



U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

5.4.11 PRESSURIZER RELIEF TANK

REVIEW RESPONSIBILITIES

Primary - ~~Auxiliary Systems Branch (ASB)~~ Plant Systems Branch (SPLB)¹

Secondary - None

I. AREAS OF REVIEW

The pressurizer relief tank is a pressure vessel provided in typical pressurized water reactor (PWR) primary systems to condense and cool the discharge from the pressurizer safety and relief valves. Discharges from small relief valves located inside the containment may also be piped to the tank. Tank capacity is based on a requirement to absorb the pressurizer discharge during a specified step load decrease.

The review of the pressurizer relief tank, as described in the applicant's safety analysis report (SAR), includes the tank, the piping connections from the tank to the pressurizer relief and safety valves, the tank spray system and associated piping, the nitrogen supply piping, and piping leaving the tank to the cover gas analyzer and to the reactor coolant drain tank. The pressurizer relief tank system is nonsafety related; the review is primarily directed toward ~~assuring~~ensuring, in accordance with applicable criteria,² that its operation is consistent with transient analyses of related systems and that failure or malfunction of the system could not adversely affect essential systems or components ~~in accordance with applicable criteria~~.

The review covers the following specific areas:

1. The seismic design classification of the pressurizer relief tank and its supporting systems.

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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.

2. The quality standards to which the tank and its supporting systems will be designed, fabricated, erected, and tested.
3. The measures taken in the design to prevent system performance degradation below acceptable levels as a result of failures of other nearby systems or as a result of the tank failure during an anticipated abnormal occurrence.
4. The steam condensing capacity of the tank compared to with³ the largest anticipated plant step load decrease.
5. The instrumentation provided to measure and indicate pressurizer relief tank pressure, temperature, and liquid level, and to signal the operator in the event of abnormal parameters.
6. The tank rupture disk relief capacity compared to with the capacity of the pressurizer relief and safety valves.

Review Interfaces⁴

The review of the pressurizer relief tank system will involve reviews performed by other branches. The results of these reviews will be coordinated by ASB the SPLB⁵ to complete the overall evaluation of the system. The evaluations performed by others are as follows:

- A. The Reactor Systems Branch (RSBSRXB⁷) will determine that the anticipated and maximum pressurizer relief and safety valve discharge rates are acceptable based on a review of the limiting transient and will determine that the piping between the valves and the tank is adequately sized as part of its primary review responsibility for Standard Review Plan (SRP)⁸ Section 5.2.2.
- B. ~~The Materials Engineering Branch (MTEB)~~ The Civil Engineering and Geosciences Branch (ECGB)⁹ will verify that inservice inspection requirements are met for system components as part of its primary review responsibility for SRP Section 6.6 and, upon request, will verify the compatibility of the materials of construction with service conditions.
- C. The Materials and Chemical Engineering Branch (EMCB), upon request, will verify the compatibility of the materials of construction with service conditions.¹⁰
- D. The Mechanical Engineering Branch (~~MEB~~EMEB¹¹) will confirm that the system is designed in accordance with applicable codes and standards as part of its primary responsibility for SRP Sections 3.9.1 through 3.9.3. The ~~MEB, also,~~EMEB also¹² 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.
- D. The review for fire protection, technical specifications, and quality assurance are coordinated and performed by the ~~Chemical Engineering Branch~~SPLB,¹³ ~~Licensing Guidance Branch~~ Technical Specifications Branch (TSB),¹⁴ and ~~Quality Assurance~~

Branch Quality Assurance and Maintenance Branch (HQMB)¹⁵ as part of their primary review responsibility for SRP Sections 9.5.1, 16.0, and 17.3¹⁶ respectively.

For those areas of review identified above 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.¹⁷

II. ACCEPTANCE CRITERIA

Since the pressurizer relief tank system is located inside containment, possibly in close proximity to essential systems and components, acceptance is based on a failure or malfunction of the system not having an adverse effect on equipment necessary to bring the plant to a safe shutdown condition, to prevent accidents or to mitigate the consequences of an accident. Therefore, the design of the pressurizer relief tank system is acceptable if the integrated system design is in accordance with the following criteria:

