



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

9.2.3 DEMINERALIZED WATER MAKEUP SYSTEM

REVIEW RESPONSIBILITIES

Primary - ~~Auxiliary Systems Branch (ASB)~~ Materials and Chemical Engineering Branch (EMCB)¹

Secondary - ~~None~~ Plant Systems Branch (SPLB)²

I. AREAS OF REVIEW

A. The ~~ASB~~EMCB³ reviews the demineralized water makeup system (DWMS) from the supply connection of the service or municipal water source to the points of discharge. The capability to provide an adequate supply of treated water of reactor coolant purity to other systems as makeup, and to provide other plant demineralized water requirements is reviewed. The design of the DWMS is generally not safety related; the review is primarily directed toward ~~assuring~~ensuring⁴ that a failure or malfunction of the system could not adversely affect essential systems requirements in accordance with General Design Criteria 2 and 5.

1. The ~~ASB~~EMCB⁵ review of the DWMS system⁶ includes the following considerations:
 - a. Capability of the system to effectively store, handle, and dispense all chemicals utilized in the demineralizing and regeneration process.
 - b. Capability of the DWMS to operate within the environment to which it is exposed.

DRAFT Rev. 3 - April 1996

USNRC STANDARD REVIEW PLAN

Standard review plans are prepared for the guidance of the Office of Nuclear Reactor Regulation staff responsible for the review of applications to construct and operate nuclear power plants. These documents are made available to the public as part of the Commission's policy to inform the nuclear industry and the general public of regulatory procedures and policies. Standard review plans are not substitutes for regulatory guides or the Commission's regulations and compliance with them is not required. The standard review plan sections are keyed to the Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants. Not all sections of the Standard Format have a corresponding review plan.

Published standard review plans will be revised periodically, as appropriate, to accommodate comments and to reflect new information and experience.

Comments and suggestions for improvement will be considered and should be sent to the U.S. Nuclear Regulatory Commission, Office of Nuclear Reactor Regulation, Washington, D.C. 20555.

- c. Provisions for the regeneration wastes to be directed to a suitable point in the radwaste system or other specified areas for subsequent processing prior to discharge to the environment and instrumentation and isolation capabilities provided, including the ability to detect corrosive solutions and the valving necessary to isolate the system.
2. The ASBEMCB⁷ reviews the system function relative to other safety-related systems to determine whether portions of the system are safety related and to determine whether a seismic Category I makeup source is required.
3. The EMCB reviews the DWMS ~~is also reviewed to assure~~⁸ that a malfunction or failure of a component will not have an adverse effect on any safety-related system or components.
4. ~~The Materials Engineering Branch (MTEB)~~ The EMCB⁹ ~~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,~~¹⁰ verifies the compatibility of the materials of construction with service conditions.
5. ~~The Chemical Engineering Branch (CMEB)~~ EMCB¹¹ verifies the capability of the DWMS to chemically process raw water to provide reactor coolant purity water for makeup to the reactor coolant system and associated systems and to provide demineralized water to other systems as required as part of its primary review responsibility for SRP Sections 5.4.8, 9.3.4, and 5.4.2.1 (BTP-MTEB 5-3).¹²

Review Interfaces¹³

In addition, the ASBEMCB¹⁴ will coordinate other branch evaluations that interface with the overall review of the system as follows:

1. ASBSPLB¹⁵ ~~also~~ performs the following reviews under the Standard Review Plan (SRP)¹⁶ sections indicated:
 - a. Review of 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; and
 - d. Review of high- and moderate-energy pipe breaks is performed under SRP Section 3.6.1.
2. ~~The Structural Engineering Branch (SEB)~~ Civil Engineering and Geosciences Branch (ECGB)¹⁷ 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. The ECGB also verifies that inservice inspection requirements are met for system components as part of its primary review responsibility for SRP Section 6.6.¹⁸

