**U.S. NUCLEAR REGULATORY COMMISSION**

# STANDARD REVIEW PLAN

**OFFICE OF NUCLEAR REACTOR REGULATION**

## 6.2.3 SECONDARY CONTAINMENT FUNCTIONAL DESIGN

REVIEW RESPONSIBILITIES

Primary - Containment Systems and Severe Accident Branch (SCSB)[1]

Secondary - None

## I. AREAS OF REVIEW

The SCSB[2] reviews the information in the applicant's safety analysis report (SAR) concerning the functional capability of the secondary containment system. The secondary containment system includes the outer containment structure of dual containment plants and the associated systems provided to mitigate the radiological consequences of postulated accidents. The secondary containment structure and supporting systems are provided to collect and process radioactive material that may leak from the primary containment following an accident. The supporting systems maintain a negative pressure within the secondary containment and process this leakage. Plant areas and systems contiguous to the secondary containment which also collect and process radioactive material that may leak from the primary containment following an accident are reviewed by the SCSB[3] in the same manner as the secondary containment.

The SCSB[4] review of the functional capability of the secondary containment system of dual containment designs includes the following points:

1. Analyses of the pressure and temperature response of the secondary containment to a loss-of-coolant accident within the primary containment.

2. Analyses of the effect of openings in the secondary containment on the capability of the depressurization and filtration system to accomplish its design objective of establishing a negative pressure in a prescribed time.

3. Analyses of the pressure and temperature response of the annular region between the primary and secondary containment to a high energy line rupture within the secondary containment.

4. The functional design criteria applied to guard pipes surrounding high energy lines within the secondary containment.

5. Analyses of any primary containment leakage paths that bypass the secondary containment.

6. The design provisions for periodic leakage testing of secondary containment bypass leakage paths.

7. Analyses of the pressure response of the secondary containment resulting from inadvertent depressurization of the primary containment when there is vacuum relief from the secondary containment.

8. The acceptability of the mass and energy release data used in the analysis of the secondary containment pressure response to postulated high energy line breaks.

Review Interfaces

SCSB also performs the following review under the SRP Section indicated:[5]

Evaluates the design requirements and the periodic inspection and operability test program for the depressurization and filtration systems as part of its primary review responsibility for SRP Section 6.2.6.[6]

In addition, the SCSB will coordinate other branches' evaluations that interface with the overall review of the secondary containment functional design, as follows:[7]

1. The ~~Auxiliary~~Plant Systems Branch (~~ASB~~SPLB)[8], as part of its primary review responsibility for SRP Section 3.6.1, will evaluate the plant design for protection against postulated pipe ruptures in auxiliary areas outside primary containment that serve as the secondary containment. The ~~Accident Evaluation Branch (AEB)~~SPLB[9], as part of its primary review responsibility for SRP Sections 6.5.1 and 6.5.3 ~~and SRP Section 6.2.6~~,[10] will evaluate the design requirements and the periodic inspection and operability test program for the depressurization and filtration systems. The ~~AEB~~SPLB[11] also will evaluate the fission product removal capability of the secondary containment supporting systems under SRP Section 6.5.3. The SPLB also determines that the plant design adequately protects control room personnel against radiation exposure during accidents as part of its primary review responsibility for SRP Section 6.4.[12]

2. The Instrumentation and Control ~~Systems~~ Branch (~~ICSB~~HICB) reviews and evaluates instrumentation necessary for the actuation and control features for the secondary containment function as part of its primary review responsibility for SRP Sections[13] 7.1 thr~~u~~ough[14] 7.5.

3. The Mechanical Engineering Branch (EMEB)[15], as part of its primary review responsibility for SRP Section 3.6.2, will evaluate the break locations and dynamic effects associated with the postulated rupture of piping outside the primary containment.

4. The ~~Licensing Guidance~~Technical Specifications Branch (~~LGB~~TSB)[16], at the operating licensing stage of review, and during design certification reviews,[17] will review the proposed technical specifications pertaining to the functional capability of the secondary containment system and the leakage testing of bypass leakage paths as part of its primary review responsibility for SRP Section 16.0.

