



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

9.1.3 SPENT FUEL POOL COOLING AND CLEANUP SYSTEM

REVIEW RESPONSIBILITIES

Primary - ~~Auxiliary Systems Branch (ASB)~~ ~~Plant Systems Branch (SPLB)~~[†] **Organization responsible for the review of cooling water systems associated with the balance of plant**

Secondary - ~~Chemical Engineering Branch (CMEB)~~ ~~Materials and Chemical Engineering Branch (EMCB)~~[‡] **Organization responsible for the review of chemical engineering issues**

I. AREAS OF REVIEW

All nuclear reactor plants include a spent fuel pool for the wet storage of spent fuel assemblies. The methods used to provide cooling for the removal of decay heat from the stored assemblies vary from plant to plant, depending upon the individual design. The safety function to be performed by the system in all cases remains the same; that is, the spent fuel assemblies must be cooled and must remain covered with water during all storage conditions. Other functions performed by the system; but not related to safety; include water cleanup for the spent fuel pool, refueling canal, refueling water storage tank, and other equipment storage pools[‡]; means for filling and draining the refueling canal and other storage pools; and surface skimming to provide clear water in the storage pool.[‡]

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USNRC STANDARD REVIEW PLAN

This Standard Review Plan (SRP), NUREG-0800, has been prepared to establish criteria that the Office of Nuclear Reactor Regulation 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 their 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 the Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of the standard format have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) will be based on Regulatory Guide DG-1145, "Combined License Applications for Nuclear Power Plants (LWR Edition)," as superseded by the final guide, until the SRP itself is updated.

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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The **ASBSPLB**⁴ review of the spent fuel pool cooling and cleanup system (SFPCCS)⁵ covers the system from inlet to and exit from the storage pool and pits, the seismic Category I water source and piping used for fuel pool makeup, the cleanup system filter-demineralizers,⁶ and the regenerative process to the point of discharge to the radwaste system.

1. The seismic classification and quality standards applied to the design-capability of the spent fuel pool cooling and cleanup system to provide adequate cooling to the spent fuel during all operating conditions ~~is~~ **are** reviewed on ~~one~~ **either**⁷ of two bases.

- a.⁸ ~~The first basis requires-~~ To satisfy the first basis, the cooling portion of the system is ~~to be designed to seismic Category I (Regulatory Guide 1.29)⁹, Quality Group C (Regulatory Guide 1.26)¹⁰ requirements~~ guidelines.

- b.¹¹ ~~The second basis allows a non-seismic Category I, Quality Group C,~~ To satisfy the second basis, a spent fuel pool cooling system not designed to seismic Category I, Quality Group C guidelines is acceptable, provided that the following systems are designed to seismic Category I, Quality Group C guidelines ~~requirements~~ and are protected against tornadoes: the fuel pool make-up water system and its source; and, the fuel pool building and its ventilation and filtration system. ~~The makeup, ventilation and filtration systems must also withstand a single active failure. In addition, the transient temperature (T_a) used in evaluating combined load on structures shall be the boiling temperature of water when the cooling system is not designed to seismic Category I requirements.~~

2. **The ASBSPLB**¹² ~~reviews~~ **This section addresses** the capability of the spent fuel pool cooling, makeup, and cleanup systems to provide adequate cooling to the spent fuel during all operating and accident conditions. The review includes the following considerations:

- a. The quantity of fuel to be cooled, including the corresponding requirements for continuous cooling during ~~normal, abnormal,~~ anticipated operating and accident conditions.
 - b. The ability of the system to maintain pool water levels.
 - c. The ability to provide alternate cooling capability and the associated time required for operation.
 - d. Provisions to provide adequate makeup to the pool.
 - e. Provisions to preclude loss of function resulting from single active failures or failures of non-safety-related components or systems.
 - f. The means provided for the detection and isolation of system components that could develop leaks or failures.
 - g. The instrumentation provided for initiating appropriate safety actions.
 - h. The ability of the system to maintain uniform pool water temperature conditions.

3. ASB¹³ also performs the following reviews under the Standard Review Plan (SRP)¹⁴ sections indicated:
 - a. Review for flood protection is performed under SRP Section 3.4.1.
 - b. Review of the protection against internally generated missiles is performed under SRP Section 3.5.1.1.
 - c. Review of the structures, systems and components to be protected against externally generated missiles is performed under SRP Section 3.5.2.
 - d. Review of high- and moderate-energy pipe breaks is performed under SRP Section 3.6.1.
 - e. Review for fire protection is performed under SRP Section 9.5.1.¹⁵
 - f. Review of environmental qualification of mechanical and electrical equipment is performed under SRP Section 3.11.¹⁶
 - g. Review to verify that the limits for radioactivity concentrations are not exceeded is performed under SRP Sections 11.1 and 11.2.¹⁷
3. The staff performs a secondary review of the capability and capacity of the spent fuel pool cleanup system to remove corrosion products, radioactive materials and impurities from the pool water. In addition, at the request of the primary reviewer, an evaluation is performed of the spent fuel pool cooling system materials — fluid compatibility and potential for metal corrosion degradation and compatibility of the materials of construction with service conditions.
4. Inspection, Test, analysis, and Acceptance Criteria (ITAAC)

For design certification and combined license (COL) reviews, the applicant's proposed information on the ITAAC associated with the systems, structures, and components (SSCs) related to this standard review plan (SRP) section is reviewed in accordance with SRP Section 14.3. The staff recognizes that the review of ITAAC is performed after review of the rest of this portion of the application against acceptance criteria contained in this SRP section. Furthermore, the ITAAC are reviewed to assure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.

Review Interfaces⁴⁸

- 4A.¹⁹ A secondary review is performed by CMEB²⁰ and the results used by the ASB²¹ to complete the overall evaluation. CMEB²² provides an safety evaluation report (SER)²³ input to ASB²⁴ on a routine basis that includes an evaluation of the capability and capacity of the spent fuel pool cleanup system to remove corrosion products, radioactive materials and impurities from the pool water. Also upon request the CMEB²⁵ will provide ASB²⁶ with an evaluation of the spent fuel pool and the spent fuel pool cooling system materials — fluid compatibility

and potential for metal corrosion degradation. ASBThe SPLB²⁷ will request such input if the materials used in the design differs significantly from previously approved designs.

The EMCB, upon request, verifies the compatibility of the materials of construction with service conditions.²⁸

B.²⁹ Coordinated reviews are performed by other branches and the results used by ASBthe SPLB³⁰ in the overall evaluation of the SFPCCS. The coordinated reviews are as follows:

1.³¹ The Structural Engineering Branch (SEB)Mechanical Engineering Branch (EMEB)³² determines 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 (SSE), the probable maximum flood (PMF), and tornado missiles as part of its primary review responsibility for 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.

2.³³ The Mechanical Engineering Branch (MEB)(EMEB)³⁴ determines that the components piping and structures are designed in accordance with applicable codes and standards as part of its primary review responsibility for SRP Sections 3.9.1 through 3.9.3. The (MEB)EMEB,³⁵ also, determines the acceptability of the seismic and quality group classifications for system components as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2. The (MEB)EMEB³⁶ also reviews the adequacy of the inservice testing program of pumps and valves as part of its primary review responsibility for SRP Section 3.9.6.

3. The Materials Engineering Branch (MTEB)ECGB verifies that inservice inspection requirements are met for system components as part of its primary review responsibility for SRP Section 6.6, and, upon request, verifies the compatibility of the materials of construction with services conditions.³⁷

4.³⁸ The review for Fire Protection,³⁹ Technical Specifications, and Quality Assurance are is⁴⁰ coordinated and performed by the Chemical Engineering Branch, Licensing Guidance Branch, and Quality Assurance BranchTechnical Specifications Branch (TSB)⁴¹ as part of theirits primary review responsibility for SRP Sections 9.5.1,⁴² 16.0 and 17.0, respectively.

