



U.S. NUCLEAR REGULATORY COMMISSION
STANDARD REVIEW PLAN
OFFICE OF NUCLEAR REACTOR REGULATION

10.4.2 MAIN CONDENSER EVACUATION SYSTEM

REVIEW RESPONSIBILITIES

Primary - ~~Effluent Treatment Systems Branch (ETSB)~~ Plant Systems Branch (SPLB)¹

Secondary - ~~Non-Emergency Preparedness and Radiation Protection Branch (PERB)~~²

I. AREAS OF REVIEW

At the construction permit (CP) stage of review, ~~ETSB~~SPLB reviews the information in the applicant's safety analysis report (SAR) in the specific areas that follow. At the operating license (OL) stage of review, the ~~ETSB~~SPLB review consists of confirming the design accepted at the CP stage.

The main condenser evacuation system (MCES) generally consists of two subsystems: the "hogging" or startup system which initially establishes main condenser vacuum and the normal system which maintains condenser vacuum once it has been established.

1. The ~~ETSB~~SPLB review of each MCES subsystem includes the design, design objectives, capacity, method of operation, and factors that influence gaseous radioactive material handling, e.g., system interfaces and potential bypass routes. The ~~ETSB~~SPLB review includes the system piping and instrumentation diagrams (P&IDs).
2. Design features to preclude the possibility of an explosion if the potential for explosive mixtures exists are reviewed by ~~ETSB~~SPLB.
3. Provisions incorporated to detect explosive gas mixtures and monitor radioactive materials in gaseous effluents from the MCES are reviewed in SRP Sections 11.3

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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.

and 11.5 by ETSBSPLB, with a secondary review performed by PERB with respect to gaseous effluents and radiation monitors for the MCES as defined in these SRP sections.³

Review Interfaces⁴

In addition,⁵ the⁶ ETSBSPLB will coordinate evaluations of other branches that interface with the overall review of the system as follows:

- A.⁷ The Mechanical Engineering Branch (MEBEMEB⁸) reviews systems quality group classifications as part of its primary review responsibility for SRP Section 3.2.2.
- B. The Quality Assurance and Maintenance Branch (QABHQMB⁹) reviews systems quality assurance programs as part of its primary review responsibility for SRP Sections 17.1 and 17.2.

For those areas of review identified as being reviewed 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 branch.¹⁰

II. ACCEPTANCE CRITERIA

ETSBSPLB will accept the MCES design if the following Commission regulations are met:

1. General Design Criterion 60 as it relates to the MCES design for the control of releases of radioactive materials to the environment.
2. General Design Criterion 64 as it relates to the MCES design for the monitoring of releases of radioactive materials to the environment.

The requirements of the Commission regulations identified above are met by using the regulatory positions contained in the following regulatory guides and industrial standard:

1. Regulatory Guide 1.26 as it relates to the quality group classification for the MCES that may contain radioactive materials, but are not part of the reactor coolant pressure boundary and are not important to safety.
2. ~~Regulatory Guides 1.123 and 1.33 as they relate to the quality assurance programs for the MCES components that may contain radioactive materials.~~¹¹
3. "Standards for Steam Surface Condensers" (Ref. 2)¹² as it relates to the MCES components that may contain radioactive materials.

Specific criteria necessary to meet the relevant requirements of 10 CFR Part 50, Appendix A, General Design Criteria 60 and 64 are as follows:

1. The MCES capacity should be consistent with the industry guidelines given in Reference 2. Either mechanical vacuum pumps or steam jet air ejectors may be used for hogging (startup) or normal evacuation of the main condenser.
2. The components of the MCES should be designed to Quality Group D as defined in Regulatory Guide 1.26 (Ref. 3)¹³ and to a nonseismic design classification. These quality standards meet the requirements of 10 CFR 50.55a for water- and steam-containing components that may contain radioactive materials but are not part of the reactor coolant pressure boundary and are less~~not~~¹⁴ important to safety.
3. If there is a potential for explosive mixtures to exist, the MCES should be designed to withstand the effects of an explosion and the applicant should¹⁵ provide instrumentation to detect and annunciate the buildup of potentially explosive mixtures, or provide dual instrumentation to detect, annunciate, and effect control measures to prevent the buildup of potentially explosive mixtures, as outlined in SRP Section 11.3, subsection II, "Acceptance Criteria," Item B.¹⁶ Such a potential does not exist on systems designed to maintain the steam content in all MCES components above 58% by volume in hydrogen-air mixtures or nitrogen content above 92% by volume in hydrogen-oxygen mixtures in all MCES components¹⁷.
4. Provisions to control and monitor releases of radioactivity to the environment from the MCES must conform to the requirements of General Design Criteria 60 and 64 (Ref. 4)¹⁸.
5. The design pressure and normal operational absolute pressure should be provided for MCES components containing potentially explosive mixtures.

