements for the isolation valves.

   B. Safety-related or risk-significant portions of the CSF, including the isolation valves separating seismic Category I portions from the nonseismic portions, are classified as Quality Group C and seismic Category I.

C. Design provisions have been incorporated that permit appropriate inservice inspection and functional testing of safety-related or risk-significant system components. It will be acceptable if the application delineates a testing and inspection program and if the system design shows the necessary test recirculation loops around pumps or isolation valves that this program would require.

4. The CSF is reviewed to ensure that it meets the requirements of 10 CFR 20.1406 for which guidance is provided in DC/COL-ISG-06, "Final Interim Staff Guidance Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Applications", (ADAMS Accession No. ML092470100) and RG 4.21.

5. The reviewer verifies that the system has been designed so that facility integrity functions are maintained as required in the event of adverse natural phenomena such as tornadoes, hurricanes, and floods, and/or a loss of offsite power or an SBO. The reviewer evaluates the facility using engineering judgment and the results of failure modes and effects analyses to determine the following:

   A. The failure of portions of the facility or of other systems not designed to seismic Category I standards and located close to safety-related or risk-significant portions of the facility or nonseismic Category I structures that house, support, or are close to safety-related portions of the CSF does not preclude safety-related or risk-significant functions. References will be necessary to Chapter 2, of the applicant's technical submittal, which describes site features and the general arrangement and layout drawings, and to the applicant's tabulation of seismic design classifications for structures and facilities. Statements in the applicant's submittal that the above conditions are met are acceptable.

   B. The safety-related portions of the CSF for which failures that could adversely impact safety-related or risk-significant SSCs in other systems are protected from the effects of floods, cold weather conditions, hurricanes, tornadoes, and internally or externally generated missiles. The DSRS sections for Chapter 3 of the applicant's submittal discuss and evaluate in detail the flood protection and missile protection criteria. The location and design of the facility and structures are reviewed to confirm that the degree of protection provided is adequate. A statement is acceptable if it indicates (1) that the facility is located in a seismic Category I structure that is protected from tornadoes, missiles, and floods or (2) that components of the facility will be located in individual structures that will withstand the effects of freezing, flooding, and missiles.

   C. The CSF provides sufficient net positive suction head (NPSH) at safety-related pump suction locations, assuming low condensate storage tank water levels. The SAR should indicate the minimum water level of the condensate storage tank and the elevation of the pump impellers. An independent calculation verifying the applicant's conclusion regarding pump NPSH may be necessary.

D. The condensate storage tank is equipped with instrumentation to monitor the water level in the tank and to actuate an alarm when the water level reaches the low-level setpoint that indicates the minimum reserve condensate storage for safety-related or risk-significant system supply.

E. The condensate storage tank overflow piping is connected to the radioactive waste system. The outdoor storage tank is designed in compliance with GDC 60 and the guidance of RG 1.143 and has a dike or retention basin capable of preventing runoff if a tank overflows or fails; for a non-safety-related storage facility, the need for a seismic Category I dike or retention basin is reviewed. In accordance with RG 1.143, high liquid level conditions actuate alarms both locally and in the control room.

F. The portions of the CSF for which failures could adversely impact safety-related or risk-significant SSCs in other systems are protected from the effects of high-and moderate-energy line breaks or cracks. The design is reviewed to ensure that no high- or moderate-energy piping systems are close to safety-related or risk-significant portions of the CSF or, if necessary, protection from the effects of failure will be provided. Section 3.6 of the applicant's Safety Analysis Report (SAR) will describe the means of providing such protection, and corresponding DSRS sections note the procedures for reviewing this information.

G. The functions of the safety-related components and subsystems of the CSF (i.e., those necessary for plant safe shutdown) will not be precluded by a loss of offsite power. The CSF design will be acceptable if minimum system requirements are met with onsite power.

H. The condensate storage tank has design provisions that automatically transfer, as required, from a normal nonsafety-related source to a seismic Category I source.

I. If a changeover from a nonsafety-related condensate storage source to a safety-related water source is required for safe shutdown or accident mitigation, then the automatic changeover feature should meet all of the requirements for a safety-related system or component.

J. The CSF capacity and features supporting flow delivery from the CSF are sufficient to support withstanding or coping with, and recovering from, a SBO, as reviewed under DSRS Section 8.4. Regulatory Guide 1.155 contains staff positions related to systems and components required for decay heat removal during an SBO. Positions C.3.2, C.3.3.2, and C.3.5 apply to those portions of the CSF necessary for decay heat removal.

6. The descriptive information, P&IDs, system drawings, and failure modes and effects analyses in the SAR are reviewed to ensure that safety-related portions of the CSF will function as needed following design-basis accidents, assuming a concurrent single active or passive component failure. The reviewer evaluates the information in the SAR

to determine the ability of required components to function, traces the availability of these components on system drawings, and checks that the SAR contains verification that system flow requirements are met for each accident situation for the required time spans. For each case, the design will be acceptable if minimum system flow requirements are met.

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 DCD.