5. The review for Quality Assurance is coordinated and performed by the Quality Assurance and Maintenance Branch (HQMB) as part of its primary review responsibility for SRP Sections 17.1, 17.2, or 17.3.⁴³

6.⁴⁴ The EQBEMEB⁴⁵ reviews the seismic qualifications of Category I instrumentation and electrical equipment and the environmental qualification of mechanical and electrical equipment as part of its primary review responsibility for SRP Sections 3.10 and 3.11, respectively.as part of its primary review responsibility for SRP Section 3.10.⁴⁶

- 7.⁴⁷ The Instrumentation and Control Systems Branch (ICSB) Branch (HICB)⁴⁶ and the Power Systems Branch (PSB)⁴⁸ will verify the adequacy of the design, installation, inspection and testing all electrical systems (sensing, control and power) required for proper operation of the SFPCCS of the SFPCCS instrumentation and controls important to safety as part of their primary review responsibility for SRP Section 7.1 and Appendix 7-A for ICSB and SRP Section 8.3.1 for PSB.
- 8.⁵⁰ The Electrical Engineering Branch (EELB) will verify the adequacy of the design, installation, inspection and testing of onsite ac power systems required for proper operation of the SFPCCS as part of its primary review responsibility for SRP Section 8.3.1.
- 9. For new plant applicants, the spent fuel pool cooling system may be included in the systematic assessment of shutdown risks as an alternate feature that can maintain core cooling in the event of a loss of normal decay heat removal during shutdown conditions. The Probabilistic Safety Assessment Branch (SPSB) coordinates and performs the shutdown risk assessment reviews as part of its primary review responsibility for SRP Section 19.1 (Proposed).⁵¹
- The Effluent Treatment Systems Branch (ETSB) will verify that the limits for radioactivity concentrations are not exceeded as part of its primary review responsibility for SRP Sections 11.1 and 11.2.⁵²
- G.⁵³ For those areas of review identified above as being the primary responsibility of other branches, the acceptance criteria and methods of review application are contained in the referenced SRP sections corresponding to those branches.⁵⁴

Related SRP sections are identified by functional relationship:

1. Review for flood protection is performed under SRP Section 3.4.1.
2. Review of the protection against internally generated missiles is performed under SRP Section 3.5.1.1.
3. Review of the structures, systems and components to be protected against externally generated missiles is performed under SRP Section 3.5.2.
4. Review of high- and moderate-energy pipe breaks is performed under SRP Section 3.6.1.
5. Review for fire protection is performed under SRP Section 9.5.1.⁴⁵
6. Review of environmental qualification of mechanical and electrical equipment is performed under SRP Section 3.11.⁴⁶
7. Review to verify that the limits for radioactivity concentrations are not exceeded is performed under SRP Sections 11.1 and 11.2.⁴⁷

8. Review of 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 (SSE), the probable maximum flood (PMF), and tornado missiles is performed under SRP Sections 3.3.1, 3.3.2, 3.5.3, 3.7.1 through 3.7.4, 3.8.4, and 3.8.5.
9. Review that the components piping and structures are designed in accordance with applicable codes and standards is performed under SRP Sections 3.9.1 through 3.9.3.
10. Review of the acceptability of the seismic and quality group classifications for system components is performed under SRP Sections 3.2.1 and 3.2.2.
11. Review of the adequacy of the inservice testing program of pumps and valves is performed under SRP Section 3.9.6.
12. Review that inservice inspection requirements are met for system components is performed under SRP Section 6.6.
13. Review of Technical Specifications is performed under SRP Section 16.0.
14. Review of quality assurance is performed under SRP Chapter 17.⁴³
15. Review of the seismic qualifications of Category I instrumentation and electrical equipment is performed under SRP Section 3.10.⁴⁶
16. Review of the adequacy of the design, installation, inspection and testing of the SFPCCS instrumentation and controls important to safety is performed under SRP Section 7.1 and Appendix 7-A.
17. Review of the the adequacy of the design, installation, inspection and testing of onsite ac power systems required for proper operation of the SFPCCS is performed under SRP Section 8.3.1.
- ~~18. For new plant applicants, the spent fuel pool cooling system may be included in the systematic assessment of shutdown risks as an alternate feature that can maintain core cooling in the event of a loss of normal decay heat removal during shutdown conditions. Review of this is performed under SRP Section 19.1 (Proposed).⁵¹~~

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

II. ACCEPTANCE CRITERIA

Acceptability of the design of the spent fuel pool cooling and cleanup system, as described in the applicant's safety analysis report (SAR), including related sections of Chapters 2 and 3 of the SAR, is based on meeting the identified general design criteria from Appendix A to

10 CFR Part 50 and other identified regulations. Specific criteria that meet¹ the relevant requirements are contained in the identified and regulatory guides, and are supported by independent calculations and staff judgments with respect to system functions and component selection.

1. The design of the spent fuel pool cooling and cleanup system and its makeup system is acceptable if the integrated design is in accordance with the following criteria:

- a. General Design Criterion 2 (GDC 2) contained in Appendix A to 10 CFR Part 50,⁵⁵ as related to structures housing the system and the system itself being capable of withstanding the effects of natural phenomena such as earthquakes, tornadoes, and hurricanes. Acceptance for meeting this criterion is based on conformance to positions C.1, C.2, C.6, and C.8 of Regulatory Guide (RG) 1.13 and position C.1 of ~~Regulatory Guide~~ RG 1.29 for safety-related portions,⁵⁶ and position C.2 of ~~Regulatory Guide~~ RG 1.29 for nonsafety-related portions of the system.

⁵⁷This criterion does not apply to the cleanup portion of the system and need not apply to the cooling system if the fuel pool makeup water system and its source meet this criterion,⁵⁸ and the fuel pool building and its ventilation and filtration system meet this criterion, and the ventilation and filtration system meets the guidelines of ~~Regulatory Guide~~ RG 1.52.

⁵⁹The cooling and makeup system should ~~also~~⁶⁰ be designed to Quality Group C requirements in accordance with ~~Regulatory Guide~~ RG 1.26. However, when the cooling system is not designated Category I it need not meet the requirements of ASME Section XI for inservice inspection of nuclear plant components.

- b. ~~General Design Criterion 4 (GDC 4),⁶¹~~ GDC 4 with respect to the capability of the system and the structure housing the system to withstanding the effects of external missiles. Acceptance is based on meeting position C.2 of ~~Regulatory Guide~~ RG 1.13.

⁶²This criterion does not apply to the cleanup system and need not apply to the cooling water system if the makeup system, and its source, and the building, and its ventilation and filtration system are tornado protected, and the ventilation and filtration system meets the guidelines of ~~Regulatory Guide~~ RG 1.52.⁶³

- c. ~~General Design Criterion 5 (GDC 5),⁶⁴~~ GDC 5 as related to shared systems and components important to safety being capable of performing required safety functions.

- ~~d. General Design Criterion 44 (GDC 44),⁶⁵ GDC 44 to include as related to⁶⁶:~~

¹Note: The SRP is not a substitute for the NRC's regulations, and compliance with it is not required. However, pursuant to 50.34(h), 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's regulations.

- (1) The capability to transfer heat loads from safety-related structures, systems, and components to a heat sink under both normal operating and accident conditions.
- (2) Suitable redundancy of components so that safety functions can be performed assuming a single active failure of a component coincident with the loss of all offsite power.
- (3) The capability to isolate components, systems, or piping, if required, so that the system safety function will not be compromised.
- (4) In meeting this criterion,⁶⁷ acceptance is based on the recommendations of Branch Technical Position ASB 9-2 SPLB 9-2, "Residual Decay Energy for Light-Water Reactors for Long-Term Cooling" (located in SRP Section 9.2.5)⁶⁸ for calculating the heat loads and the assumptions set forth in item 1.h of subsection III of this SRP section. The temperature limitations of the pool water identified in item 1.d of subsection III of this SRP section is also used as a basis for meeting this criterion.

e. General Design Criterion 45 (GDC 45);⁶⁹ GDC 45 as related to the design provisions to permit periodic inspection of safety-related components and equipment.

f. General Design Criterion 46 (GDC 46);⁷⁰ GDC 46 as related to the design provisions to permit operational functional testing of safety-related systems or components to assure⁷¹ structural integrity and system leak tightness, operability, and adequate performance of active system components, and the capability of the integrated system to perform required functions during normal, shutdown, and accident situations.

dg. General Design Criterion 61 (GDC 61);⁷² GDC 61 as related to the system design for fuel storage and handling of radioactive materials, including the following elements:

- (1) The capability for periodic testing of components important to safety.
- (2) Provisions for containment.
- (3) Provisions for decay heat removal that reflect its importance to safety.
- (4) The capability to prevent reduction in fuel storage coolant inventory under accident conditions in accordance with the guidelines of position C.6 of Regulatory Guide 1.13.
- (5) The capability and capacity to remove corrosion products, radioactive materials and impurities from the pool water and reducing occupational exposures to radiation.