5. The Emergency Preparedness and Radiation Protection Branch (PERB), as part of its primary review responsibility for SRP Section 15.6.5, Appendices A, B, and D, evaluates analyses of the radiological consequences of design basis LOCAs, including assumptions related to the secondary containment.[18]

~~The CSB will coordinate other branch evaluations that interface with the overall review of the secondary containment functional design, as follows: The Accident Evaluation Branch (AEB), as part of its primary review responsibility for SRP Section 6.5 and SRP Section 6.2.6 will evaluate the design requirements and the periodic inspection and operability test program for the depressurization and filtration systems. The AEB also will evaluate the fission product removal capability of the secondary containment supporting systems. The Auxiliary Systems Branch (ASB), as part of its primary review responsibility for SRP Section 3.6.1, will evaluate the plant design for protection against postulated pipe ruptures in auxiliary areas outside primary containment that serve as the secondary containment. The Instrumentation and Control Systems Branch (ICSB) reviews and evaluates instrumentation necessary for the actuation and control features for the secondary containment function as part of its primary review responsibility for SRP Section 7.1 thru 7.5. The Mechanical Engineering Branch (MEB), as part of its primary review responsibility for SRP Section 3.6.2, will evaluate the break locations and dynamic effects associated with the postulated rupture of piping outside the primary containment. The Licensing Guidance Branch (LGB), at the operating licensing stage of review, will review the proposed technical specifications pertaining to the functional capability of the secondary containment system and the leakage testing of bypass leakage paths as part of its primary review responsibility for SRP Section 16.0.~~

For these areas of review identified above as being part of the ~~primary review responsibility of other branches~~review under other SRP sections, the acceptance criteria necessary for the review and their methods of application are contained in the referenced SRP sections ~~of the corresponding primary branch~~.[19]

II. ACCEPTANCE CRITERIA

SCSB[20] accepts the secondary containment functional design if the relevant requirements of General Design Criteria 4, 16, and 4~~5~~3[21] and Appendix J to 10 CFR Part 50 are complied with. The relevant requirements are as follows:

A. General Design Criterion 4 as it relates to structures, systems and components important to safety being designed to accommodate the effects of environmental conditions associated with[22] normal operation, maintenance, testing,[23] and postulated accidents, and being protected against dynamic effects (e.g., the effects of missiles, pipe whipping, and discharging fluids) that may result from equipment failures.

B. General Design Criterion 16 as it relates to reactor containment and associated systems being provided to establish an essentially leak-tight barrier~~s~~[24] against the uncontrolled release of radioactivity to the environment.

C. General Design Criterion 43 as it relates to containment atmosphere cleanup systems ~~having the design capability~~ being designed to permit appropriate periodic pressure and functional testing to assure ~~system~~ component[25] integrity, the operability of active components, ~~and~~ the operability of the system as a whole,[26] and the performance of the operational sequence that brings the system into operation.

D. 10 CFR Part 50, Appendix J as it relates to ~~the~~ secondary containment ~~being designed to permit preoperational and periodic~~ leakage rate testing in accordance with the procedures specified in the technical specifications, or associated bases, so that bypass leakage paths are identified and associated bypass leakage rates are determined.[27]

Specific criteria that pertain to design and functional capability of the secondary systems which are necessary to meet the relevant requirements of GDC 4, 16 and 43 and 10 CFR Part 50, Appendix J are as follows:

1. In meeting the requirements of GDC 16 regarding functional capability of the secondary containment, the analysis of the pressure and temperature response of the secondary containment to a loss-of-coolant accident occurring in the primary containment should be based on the following guidelines:

    a. Heat transfer from the primary to secondary containment should be considered.

        (1) Heat transfer from the primary containment atmosphere to the primary containment structure should be calculated using conservative heat transfer coefficients such as those provided in Branch Technical Position CSB 6-1 (Ref~~-~~erence ~~6~~7)[28].

        (2) Conductive heat transfer through the primary containment structure and convective heat transfer to the secondary containment atmosphere should be considered.

(3) Radiant heat transfer to the secondary containment should be considered.

b. Adiabatic boundary conditions should be assumed for the surface of the secondary containment structure exposed to the outside environment.

c. The compressive effect of primary containment expansion on the secondary containment atmosphere should be considered.

d. Secondary containment inleakage should be considered.

e. No credit should be taken for secondary containment outleakage.

f. Secondary containment response analyses should be based on the assumption of loss of offsite power and the most severe single active failure in the emergency power system (e.g., a diesel generator failure), in the primary containment heat removal systems, in the core cooling systems, or in the secondary containment depressurization and filtration system. Any delay, due to system design, in actuating the secondary containment depressurization and filtration system should be considered.

g. Heat loads generated within the secondary containment (e.g., equipment heat loads) should be considered.

h. Fan performance characteristics should be considered in evaluating the depressurization of the secondary containment.

