



U.S. NUCLEAR REGULATORY COMMISSION  
**STANDARD REVIEW PLAN**

**6.2.1.5 MINIMUM CONTAINMENT PRESSURE ANALYSIS FOR EMERGENCY CORE COOLING SYSTEM PERFORMANCE CAPABILITY STUDIES**

**REVIEW RESPONSIBILITIES**

**Primary** - Organization responsible for the review of containment integrity

**Secondary** - None

I. AREAS OF REVIEW

The specific areas of review are as follows:

1. Following a loss-of-coolant accident in a pressurized water reactor (PWR) plant, the emergency core cooling system (ECCS) supplies water to the reactor vessel to reflood, and thereby cool, the reactor core. The core flooding rate is governed by the capability of ECCS water to displace the steam generated in the reactor vessel during the core reflooding period. For PWR plants, core flooding rate depends directly on containment pressure (i.e., the core flooding rate increases with increasing containment pressure). Therefore, as part of the overall evaluation of ECCS performance, the primary reviewer reviews analyses of the minimum containment pressure possible during the time until the core is reflooded following a loss-of-coolant accident (LOCA) to confirm the validity of the containment pressure in ECCS performance capability studies. The primary reviewer reviews the assumptions for the operation of engineered safety feature heat removal systems, the effectiveness of structural heat sinks within the containment to remove energy from the containment atmosphere, and such other heat removal

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**USNRC STANDARD REVIEW PLAN**

This Standard Review Plan, NUREG-0800, has been prepared to establish criteria that the U.S. Nuclear Regulatory Commission 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 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 regulations.

The standard review plan sections are numbered in accordance with corresponding sections in Regulatory Guide 1.70, "Standard Format and Content of Safety Analysis Reports for Nuclear Power Plants (LWR Edition)." Not all sections of Regulatory Guide 1.70 have a corresponding review plan section. The SRP sections applicable to a combined license application for a new light-water reactor (LWR) are based on Regulatory Guide 1.206, "Combined License Applications for Nuclear Power Plants (LWR Edition)."

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](mailto:NRR_SRP@nrc.gov).

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processes as steam in the containment mixing with ECCS water spilling from the break in the reactor coolant system; and in ice condenser containments mixing with water from melted ice that drains into the lower containment volume. The review is for all PWR containment types (i.e., dry, subatmospheric, and ice condenser containments).

It should be noted that the minimum containment pressure analysis for ECCS performance evaluation differs from the containment functional performance analysis in that the conservatisms and margins are taken in opposite directions; thus, the minimum containment pressure analysis required by the regulations for ECCS performance evaluation is not conservative as to peak containment pressure in a LOCA and cannot be used to determine the containment design basis.

2. Inspection, Test, Analysis, and Acceptance Criteria (ITAAC). For design certification (DC) and combined license (COL) reviews, the staff reviews the applicant's proposed ITAAC associated with the structures, systems, and components (SSCs) related to this SRP section in accordance with SRP Section 14.3, "Inspections, Tests, Analyses, and Acceptance Criteria." The staff recognizes that the review of ITAAC cannot be completed until after the rest of this portion of the application has been reviewed against acceptance criteria contained in this SRP section. Furthermore, the staff reviews the ITAAC to ensure that all SSCs in this area of review are identified and addressed as appropriate in accordance with SRP Section 14.3.
3. COL Action Items and Certification Requirements and Restrictions. For a DC application, the review will also address COL action items and requirements and restrictions (e.g., interface requirements and site parameters).

For a COL application referencing a DC, a COL applicant must address COL action items (referred to as COL license information in certain DCs) included in the referenced DC. Additionally, a COL applicant must address requirements and restrictions (e.g., interface requirements and site parameters) included in the referenced DC.

### Review Interfaces

Other SRP sections interface with this section as follows:

1. Section 6.3: Coordination with the reviewer responsible for determining the acceptability of the mass and energy release data in the minimum containment pressure analysis. This information is derived from the applicant's evaluation of ECCS performance capability in accordance with 10 CFR 50.46.

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

## II. ACCEPTANCE CRITERIA

### Requirements

Acceptance criteria are based on the relevant requirements of 10 CFR 50.46, which allows either an acceptable ECCS evaluation model that realistically describes the behavior of the

reactor during LOCAs or an ECCS evaluation model developed in compliance with 10 CFR Part 50, Appendix K. The primary reviewer accepts the analysis if it meets the following requirements, as applicable:

1. 10 CFR 50.46(a)(1)(i), with respect to an acceptable ECCS evaluation model that realistically describes the behavior of the reactor during LOCAs or
2. 10 CFR 50.46(a)(1)(ii), with respect to an ECCS evaluation model developed in compliance with 10 CFR 50, Appendix K, paragraph I.D.2, which requires that the containment pressure used for evaluating cooling effectiveness during reflood and spray cooling not exceed pressure calculated conservatively for that purpose.
3. 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.
4. 10 CFR 52.80(a), which requires that a COL application contain the proposed inspections, tests, and analyses, including those applicable to emergency planning, that the licensee shall perform, and the acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, the facility has been constructed and will operate in conformity with the combined license, the provisions of the Atomic Energy Act, and the NRC's regulations.

#### SRP Acceptance Criteria

Specific SRP acceptance criteria acceptable to meet the relevant requirements of the NRC's regulations identified above are as follows for review described in Subsection I of this SRP section. The SRP 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 its facility and the SRP acceptance criteria and evaluate how the proposed alternatives to the SRP acceptance criteria provide acceptable methods of compliance with the NRC regulations.