- eh.** ~~General Design Criterion 63 (GDC 63),⁷³~~ **GDC 63** as it relates to monitoring systems provided to detect conditions that could result in the loss of decay heat removal, to detect excessive radiation levels, and to initiate appropriate safety actions.
- fi.** ~~10 CFR Part 20, paragraph 20.1(c) 20.1101(b)⁷⁴~~ as it relates to radiation doses being kept as low as is reasonably achievable (ALARA). In meeting this regulation,⁷⁵ ~~Regulatory Guide~~ **RG 8.8**, positions C.2.f(2) and C.2.f(3) ~~will~~ **can** be used as a basis for acceptance.
- gj.** **10 CFR 52.47(a)(1)(vi) as it relates to ITAAC (for design certification) sufficient to assure that the SSCs in this area of review will operate in accordance with the certification.**
- hk.** **10 CFR 52.97(b)(1) as it relates to ITAAC (for combined licenses) sufficient to assure that the SSCs in this area of review have been constructed and will be operated in conformity with the license and the Commission's regulations.**

Technical Rationale

The technical rationale for application of these acceptance criteria to the review of spent fuel pool cooling and cleanup system is discussed in the following paragraphs:⁷⁶

- A. Compliance with GDC 2 requires that structures, systems, and components important to safety be designed to withstand the effects of expected natural phenomena combined with the appropriate effects of normal and accident conditions without loss of capability to perform their safety functions.

This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system. It cites RG 1.13 to describe the design basis, RG 1.26 to describe quality group classifications, and RG 1.29 to describe seismic design classifications. These positions describe the design bases needed to resist expected natural phenomena when combined with the appropriate effects of normal and accident conditions.

Meeting the requirements of GDC 2 provides assurance that components of the spent fuel pool cooling and cleanup system will be designed to withstand the effects of expected natural phenomena and will be capable of performing their intended safety functions.⁷⁷

- B. Compliance with GDC 4 requires that structures, systems, and components important to safety be designed to accommodate the effects of, and be compatible with, environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents and dynamic effects resulting from pipe whip, missiles, and discharging fluids.

This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system and cites RG 1.13 to describe the design basis, including that for protecting the spent fuel storage facility against missiles and heavy loads.

Meeting the requirements of GDC 4 provides assurance that components of the spent fuel pool cooling and cleanup system will be designed to accommodate expected environmental conditions and will be capable of performing their intended safety functions.⁷⁸

- C. Compliance with GDC 5 requires that structures, systems, and components important to safety not be shared among nuclear power units unless it can be shown that such sharing will not impair their ability to perform their safety functions.

This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system, whose safety function is to ensure that no single failure will prevent the system from cooling the spent fuel.

Meeting the requirements of GDC 5 provides assurance that components of the spent fuel pool cooling and cleanup system will be designed to accommodate shared systems, structures and components such that no single failure will prevent the system from performing its safety function.⁷⁹

- ~~D. Compliance with GDC 44 requires that a system be provided to transfer heat from structures, systems, and components important to safety. The system must function under normal and accident conditions, assuming a single failure.~~

~~— This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system, including assumptions concerning heat loads, redundancy of components, capability to isolate components, and temperature limits.~~

~~— Meeting the requirements of GDC 44 provides assurance that components of the spent fuel pool cooling and cleanup system will be designed to transfer heat from the system under normal and accident conditions, assuming a single failure.⁸⁰~~

- E. ~~Compliance with GDC 45 requires that the cooling water system be designed to permit appropriate periodic inspection of important components such as heat exchangers and piping, thereby ensuring the integrity and capability of the system.~~

~~— This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system, including inspection of the system and its components.~~

~~— Meeting the requirements of GDC 45 provides assurance that components of the spent fuel pool cooling and cleanup system can and will be inspected, thereby ensuring that the system is capable of performing its intended safety function.⁸¹~~

- F. ~~Compliance with GDC 46 requires that the cooling water system be designed to permit appropriate periodic pressure and functional testing to ensure the leaktight integrity of its components, the operability of its components, and the operability of the system as a whole at conditions that are as close to the design basis as practical.~~

~~— This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system, including testing of the system and its components.~~

~~Meeting the requirements of GDC 46 provides assurance that components of the spent fuel pool cooling and cleanup system can and will be tested, thereby ensuring that the system is capable of performing its intended safety function.⁶²~~

- DG.** Compliance with GDC 61 requires that the fuel storage system be designed to ensure adequate safety under normal and postulated accident conditions. The system shall be designed with: the capability to permit appropriate periodic inspection and testing of components important to safety; suitable shielding for radiation protection; appropriate containment, confinement and filtering capability; residual heat removal that reflects the importance to safety of decay heat and other residual heat removal; and the capability to prevent a significant reduction in fuel storage coolant inventory under accident conditions.

This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system, including provisions for inspection and testing, containment and confinement, residual heat removal, maintenance of an adequate coolant inventory under accident conditions, and shielding and filtration capability to reduce occupational exposure to radiation. Provisions for inspection and testing are satisfied by designing essential portions of the cooling system to Quality Group C criteria. Provisions for containment are satisfied by provisions to collect and isolate leakage. Provisions for residual heat removal that reflect its importance to safety are satisfied by (1) designing essential portions of the cooling system to seismic Category I criteria and with adequate cooling capacity assuming a single active failure, and (2) providing a forced-circulation cooling capability that maintains the pool at temperatures suitable for fuel handling during routine operating conditions, including refueling. The capability to prevent a significant reduction in fuel storage coolant inventory under accident conditions is satisfied by providing adequate makeup capability and designing the FPCCS such that the coolant can neither be drained nor siphoned below a specified level. Provisions to minimize occupational exposure to radiation are satisfied by providing the capability to remove impurities from the coolant and maintain an adequate water level for shielding of stored fuel.

Meeting the requirements of GDC 61 provides assurance that components of the spent fuel pool cooling and cleanup system will be inspected, tested, shielded, and provided with containment, confinement, and residual heat removal capability to ensure that the system is capable of performing its intended safety function under normal and postulated accident conditions.⁶³

- EH.** Compliance with GDC 63 requires that appropriate systems be provided in the fuel storage area to detect conditions that may result in the loss of residual heat removal capability or excessive radiation levels, and initiate appropriate safety actions.

This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system, including provisions for monitoring and detection systems.

Meeting the requirements of GDC 63 provides assurance that components of the spent fuel pool cooling and cleanup system will be provided with monitoring and detection capabilities to ensure that the system is capable of performing its intended safety function.⁶⁴

Ff. Compliance with 10 CFR 20.1101(b) requires that the licensee use, to the extent practicable, procedures and engineering controls based on sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable.

This SRP section describes staff positions related to the design of the spent fuel pool cooling and cleanup system, including positions to achieve radiation doses in conformance with the ALARA principle. Positions in RG 8.8 regarding methods for preventing the generation and spread of contamination are provided.

Meeting the requirements of 10 CFR 20.1101(b) provides assurance that components of the spent fuel pool cooling and cleanup system will result in radiation doses that comply with the ALARA standard.⁸⁵

III. REVIEW PROCEDURES

For reviews under 10 CFR Part 50, the ~~The~~ procedures set forth below are used during the construction permit (CP) application review to determine that the design criteria and bases and the preliminary design as set forth in the preliminary safety analysis report meet the acceptance criteria given in subsection II of this SRP section. For the review of operating license (OL) applications, the review procedures ~~and~~ are used to determine that the acceptance criteria and bases have been appropriately implemented in the final design as set forth in the final safety analysis report. The review procedures for OL applications include a determination that the content and intent of the technical specifications prepared by the applicant are in agreement with the requirements for system testing, minimum performance, and surveillance developed as a result of the staff's review.

For reviews of COL applications under 10 CFR Part 52, the reviewer should follow the above procedures to verify that the design set forth in the safety analysis report and, if applicable, site interface requirements, meet the acceptance criteria. For design certification applications, the reviewer should identify necessary combined license action items. Following this review, SRP Section 14.3 should be followed for the review of Tier I information for the design, including the postulated site parameters, interface criteria, and ITAAC. With respect to COL applications, the scope of the review is dependent on whether the COL applicant references a design certification, an ESP or other NRC-approved applications and reports.⁴⁴⁴

Upon request from the primary reviewer, the coordinating interfacing review branches will provide input for the areas of review stated in subsection I of this SRP section. The secondary review branch, ~~CMEBEMCB~~⁸⁶, will provide input on a routine basis for those areas of review indicated in this SRP section. The primary reviewer (~~ASBSPLB~~⁸⁷) obtains and uses such input as required ~~necessary to assure~~⁸⁸ that this review procedure is complete.