1. General Design Criterion 2 (GDC 2),¹⁸ as it relates to the protection of essential systems from the effects of earthquakes. Acceptance is based on meeting the guidelines of Regulatory Guide 1.29, position C.2, with regard to the location of the tank in relation to other plant systems (the design of the tank system should be such that the plant safety-related systems would not be endangered and continue to perform their safety function in the event of a tank failure)¹⁹ and position C.3 regarding the extension of seismic Category I boundaries.
2. General Design Criterion 4 (GDC 4),²⁰ as it relates to a failure of the system resulting in missiles or adverse environmental conditions that could result in unnecessary damage to safety-related systems or components. The following specific criteria are used to determine if the requirements of GDC 4 are met:
 - a. The rupture disks have a relief capacity at least equal to the combined capacity of the pressurizer relief and safety valves with sufficient allowance for rupture disk tolerance.
 - b. The pressurizer relief tank volume and the quantity of water initially stored in the tank should be such that no steam or water will be released to containment under any normal operating conditions or anticipated operational abnormal²¹ occurrences. The initial temperature of water inside the²² tank should be assumed to be no lower than 120°F/49°C (120°F).²³
 - c. The pressurizer relief tank and rupture disk should be designed for full vacuum so that the collapse of the tank will not occur if the contents are cooled following a discharge of steam without the addition of nitrogen.
 - d. High temperature, high pressure, high and low liquid level alarms for the pressurizer relief tank have been provided.

- e. The tank should be located in such a manner that the rupture discs are not a missile threat to safety-related equipment.

Technical Rationale

The technical rationale for application of these acceptance criteria to reviewing the pressurizer relief tank is discussed in the following paragraphs:²⁴

- A. Compliance with GDC 2 requires that systems, structures, 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. The design of nonsafety-related equipment such as the pressurizer relief tank should be consistent with this objective.

GDC 2 is applicable to SRP Section 5.4.11 because the reviewer verifies that the design of the pressurizer relief system is consistent with transient analyses of related or adjacent systems and that failure or malfunction of the pressurizer relief tank system will not adversely affect the performance, in accordance with applicable criteria, of safety-related structures, systems, or components.

Meeting the requirements of GDC 2 provides assurance that the failure of the pressurizer relief tank system will not prevent structures, systems, and components important to safety from performing their intended safety function.²⁵

- B. Compliance with GDC 4 requires that 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 such as pipe whip, missiles, and discharging fluids. The design of nonsafety-related equipment, such as the pressurizer relief tank should be consistent with that design objective.

GDC 4 is applicable to SRP Section 5.4.11 because the reviewer verifies that failure of the pressurizer relief tank system will not generate missiles or adverse environmental conditions that could result in damage to safety-related structures, systems, or components.

Meeting the requirements of GDC 4 provides assurance that the pressurizer relief tank system will not generate missiles or cause adverse environmental conditions that could damage safety-related structures, systems, or components to the degree that they cannot perform their intended safety functions.²⁶

III. REVIEW PROCEDURES

The procedures below are used in the construction permit (CP) review to determine that the design criteria and bases and the preliminary design described in the SAR meet the acceptance criteria given in subsection II of this SRP section. For operating license (OL) reviews, the

procedures are used to verify that the initial design criteria and bases have been appropriately implemented in the final design.

Upon request from the primary reviewer, the coordinating review branches will provide input for the areas of review stated in subsection I of this SRP section. The primary reviewer obtains and uses such input as required to ~~assure~~ensure²⁷ 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 pressurizer relief tank system or portions thereof are safety-related. In confirming this design aspect, an analysis is made in which it is assumed that any system 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.~~²⁸

1. The SAR is reviewed to establish that the pressurizer relief tank system description and related diagrams clearly delineate system operation and the system capability to accept the steam flow released from the pressurizer for step load decreases.
2. The SAR is reviewed to determine that the rupture disks on the relief tank have a relief capacity at least equal to the combined capacity of the pressurizer relief and safety valves. The reviewer determines that the tank design pressure provides a conservative margin above the calculated pressure resulting from the maximum design relief and safety valve discharge, i.e., the maximum surge resulting from complete loss of load. The reviewer verifies that the tank and rupture disks are designed for full vacuum, so as to prevent tank collapse if the contents are cooled following a discharge without nitrogen being added.
3. The pressure suppression capability of the system is reviewed to ~~assure~~ensure²⁹ proper system operation. The ~~RSBSRXB~~³⁰ will verify the mass and energy blowdown data including rate of energy release to evaluate the above effects.
4. The piping and instrumentation diagrams are reviewed to verify that high temperature and pressure alarms and high and low liquid level alarms have been provided for the pressurizer relief tank.
5. The reviewer verifies that the system will function following anticipated abnormal occurrences. The reviewer evaluates the failure modes and effects analysis presented in the SAR to ~~assure~~ensure³¹ function of required components, traces the availability of these components on system drawings, and checks that the SAR information contains verification that minimum system flow and heat transfer requirements are met for each degraded situation over the required time spans. For each case, the design will be acceptable if minimum system requirements are met.
6. The reviewer determines that failure of the pressurizer relief tank system or portions of the system ~~not designed to seismic Category I, and which are~~³² located close to safety-related systems, will not as a result of their failure preclude essential operations of

these safety systems. Reference to the general arrangement and layout drawings for structures and systems will be necessary.

