



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

14.3.4¹ REACTOR SYSTEMS (Tier 1)

REVIEW RESPONSIBILITIES

Primary - Reactor Systems Branch (SRXB)

Secondary - Containment Systems and Severe Accident Branch (SCSB), Probabilistic Safety Assessment Branch (SPSB)

I. AREAS OF REVIEW

SRXB reviews Tier 1 portion of the Design Control Document (DCD) submitted by the applicant. SRXB has primary review responsibility for the reactor systems, fuel control rods, loose parts monitoring system, and core cooling systems in Tier 1. Review responsibilities may be consistent with those contained in Appendix B to SRP Section 14.3. SRXB has secondary review responsibilities for those systems that could affect the operation of the reactor and core cooling systems. In addition, SRXB has responsibility for the review of selected definitions, interface requirements of the standard design with the site, and site parameters for the design, that pertain to reactor systems issues.

Review Interfaces

The SCSB is responsible for providing inputs to SRXB regarding the design features and functions of SSCs that should be addressed in Tier 1 information based on severe accident analyses. The SPSB is responsible for providing inputs to SRXB regarding the risk significant design features and functions of SSCs that should be addressed in Tier 1 information based on probabilistic risk assessment (PRA) and shutdown safety evaluations.

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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.

SRP Section 14.3 provides general guidance on review interfaces. SRXB performs related reviews and coordination activities, as requested by other branches, for issues in Tier 1 related to reactor systems. In addition, SRXB will coordinate other branches' evaluations that interface with the overall review of the systems as follows:

1. The Electrical Engineering Branch (EELB) determines the acceptability of Tier 1 information regarding electrical SSCs in SRP Section 14.3.6.
2. The Civil Engineering and Geosciences Branch (ECGB) determines the acceptability of Tier 1 information regarding the ability of SSCs to withstand various natural phenomena in SRP Sections 14.3.1 and 14.3.2, and regarding piping design in SRP Section 14.3.3.
3. The Instrumentation and Controls Branch (HICB) determines the acceptability of Tier 1 information regarding the I&C aspects of the standard design in SRP Section 14.3.5.

II. ACCEPTANCE CRITERIA

The acceptance criteria for ITAAC are based on meeting 10 CFR 52.97(b)(1), which sets forth the comprehensive requirements for ITAAC. For design certification reviews, the scope of ITAAC is limited to the scope of the certified design as required by 10 CFR 52.47(b).

The reviewer should primarily utilize the SRP sections related to reactor and core cooling systems in its review of Tier 1 to determine the safety significance of SSCs for the design of reactor and core cooling systems. Other sources include applicable rules and regulations, GDCs, RGs, USIs and GSIs, NRC generic correspondence, PRA, insights from the standard design's safety and severe accident analyses, and operating experience. Tier 1 should be reviewed for consistency with the initial test program described in DCD Tier 2 Chapter 14.2. The reviewer should also use the review checklists provided in Appendix D to SRP Section 14.3 as an aid for establishing consistency and comprehensiveness in his review of the systems. If applicable, the reviewer should utilize regulatory guidance from the Commission for selected policy and technical issues related to particular design. Examples of these are contained in SECY-93-087, "Policy, Technical, and Licensing Issues Pertaining to Evolutionary and Advanced Light-Water Reactor Designs." The SRM related to this is dated July 21, 1993.

Tier 1 should be reviewed for treatment of design information proportional to the safety significance of the SSC for that system. Many items may be judged to be important to safety, and thus should be included in Tier 1. The following issues are identified to ensure comprehensive and consistent treatment in Tier 1 based on the safety significance of the system being reviewed:

- (1) System purpose and functions
- (2) Location of system
- (3) Key design features of the system
- (4) Seismic and ASME code classifications
- (5) System operation in various modes
- (6) Controls, alarms, and displays
- (7) Logic

- (8) Interlocks
- (9) Class 1E electrical power sources and divisions
- (10) Equipment to be qualified for harsh environments
- (11) Interface requirements
- (12) Numeric performance values
- (13) Accuracy and quality of figures

Additionally, standard ITAAC entries should be utilized to verify selected issues, where appropriate. The reviewer should ensure consistent application and treatment of all of the standard ITAAC entries, since most apply to the treatment of issues for reactor systems. Also, the reviewer should utilize the review checklist for fluid systems in Appendix C to SRP Section 14.3. In general, many of the reactor and core cooling systems are classified as safety-related, and therefore many of the characteristics and features of these systems are judged to have safety significance. This is reflected in a relatively higher level of detail in Tier 1 for these systems than other systems of the standard design.

Tier 1 should be reviewed to verify that plant safety analyses, such as for core cooling, transients, overpressure protection, steam generator tube rupture, and anticipated transient without scram (ATWS), are adequately addressed. Applicants should provide tables in DCD Tier 2 Section 14.3 to show how the important input parameters used in the transient and accident analyses for the design are verified by the ITAAC.

SRXB should also receive inputs from PRA, including shutdown safety evaluations, and severe accident analyses to ensure important insights and design features from these analyses are incorporated into Tier 1. For the severe accident analyses in particular, the basis for the staff's review for the evolutionary standard designs was the Commission guidance related to SECYs 90-016 and 93-087, later included in the design certification rules for these designs. For both PRA and severe accident analyses, although large uncertainties and unknowns may be associated with the event phenomena, design features important for severe accident prevention and mitigation resulting from these analyses should be selected for treatment in Tier 1. The supporting information regarding the detailed design and analyses should remain in Tier 2. For many of the design features, it may be impractical to test their functionality because of the absence of simulated severe accident conditions. An example might be the ability of the reactor cavity to absorb the heat and radiation effects of a molten core. Consequently, the existence of the feature on a figure, subject to a basic configuration walkdown, may be considered sufficient Tier 1 treatment.

