



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

15.0 INTRODUCTION

The review branches in the ~~Division of Systems Integration~~ Divisions of Systems Safety and Analysis, Technical Support, Reactor Controls and Human Factors,¹ and Engineering that have some responsibility for review of anticipated operational occurrences and postulated accidents listed in this chapter are as follows:

Reactor Systems Branch (~~RSBSRXB~~)² - reviews analyses of anticipated operational occurrences and postulated accidents from the viewpoint of systems operation, transient dynamics, analytical methodology, and meeting defined acceptance criteria. In addition, SRXB reviews analyses of core physics and fuel behavior core thermal-hydraulic performance; it also performs generic reviews of thermal-hydraulic computer codes and topical reports.³

~~Core Performance Branch (CPB) - reviews analyses of core physics, fuel behavior core thermal-hydraulic performance, and performs generic reviews of thermal-hydraulic computer codes and topical reports.~~⁴

Emergency Preparedness and Radiation Protection Branch (PERB) - reviews analyses of postulated spills of radioactive material outside containment, and evaluates possible radiological consequences of transients and accidents.⁵

~~Effluent Treatment Systems Branch (ETSB) - reviews analyses of postulated spills of radioactive material outside containment.~~⁶

~~Accident Evaluation Branch (AEB) - evaluates possible radiological consequences of the transients and accidents.~~⁷

Instrumentation and Controls ~~Systems~~ Branch (~~ICSBHICB~~)⁸ - reviews and evaluates the reactor protection and safety instrumentation and control instrumentation.

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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.

~~Power Systems Branch (PSB)~~ Plant Systems Branch (SPLB)⁹ - reviews and evaluates emergency onsite power, evaluates the operation and performance of the auxiliary systems (e.g., auxiliary feedwater systems) after anticipated operational occurrences and postulated accidents, and reviews the operability of reactor primary system components.¹⁰

~~Auxiliary Systems Branch (ASB)~~ - evaluates the operation and performance of the auxiliary systems following anticipated operational occurrences and postulated accidents (i.e., auxiliary feedwater systems).¹¹

Mechanical Engineering Branch (EMEB)¹² - evaluates the mechanical design of the reactor primary system and components, pipe restraints, and other safety-related mechanical components and classification of structures, components, and systems.

~~The Equipment Qualification Branch (EQB)~~ - reviews the operability of reactor primary system components.¹³

Containment Systems and Severe Accident Branch (SCSB)¹⁴ - evaluates the response of the containment to postulated accidents.

Severe accidents (i.e., beyond design basis) and Events¹⁵ such as fires, floods, storms, or earthquakes are not explicitly considered in the review of anticipated operational occurrences and postulated accidents in Chapter 15. Rather, the requirements to design for these events are reviewed under other Standard Review Plan (SRP)¹⁶ sections, as listed in Table 15-1 (attached).

The reviewers are responsible for the selection and emphasis of aspects of the reviews of anticipated operational occurrences and postulated accidents in this chapter. Judgment on the areas to be given attention during each review is based on an inspection of the information provided, the similarity of this material to that recently reviewed on other plants, and whether items of special or unique safety significance are involved.

The Reactor Systems Branch reviews the majority of anticipated operational occurrences and postulated accidents as indicated in the SRP sections for Chapter 15. Various anticipated process disturbances, equipment malfunctions, potential operator actions or errors, and component failures are examined to evaluate the plant capability to control or accommodate such failures and malfunctions. The ~~RSBSRXB~~ review includes an analysis of the pressure to which the reactor and steam systems are subjected and the need for engineered safety features to mitigate the consequences. The impact of various single failures on the course of anticipated operational occurrences and postulated accidents is also considered. For new applications, loss of offsite power should not be considered as a single-failure event; rather, it should be assumed in the analysis of each event without changing the event category. The applicant's Safety Analysis Report should discuss each transient and accident analysis to justify that it conforms to General Design Criterion (GDC) 17 requirements. (This position is based upon interpretation of GDC 17, as documented in the Final Safety Evaluation Report for the ABB-CE System 80+ design certification.)¹⁷

The transient and accident sequences are reviewed to identify necessary operator actions and to confirm that actions prescribed by ~~procedures developed under Action Plan Item I.C.1~~ emergency operating procedures¹⁸ have been appropriately accounted for.

~~The Procedures and Test Review Branch~~ Human Factors Assessment Branch,¹⁹ upon request, will assist the ~~RSBSRXB~~ reviewer in identifying all prescribed operator actions.