7. The reviewer determines that other systems inside containment are protected from the effects of high-energy line breaks and moderate-energy leakage cracks in the pressurizer relief system. Layout drawings are reviewed to assure³³ that other systems are not located close to the pressurizer relief system, or that protection from the effects of failure will be provided.

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.³⁴

IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and ~~his~~ that the³⁵ review supports conclusions of the following type, to be included in the staff's safety evaluation report (SER).³⁶

The pressurizer relief tank system includes components and piping such as the pressurizer relief and safety valve connections to the tank, the relief tank spray system piping, the nitrogen supply piping, and piping leaving the tank to the cover gas analyzer and reactor coolant drain tank. The pressurizer relief tank system is designed to nonnuclear safety and Quality Group D (see Regulatory Guide 1.26)³⁷ requirements since it is not necessary for safe shutdown, accident prevention or accident mitigation.

The staff concludes that the design of the pressurizer relief tank system meets the requirements of General Design Criteria 2 and 4, and is acceptable. This conclusion is based on the following:

1. The applicant's design meets the requirements of General Design Criterion 4 as it relates to protection against the effects of earthquakes by meeting positions C.2 and C.3 of Regulatory Guide 1.29 ~~regarding the failure of nonsafety-related systems having no adverse affects on safety-related systems and the extension of seismic Category I design requirements to the first seismic restraint beyond the defined boundaries (i.e., the piping from the safety and relief valves to the first downstream restraint)~~.^{1.29} Position C.2 indicates that the failure of nonsafety-related systems should have no adverse effects on safety-related systems. Position C.3 indicates that seismic Category 1 design requirements should extend to the first seismic restraint beyond the defined boundaries (i.e., the piping from the safety and relief valves to the first downstream restraint).³⁸

2. The applicant's design meets the requirements of General Design Criterion 4 as it relates to protection of safety-related equipment from adverse environmental affects and from missiles generated by rupture disc failure. This criterion is met since the system is designed to prevent steam or water release to containment under any normal operating conditions or anticipated abnormal occurrences and the tank is orientated in such a manner that the rupture discs do not become a missile hazard to safety-related equipment.

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.³⁹

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the 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 52.⁴⁰ 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 on 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.⁴¹

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 4, "Environmental and ~~Missile~~Dynamic Effects⁴² Design Bases."
3. Regulatory Guide 1.29, "Seismic Design Classification."
4. Regulatory Guide 1.26, "Quality Group Classifications and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."⁴³

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SRP Draft Section 5.4.11
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 REVIEW RESPONSIBILITIES to reflect current PRB responsibility for SRP Section 5.4.11. |
| 2. | Editorial | Changed "assuring" to "ensuring." Relocated the phrase "in accordance with applicable criteria" from the end of the sentence to correct a misplaced modifier. |
| 3. | Editorial | Changed "compared to" to "compared with" in order to accommodate scientific usage global change for this section. |
| 4. | SRP-UDP format item | Added "Review Interfaces" to AREAS OF REVIEW and reformatted the large review paragraph into itemized interfaces. |
| 5. | Primary review branch and current abbreviation | Changed "ASB" to "SPLB" to reflect primary review branch and its current designation. |
| 6. | SRP-UDP format item | Added letter designations in order to separate the individual branch interface responsibilities in the existing text. |
| 7. | Current review branch abbreviation | Changed "RSB" to "SRXB" in accordance with current review interface branch designation. |
| 8. | Editorial | Defined "SRP" as "Standard Review Plan." |
| 9. | Current review branch name and abbreviation | Changed the "Materials Engineering Branch (MTEB)" to the "Civil Engineering and Geosciences Branch (ECGB)" to reflect the current branch designation. |
| 10. | PRB Assignments | Revised text to reflect that the PRB reviewing materials compatibility and ISI (SRP 6.6) is no longer the same branch. |
| 11. | Current review branch abbreviation | Changed "MEB" to "EMEB" to reflect current branch designation. |
| 12. | Editorial correction/ Current review branch abbreviation | Eliminated extra commas from text. Changed "MEB" to "EMEB" to reflect current branch abbreviation. |
| 13. | Current primary review branch assignment and abbreviation | Eliminated the phrase "Chemical Engineering Branch" and substituted "SPLB" to reflect current primary review branch responsibility for SRP Section 9.5.1. |
| 14. | Current review branch assignment and abbreviation | Eliminated the phrase "Licensing Guidance Branch" and substituted "Technical Specifications Branch (TSB)" to reflect current review interface branch responsibility for SRP Section 16.0. |