3. The Mechanical Engineering Branch (~~MEB~~)(EMEB)¹⁹ performs the following:
 - a. 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;
 - b. ~~The (MEB), also, d~~²⁰ 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; and
 - c. ~~The MEB also r~~²¹ 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.
4. The Instrumentation and Controls Branch (~~HCSB~~)(HICB)²² and the ~~Power Systems Branch (PSB)~~Electrical Engineering Branch (EELB)²³ determine the adequacy of the design, installation, inspection, and testing of all essential electrical components (sensing, control, and power) required for proper operation as part of their primary review responsibility for SRP Sections 7.1 and 8.1, respectively.
5. ~~The Effluent Treatment Systems Branch (ETSB)~~Emergency Preparedness and Radiation Protection Branch (PERB)²⁴ verifies that the limits for radioactivity concentrations are met as part of its primary review responsibility for SRP Section 11.5.
6. ~~The Chemical Engineering Branch~~Plant Systems Branch (SPLB)²⁵ coordinates and performs reviews for Fire Protection as part of its primary review responsibility for SRP Section 9.5.1.
7. ~~The Licensing Guidance Branch~~Technical Specifications Branch (TSB)²⁶ coordinates and performs reviews for Technical Specifications as part of its primary review responsibility for SRP Section 16.0.
8. ~~The Quality Assurance Branch~~Quality Assurance and Maintenance Branch (HQMB)²⁷ coordinates and performs reviews for Quality Assurance as part of its primary review responsibility for SRP Section Chapter 17.0.²⁸

~~In addition, the ASB will coordinate other branch evaluations that interface with the overall review of the system as follows:~~

~~The Structural Engineering Branch (SEB) 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. The Mechanical Engineering Branch (MEB) 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, 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 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. The Materials Engineering Branch (MTEB) 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 service conditions. The Instrument and Control Systems Branch (ICSB) and the Power Systems Branch (PSB) determine the adequacy of the design, installation, inspection, and testing of all essential electrical components (sensing, control, and power) required for proper operation as part of their primary review responsibility for SRP Sections 7.1 and 8.1, respectively. The Effluent Treatment Systems Branch (ETSB) verifies that the limits for radioactivity concentrations are met as part of its primary review responsibility for SRP Section 11.5.

The Chemical Engineering Branch (CMEB) verifies the capability of the DWMS to chemically process raw water to provide reactor coolant purity water for makeup to the reactor coolant system and associated systems and to provide demineralized water to other systems as required as part of its primary review responsibility for SRP Sections 5.4.8, 9.3.4 and 5.4.2.1 (BTP-MTEB 5-3). The reviews for Fire Protection, Technical Specifications, and Quality Assurance are coordinated and performed by the Chemical Engineering Branch, Licensing Guidance Branch, and Quality Assurance Branch as part of their primary review responsibility for SRP Sections 9.5.1, 16.0, and 17.0, respectively.²⁹

For those areas of review identified above as part of the primary review responsibility of other branches, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP section of the corresponding primary review branch.³⁰

II. ACCEPTANCE CRITERIA

Acceptability of the design of the DWMS, as described in the applicant's safety analysis report (SAR), is based on design criteria or regulatory guides that apply directly to the safety-related functional performance requirements for the DWMS. The ASBEMCB³¹ assuresensures that the system is capable of providing the required supply of reactor coolant purity water to all systems.

Several general design criteria and regulatory guides are used to evaluate the system design for those cases when a failure or malfunction of the DWMS could adversely affect essential systems

or components (i.e., those necessary for safe shutdown or accident prevention or mitigation). These are as follows:

1. General Design Criterion 2 (GDC 2),³² "Design Bases for Protection Against Natural Phenomena," as related to the safety-related portions of the system being capable of withstanding the effects of earthquakes. Acceptance is based on meeting the guidance of Regulatory Guide 1.29, Position C-1, if any portion of the system is deemed to be safety-related, and Position C-2 for nonsafety-related functions.
2. General Design Criterion 5 (GDC 5),³³ "Sharing of Structures, Systems, and Components," in regard to the effect of sharing in multiple-unit facilities.