These review procedures are based on the identified SRP acceptance criteria. For deviations from these specific acceptance criteria, including review of unique designs, the staff should review the applicant's evaluation of how the proposed alternatives to the SRP criteria provide an acceptable method of complying with the relevant NRC requirements identified in subsection II. ~~The review procedures given below are for a typical system. Any variance of the review, to take account of a proposed unique design, will be such as to assure~~⁸⁹ ~~that the system meets the criteria of subsection II of this SRP section.~~ In the review, the staff evaluates

spent fuel pool cooling and cleanup system and its makeup system are evaluated with respect to their capability to perform the necessary safety functions during all conditions, including normal operation, refueling, abnormal storage conditions, and accident conditions.

1. The reviewer will identify the safety function of the system for refueling and normal operations ~~is identified~~ by reviewing the information provided in the SAR application pertaining to the design bases and criteria and the safety evaluation section. The SAR application section ~~on describing the system functional performance requirements~~ is also reviewed to determine that it describes the minimum system heat transfer and system flow requirements for normal plant operation, component operational degradation requirements (i.e., pump leakage, etc.) and describes the procedures that will be followed to detect and correct these conditions should degradation become excessive. The reviewer, using failure modes and effects analyses, determines that the system is capable of sustaining the loss of any active component and evaluates, on the basis of previously approved systems or independent calculations, that the minimum system requirements (cooling load and flow) are met for these failure conditions. The system piping and instrumentation diagrams (P&IDs), layout drawings, and component descriptions are then reviewed for the following points:
 - a. Essential portions of the system are correctly identified and are isolable from the nonessential portions of the system. The drawings ~~P&IDs~~ are reviewed to verify that they clearly indicate the physical division between each portion and indicate ~~required~~ classification changes. The reviewer also ensures that system drawings ~~are also reviewed to see that they~~ show the means for accomplishing isolation and that the system description ~~is reviewed~~ to identify minimum performance requirements for the isolation valves. For the typical system, the reviewer examines drawings and description ~~are reviewed~~ to verify that adequate isolation valves separate non-essential portions and components from the essential portions.
 - b. Heat exchangers, pumps, valves and piping for the cooling portion of the system are constructed to Quality Group C and designed to seismic Category I requirements in accordance with the guidance provided in RGs 1.26 and 1.29. As an acceptable alternative, the cooling loop may be constructed to non-seismic Category I requirements, provided the spent fuel pool water makeup system and the building ventilation and filtration system are 1) designed to Quality Group C and seismic Category I requirements; 2) are protected from the effects of tornadoes; and 3) meet the single failure requirements. **Where this alternative is selected, the ventilation system provides the capability to vent steam/moisture to the atmosphere to protect safety-related components from the effects of boiling in the SFP. If necessary to limit the offsite dose consequences of spent fuel pool boiling, the ventilation and filtration system should also meet the guidelines of RG 1.52.** The review for seismic design ~~is performed by SEB~~ ⁹⁰ ~~the ECGB~~ and the review for seismic and quality group classification is performed under SRP Sections 3.7.1 through 3.7.4, and 3.2.1 and 3.2.2, respectively. ~~by MEB is the EMEB, as⁹¹ indicated in subsection I of this SRP section.~~
 - c. The stated quantity of fuel to be cooled by the spent fuel cooling system is consistent with the quantity of fuel stored, ~~as stated in Section 9.1.2 of the SAR.~~

- d. The minimum heat removal capacity with the forced-circulation cooling system in operation, the pool at the design temperature of the structure, and the heat sink at its maximum design temperature is greater than 0.3 percent of the reactor rated thermal power. The cooling system retains at least half of its full heat removal capacity assuming a single active failure. This capacity provides reasonable assurance that the pool temperature will remain within design bounds for the structure during full core discharges to the spent fuel pool when the forced-circulation cooling system is in operation, and ensures that significant heat removal capacity will remain available when an active component is unavailable due to a single failure or maintenance. The forced cooling capacity remaining following a single failure is adequate due to the low probability that the single failure would occur coincident with maximum decay heat load and the maximum heat sink temperature. For the maximum normal heat load with normal cooling systems in operation, and assuming a single active failure, the temperature of the pool should be kept at or below 140°F 60°C (140°F)⁹² and the liquid level in the pool should be maintained. For the abnormal maximum heat load (full core unload) the temperature of the pool water should be kept below boiling and the liquid level maintained with normal systems in operation. A single active failure need not be considered for the abnormal case. The associated parameters for the decay heat load of the fuel assemblies, the temperature of the pool water, and the heatup time or rate of pool temperature rise for the stated storage conditions are reviewed on the basis of independent analyses or comparative analyses of pool conditions that have been previously found acceptable.
- e. The spent fuel pool and cooling systems have been designed so that in the event of failure of inlets, outlets, piping, or drains, the pool level will not be inadvertently drained below a point approximately 10 feet 3 meters (10 feet)⁹³ above the top of the active fuel. Pipes or external lines extending into the pool that are equipped with siphon breakers, check valves, or other devices to prevent drainage are acceptable as a means of implementing this requirement.
- f. A seismic Category I, Quality Group C makeup system and an appropriate backup method to add coolant to the spent fuel pool are provided. If the forced-circulation cooling system is designed to Seismic Category I, Quality Group C standards, the backup system need not be a permanently installed system, nor Category I, but should take water from a seismic Category I source. Otherwise, the backup system should also be permanently installed, physically separate and independent from the primary makeup system, and designed to seismic Category I, Quality Group C standards. The minimum makeup capacity for each system exceeds the larger of the pool leakage rate assuming spent fuel pool liner perforation resulting from a dropped fuel assembly or the evaporation rate necessary to remove 0.3% of the reactor rated thermal power. The design permits initiation of makeup water flow through either system from locations remote from the operating floor surrounding the pool surface. Engineering judgment and comparison with plants of similar design are used to determine that the makeup capacities and the time necessary to align systems and connect makeup systems not permanently installed make associated hookups is consistent with heatup times or expected leakage from structural damage.

- g. Design provisions have been made that permit appropriate inservice inspection and functional testing of system components important to safety. ~~It will be acceptable if the SAR provides a~~ A statement that essential portions of the spent fuel pool cooling, and makeup, ~~and cleanup system~~ is systems are included in the inservice inspection program per SRP Section 6.6 and the inservice testing program of SRP Section 3-6-63.9.6 is acceptable.⁹⁴ ~~These SRP sections are reviewed by the MTEB and MEBEMCB and EMEB,⁹⁵ respectively.~~
- h. The system design provides adequate SFP cooling capacity for routine operations, including refueling. The staff reviews either a bounding evaluation of potential refueling conditions or a method of performing outage-specific evaluations described in the safety analysis report. The largest heat load placed on the SFCCS heat exchangers is imposed by refueling offloads, which are deliberate, planned evolutions. ~~Emergency offloads are not credible because fuel transfer requires plant cooldown, reactor disassembly and refueling cavity flooding, which are processes that depend on continued decay heat removal through the the reactor coolant system and shutdown cooling system.~~ As a result, if necessary for adequate cooling of the fuel, factors that increase heat load (e.g., power increases, decay time reductions, or storage capacity increases) may be offset by operational factors that reduce heat load (e.g., longer decay times or transfer of fewer fuel assemblies to the SFP) or that increase heat removal capability (e.g., scheduling offloads for periods of reduced ultimate heat sink temperature or optimizing cooling system performance).

Considering the preceding measures to manage the heat load relative to cooling capability, the staff evaluates the following criteria:

- (a) performing decay heat load calculations using a conservative model that evaluates multiple fission product groups and considers offload size, decay time, power history, and inventory of previously discharged assemblies.
- (b) calculating heat removal capability for a bulk SFP temperature of 60°C (140°F) and considering ultimate heat sink temperature, cooling system flow rates, and heat exchanger performance (i.e., fouling and tube plugging margin).
- (c) describing appropriate administrative controls in the SAR to ensure that the full heat removal capability at a SFP temperature of 60°C (140°F) will exceed the calculated decay heat load at all times during the refueling offload.