As required by Item II.K.3.44 of NUREG-0737, boiling water reactor (BWR)²⁰ applicants must demonstrate that for anticipated transients combined with the worst single failure and assuming proper operator actions, the core remains covered or provide analysis to show that no significant fuel damage results from ~~uncovering the core-uncovery~~.²¹ Transients which result in a stuck-open relief valve should be included in this category. This may be demonstrated by plant-specific analyses or reference to applicable generic analyses. Generic analyses are considered applicable if geometry and input conditions used for the analyses are representative or bounding. Generic Letter 81-32 documented the NRC staff acceptance of a report addressing Item II.K.3.44 issued by the General Electric BWR Owner Group on December 29, 1980, contingent on verification that the assumptions and initial conditions used in the analyses are representative for the plant under review.²²

In a related requirement for pressurized water reactor (PWR) operating license applicants, Action Item II.K.2.17 of NUREG-0737 requires each applicant to analyze the potential for voiding in the reactor coolant system during anticipated transients.²³

Action Item II.K.3.7 is applicable to Babcock and Wilcox (B&W) plants and requires documentation that the power-operated relief valve (PORV) will open in less than 5% of all anticipated overpressure transients.²⁴

~~The Core Performance Branch~~ Reactor Systems Branch is also²⁵ responsible for the review of all reactor physics data presented in this chapter. This includes power levels, power distributions, doppler coefficients, moderator temperature coefficients, void coefficients, reactor kinetics parameters, and control rod worths. The ~~CPBSRXB~~ review includes the evaluation of possible damage to the fuel as well as the operating and uncertainty bands associated with these variables. ~~and assists RSB as requested.~~²⁶

The review of anticipated operational occurrences and postulated accidents by ~~RSBSRXB and CPB~~ requires an evaluation of results, presented in the application, of analytical methods which frequently are not documented in the application. In such cases, the applicant may refer to a vendor topical report. The methods include departure from nucleate boiling (DNB) correlation development, subchannel analysis, system transient analysis, analysis of reactivity-initiated accidents (RIA), and loss-of-coolant accident (LOCA) analysis. For those cases where applicants use techniques previously considered and approved by the staff, additional review of methods may not be required. However, if new methods are involved, ~~RSBSRXB and CPB~~ performs a review of topical reports and other information which describe the method of analysis. Such a review generally includes vendor model description, data correlations and empirical relationships, solution techniques, summary of computer codes (if involved), sample problems, experimental verification, and comparative calculations.²⁷

In its review of anticipated operational occurrences and postulated accidents, ~~RSBSRXB~~ and ~~CPB~~ may perform an independent check of the results submitted by the applicant. In such cases, ~~RSBSRXB~~ or ~~CPB~~ obtains input data for use in the audit analysis which is obtained from the applicant.²⁸

Upon request of ~~RSBSRXB~~, the Instrumentation and Control ~~Systems~~ Branch provides assistance in evaluating the sequence of postulated events, protective and safeguards systems actuation and potential bypass modes, and manual control. ~~CSBHICB~~ determines whether reactor protection and safeguards control and instrumentation will function as assumed in the transient analysis with regard to manual or automatic actuation; remote sensing, indication, and control; and interlocks with auxiliary or shared systems. ~~PSBSPLB~~ determines the adequacy of onsite emergency power systems.²⁹

The ~~AEBPERB~~³⁰ review is concentrated on those more severe accidents that could result in the release of radioactive materials and could have significant radiological consequences involving the general public. ~~AEBPERB~~ determines the potential doses resulting from the accidents and compares these doses to established dose criteria and guidelines. Based on the results of these analyses, ~~AEBPERB~~ determines the adequacy of equipment designed to mitigate radiological consequences. In addition, radiological analyses are made to determine certain technical specification limits for safety-related equipment and structures.

Note: Potential doses due to accidents involving fuel damage have traditionally been predicted using the approach outlined in TID 14844. In SECY 90-016, the staff recommended that deviations from past methodologies used to calculate 10 CFR Part 100 doses be evaluated on a case-by-case basis, while ensuring that the requirements of Part 100 are met. In the staff's Final Safety Evaluation Report for ABB-CE System 80+ design certification, they accepted an exemption from the requirements of 10 CFR 50.34(f)(2) to evaluate release pathways under accident conditions resulting in a TID 14844 source term release and allowed ABB-CE to implement the new source term technology summarized in Draft NUREG-1465. Consistent with this exemption and the position stated in SECY 90-016, the staff reviewed the applicant's analyses of the radiological consequences of accidents using the assumptions specified in NUREG-1465.³¹

The ~~ASBSPLB~~ provides an evaluation of the auxiliary systems to confirm that these systems can supply all the functions required to support ECCS during and following a design basic accident (DBA), LOCA, or any other primary system pipe break.