2. In meeting the requirement of GDC 4 to protect[29] structures, systems and components important to safety against dynamic effects, high energy lines passing through the secondary containment should be provided with guard pipes. Design criteria for guard pipes are given in SRP Section 3.6.2. If guard pipes are not provided, analyses should be provided which demonstrate that both the primary containment structure and the secondary containment structure are capable of withstanding the effects of a high energy pipe rupture occurring inside the secondary containment without loss of integrity.

3. In meeting the requirements of GDC 16, regarding the functional capability of the secondary containment, the following criteria apply:

a. The secondary containment depressurization and filtration systems should meet the guidelines of Regulatory Guide 1.52 and be capable of maintaining a uniform negative pressure throughout the secondary containment, as well as other areas served by the systems.

b. The negative pressure differential to be maintained in the secondary containment and other contiguous plant areas should be no less than 0.063 kPa [0.25 inches (water)][30] when compared with adjacent regions, under all wind conditions up to the wind speed at which diffusion becomes great enough to assure site boundary exposures less than those calculated for the design basis accident even if

exfiltration occurs. If the leakage rate is in excess of 100% of the volume per day, a special exfiltration analysis should be performed.

c. All openings, such as personnel doors and equipment hatches, should be under administrative control. These openings should be provided with position indicators and alarms having readout and alarm capability in the main control room. The effect of open doors or hatches on the functional capability of the depressurization and filtration systems should be evaluated and confirmatory preoperational tests conducted.

d. Some plants may have only portions of the primary containment enclosed, rather than having a secondary containment structure or shield building that completely encloses the primary containment. These enclosed areas are areas into which the primary containment would most likely leak, and they may be equipped with air filtration systems. Quantitative credit cannot be given for the holdup effect of these enclosed areas or for the air filtration systems, to mitigate the radiological consequences of a postulated accident, unless the magnitude of unprocessed leakage can be adequately demonstrated. Quantitative credit for leakage collection in a partial-dual containment will be reviewed on a case-by-case basis.

e. The external design pressure of the secondary containment structure should provide an adequate margin above the maximum expected external pressure.

4. In meeting the requirements of GDC 43 and 10 CFR Part 50, Appendix J, regarding the ~~inspection and~~[31] testing of the secondary containment system, the following criteria apply:

a. The fraction of primary containment leakage bypassing the secondary containment and escaping directly to the environment should be specified. Branch Technical Position (BTP) CSB 6-3 (Ref~~.~~erence ~~56~~)[32] provides guidance for identifying the leakage paths to the environment which may bypass the secondary containment. The periodic leakage rate testing program for measuring the fraction of primary containment leakage that may directly bypass the secondary containment and other contiguous areas served by ventilation and filtration systems should be described. The individual tests should be in accordance with the procedures specified in the technical specifications, or associated bases.[33]

b. Provisions should be made in the design of the secondary containment system to permit inspections and monitoring of the functional capability. The determination of the depressurization time, the secondary containment in leakage rate, the uniformity of negative pressure throughout the secondary containment and other contiguous areas, and the potential for exfiltration should be included in the preoperational and periodic test programs.

Technical Rationale[34]

The technical rationale for application of the above acceptance criteria to the secondary containment functional design is discussed in the following paragraphs:

1. GDC 4 requires that structures, systems and components important to safety be designed to accommodate the effects of environmental conditions associated with normal operation, maintenance, testing, and postulated accidents (including LOCAs), and that they be protected against dynamic effects that may result from equipment failures. The function of the secondary containment is to minimize offsite radioactive releases by confining a substantial fraction of leakage from primary containment following a LOCA. Application of GDC 4 to the secondary containment provides assurance that the environmental conditions and equipment failures to which it may be exposed will not affect its capability to contain radioactive material under all operating conditions, including accidents.

2. GDC 16 requires that reactor containment and associated systems be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment. The secondary containment minimizes radioactive releases by confining primary containment leakage following a LOCA. Application of GDC 16 to the secondary containment minimizes the likelihood and magnitude of radiation exposures to control room personnel and the public resulting from radioactive releases.