~~The calculation for the maximum amount of thermal energy to be removed by the spent fuel cooling system will be made in accordance with Branch Technical Position ASB 9-2, "Residual Decay Energy for Light Water Reactors for Long-Term Cooling" (located in SRP Section 9.2.5) SPLB 9-2⁹⁶ under the following assumed conditions.~~

- ~~i.(1)⁹⁷ The uncertainty factor K is set equal to 0.1 for long-term cooling (greater than 107 seconds).~~

ii.(2) The normal maximum spent fuel heat load is set at one refueling load at equilibrium conditions after 150 hours decay and one refueling load to equilibrium conditions after one year decay. (Maximum pool temperature 140°F/60 °C (140 °F)⁹⁸)

iii.(3) The spent fuel pool cooling system should have the capacity to remove the decay heat from one full core at equilibrium conditions after 150 hours decay and one refueling load at equilibrium conditions after 36 days decay, without spent fuel pool bulk water boiling. Cooling system single failure need not be considered concurrent for this condition.

iv.(4) For pools with greater than 1-1/3 core capacity, one additional refueling batch at equilibrium conditions after 400 days decay should be included in the cooling requirements.

2. The reviewer verifies that the system has been designed so that system functions will be maintained, as required, in the event of adverse natural phenomena such as earthquakes, tornadoes, hurricanes, and floods. The reviewer evaluates the system, using engineering judgment and the results of failure modes and effects analyses to determine the following:

a. The failure of portions of the system, or of other systems not designed to seismic Category I standards and located close to essential portions of the system, or of non-seismic Category I structures that house, support, or are close to essential portions of the pool and cooling system, will not preclude essential functions. Statements in the SAR to the effect that the above conditions are met are acceptable. (CP) for the CP review.⁹⁹ Reference to SAR Chapter 2, describing site features, and the general arrangement and layout drawings, will be necessary as well as to the SAR tabulation of and the seismic design classifications for structures and systems included with the application will be necessary.

b. The essential portions of the spent fuel pool cooling system are protected from the effects of floods, hurricanes, tornadoes, and internally or externally generated missiles. Flood protection and missile protection criteria are discussed and evaluated in detail under the in the respective SRP sections for Chapter 3 of the SAR.

The reviewer utilizes the procedures identified in these plans to assure¹⁰⁰ that the analyses presented are valid. A statement to the effect that the system is located in a seismic Category I structure that is tornado missile and flood protected, or that components of the system will be located in individual cubicles or rooms that will withstand the effects of both flooding and missiles is acceptable. The staff reviews the location and design of the system, structures, and pump rooms (cubicles) are reviewed to determine that the degree of protection provided is adequate.

3. The reviewer analyzes the system design information and drawings are analyzed to assure¹⁰¹ that the following features to contain radioactivity will be incorporated.

A statement that these features will be included in the design by the following ~~some appropriate means~~ is a basis for acceptance. ~~(CP) for the CP review.~~⁴⁰²

- a. A leakage detection system is provided to detect component or system leakage. An adequate means for implementing this requirement is to provide sumps or drains with adequate capacity and appropriate alarms in the immediate area of the system.
 - b. Components and headers of the system are designed to provide individual isolation capabilities to ~~assure~~⁴⁰³ system function, control system leakage, and allow system maintenance.
 - c. Design provisions are made to ~~assure~~⁴⁰⁴ the capability to detect leakage of radioactivity ~~or chemical contamination from one system to another and to preclude long-term corrosion, organic fouling, or the spreading of radioactivity.~~ Radioactivity monitors and conductivity monitors located in the system discharge lines are acceptable means for implementing this requirement.
4. ~~The SAR descriptive~~ Descriptive information, P&IDs, layout drawings, and system analyses are reviewed to ~~assure~~⁴⁰⁵ that essential portions of the system will function following design basis accidents, assuming a concurrent single active component failure. The reviewer evaluates failure mode and effects analyses presented in the SAR to ~~assure~~⁴⁰⁶ the function of required components, trace the availability of these components on system drawings, and check that minimum system flow, makeup, and heat transfer requirements are met for each degraded situation over the required time spans. For each case, the design will be acceptable if alarms are provided to notify operators of the degraded condition and essential functions can credibly be restored ~~minimum system requirements are met.~~
5. The spent fuel pool cleanup system and various auxiliary systems are designated as nonsafety-related systems and are designed accordingly (nonseismic Category I). These systems are evaluated to ~~assure~~⁴⁰⁷ that their failure cannot affect the functional performance of any safety-related system or component. The relationship and proximity between the nonsafety-related system and safety-related systems or components are determined by reviewing the integrated structure and component layout diagrams. Independent analyses, engineering judgment, and comparisons with previously approved systems are used to verify that where a nonsafety-related system interconnects or interfaces with the cooling system, its failure by any event or malfunction will not preclude adequate functional performance of the cooling system.
- 76.⁴⁰⁸ The staff also reviews the cleanup system ~~is also reviewed to assure~~⁴⁰⁹ that it has been designed with the capability to maintain acceptable pool water conditions. The staff reviews the descriptive information and drawings provided in the application P&IDs ~~and associated information provided in the SAR is reviewed to verify the following:~~
- a. ~~A means has been provided for mixing to produce a uniform temperature throughout the pool.~~

- ab. **The secondary reviewer reviews** the cleanup system is reviewed by ~~CMEB~~the ~~EMCB~~⁴⁴⁰ to verify they have the capacity and capability to remove corrosion products, radioactive materials, and impurities so that water clarity and quality will enable safe operating conditions in the pool. This includes instrumentation and sampling to monitor the water purity and need for demineralizer resin replacement, including the chemical and radiochemical limits such as conductivity, gross gamma and iodine activity, demineralizer differential pressure, pH and crud level which are used to initiate corrective action.
- be. The capability for processing the refueling canal coolant during refueling operations has been provided.
- cd. Provisions to preclude the inadvertent transfer of spent filter and demineralized media to any place other than the radwaste facility have been provided.

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that ~~his~~ the⁴⁴² review supports conclusions of the following type, to be included in the staff's ~~safety evaluation report~~ SER.⁴⁴³

The spent fuel pool cooling and cleanup system includes all components and piping of the system from inlet to and exit from the storage pool and pits, the seismic Category I water source and piping used for fuel pool makeup, the cleanup system filter-demineralizers and the regenerative process to the point of discharge to the radwaste system. The scope of review of the spent fuel pool cooling and cleanup system included layout drawings, process flow diagrams, piping and instrumentation diagrams, and descriptive information for the system and the supporting systems that are essential to safe operation. ~~The cooling portions of the systems essential for adequate cooling and maintenance of an adequate fuel storage coolant inventory have been identified and the primary makeup system are designed to seismic Category I, Quality Group C requirements standards since they are necessary to remove decay heat from the spent fuel and to prevent fuel damage that could lead to unacceptable releases of radioactivity. The cooling portion of the system need not be designed to seismic Category I requirements if the makeup system and the building ventilation and filtration system are seismic Category I, and if the ventilation and filtration system meet the guidelines of Regulatory Guide 1.52.~~ In sum:

- ⁴⁴⁵1. The applicant has met the requirements of ~~General Design Criterion~~ GDC 2 with respect to safety-related portions of the system being protected against natural phenomena. Acceptance is based on ~~meeting~~having met the guidelines of ~~Regulatory Guide RG 1.13, position C.1, which recommends a seismic Category I design for necessary portions of the spent fuel storage facility; position C.2, regarding protection against winds and wind generated missiles; position C.6, as it relates to the system being capable of withstanding earthquakes without loss of coolant that would uncover the fuel; and position C.8, which recommends a seismic Category I makeup system with appropriate redundancy or a backup from a Category I water source.~~ Acceptance is also based on ~~meeting~~having met the seismic design

requirements of Regulatory Guide RG 1.29, position C.1, for safety-related portions of the system necessary for adequate cooling to prevent excessive radioactivity releases (position C.1.p of Regulatory Guide RG 1.29) and position C.2 as it relates to the failure of nonsafety-related portions of the system. ~~If the fuel pool building ventilation and filtration systems are designed to seismic Category I requirements and in accordance with the guidelines of Regulatory Guide 1.52 the cooling portion of the system need not be seismic Category I.~~