Technical Rationale³⁴

The technical rationale for application of these acceptance criteria to reviewing the DWMS is discussed in the following paragraphs:³⁵

1. Compliance with GDC 2 requires that nuclear power plant structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as earthquake, tornado, hurricane, flood, tsunami, and seiche without loss of capability to perform their intended safety functions.

GDC 5 applies to this SRP section because the reviewer evaluates the DWMS to ensure that it will withstand the effects of natural phenomena and will be capable of providing water of reactor coolant purity for makeup to the reactor coolant and associated systems, as well as providing water for other systems.

Meeting the requirements of GDC 2 provides assurance that equipment associated with the DWMS will operate under the most severe credible natural phenomena in combination with normal and accident conditions without loss of capability to perform its intended safety functions.³⁶

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

The requirements of GDC 5 are imposed to ensure that the shared use of the DWMS in a multiple-unit plant will not significantly affect the orderly shutdown and cooldown in one plant in the event of an accident in another.

Meeting the requirements of GDC 5 provides assurance that the operation of DWMS equipment will not be significantly impaired if it is shared by multiple units of a nuclear power plant.³⁷

III. REVIEW PROCEDURES

The procedures set forth below are used during construction permit (CP) or early site permit³⁸ application review to determine that the design criteria and bases and the preliminary design as set forth in the preliminary SAR meet the acceptance criteria given in subsection II. For the review of operating license (OL) or combined license (COL)³⁹ applications, the review procedures and acceptance criteria are utilized to verify that the initial design criteria and bases have been appropriately implemented in the final design as set forth in the final SAR.

Upon request from the primary reviewer, the coordinating review branches will provide input for the areas of review stated in subsection I. The primary reviewer obtains and uses such input as required to assure⁴⁰ that this review procedure is complete.

The reviewer selects and emphasizes material from this SRP section, as may be appropriate for a particular case. A determination will be made as to whether the DWMS or portions thereof are safety related, including whether a seismic Category I makeup source is required for safe shutdown or for accident conditions. In confirming this design aspect, an analysis is made in which it is assumed that any DWMS pipe fails or component malfunctions or fails in such a manner as to cause maximum damage to other equipment located nearby. The system will be considered nonsafety related if its failure does not affect the ability of the reactor facility to achieve and maintain safe shutdown conditions.

1. The ASBEMCB⁴⁰ evaluates the system design information and drawings and, utilizing engineering judgment, operational experience, and performance characteristics of similar, previously approved systems, to verify that:
 - a. The system is capable of fulfilling the requirements of the facility for makeup water on a day-to-day basis.
 - b. The component redundancy necessary for the system to perform its design function is provided.
 - c. The potential for leakage and accidental spills has been minimized.
 - d. Instrumentation (e.g., a conductivity monitor) has been provided together with the capability to isolate the system should planned operating conditions be exceeded.
 - e. Piping has been provided as necessary to direct solutions and regenerative wastes to the radwaste system or other specified areas for processing and disposal.
2. The ASBEMCB⁴¹ also verifies, ~~with input from the CMEB as requested,~~⁴² the following:
 - a. Precautions are taken or incorporated into the system design to properly store, handle, and dispense corrosive and toxic chemicals effectively and safely so that safety-related systems would not be adversely affected in the event of a leak or spill.
 - b. The components utilized are compatible with the associated chemicals.

The review for seismic design is performed by SEBECGB⁴³ and the review for seismic and quality group classification is performed by MEBEMEB⁴⁴ as indicated in subsection I of this SRP section.

The ASBEMCB⁴⁵ reviews the interface between seismic and nonseismic portions of the system and the isolation capabilities to assure that a failure of the nonseismic portion would not affect the seismic Category I portion and will not prevent safe plant shutdown.