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| Item | Source | Description |
|------|---|---|
| 15. | Current review branch assignment and abbreviation | Eliminated the phrase "Quality Assurance Branch" and substituted "Quality Assurance and Maintenance Branch (HQMB)" to reflect current review interface branch responsibility for SRP Section 17.3. |
| 16. | Editorial | Deleted "17.0" and substituted "17.3" because there is no SRP Section 17.0. |
| 17. | Editorial | Simplified for clarity and readability. |
| 18. | Editorial | Introduced "GDC 2" as initialism for "General Design Criterion 2." |
| 19. | Editorial | Added to and set off the phrase that now reads, "(the design of the tank system should be such that the plant safety-related systems would continue to perform their safety function in the event of a tank failure)" in order to clarify the sentence and correct the grammar. |
| 20. | Editorial | Introduced "GDC 4" as initialism for "General Design Criterion 4." |
| 21. | Editorial | Changed "abnormal" to "operational" to improve clarity. |
| 22. | Editorial | Supplied missing article in the sentence. |
| 23. | SRP-UDP format item | Converted 120°F to 49°C in accordance with Federal Standard 376B and noted the value in accordance with the required standard format. |
| 24. | SRP-UDP format item | Added "Technical Rationale" and lead-in statement to describe safety benefits of conforming to applicable General Design Criteria. |
| 25. | SRP-UDP format item | Added technical rationale for GDC 2. |
| 26. | SRP-UDP format item | Added technical rationale for GDC 4. |
| 27. | Editorial | Changed "assure" to "ensure." |

SRP Draft Section 5.4.11
Attachment A - Proposed Changes in Order of Occurrence

| Item | Source | Description |
|------|------------------------------------|---|
| 28. | Editorial | Deleted three sentences. The first deleted sentence was misleading and not consistent with the rest of SRP Section 5.4.11. The second sentence of the second paragraph of AREAS OF REVIEW, Subsection I, states that the pressurizer relief tank is not safety related. This statement provides the basis for the ACCEPTANCE CRITERIA, Subsection II, and EVALUATION FINDINGS, Subsection IV. Further, no guidance is offered elsewhere in SRP Section 5.4.11 concerning additional or alternative review actions if a determination is made that the pressurizer relief tank system is safety related. The second and third deleted sentences are not applicable if the first sentence is deleted. Also these sentences infer a definition of "safety related" that is not in accordance with the usually accepted meaning of this term. Subsection III.6, REVIEW PROCEDURES, appears to cover the concerns in the deleted text. |
| 29. | Editorial | Changed "assure" to "ensure." |
| 30. | Current review branch abbreviation | Changed "RSB" to "SRXB" to reflect current review branch abbreviation. |
| 31. | Editorial | Changed "assure" to "ensure." |
| 32. | Editorial | Deleted the phrase "not designed to seismic Category I, and which are" because it is ambiguous. The sentence, as now constructed, excludes from its scope those components that are designed as seismic Category 1. The phrase also infers that certain portions of the pressurizer relief tank system should be designed to be seismic Category 1, which is inconsistent with the guidance in Subsection C.2 of Regulatory Guide 1.29. |
| 33. | Editorial | Changed "assure" to "ensure." |
| 34. | SRP-UDP format item 10 CFR Part 52 | Added paragraph at the end of REVIEW PROCEDURES that refers to design certification reviews. |
| 35. | Editorial | Modified to eliminate gender-specific reference |
| 36. | Editorial | Provided "SER" as initialism for "safety evaluation report." |
| 37. | Editorial | Added the parenthetical citation to Regulatory Guide 1.26 to explain the use of the term "Quality Group D" in the sentence. |
| 38. | Editorial | Deleted phrase at the end of the sentence and broke it into two new sentences in order to correct the grammar. |

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Attachment A - Proposed Changes in Order of Occurrence

| Item | Source | Description |
|------|---|--|
| 39. | SRP-UDP format item 10 CFR Part 52 | Added paragraph at the end of EVALUATION FINDINGS that refers to design certification reviews. |
| 40. | 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. |
| 41. | SRP-UDP Guidance | Added standard paragraph to indicate applicability of this section to reviews of future applications. |
| 42. | SRP-UDP format item | Updated title of GDC 4. |
| 43. | Editorial | Added reference 4 to cover citation of Regulatory Guide 1.26 in the text. |

SRP Draft Section 5.4.11
Attachment B - Cross Reference of Integrated Impacts

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