2. The design meets the requirements of General Design Criterion GDC 4 with regards to protection against the effects of externally generated missiles; since it is in accordance with position C.2 of Regulatory Guide RG 1.13 ~~sincebecause~~ no loss of watertight integrity or fuel damage occur in the event of tornado missiles.
3. The design meets the requirements of General Design Criterion GDC 5 regarding the sharing of safety-related structures, systems, and components ~~sincebecause~~ no single failure will prevent the system from performing its safety-related function which is cooling the spent fuel.
4. ~~The design meets the requirements of General Design Criterion 44 regarding decay heat removal redundancy and power supplies, since the system has the capability to remove decay heat from the spent fuel under both normal operating and accident conditions. The system has redundancy so that decay heat can be removed assuming a single active failure coincident with a loss of all offsite power, and is designed with isolation capability of system components and piping, if required, such that the ability of the system to remove decay heat will not be compromised.~~
5. ~~The system meets the inspection and testing requirements of General Design Criteria 45 and 46 since the system is designed and constructed with suitable clearances and location to allow periodic inspection of major components, and is designed to permit functional operational testing to assure ¹¹⁸ensure structural integrity and system leak tightness, operability, and adequate performance of active system components.~~
4. The system is designed in accordance with the requirements of General Design Criterion GDC 61 as it relates to the system design for fuel storage ~~sincebecause~~ the system has the following design capabilities: the system has the capability for periodic testing of components important to safety. ~~The system is designed to provide suitable shielding by maintaining a minimum water level above the fuel. There is redundancy and testability of the decay heat removal portions of the system, and the system is designed to prevent reduction in fuel storage coolant inventory under accident conditions in accordance with position C.6 of Regulatory Guide 1.13.~~; the system has the capability to remove decay heat from the spent fuel under both normal operating and accident conditions; the system has redundancy so that decay heat can be removed assuming a single active failure; the system is designed to provide suitable shielding by maintaining a minimum water level above the fuel; the system provides appropriate containment of radioactivity by collecting and providing a

means for detecting leakage; and the system is designed to prevent reduction in fuel storage coolant inventory under accident conditions in accordance with position C.6 of Regulatory Guide 1.13. The spent fuel pool cleanup portion of the system (1) provides the capability and capacity of removing radioactive materials, corrosion products, and impurities from the pool water and thus meets the requirements of Criterion 61 as it relates to appropriate filtering systems for fuel cooling and storage, (2) reduces occupational exposure to radiation by removing radioactive materials from the pool water and thus meets the requirements of 10 CFR ~~Part 20, 20.1(e)~~ 20.1101(b)⁴⁴⁷ as it relates to maintaining radiation exposures ~~as low as reasonably achievable (ALARA)~~⁴⁴⁸ and, (3) retains radioactive materials and crud in the pool water in the demineralizer and filters and thus meets positions ~~C.2.f(2) and (3)~~ C.2.f(2) and C.2.f(3)⁴⁴⁹ of Regulatory Guide 8.8.

7. The system design meets the requirements of ~~General Design Criterion~~ GDC 63 since it has provisions to detect the loss of heat removal function through the use of loss of flow and temperature alarms, and to detect conditions that would result in excessive radiation through the use of coolant low level alarms and radiation monitoring alarms. ~~And the~~ The above alarms provide adequate notification of abnormal conditions for operators to initiate timely actions to ensure the safety functions are satisfied due to the large coolant inventory within the storage pool.⁴²⁰ ~~system has the capability to initiate appropriate safety actions since it has an automatic makeup system and the cooling system and ventilation and filtration system can be operated from the control room in the event of high radiation or low level alarms.~~

⁴⁴⁴Accordingly, the staff concludes that the design of the spent fuel pool cooling and cleanup system and its makeup system meets the requirements of General Design Criteria 2, 4, 5, ~~44, 45, 46~~, 61, and 63. This conclusion is based on the following:

For design certification and combined license reviews, the findings will also summarize (to the extent that the review is not discussed in other safety evaluation report sections) the staff's evaluation of the ITAAC, including design acceptance criteria (DAC), as applicable, and interface requirements and combined license action items relevant to this SRP Section.⁴²⁴

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff's plans for using this SRP section.

This SRP section will be used by the staff when performing safety evaluations of design certifications and license applications submitted by applicants pursuant to 10 CFR Part 50 or Part 52.52.⁴²² Except in those cases in which the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the method described herein will be used by the staff in its evaluation of conformance with Commission regulations.

The provisions of this SRP section apply to reviews of applications docketed 6 months or more after the date of issuance of this SRP section, unless superseded by a later revision.⁴²³

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides.

VI. REFERENCES

1. 10 CFR Part 20, §20.1(e), "General Provisions for Standards for Protection Against Radiation." Subpart B, § 20.1101(b), "Radiation Protection Programs."⁴²⁴
2. 10 CFR Part 50, Appendix A, General Design Criterion (GDC) 2, "Design Bases for Protection Against Natural Phenomena."
3. 10 CFR Part 50, Appendix A, General Design Criterion GDC 4, "Environmental and Missile Dynamic Effects"⁴²⁵ Design Bases."
4. 10 CFR Part 50, Appendix A, General Design Criterion GDC 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."
- 8.5. 10 CFR Part 50, Appendix A, General Design Criterion GDC 61, "Fuel Storage and Handling and Radioactivity Control."
- 9.6. 10 CFR Part 50, Appendix A, General Design Criterion GDC 63, "Monitoring Fuel and Waste Storage."
- 10.7. Regulatory Guide (RG) 1.13, "Fuel Storage Facility Design Basis."
- 11.8. Regulatory Guide RG 1.26 "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."
- 12.9. Regulatory Guide RG 1.29, "Seismic Design Classification."
- 13.10. Regulatory Guide RG 1.52, "Design, Testing, and Maintenance Criteria for Engineered-Safety-Feature Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."
- 14.11. Regulatory Guide RG 8.8, "Information Relevant to Ensuring That Occupational Radiation Exposures at Nuclear Power Stations Will Be As Low As Is Reasonably Achievable."

PAPERWORK REDUCTION ACT STATEMENT

The information collections contained in the draft standard review plan are covered by the requirements of 10 CFR Part 50.54, which were approved by the Office of Management and Budget (OMB), approval number 3150 - 0011.

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.

SRP Draft Section 9.1.3
Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current primary review branch and abbreviation	Changed "Auxiliary Systems Branch (ASB)" to "Plant Systems Branch (SPLB)."
2.	Current secondary review branch and abbreviation	Changed "Chemical Engineering Branch (CMEB)" to "Materials and Chemical Engineering Branch (EMCB)."
3.	Editorial	Modified punctuation and added article, "but," to improve clarity and readability.
4.	Current primary review branch and abbreviation	Changed "ASB" to "SPLB."
5.	Editorial	Added acronym "SFPCCS" to describe the spent fuel pool cooling and cleanup system. This acronym was used elsewhere in this SRP section but had not been defined.
6.	Editorial	Added comma to correct punctuation and clarify sentence.
7.	Editorial	Substituted the word "either" for "one" for clarity.
8.	Editorial	Divided Subsection I.1 by adding Subsection I.1.a. As previously written, it is not clear that the last three sentences in the paragraph only apply to the second option.
9.	Editorial	Added citation of Regulatory Guide 1.29 to explain the reference to "seismic Category 1" in the sentence.
10.	Editorial	Added citation of Regulatory Guide 1.26 to explain the reference to "Quality Group C" in the sentence.
11.	Editorial	Divided Subsection I.1 by adding Subsection I.1.b. As previously written, it is not clear that the last three sentences in the paragraph only apply to the second option.
12.	Current primary review branch and abbreviation	Changed "ASB" to "SPLB."
13.	Current primary review branch and abbreviation	Changed "ASB" to "SPLB."
14.	Editorial	Defined "SRP" as "Standard Review Plan."
15.	SRP-UDP format item	Added Subsection I.3.e, "Review for fire protection is performed under SRP Section 9.5.1." This information was extracted from the paragraph that formerly followed and could not be subsumed under "Review Interfaces" because the primary review branch for SRP Section 9.5.1 is now SPLB.

SRP Draft Section 9.1.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
16.	SRP-UDP format item	Added Subsection 1.3.f, "Review of environmental qualification of mechanical and electrical equipment is performed under SRP Section 3.11." This information was extracted from the paragraph that formerly followed and could not be subsumed under "Review Interfaces" because the primary review branch for SRP Section 3.11 is now SPLB.
17.	SRP-UDP format item	Added Subsection 1.3.g, "Verification that the limits for radioactivity concentrations are not exceeded is performed under SRP Sections 11.1 and 11.2. This information was extracted from the paragraph that formerly followed and could not be subsumed under "Review Interfaces" because the primary review branch for SRP Sections 11.1 and 11.2 is now SPLB.
18.	SRP-UDP format item	Added "Review Interfaces" under REVIEW RESPONSIBILITIES.
19.	Editorial	Changed Subsection I.4 to Subsection I.A under "Review Interfaces."
20.	Current review interface branch designation	Changed "CMEB" to "the EMCB."
21.	Current review interface branch designation	Changed "ASB" to "SPLB."
22.	Current secondary review branch designation	Changed "CMEB" to "The EMCB."
23.	Editorial	Defined "SER" as "safety evaluation report."
24.	Current primary review branch designation	Changed "ASB" to "the SPLB."
25.	Current secondary review branch designation	Changed "CMEB" to "EMCB."
26.	Current primary review branch designation	Changed "ASB" to "the SPLB."
27.	Current primary review branch designation	Changed "ASB" to "The SPLB."
28.	SRP-UDP format item. Current secondary review branch designation	Moved paragraph on inservice inspection review and provided current secondary review branch designation to conform to established format.
29.	SRP-UDP format item	Added designation of Subsection I.B under "Review Interfaces," the text of which is generally the same as previously written, except as noted.
30.	Current primary review branch designation	Changed "ASB" to "the SPLB."