~~CSBSCSB~~³² evaluates the functional capability of the containment and subcompartments for the spectrum of loss-of-coolant events under SRP Section 6.2.1. ~~CSBSCSB~~, on request from the ~~RSBSRXB~~, also provides an evaluation of containment pressure calculations utilized in the reflood portion of the ECCS performance analyses.

~~MEBEMEB~~³³ is responsible for the review of the effects of blowdown loads on core support structures and on control rod guide structures. ~~MEBEMEB~~ verifies that the core remains in place in case of a LOCA and that the control rods can be inserted. ~~MEBEMEB~~ is also responsible for evaluating the effects of blowdown loads, including jet forces on the piping of the reactor coolant system and on the support structures of the components of the reactor coolant

system. ~~MEB~~EMEB verifies that acceptable criteria have been employed in the design of the reactor coolant system and its supports to prevent failures in the reactor coolant pressure boundary or in engineered safety feature equipment in the event of a LOCA.

TABLE 15-1³⁴

| Postulated Event | SRP Section | | Branches Having Primary Review Responsibility |
|-------------------------------|-------------|---|---|
| Accidents at Nearby Locations | 2.2.3 | Evaluation of Potential Accidents | Civil Engineering and Geosciences Branch (ECGB) |
| Storms | 2.3 | Meteorology | Emergency Preparedness and Geosciences Branch (PERB) |
| | 3.3 | Wind and Tornado Loadings | ECGB |
| Floods | 2.4 | Hydrologic Engineering | ECGB |
| | 3.4 | Water Level (Flood) Design | Plant Systems Branch (SPLB) and ECGB |
| Earthquakes | 2.5 | Geology and Seismology | ECGB |
| | 3.2 | Classification of Structures, Components, and Systems | Mechanical Engineering Branch (EMEB) |
| | 3.7 | Seismic Design of Structures | ECGB |
| | 3.8 | Design of Category I Structures | ECGB |
| | 3.9.2 | Dynamic Testing and Analysis of Mechanical Systems and Components | EMEB |
| | 3.9.3 | ASME Code Class 1, 2, and 3 Components Supports and Core Support Structures | EMEB |
| | 3.10 | Seismic and Dynamic Qualifications of Mechanical and Electrical Equipment Important to Safety | EMEB |
| Missiles | 3.5 | Missile Protection | SPLB, ECGB, and Materials and Chemical Engineering Branch |
| Fires | 9.5.1 | Fire Protection System | SPLB |
| PRA/Severe Accidents | 19.1 | (proposed) Site-Specific Probabilistic Risk Assessment and Analysis of External Events | Probabilistic Safety Assessment Branch (SPSB) |

| | | | |
|--|------|---|--|
| Severe Accident Containment Performance | 19.2 | (proposed) Severe Accident - Containment Performance | Containment Systems and Severe Accident Branch (SCSB) |
|--|------|---|--|

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SRP Draft Section 15.0
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. | SRP-UDP format item | Updated references to divisions with review responsibilities. |
| 2. | SRP-UDP format item | Changed RSB to SRXB (global change for this section). |
| 3. | SRP-UDP format item | Added responsibilities formerly assigned to the Core Performance Branch to those of the Reactor Systems Branch. The Core Performance Branch has been incorporated into the SRXB. |
| 4. | SRP-UDP format item | Deleted paragraph describing Core Performance Branch responsibilities. The Core Performance Branch has been incorporated into the SRXB. |
| 5. | SRP-UDP format item | Identified responsibilities formerly assigned to the Effluent Treatment Systems Branch and Accident Evaluation Branch that are currently assigned to PERB. |
| 6. | SRP-UDP format item | Deleted responsibilities formerly assigned to the Effluent Treatment Systems Branch that are currently assigned to PERB. |
| 7. | SRP-UDP format item | Deleted responsibilities formerly assigned to the Accident Evaluation Branch that are currently assigned to PERB. |
| 8. | SRP-UDP format item | Corrected name and changed ICSB to HICB. |
| 9. | SRP-UDP format item | Responsibility for reviewing emergency onsite power is currently assigned to the Plant Systems Branch. |
| 10. | SRP-UDP format item | Listed review responsibilities formerly assigned to ASB and EQB under the Plant Systems Branch. |
| 11. | SRP-UDP format item | Review responsibilities formerly assigned to ASB moved to the Plant Systems Branch. |
| 12. | SRP-UDP format item | Changed MEB to EMEB. |
| 13. | SRP-UDP format item | Review responsibilities formerly assigned to EQB moved to the Plant Systems Branch. |
| 14. | SRP-UDP format item | Changed branch name to Containment Systems and Severe Accident Branch (SCSB). |
| 15. | Integrated Impact 1474 | Added severe accidents to the list of events evaluated in SRP sections other than Chapter 15 to accommodate addition of SRP Section 19.1 and 19.2 to Table 15-1. |
| 16. | Editorial | Defined SRP. |