Technical Rationale

The technical rationale for application of the acceptance criteria for the main condenser evacuation system is discussed in the following paragraphs.¹⁹

Compliance with GDC 60 requires that provisions be included in the nuclear power unit design to control suitably the release of radioactive materials in gaseous and liquid effluents during normal operation, including anticipated operational occurrences.

GDC 60 is applicable to the design of the main condenser evacuation system because radioactive materials in both gaseous and liquid form are routinely processed in this system in BWRs during normal operation. In BWRs, the radioactivity in the main steam lines and the air ejector discharge are monitored to ensure that releases are suitably controlled. In PWRs, radioactive materials are processed in this system only if there is a primary-to-secondary steam generator tube leak. Measures are taken to detect primary-to-secondary leakage in PWRs by monitoring the radioactivity in the steam generator blowdown and in the air ejector discharge.

Regulatory Guide 1.26 specifies the quality group classification for the main condenser evacuation system that may contain radioactive materials.

Meeting these requirements provides assurance that the release of radioactive materials in gaseous and liquid effluents from the main condenser evacuation system during normal operation, including anticipated operational occurrences, is kept as low as is reasonably achievable, in accordance with 10 CFR Part 50.²⁰

Compliance with GDC 64 requires that means be provided for monitoring effluent discharge paths for radioactivity that may be released from normal operations, including anticipated operational occurrences, and from postulated accidents.

GDC 64 is applicable to the main condenser evacuation system because this system is a normal discharge path for radioactivity in BWRs during normal operation, including anticipated operational occurrences. For PWRs, radioactivity detected in this system is usually the first indication of a primary-to-secondary steam generator tube leak. Postulated accidents can result in fuel damage or failure, and the detectors installed in this system would serve to monitor such radioactivity in order to control and limit its release.

Meeting the requirements of GDC 64 provides a level of assurance that effluents from the main condenser evacuation system are suitably monitored and controlled.²¹

III. REVIEW PROCEDURES

The ETSBSPLB reviewer will select and emphasize material from this SRP section as may be appropriate for a particular case.

1. In the ETSBSPLB review of the MCES, the P&IDs are reviewed to determine the flow paths of gases through the system, including all bypasses, and the points of release of gaseous wastes to the environment or other systems. This information is used in SRP Section 11.3 to calculate the quantity of radioactive material released annually in gaseous effluents during normal operations, including anticipated operational occurrences. ETSBSPLB verifies that water from the mechanical vacuum pumps and condensate from the steam jet air ejectors are classified as radioactive liquids and treated accordingly.
2. ETSBSPLB reviews the equipment quality group classifications to meet the guidelines of Regulatory Guide 1.26 (Ref. 3)²². Exceptions are transmitted to MEBEMEB²³, which has primary review²⁴ responsibility underfor²⁵ SRP Section 3.2.2.
3. If there is a potential that explosive mixtures may exist, ETSBSPLB determines whether the applicant has designed the MCES to withstand the effects of such an explosion and has provided instrumentation to detect and annunciate or has provided dual instrumentation on redundant MCES trains to detect, annunciate, and effect control measures to prevent the buildup of potentially explosive mixtures. This review is conducted by ETSBSPLB concurrently with its review as outlined in SRP Section 11.3 for a gaseous radioactive waste management system. ETSBSPLB will also determine if

the applicant's design includes adequate provisions to stop continuous leakage paths after an explosion.

4. ~~ETSB reviews the quality assurance for the design, construction, and operational phases for the MCES according to the guidelines of Regulatory Guides 1.123 and 1.33 (Refs. 4 and 5). Exceptions are transmitted to QAB, which has primary responsibility under SRP Sections 17.1 and 17.2.²⁶~~

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.²⁷

IV. EVALUATION FINDINGS

ETSB/SPLB verifies that sufficient information has been provided and that the review is adequate to support conclusions of the following type, to be included in the staff's safety evaluation report (SER):

The main condenser evacuation system includes equipment and instruments to establish and maintain condenser vacuum and to prevent an uncontrolled release of radioactive material to the environment. The scope of our review included the system capability to transfer radioactive gases to the gaseous waste processing system or ventilation exhaust systems, and²⁸ the design provisions incorporated to monitor and control releases of radioactive materials in effluents. The staff has reviewed the applicant's system descriptions, piping and instrumentation diagrams, and design criteria for the components of the main condenser evacuation system.