Specific criteria that pertain to minimum containment pressure analysis for ECCS performance studies are indicated below:

1. To meet the requirements of 10 CFR 50.46(a)(1)(i), the model to determine minimum containment pressure for ECCS studies should comply with Regulatory Guide (RG) 1.157, Position C.3.12.1, which describes acceptable containment pressure models for ECCS performance analysis.
2. To meet the requirements of 10 CFR Part 50.46(a)(1)(ii), the following specific criteria indicate the conservatism that analyses of the containment response to LOCAs should have for determining the minimum containment pressure for ECCS performance capability studies:

- A. Calculations of the mass and energy released during postulated LOCAs should be based on the requirements of 10 CFR Part 50, Appendix K.
- B. Branch Technical Position 6-2, "Minimum Containment Pressure Model for PWR ECCS Performance Evaluation," delineates the calculation approach that should be followed for a conservative prediction of the minimum containment pressure.

### Technical Rationale

The technical rationale for application of these acceptance criteria to the areas of review addressed by this SRP section is discussed in the following paragraphs:

1. 10 CFR 50.46(a)(1)(i) requires plants to have ECCSs, the cooling performance of which is evaluated for the most severe postulated LOCA. 10 CFR 50.46(a)(1)(i) allows the ECCS evaluation to use a realistic model that describes the behavior of the reactor coolant system during a LOCA. Containment minimum pressure directly affects ECCS performance. Calculation and analysis of this parameter, therefore, is a part of the ECCS performance evaluation. RG 1.157 provides specific methods acceptable to the staff for meeting 10 CFR 50.46(a)(1)(i). This regulation assures that, in a LOCA, the ECCS will perform as predicted, meeting limits on maximum peak cladding temperature, maximum cladding oxidation, and maximum hydrogen generation and maintaining a coolable geometry.
2. 10 CFR 50.46(a)(1)(ii) requires plants to have ECCSs, the cooling performance of which is evaluated for the most severe postulated LOCA. As an alternative to the requirements of 10 CFR 50.46(a)(1)(i), 10 CFR 50.46(a)(1)(ii) requires for the ECCS performance evaluation a model based on 10 CFR Part 50, Appendix K, which provides specific calculation methods for evaluating ECCS performance and significant conservatisms to address the uncertainties of post-LOCA plant behavior. Containment minimum pressure directly affects ECCS performance. Calculation and analysis of this parameter, therefore, is part of the ECCS performance evaluation. This regulation assures that, in a LOCA, the ECCS will perform as predicted, limit maximum peak cladding temperature, maximum cladding oxidation, and maximum hydrogen generation; and maintain a coolable geometry.

### III. REVIEW PROCEDURES

The reviewer will select and emphasize material from the procedures described below, as may be appropriate for a particular case.

For each area of review specified in Subsection I of this SRP section, the review procedure is identified below. These review procedures are based on the identified SRP acceptance criteria. For deviations from these specific acceptance criteria, 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.

1. Primary review is of the analyses in the safety analysis report of the minimum containment pressure following a LOCA. The reviewer responsible for SRP Section 6.3 confirms the validity of the applicant's mass and energy release data. The primary

reviewer evaluates the conservatism of the applicant's assumptions for the operation of containment heat removal systems and the effectiveness of structural heat sinks by comparing the applicant's calculation approach to either the method outlined in Branch Technical Position 6-2 or RG 1.157, Position C.3.12.1 (consistent with Subsection II of this SRP section). In certain cases, the reviewer may perform confirmatory containment pressure response analyses. In these cases, containment pressure calculated by the primary reviewer is compared to that in the applicant's evaluation of ECCS performance capability for assurance of an appropriately conservative value. The primary reviewer advises the SRP Section 6.3 reviewer of the acceptability of the containment back pressure in the ECCS performance evaluation.

2. For review of a DC application, the reviewer should follow the above procedures to verify that the design, including requirements and restrictions (e.g., interface requirements and site parameters), set forth in the final safety analysis report (FSAR) meets the acceptance criteria. DCs have referred to the FSAR as the design control document (DCD). The reviewer should also consider the appropriateness of identified COL action items. The reviewer may identify additional COL action items; however, to ensure these COL action items are addressed during a COL application, they should be added to the DC FSAR.

For review of a COL application, the scope of the review is dependent on whether the COL applicant references a DC, an early site permit (ESP) or other NRC approvals (e.g., manufacturing license, site suitability report or topical report)

3. For review of both DC and COL applications, SRP Section 14.3 should be followed for the review of ITAAC. The review of ITAAC cannot be completed until after the completion of this section.

#### IV. EVALUATION FINDINGS

The reviewer verifies that the applicant has provided sufficient information and that the review and calculations (if applicable) support conclusions to be included in the staff's safety evaluation report (SER). The reviewer also states the bases for those conclusions.

The conclusions reached on completion of the review under this SRP section are presented in SRP Section 6.2.1.

For DC and COL reviews, the findings will also summarize the staff's evaluation of requirements and restrictions (e.g., interface requirements and site parameters) and COL action items relevant to this SRP section.

In addition, to the extent that the review is not discussed in other SER sections, the findings will summarize the staff's evaluation of the ITAAC, including design acceptance criteria, as applicable.

#### V. IMPLEMENTATION

The staff will use this SRP section in performing safety evaluations of DC applications and license applications submitted by applicants pursuant to 10 CFR Part 50 or 10 CFR Part 52.

Except when the applicant proposes an acceptable alternative method for complying with specified portions of the Commission's regulations, the staff will use the method described herein to evaluate conformance with Commission regulations.

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

VI. REFERENCES

1. References for this SRP section as listed in SRP Section 6.2.1.

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**PAPERWORK REDUCTION ACT STATEMENT**

The information collections contained in the Standard Review Plan are covered by the requirements of 10 CFR Part 50 and 10 CFR Part 52, and were approved by the Office of Management and Budget, approval number 3150-0011 and 3150-0151.

**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.

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