SRP Draft Section 15.0
Attachment A - Proposed Changes in Order of Occurrence

| Item | Source | Description |
|------|-------------------------------|--|
| 17. | Integrated Impact 1472 | Added discussion of the new staff position that GDC 17 requires consideration of Loss of Offsite Power in addition to the most limiting single failure. |
| 18. | Integrated Impact No. 1004 | Replaced reference to TMI Action Plan 'short-term' item I.C.1 with a general reference to emergency operating procedures. |
| 19. | SRP-UDP format item | Replaced Procedures and Test Review Branch with Human Factors Assessment Branch. |
| 20. | Editorial | Defined "BWR" as "boiling water reactor." |
| 21. | Editorial | Replaced "uncovery" with "uncovering." |
| 22. | Integrated Impact No. 1076 | Referenced Generic Letter 81-32 pertaining to TMI Action Item II.K.3.44. |
| 23. | Integrated Impact No. 1113 | Added sentence referencing TMI Action Item II.K.2.17, requiring an analysis of the potential for voiding in the reactor coolant system during anticipated transients. |
| 24. | Integrated Impact No. 1070 | Added sentence referencing TMI Action Item II.K.3.7, applicable to B&W plants, requiring documentation that the PORV will open in less than 5% of all anticipated overpressure transients. |
| 25. | SRP-UDP format item | Replaced "Core Performance Branch" with "Reactor Systems Branch." The Core Performance Branch has been incorporated into the SRXB. |
| 26. | SRP-UDP format item | Revised sentence to reflect organizational change. The Core Performance Branch has been incorporated into the SRXB. |
| 27. | SRP-UDP format item | Revised sentence to reflect organizational change. The Core Performance Branch has been incorporated into the SRXB. |
| 28. | SRP-UDP format item | Revised sentence to reflect organizational change. The Core Performance Branch has been incorporated into the SRXB. |
| 29. | SRP-UDP format item | Revised sentence to reflect organizational and branch name changes. |
| 30. | SRP-UDP format item | Changed AEB to PERB (global change for this section). |
| 31. | Integrated Impact 1473 | Added informational note regarding staff acceptance of source term approach in draft NUREG 1465. |
| 32. | SRP-UDP format item | Changed CSB to SCSB (global change for this section). |

SRP Draft Section 15.0
Attachment A - Proposed Changes in Order of Occurrence

| Item | Source | Description |
|-------------|---------------------|---|
| 33. | SRP-UDP format item | Changed MEB to EMEB (global change for this section). |
| 34. | SRP-UDP format item | Because of the large number of organizational changes, a new Table 15-1 was prepared. |

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SRP Draft Section 15.0
Attachment B - Cross Reference of Integrated Impacts

| Integrated Impact No. | Issue | SRP Subsections Affected |
|-----------------------|--|---|
| 414 | Identify appropriate SRP review interfaces for new chapter on PRAs for severe accidents - future work. | No changes in SRP Section 15.0 are appropriate at this time. |
| 1004 | Replace reference to TMI Action Plan 'short-term' item I.C.1 with a general reference to emergency operating procedures. | 15.0, INTRODUCTION, fifth paragraph |
| 1070 | Revise SRP Section 15.0 to incorporate TMI Action Item II.K.3.7 of NUREG-0737 regarding documentation ensuring that PORVs will open in less than 5% of all anticipated overpressure transients for B&W plants. | 15.0, INTRODUCTION, new ninth paragraph |
| 1076 | Add reference to Generis Letter 18-32 that documented the staff acceptance of General Electric BWR Owner Group report dated December 29, 1980 (re TMI Action Item II.K.3.44). | 15.0, INTRODUCTION, seventh paragraph |
| 1113 | Add sentence referencing TMI Action Item II.K.2.17, requiring an analysis of the potential for voiding in the reactor coolant system during anticipated transients. | 15.0, INTRODUCTION, new eighth paragraph |
| 1472 | Modify Introduction to include the requirements of General Design Criterion 17 (GDC 17), "Electric Power Systems" and staff guidance for the assumption of the loss-of-offsite power (LOOP), in addition to the limiting single failure event, for the analysis of all transients and accidents. | 15.0, INTRODUCTION, fifteenth paragraph. |
| 1473 | Added a note to address the methods for an applicants analyses of the radiological consequences of accidents using the information contained in NUREG-1465. | 15.0, INTRODUCTION, added a note after discussion on PERB responsibilities. |
| 1474 | Revised the text and Table 15-1 to indicate that severe accidents are outside the scope of Chapter 15 and reviewed in SRP Sections 19.1 and 19.2. | 15.0, INTRODUCTION, and TABLE 15-1. |