SRP Draft Section 9.1.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
31.	SRP-UDP format item	Added Subsection I.B.1, under "Review Interfaces," the text of which is generally the same as previously written, except as noted.
32.	Current review interface branch designation	Changed "Structural Engineering Branch (SEB)" to "Civil Engineering and Geosciences Branch (ECGB)."
33.	SRP-UDP format item	Added Subsection I.B.2, under "Review Interfaces," the text of which is generally the same as previously written, except as noted.
34.	Current review interface branch designation	Changed "MEB" to "EMEB."
35.	Current review interface branch designation	Changed "MEB" to "EMEB."
36.	Current review interface branch designation	Changed "MEB" to "EMEB."
37.	SRP-UDP format item	Identified the ECGB as the current PRB responsible for SRP Section 6.6, and deleted text in current location related to material compatibility reviews and relocated it as the new second paragraph under Subsection I.A.
38.	SRP-UDP format item	Added Subsection I.B.4, under "Review Interfaces," the text of which is generally the same as previously written, except as noted.
39.	SRP-UDP format item	Deleted reference to fire protection because this is now a primary review branch (SPLB) responsibility. See new Subsection 1.3.e.
40.	Editorial	Broke the review of technical specifications and the review of quality assurance into two separate review interfaces.
41.	SRP-UDP format item	Deleted "Chemical Engineering Branch, Licensing Guidance Branch, and Quality Assurance Branch" and inserted "Technical Specifications Branch (TSB) and the Quality Assurance and Maintenance Branch (HQMB)" to reflect current review interface branch responsibilities for SRP Sections 16.0 and 17.1/2.
42.	SRP-UDP format item	Deleted citation of SRP Section 9.5.1 in this subsection. See new Subsection I.3.e.
43.	SRP-UDP format item	Moved the interface for review of quality assurance down from the previous paragraph, corrected the responsible review branch, and added SRP Section 17.3 as guidance for that review.
44.	SRP-UDP format item	Added Subsection I.B.6, under "Review Interfaces," the text of which is generally the same as previously written, except as noted.

SRP Draft Section 9.1.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
45.	Current review interface branch designation	Deleted "EQB" and inserted "EMEB" pertaining to primary review responsibility for SRP Section 3.10.
46.	SRP-UDP format item	Deleted "and the environmental qualification of mechanical and electrical equipment as part of its primary review responsibility for SRP Sections 3.10 and 3.11, respectively" and substituted "as part of its primary review responsibility for SRP Section 3.10." The SPLB has responsibility for primary review of SRP Section 3.11, which is covered under new Subsection I.3.f.
47.	SRP-UDP format item	Added Subsection I.B.7, under "Review Interfaces," the text of which is generally the same as previously written, except as noted.
48.	Current review interface branch designation and abbreviation	Deleted "Systems" from the title and substituted "HICB" for "ICSB."
49.	SRP-UDP format item	Broke the reviews by ICSB and PSB into two separate review interfaces and clarified the subject of the review covered by SRP Section 7.1.
50.	SRP-UDP format item	Moved the interface for review of onsite ac power down from the previous paragraph, corrected the responsible review branch, and added wording describing the subject matter addressed by SRP Section 8.3.1
51.	SRP-UDP Format Item, Review Interfaces	This review interface identifies reviews conducted to satisfy SECY 93-087 and ABWR FSER Staff guidance on Shutdown and Low Power Operations. The staff requested that design certification applicants complete an assessment of shutdown and low-power risk. The shutdown and low-power risk assessment must identify design-specific vulnerabilities and weaknesses and document consideration and incorporation of design features that minimize such vulnerabilities. The spent fuel pool cooling system was included in the ABWR FSER risk assessment as a system that can provide alternative core cooling capability in the event of the loss of normal decay heat removal. Consideration of the spent fuel pool cooling system in the shutdown and low-power risk assessment is the responsibility of the SPSB and will be included in the proposed SRP Section 19.1 on risk assessments.
52.	SRP-UDP format item	Deleted paragraph regarding SRP Sections 11.1 and 11.2. SPLB has primary review branch responsibility for these SRP sections and new Subsection I.3.g now applies.
53.	SRP-UDP format item	Added new Subsection number I.C. Text is the same as previously written, except as noted.

SRP Draft Section 9.1.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
54.	Editorial	Modified for clarity and readability.
55.	Editorial	Provided "GDC 2" as initialism for "General Design Criterion 2."
56.	Editorial	Added comma to separate phrases and improve clarity of the sentence.
57.	Editorial	Added paragraph break to Subsection II.1.a. for clarification.
58.	Editorial	Added the words "meet this criterion" to clarify the meaning of the sentence.
59.	Editorial	Added paragraph break to Subsection II.1.a for clarification.
60.	Editorial	Deleted the word "also" which is confusing in this sentence.
61.	Editorial	Provided "GDC 4" as initialism for "General Design Criterion 4."
62.	Editorial	Added paragraph break to Subsection II.1.b for clarification.
63.	Editorial	Made minor corrections to grammar and punctuation in sentence for clarification.
64.	Editorial	Provided "GDC 5" as initialism for "General Design Criterion 5."
65.	Editorial	Provided "GDC 44" as initialism for "General Design Criterion 44."
66.	Editorial	Deleted "to include" and substituted "as related to" to make the subsection compatible with the introductory phrase in Subsection II.1.
67.	Editorial	Added comma to set off the prepositional phrase.
68.	Editorial	Changed designation from "ASB 9-2" to "SPLB 9-2," and added title and description at first occurrence of citation of this appendix.
69.	Editorial	Provided "GDC 45" as initialism for "General Design Criterion 45."
70.	Editorial	Provided "GDC 46" as initialism for "General Design Criterion 46."
71.	Editorial	Changed "assure" to "ensure" to correct usage.
72.	Editorial	Provided "GDC 61" as initialism for "General Design Criterion 61."

SRP Draft Section 9.1.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
73.	Editorial	Provided "GDC 63" as initialism for "General Design Criterion 63."
74.	SRP-UDP format item	Changed "Part 20, paragraph 20.1(c)" to "20.1101(b)" to reflect the current location of the regulation concerning ALARA in the CFR.
75.	Editorial	Added comma to clarify sentence.
76.	SRP-UDP format item	Added "Technical Rationale" and lead-in sentence under ACCEPTANCE CRITERIA.
77.	SRP-UDP format item	Added technical rationale for GDC 2.
78.	SRP-UDP format item	Added technical rationale for GDC 4.
79.	SRP-UDP format item	Added technical rationale for GDC 5.
80.	SRP-UDP format item	Added technical rationale for GDC 44.
81.	SRP-UDP format item	Added technical rationale for GDC 45.
82.	SRP-UDP format item	Added technical rationale for GDC 46.
83.	SRP-UDP format item	Added technical rationale for GDC 61.
84.	SRP-UDP format item	Added technical rationale for GDC 63.
85.	SRP-UDP format item	Added technical rationale for 10 CFR 20.1101(b).
86.	Current secondary review branch abbreviation	Changed "CMEB" to "EMCB."
87.	Current primary review branch abbreviation.	Changed "ASB" to "SPLB."
88.	Editorial	Changed "assure" to "ensure."
89.	Editorial	Changed "assure" to "ensure."
90.	Current review interface branch designation	Changed "SEB" to "the ECGB."
91.	Current review interface branch designation	Changed "MEB" to "the EMEB" in the sentence. Also changed "is" to "as" to correct an apparent typographical error.
92.	SRP-UDP format item	Deleted "140°F" and substituted "60 °C (140 °F)" to apply metric units with English conversion.
93.	SRP-UDP format item	Deleted "10 feet" and substituted "3 meters (10 feet)" to apply metric units with English conversion.
94.	Editorial	Changed designation of SRP Section "3.6.6" to "3.9.6" to correct a typographical error.
95.	Current review interface branch abbreviations	Changed "MTEB and MEB" to "EMCB and EMEB."