For standard design certification reviews under 10 CFR Part 52, the procedures above should be followed, as modified by the procedures in SRP Section 14.3 (proposed), to verify that the design set forth in the standard safety analysis report, including inspections, tests, analysis, and acceptance criteria (ITAAC), site interface requirements and combined license action items, meet the acceptance criteria given in subsection II. SRP Section 14.3 (proposed) contains procedures for the review of certified design material (CDM) for the standard design, including the site parameters, interface criteria, and ITAAC.⁴⁶

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and the review supports conclusions of the following type, to be included in the staff's safety evaluation report (SER):⁴⁷

The demineralized water makeup system includes all components and piping associated with the system from the service or municipal water source to the points of discharge to other systems or to a discharge canal. The review has determined the adequacy of the applicant's proposed design criteria and design bases for the demineralized water makeup system, regarding safety-related requirements (if any) for an adequate supply of reactor coolant purity water during all conditions of plant operation.

Portions of the ~~DMW system~~ DWMS⁴⁸ that are necessary for safe shutdown or necessary to mitigate the consequences of an accident are classified seismic Category I and Quality Group C.

The staff concludes that the design of the demineralized water makeup system is acceptable and meets the requirements of General Design Criteria 2 and 5. This conclusion is based on the following:

1. The applicant has met the requirements of General Design Criterion 2 with respect to safety-related portions of the system being capable of withstanding the effects of earthquakes. Acceptance is based on meeting the guidance of Regulatory Guide 1.29, Position C-1, if any operation is deemed safety related, and Position C-2, for nonsafety-related portions. Portions of the system are deemed safety related if a failure or malfunction could result in adverse effects on essential systems or components (i.e., necessary for safe shutdown, accident prevention or accident mitigation).

2. The applicant has met the requirements of General Design Criterion 5 with respect to sharing of structures, systems, and components by demonstrating that such sharing does not affect the safe shutdown of either unit in the event of an active or passive failure.

For design certification 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 inspections, tests, analyses, and acceptance criteria (ITAAC), including design acceptance criteria (DAC), site interface requirements, and combined license action items that are relevant to this SRP section.⁴⁹

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 license applications submitted by applicants pursuant to 10 CFR 50 or 10 CFR 52.⁵⁰ 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 six months or more after the date of issuance of this SRP section.⁵¹

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

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."
2. 10 CFR Part 50, Appendix A, General Design Criterion 5, "Sharing of Structures, Systems, and Components."
3. Regulatory Guide 1.29, "Seismic Design Classification."

SRP Draft Section 9.2.3
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 designation and abbreviation	Changed "Auxiliary Systems Branch" to "Materials and Chemical Engineering Branch" (EMCB) to reflect the current primary review responsibility for SRP Section 9.2.3.
2.	Current secondary review branch designation and abbreviation	Added "Plant Systems Branch" (SPLB) as secondary reviewer of SRP Section 9.2.3.
3.	Current PRB abbreviation	Changed PRB to EMCB.
4.	Editorial	Changed "assuring" to "ensuring."
5.	Current PRB abbreviation	Changed PRB to EMCB.
6.	Editorial	Deleted the word "system," which is already contained within the initialism DWMS.
7.	Current PRB abbreviation	Changed PRB to EMCB.
8.	Editorial	Modified to reflect parallel construction. Changed "assure" to "ensure" (global change for this section).
9.	Current primary review branch	Changed review branch to EMCB as reassigned area of responsibility from review interface branch to PRB.
10.	PRB Assignments	This interface was relocated to accommodate reassignment of SRP 6.6 to the ECGB.
11.	Current primary review branch	Changed review interface branch to Materials and Chemical Engineering Branch to reflect current primary review responsibility for SRP Sections 5.4.8, 9.3.4, and 5.4.2.1.
12.	Current BTP abbreviation	BTP abbreviations are open items to be corrected pending resolution by the staff. BTPs historically contain the current branch abbreviation as part of the BTP identification eg., BTP-MEB 5-3. These branch identifiers can become meaningless after reorganizations.
13.	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW and organized into numbered paragraph form to describe how EMCB reviews aspects of the DWMS under other SRP sections and how other branches support the review of the DWMS.
14.	Current PRB abbreviation	Changed review branch to EMCB.
15.	Current SRB abbreviation	Changed review branch to SPLB.
16.	Editorial	Defined "SRP" as "Standard Review Plan."