3. GDC 43 requires that containment atmosphere cleanup systems be designed to permit appropriate periodic pressure and functional testing to assure component integrity, the operability of active components, the operability of the system as a whole, and the performance of the operational sequence that brings the system into operation. The depressurization and filtration systems associated with secondary containment confine radioactive material in the event of primary containment leakage. Application of GDC 43 to these systems assures that capabilities to perform this function can be periodically verified and deficiencies identified and corrected to minimize the likelihood of demand and inservice failures; this results in a high likelihood that a substantial portion of primary containment leakage will be confined.

4. 10 CFR Part 50, Appendix J requires that structures of multiple barrier or subatmospheric containments (e.g., secondary containments for boiling water reactors and shield buildings for pressurized water reactors that enclose the entire primary reactor containment or portions thereof) be subject to individual tests in accordance with the procedures specified in the technical specifications, or associated bases. The function of the secondary containment is to minimize radioactive releases by confining a substantial fraction of primary containment leakage following a LOCA. The technical specifications establish conservative limits on the total fraction of primary containment leakage which may bypass secondary containment. The technical specifications also specify periodic testing for the purpose of identifying bypass leakage paths, determining associated leakage rates, and verifying the operability of secondary containment depressurization and filtration systems. Application of Appendix J to the secondary containment system assures that capabilities to perform the confinement function are periodically verified and

deficiencies identified and corrected to minimize the likelihood of excessive bypass leakage rates; this results in a high likelihood that a substantial portion of primary containment leakage will be confined.

## III. REVIEW PROCEDURES

The procedures described below provide guidance on the review of the secondary containment system. The reviewer selects and emphasizes material from the review procedures as may be appropriate for a particular case. Portions of the review may be done on a generic basis for aspects of secondary containment functional design common to a class of plants, or by adopting the results of previous reviews of similar plants.

Upon request from the SCSB[35] primary reviewer, other branches will provide input for the areas of review stated in subsection I of this SRP section. The SCSB[36] reviewer obtains and uses such input as required to assure that this review procedure is complete.

SCSB[37] reviews the analytical models used and the assumptions made in the analyses of the pressure and temperature response of the secondary containment to loss-of-coolant accidents in the primary containment. In general, SCSB[38] determines that the analyses conservatively predict the secondary containment pressure response. In so doing, SCSB[39] compares the analyses to the guidelines in subsection II of this SRP section. For new applications, the reviewer verifies that analyses of ability to draw a negative pressure on the secondary containment volume following a LOCA assume that all lines that do not receive an isolation signal are open and that the worst-case secondary containment isolation valve fails to close.[40]

If considered necessary, SCSB[41] performs confirmatory analyses of the pressure and temperature response of the secondary containment for loss-of-coolant accidents within the primary containment and for high energy line (e.g., steam line and feedwater line) ruptures occurring within the annular region formed by the secondary containment. The analyses are done using the CONTEMPT-LT computer code (Ref~~-~~erences ~~4~~8 and 9)[42]. It should be noted that, for the analysis of the pressure and temperature response in the secondary containment for loss-of-coolant accidents within the primary containment, the present version of the CONTEMPT-LT only has the capability of calculating the pressure in the secondary containment up to the time the depressurization systems are actuated. The code is being improved to permit the calculation of the pressure response for the entire course of an accident.[43]

The analysis will be based on the guidelines given in subsection II of this SRP section, and code input data obtained from the SAR. SCSB[44] determines that the secondary containment design pressure is not exceeded and that the depressurization time is consistent with that assumed in the ~~AEB~~PERB[45] analysis of the radiological consequences of the accident. In addition, SCSB[46] determines that the primary containment external design pressure is not exceeded.

SCSB[47] determines that all direct leakage paths have been properly identified, and from a review of the proposed leakage testing program that provisions have been made in the design of the plant to measure the fraction of total primary containment leakage that bypasses the secondary containment. SCSB[48] advises ~~AEB~~PERB[49] of any inadequacies in the applicant's direct leakage

assumptions used in the radiological analysis. At the operating license stage of review, ~~LGB~~TSB[50] reviews technical specifications which specify the surveillance requirements for leakage testing of the secondary containment bypass leakage paths.