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Item	Source	Description
96.	Editorial	Cited reference to BTP SPLB 9-2 and deleted the title quoted in the text above.
97.	Editorial	Renumbered subparagraphs i through iv as (1) through (4), respectively, to conform to the established convention in Subsections II.1.d and II.1.g.
98.	SRP-UDP format item	Deleted "140°F" and substituted "60 °C (140 °F)" to apply metric units with English conversion.
99.	Editorial	Deleted the parenthetical notation "(CP)", which is ambiguous, and included the phrase "for the CP review."
100.	Editorial	Changed "assure" to "ensure."
101.	Editorial	Changed "assure" to "ensure."
102.	Editorial	Deleted the parenthetical notation "(CP)", which is ambiguous, and included the phrase "for the CP review."
103.	Editorial	Changed "assure" to "ensure."
104.	Editorial	Changed "assure" to "ensure."
105.	Editorial	Changed "assure" to "ensure."
106.	Editorial	Changed "assure" to "ensure."
107.	Editorial	Changed "assure" to "ensure."
108.	Editorial	Corrected subsection number from 7 to 6.
109.	Editorial	Changed "assure" to "ensure."
110.	Current secondary review branch designation	Changed "CMEB" to "the EMCB."
111.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
112.	Editorial	Modified to eliminate gender-specific reference.
113.	Editorial	Defined "SER" as "safety evaluation report" in item 23 above.
114.	Editorial	Indented paragraph for to improve clarity.
115.	Editorial	Indented Subsections IV.1 through IV.7 for clarity.
116.	Editorial	Changed "assure" to "ensure."
117.	SRP-UDP format item	Changed "Part 20, 20.1(c)" to "20.1101(b)" to reflect the current location of the regulation concerning ALARA in the CFR.

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Item	Source	Description
118.	Editorial	Modified to reflect that "ALARA" had previously been defined for this section.
119.	Editorial	Clarified citation of subsections in Regulatory Guide 8.8 to avoid confusion with numbering of phrases in the sentence.
120.	Editorial	Deleted the word "And" at the beginning of a sentence.
121.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items.
122.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard sentence to address application of the SRP section to reviews of applications filed under 10 CFR Part 52, as well as Part 50.
123.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
124.	SRP-UDP format item	Changed "20.1(c), 'General Provisions for Standards for Protection Against Radiation.'" to "Subpart B, § 20.1101(b), 'Radiation Protection Programs.'" to reflect the current location of the regulation concerning ALARA in the CFR.
125.	Editorial	Corrected title of GDC 4 to reflect change since this SRP section was last published.

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SRP Draft Section 9.1.3
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
1171	Revise the Acceptance Criteria, Review Procedures, and Evaluation Findings as necessary to incorporate the guidance of the proposed draft Regulatory Guide CE-913 (proposed revision 2 to Regulatory Guide 1.13).	This is a placeholder integrated impact. No change made.

SRP Draft Section 9.1.3

Description of Changes

The following summarizes the changes in Revision 2, dated xxxxxx 2006.

1. General changes included editorial and formatting changes. Note: minor editorial and formatting changes are not identified by side bars.
2. Standard language was added throughout the SRP section to extend the applicability to licensing and design certification reviews submitted under 10 CFR Part 52, including the applicability of the Combined License Applications for Nuclear Power Plants (LWR Edition) - Regulatory Guide DG-1145 as superceded by the final guide expected December 2006.
3. Language was added to the boilerplate on the front page, acceptance criteria and review procedures to clarify that the SRP represents an acceptable approach for meeting the Commission's regulations and that applicants are required to identify deviations from this criteria and evaluate how the alternative approaches meet the Commission's regulations.
4. Specific changes identified by section of the SRP:

REVIEW RESPONSIBILITIES - Editorial revision to reflect change in primary review branch resulting from office reorganization – identified by function. This change is reflected throughout the SRP section. Added secondary review functions as a result of reorganization.

I. AREAS OF REVIEW:

5. ~~Review Responsibilities~~

~~No changes were incorporated.~~

6. ~~Areas of Review~~

- a. ~~Added a review interface to satisfy SECY 93-087 and ABWR FSER Staff guidance on Shutdown and Low Power Operations. The staff requested that design certification applicants complete an assessment of shutdown and low-power risk. The shutdown and low-power risk assessment must identify design-specific vulnerabilities and weaknesses and document consideration and incorporation of design features that minimize such vulnerabilities. The spent fuel pool cooling system was included in the ABWR FSER risk assessment as a system that can provide alternative core cooling capability in the event of the loss of normal decay heat removal. Consideration of the spent fuel pool cooling system in the shutdown and low-power risk assessment is the responsibility of DRA and will be included in the proposed SRP Section 19.1 on risk assessments. [Are we adopting this]?~~

a. Added standard paragraph to identify secondary review of the capability and capacity of the spent fuel pool cleanup system to remove corrosion products, radioactive materials and impurities from the pool water.

b. Added standard paragraph to identify primary review of the ITAAC for design certifications and combined license reviews as it relates to the SSC described in this

section. The ITAAC are reviewed to assure that all SSC in this area of review are identified and addressed as appropriate in accordance with SRP 14.3.

II. ACCEPTANCE CRITERIA

7. Acceptance Criteria

a. Deleted acceptance criteria related to GDC 44, 45 and 46. The requirements related to the capability to transfer heat, permit periodic inspections, and permit operational testing described in those criteria are encompassed by GDC 61.

b. Added standard sentences to identify acceptance criteria for ITAAC related to design certification and combined licensed reviews.

III. REVIEW PROCEDURES

8. Review Procedures

a. Added standard paragraph to address application of Review Procedures in design certification reviews.

b. Modified the review procedure to clarify the staff position when the applicant opts for an alternative of a Quality Group C and seismic Category I spent fuel pool make-up system and ventilation system instead of a Quality Group C and seismic Category I SFPCS. The modification added a statement that the ventilation system provide the capability to vent steam/moisture to the atmosphere in order to protect safety-related components from the effects of boiling in the SFP. The modification also clarified that the ventilation and filtrations system need only meet the guidelines of RG 1.52 when filtration is necessary to limit the offsite dose consequences of spent fuel pool boiling.

c. Modified review procedure to redefine the minimum operational heat removal capacity of the SFPCS. The minimum heat removal capacity for operation of the SFPCS is defined to ensure the system can maintain the pool structure below its design temperature with a heat load defined as a percentage of rated thermal power. The system capacity following a single failure is specified as greater than half of the full system capacity. These changes separate the cooling system design basis from unrealistic refueling scenarios, while retaining a reasonably large system capacity.

d. Modified review procedure to clarify requirements for the SFPCS makeup system and its backup. The backup system quality requirements for the flow path were changed to specify that the system be permanently installed and designed to seismic Category I specifications unless the cooling system is designed to seismic Category I specifications, in which case the backup system need only be supplied from a seismic Category I source. Also, specific makeup capacity evaluation criteria was added to be consistent with the minimum heat removal capability of the cooling system and the makeup flow necessary to prevent a substantial loss of inventory following a fuel handling accident.

e. Modified review procedure to clarify the evaluation criteria for SFP cooling capacity during normal operations. The revised criteria eliminate specific refueling scenarios that often did not align with refueling practices. The revision provides criteria to maintain SFP water temperature within acceptable limits, given that adequate methods of evaluating decay heat generation and cooling system heat removal have been defined

and appropriate administrative controls are in place. The revised evaluation criteria provide flexibility by permitting a balance between factors that affect heat load, such as offload size and decay time, and factors that affect heat removal capability, such as heat sink temperature and cooling system performance.

IV. EVALUATION FINDINGS

~~9.~~ Evaluation Findings

~~a.~~ A new paragraph was added at the end of the Evaluation Findings to address design certification reviews. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items.

V. IMPLEMENTATION

~~10.~~ Implementation

~~a.~~ Added standard paragraph to indicate applicability of this section to reviews of future applications.

VI. REFERENCES

~~11.~~ References

~~a.~~ Deleted GDC 44, 45 and 46 from the references. Areas of review are covered under GDC 61. All applicable references to such GDC's included in Subsections II and IV of this section were deleted as well.