The specific fuel, control rod, and core designs presented in Tier 2 will constitute an approved design that may be used for the COL first cycle core loading, without further NRC staff review. If any other core design is requested for the first cycle, the COL applicant or licensee will be required to submit for staff review that specific fuel, control rod, and core design analyses as described in DCD Tier 2 Chapters 4, 6 and 15. Much of the detailed supporting information in Tier 2 for the nuclear fuel, fuel channel, and control rod Tier 1, if considered for a change by a COL applicant or licensee that references the certified standard design, would require prior NRC approval. Therefore, for the evolutionary designs, the staff concluded that this information should be designated as Tier 2* information. However, the staff allowed some of the Tier 2* designation to expire after first full power operation of the facility, when the detailed design was

complete and the core performance characteristics were known from the startup and power ascension test programs. The NRC bears the final responsibility for designating which material in Tier 2 is Tier 2*.

No ITAAC are required for Tier 1 information in the fuel, control rod, and core design areas because of the requirement for prior NRC approval of any proposed changes to the approved design. Post fuel load testing programs (e.g., startup testing and power ascension testing) verify that the actual core performs in accordance with the analyzed core design.

Specific issues that should be examined for treatment in Tier 1 include net positive suction head for key pumps (standard ITAAC entry specified in the applicable systems), and intersystem LOCA (the design pressure of the piping of the systems that interface with the reactor coolant pressure boundary should be specified in the design descriptions or figures of the applicable systems, using code designations and safety classes).

III. REVIEW PROCEDURES

1. Follow the general procedures for review of Tier 1 contained in the Review Procedures section of SRP Section 14.3. Ensure that the DCD is consistent with Appendix A to SRP Section 14.3. Review responsibilities may be consistent with those in Appendix B to SRP Section 14.3.
2. Ensure that all Tier 1 information is consistent with Tier 2 information. Figures and diagrams should be reviewed to ensure that they accurately depict the functional arrangement and requirements of the systems. Reviewers should use the Review Checklists in Appendix C to SRP Section 14.3 as an aid in establishing consistent and comprehensive treatment of issues.
3. Ensure that the reactor systems are clearly described in Tier 1, including the key performance characteristics and safety functions of SSCs based on their safety significance.
4. The reviewer should ensure that appropriate guidance is provided to other branches such that reactor and core cooling systems issues in Tier 1 are treated in a consistent manner among branches.
5. Ensure that inputs from SPSB regarding PRA, including shutdown safety evaluations, and SCSB regarding severe accident analyses are appropriately treated in Tier 1.
6. Ensure that standard ITAAC entries in Appendix D to SRP Section 14.3 related to reactor systems are included where appropriate in the systems of the standard design. In particular, the reviewer should ensure consistent application and treatment of the standard ITAAC, and in particular for the basic configuration ITAAC and the net positive suction head ITAAC (for safety-related pumps).
7. Ensure that design features from the resolutions of selected policy and technical issues are adequately addressed in Tier 1, based on safety significance. Ensure that the

appropriate Commission guidance, requirements, bases and resolutions for these items are documented clearly in the SER.

8. Ensure that any Tier 2* information is clearly designated in Tier 2, and consider expiration of these items at first full power, if appropriate. The staff's basis for designating the information as Tier 2* and the rationale for its decision that it requires prior NRC approval to change should be specified in the SER (See also the discussion in Appendix A to SRP Section 14.3).
9. Review Tier 1 definitions, legends, interface requirements, and site parameters to ensure that reactor systems issues are treated consistently and appropriately.

IV. EVALUATION FINDINGS

Each review branch verifies that sufficient information has been provided to satisfy the requirements of this SRP section, and concludes that Tier 1 is acceptable. A finding similar to that discussed in the Evaluation Findings section of SRP Section 14.3 should be included in a separate section of the SER.

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 certification and combined license applications submitted by applicants pursuant to 10 CFR 52. 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.

VI. REFERENCES

1. 10 CFR Part 52, §52.47 "Contents of Applications."
2. 10 CFR Part 52, §52.97 "Issuance of Combined Licenses."
3. NUREG-1503, "Final Safety Evaluation Report Related to the Certification of the Advanced Boiling Water Reactor", Volumes 1 and 2, July 1994.
4. NUREG-1462, "Final Safety Evaluation Report Related to the Certification of the System 80+ Design," Volumes 1 and 2, August 1994.

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SRP Draft Section 14.3.41
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.	Integrated Impact 1537	The scope and content of this proposed SRP section is derived from the requirements of 10 CFR Part 52, "Early Site Permits; Standard Design Certifications; and Combined Licenses for Nuclear Power Plants," as well as the guidance in staff SECY papers related to design certification and combined license reviews, and the staff positions established in the Final Safety Evaluation Reports (FSERs) for the evolutionary reactor designs. SRP Section 14.3.4 provides guidance specific to the review of reactor systems design information and related inspections, tests, analyses, and acceptance criteria (ITAAC) provided in applications submitted in accordance with the requirements of 10 CFR 52.

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SRP Draft Section 14.3.41
Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
1537	Develop Acceptance Criteria and Review Procedures for review of Certified Design Material (CDM) including associated inspections, tests, analyses and acceptance criteria (ITAAC) for reactor systems.	All