SCSB[51] reviews analyses of the capability of the secondary containment system to resist exfiltration under post-accident conditions. If the secondary containment leakage rate is in excess of 100% of the volume per day, SCSB[52] advises ~~AEB~~PERB[53] in order that they may perform a special exfiltration analysis. SCSB[54] reviews the preoperational and periodic inservice testing programs to assure that testing will be done to verify the extent of exfiltration.

SCSB[55] reviews the proposed secondary containment system testing program and the surveillance requirements to assure that tests will be periodically conducted to verify that the prescribed negative pressure can be uniformly maintained throughout the secondary containment. SCSB[56] also reviews the testing program and surveillance requirements to assure that tests will be periodically conducted to verify the secondary containment design inleakage rate and to verify the analysis of the depressurization of the secondary containment.

~~LGB~~TSB[57] reviews the proposed technical specifications to assure that adequate administrative control will be exercised over the secondary containment openings, such as personnel access doors and equipment hatches. SCSB[58] determines from the descriptive information in the SAR that all doors and hatches are provided with position indicators having readout and alarm capability in the main control room. The SCSB[59] will ascertain that normally open doors were considered in the analyses of the functional capability of the secondary containment system.

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.[60]

## IV. EVALUATION FINDINGS

The reviewer verifies that sufficient information has been provided and that his evaluation supports conclusions of the following type, to be included in the staff's safety evaluation report:

> The scope of review of the functional design of the secondary containment system for the (Plant name) has included plan and elevation drawings, system drawings, and descriptive information. This system is provided to control the atmosphere within the secondary containment and contiguous areas. The review has included the applicant's proposed design bases and analyses of the functional capability of the secondary containment system.
>
> The staff concludes that the containment functional design is acceptable and meets the requirements of General[61] Design Criteria 4, 16 and 43 and 10 CFR Part 50, Appendix

J[62]. The conclusion is based on the following: [The reviewer should discuss each item of the regulations or related set of regulations as indicated.]

1. The applicant has met the requirements of (cite regulation) with respect to (state limits of review in relation to regulation) by (for each item that is applicable to the review state how it was met and why acceptable with respect to regulation being discussed):

    a. meeting the regulatory positions in Regulatory Guide __ or Guides;

    b. providing and meeting an alternative method to regulatory positions in Regulatory Guide __, that the staff has reviewed and found to be acceptable;

    c. meeting the regulatory position in BTP __;

    d. using calculational methods for (state what was evaluated) that has been previously reviewed by the staff and found acceptable; the staff has reviewed the impact parameters in this case and found them to be suitably conservative or performed independent calculations to verify acceptability of their analysis; and/or

    e. meeting the provisions of (industry standard number and title) that has been reviewed by the staff and determined to be appropriate for this application.

2. Repeat discussion for each regulation cited above.

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.[63]

## V. IMPLEMENTATION

The following is intended to provided 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.[64] 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.[65]

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 4, "Environmental and ~~Missile~~Dynamic Effects[66] Design Bases."

2. 10 CFR Part 50, Appendix A, General Design Criterion 16, "Containment Design."

3. 10 CFR Part 50, Appendix A, General Design Criterion 43, "Testing of Containment Atmosphere Cleanup Systems."

4. 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors."[67]

5. Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."[68]

~~5~~6.[69] Branch Technical Position CSB 6-3, "Determination of Bypass Leakage Paths in Dual Containment Plants," attached to this SRP section.

~~6~~7.[70] Branch Technical Position CSB 6-1, "Minimum Containment Pressure Model for PWR ECCS Performance Evaluation," attached to SRP Section 6.2.1.5.

8. NUREG/CR-0255 (TREE-1279), "CONTEMPT-LT/028: A Computer Code for Predicting Containment Pressure-Temperature Response to a Loss-of-Coolant Accident," EG&G Idaho, Inc. for the U.S. Nuclear Regulatory Commission, March 1979.[71]

~~4~~9. R. J. Wagner and L. L. West, "CONTEMPT-LT Users Manual," Interim Report I-214-74-12.1, Aerojet Nuclear Company, August 1973.