SRP Draft Section 9.2.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
17.	Current review interface branch designation and abbreviation	Changed review interface branch to Civil Engineering and Geosciences Branch, which now has review responsibilities 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.
18.	PRB Assignments	Relocated this interface for SRP Section 6.6 to reflect reassignment to the ECGB from the EMCB.
19.	Current review interface branch abbreviation	Changed review interface branch to EMEB.
20.	Editorial	Modified to reflect parallel construction.
21.	Editorial	Modified to reflect parallel construction.
22.	Current review interface branch abbreviation	Changed review interface branch to HICB.
23.	Current review interface branch designation and abbreviation	Changed review interface branch to Electrical Engineering Branch (EELB).
24.	Current review interface branch designation and abbreviation	Changed review interface branch to Emergency Preparedness and Radiation Protection Branch to reflect responsibility for SRP Section 11.5.
25.	Current review interface branch designation and abbreviation	Changed review interface branch to Plant Systems Branch (SPLB) to reflect responsibility for SRP Section 9.5.1.
26.	Current review interface branch designation and abbreviation	Changed review interface to Technical Specifications Branch (TSB) to reflect responsibility for SRP Section 16.0.
27.	Current review interface branch designation and abbreviation	Changed review interface to Quality Assurance and Maintenance Branch (HQMB) to reflect responsibility for SRP Chapter 17.
28.	Editorial	Corrected "SRP Section 17.0" to "SRP Chapter 17."
29.	SRP-UDP format item	Relocated all line-outs to under "Review Interfaces" and reformatted into numbered paragraphs.
30.	Editorial	Simplified for clarity and readability.
31.	Current PRB abbreviation	Changed PRB to EMCB.
32.	Editorial	Introduced "GDC 2" as initialism for "General Design Criterion 2."
33.	Editorial	Introduced "GDC 5" as initialism for "General Design Criterion 5."
34.	SRP-UDP format item	Added "Technical Rationale" to ACCEPTANCE CRITERIA and formatted in numbered paragraphs describing the bases for referencing the General Design Criteria and other regulations.

SRP Draft Section 9.2.3
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
35.	SRP-UDP format item	Added lead-in sentence for "Technical Rationale."
36.	SRP-UDP format item	Added technical rationale for GDC 2.
37.	SRP-UDP format item	Added technical rationale for GDC 5.
38.	SRP-UDP format item	Added "or early site permit" after (CP).
39.	SRP-UDP format item	Added "(OL) or combined license" after operating license.
40.	Current PRB abbreviation	Changed PRB to EMCB.
41.	Current PRB abbreviation	Changed PRB to EMCB.
42.	Editorial	Deleted words no longer necessary because EMCB is the PRB.
43.	Current review interface branch abbreviation	Changed review interface branch to ECGB.
44.	Current review interface branch abbreviation	Changed review interface branch to EMEB.
45.	Current PRB abbreviation	Changed PRB to EMCB.
46.	SRP-UDP format item	Added reference to design certification reviews.
47.	Editorial	Provided "SER" as initialism for "safety evaluation report."
48.	Editorial	Deleted "DMW system" and replaced with the correct and consistently used abbreviation DMWS.
49.	SRP-UDP format item	Added reference to design certification reviews.
50.	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.
51.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.

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SRP Draft Section 9.2.3
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
	No Integrated Impacts were incorporated in this SRP Section.	