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 for the review and that the review and analysis, 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 CSF includes all components and piping associated with the facility to the points of connection or interfaces with other systems. The review confirms the adequacy of the applicant's proposed design criteria and bases for the CSF and the requirements for sufficient water supply to safety-related or risk-significant systems during normal, abnormal, and accident conditions. Portions of the CSF that are necessary to perform a safe shutdown or to mitigate the consequences of an accident are classified as seismic Category I and Quality Group C.

If applicable, the staff will conclude that the design of the CSF is acceptable and meets the requirements of 10 CFR 50.63, 10 CFR 20.1406, and GDC 2, 5, 44, 45, 46, and 60 based on the following:

1. The applicant has met the requirements of GDC 2 with respect to the ability of the safety-related or risk-significant portions of the system to withstand the effects of earthquakes. Acceptance is based on meeting the guidance of Position C.1 of RG 1.29 if any portion is deemed safety related or risk significant and of Position C.2 for nonsafety-related portions. A portion of the system is deemed safety related or risk significant if a failure or malfunction could adversely affect safety-related or risk-significant systems or components (i.e., those necessary for safe shutdown, accident prevention, or accident mitigation).

2. The applicant has met the requirements of GDC 2 with respect to safety-related or risk-significant portions of the system being designed to withstand the effects of tornadoes. Acceptance is based on meeting the guidance of RGs 1.76 and 1.117.

3. The applicant has met the requirements of GDC 2 with respect to safety-related or risk-significant portions of the system being designed to withstand the effects of floods if a failure or malfunction could adversely affect safety-related or risk-significant systems or components (i.e., those necessary for safe shutdown, accident prevention, or accident mitigation). Acceptance is based on meeting the guidance of RGs 1.59 and 1.102.

4. The applicant has met the requirements of GDC 5 with respect to sharing SSCs by demonstrating that such sharing does not affect the safe shutdown of either unit in the event of an active or passive failure.

5. The applicant has met the requirements of GDC 44 with respect to the cooling water system by demonstrating that (1) sufficient redundancy and capability exist such that a single failure with the loss of offsite power will not adversely affect the ability to shut down safely or mitigate the consequences of an accident, (2) sufficient capability is available to provide makeup water to safety-related or risk-significant cooling systems, and (2) the capability exists to isolate components, subsystems, or piping without system degradation.

6. The applicant has met the requirements of GDC 45 with respect to inservice inspection of the safety-related or risk-significant components and equipment by demonstrating the accessibility of the CSF systems for periodic inspections.

7. The applicant has met the requirements of GDC 46 with respect to periodic pressure and functional testing to ensure the structural and leak-tight integrity, operability, and performance of its active components and the operability of the system as a whole by demonstrating the capability to operate the system at full capacity during normal startup or shutdown procedures or during normal operation without degrading the system capability to provide for a safe shutdown or to mitigate the consequences of an accident.

8. The applicant has met the requirements of GDC 60 with respect to tanks located outside the reactor containment that include radioactive materials in liquids. Acceptance is based on meeting the guidance of Position C.1.2 of RG 1.143.

9. The applicant has met the requirements of 10 CFR 20.1406 consistent with the guidance in DC/COL-ISG-06 and RG 4.21 and is therefore acceptable.

10. The applicant has met the requirements of 10 CFR 50.63 with respect to CSF capacity and capability for an SBO by demonstrating a capability for adequate flow delivery from the CSF and a capacity consistent with required flow rates and the event duration, as needed to support the plant during an SBO event. Acceptance is based on meeting the guidance of Positions C.3.2, C.3.3.2, and C.3.5 of Regulatory Guide 1.155.

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 design acceptance criteria, as applicable.

V. IMPLEMENTATION

The staff will use this DSRS section in performing safety evaluations of mPower^{TM}-specific design certification (DC), or combined license (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 (ML102510405), to develop risk-informed licensing review plans for each of the small modular reactor (SMR) 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, or COL 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 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 20.1406, "Minimization of Contamination."

2. 10 CFR 50.63, Loss of All Alternating Current Power.

3. 10 CFR Part 50, Appendix A, General Design Criterion 2, Design Bases for Protection Against Natural Phenomena.

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 44, Cooling Water.

6. 10 CFR Part 50, Appendix A, General Design Criterion 45, Inspection of Cooling Water System.

7. 10 CFR Part 50, Appendix A, General Design Criterion 46, Testing of Cooling Water System.

8. 10 CFR Part 50, Appendix A, General Design Criterion 60, Control of Releases of Radioactive Materials to the Environment.

9. DC/COL-ISG-06, “Final Interim Staff Guidance Evaluation and Acceptance Criteria for 10 CFR 20.1406 to Support Design Certification and Combined License Applications”, Oct 2, 2009, (ADAMS Accession No. ML092470100).

9. Regulatory Guide 1.29, Seismic Design Classification.

11. Regulatory Guide 1.68, Initial Test Programs for Water-Cooled Nuclear Power Plants.

12. Regulatory Guide 4.21, Minimization of Contamination and Radioactive Waste Generation: Life-Cycle Planning.

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

14. Regulatory Guide 1.155, Station Blackout.