The staff concludes that the MCES design is acceptable in that the applicant has met the requirements of General Design Criteria 60 and 64 with respect to the control and monitoring of releases of radioactive materials to the environment by providing a controlled and monitored MCES. The applicant has met the requirements of industrial standard "Standards for Steam Surface Condensers" that has been reviewed by the staff and determined to be appropriate for this application.

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.²⁹

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 52.³⁰ 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.³¹

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

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 60, "Control of Releases of Radioactive Materials to the Environment," and General Design Criterion 64, "Monitoring Radioactivity Releases."
2. "Standards for Steam Surface Condensers," 6th Ed., Heat Exchanger Institute (1970).
3. Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."
- ~~4. Regulatory Guide 1.33, "Quality Assurance Program Requirements (Operation)."~~
- ~~5. Regulatory Guide 1.123, "Quality Assurance Requirements for Control of Procurement of Items and Services for Nuclear Power Plants."³²~~

SRP Draft Section 10.4.2
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 name and designation	Changed the primary review branch name and designation, SPLB (global change for this section).
2.	Current secondary review branch name and designation	Added the secondary review branch name and designation, PERB.
3.	Current primary review branch designation	Added a phrase to indicate the secondary review responsibilities for PERB.
4.	SRP-UDP format item	Added Review Interfaces subheading under AREAS OF REVIEW.
5.	Editorial change	Deleted the phrase "In addition," as not necessary since the subheading Review Interfaces was added.
6.	Editorial change	Capitalized the new beginning of the sentence.
7.	SRP-UDP format item	Divided the existing paragraph into paragraphs A and B under the subheading Review Interfaces. The existing text and order was preserved, except that the names and designations of the interfacing review branches were updated.
8.	Current interfacing review branch designation	Changed the interfacing review branch designation, EMEB.
9.	Current interfacing review branch name and designation	Changed the interfacing review branch name and designation, HQMB.
10.	Editorial change	Material deleted to improve clarity.
11.	Integrated Impact No. 534	Deleted references to Regulatory Guides from 1.123 and 1.33. Primary basis: Quality Assurance is adequately covered by HQMB as part of its primary review responsibility for SRP Sections 17.1 and 17.2.
12.	Editorial addition	Added "(Ref.2)" because it is not obvious from the title to which standard is being referred.
13.	SRP-UDP format item	Deleted Reference (3) as needlessly redundant.
14.	Editorial correction	Changed the term to "not important to safety" to be consistent with wording in paragraph 1. above regarding Regulatory Guide 1.26.
15.	Editorial addition	Added the words "the applicant should" to improve the sentence structure.
16.	Editorial correction	The correct paragraph is B.6, not 6.
17.	Editorial change	Moved the phrase "in all MCES components" to improve the sentence structure.

SRP Draft Section 10.4.2
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
18.	SRP-UDP format item	Deleted Reference (1) as needlessly redundant.
19.	SRP-UDP format item	Added Technical Rationale subheading and introductory paragraph.
20.	SRP-UDP format item	Added the technical rationale for GDC 60.
21.	SRP-UDP format item	Added the technical rationale for GDC 64.
22.	SRP-UDP format item	Deleted Reference (3) as needlessly redundant.
23.	Current interfacing review branch designation	Changed the interfacing review branch designation, EMEB.
24.	Editorial addition	Added the word "review" for consistency.
25.	Editorial change	Editorial preference.
26.	Integrated Impact No. 534.	Deleted references to Regulatory Guides from 1.123 and 1.33. Primary basis: Quality Assurance is adequately covered by HQMB as part of its primary review responsibility for SRP Sections 17.1 and 17.2.
27.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
28.	Editorial addition	Added the word "and" between phrases for clarity.
29.	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.
30.	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.
31.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
32.	Integrated Impact No. 534	Deleted references to Regulatory Guides from 1.123 (Reference 5) and 1.33 (Reference 4). Primary basis: Quality Assurance is adequately covered by HQMB as part of its primary review responsibility for SRP Sections 17.1 and 17.2.

SRP Draft Section 10.4.2
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
534	Delete reference to Regulatory Guide 1.123 and substitute Regulatory Guide 1.28 therefore. The proposed action was preempted by an SPLB recommendation to delete all references to RGs 1.123 and 1.33 within SRP Sections 10.4.2 and 10.4.3, primarily on the basis that Quality Assurance is adequately covered in SRP Sections 17.1 and 17.2.	II.2; III.4; VI.4 and 5