BRANCH TECHNICAL POSITION CSB 6-3
(Currently the responsibility of the Containment Systems and Severe Accident Branch - SCSB)[72]

DETERMINATION OF BYPASS LEAKAGE
PATHS IN DUAL CONTAINMENT PLANTS

## A. BACKGROUND

The purpose of this branch position is to provide guidance in the determination of that portion of the primary containment leakage that will not be collected and processed by the secondary containment. Bypass leakage is defined as that leakage from the primary containment which can circumvent the secondary containment boundary and escape directly to the environment, i.e., bypasses the leakage collection and filtration systems of the secondary containment. This leakage component must be considered in the radiological analysis of a loss-of-coolant accident.

The secondary containment consists of a structure which completely encloses the primary containment and can be maintained at a pressure lower than atmospheric so that primary containment leakage can be collected or processed before release to the environment. The secondary containment may include an enclosure building which forms an annular volume around the primary containment, the auxiliary building where it completely encloses the primary containment, and other regions of the plant that are provided with leakage collection and filtration systems. Depressurization systems are provided as part of the secondary containment to decrease or maintain the secondary containment volume at a negative pressure.

All primary containment leakage may not be collected because (1) direct primary containment leakage can occur while the secondary containment is being depressurized and (2) primary containment leakage can bypass the secondary containment through containment penetrations and seals which do not terminate in the secondary containment.

Direct leakage from the secondary containment to the environment can occur whenever an outward positive differential pressure exists across the secondary containment boundary. The secondary containment can experience a positive pressure transient following a postulated loss-of-coolant accident in the primary containment as a result of thermal loading and infiltration from the environment and the primary containment that will occur until the depressurization systems become effective. An outward positive differential on the secondary containment wall can also be created by wind loads. In this regard, a "positive" pressure is defined as any pressure greater than -0.063 kPa [-0.25 in. w.g. (water gauge)][73], to account for wind loads and the uncertainty in the pressure measurements. Whenever the pressure in the secondary containment volume exceeds -0.063 kPa (-0.25 in. w.g.)[74], the leakage-prevention function of the secondary containment is assumed to be negated. Since leakage from the secondary containment during positive pressure periods cannot be determined, the conservative assumption is made that,[75] all primary containment leakage is released directly to the environment during these time periods. Therefore, it becomes necessary to determine the time periods during which these threshold conditions exist.

The existence and duration of periods of positive pressure within the secondary containment should be based on analyses of the secondary containment pressure response to postulated loss-of-coolant accidents within the primary containment and the effectiveness of the depressurization systems.

The evaluation of bypass leakage involves both the identification of bypass leakage paths and the determination of leakage rates. Potential bypass leakage paths are formed by penetrations which pass through both the primary and secondary containment boundaries. Penetrations that pass through both the primary and secondary containment may include a number of barriers to leakage (e.g., isolation valves, seals, gaskets, and welded joints). While each of these barriers aid in the reduction of leakage, they do not necessarily eliminate leakage. Therefore, in identifying potential leakage paths, each of these penetrations should be considered, together with the capability to test them for leakage in a manner similar to the containment leakage tests required by Appendix J to 10 CFR Part 50.

B. BRANCH TECHNICAL POSITION

1. A secondary containment structure should completely enclose the primary containment structure, with the exception of those parts of the primary containment that are imbedded in the soil, such as the base mat of the containment structure. For partial dual containment concepts, leak rates less than the design leak rate of the primary containment should not be used in the calculation of the radiological consequences of a loss-of-coolant accident, unless the magnitude of unprocessed leakage can be adequately demonstrated. Quantitative credit for leakage collection in a partial-dual containment will be reviewed on a case-by-case basis.

2. Direct leakage from the primary containment to the environment, equivalent to the design leak rate of the primary containment, should be assumed to occur following a postulated loss-of-coolant accident whenever the secondary containment volume is at a "positive" pressure; i.e., a pressure greater than -0.063 kPa (-0.25 in. w.g.).[76] Positive pressure periods should be determined by a pressure response analysis of the secondary containment volume that includes thermal loads from the primary containment and infiltration leakage.

3. The secondary containment depressurization and filtration systems should be designed in accordance with Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water Cooled Nuclear Power Plants." Preoperational and periodic inservice inspection and test programs should be proposed for these systems and should include means for determining the secondary containment infiltration rate, and the capability of the systems to draw down the secondary containment to the prescribed negative pressure in a prescribed time.

4. For secondary containments with design leakage rates greater than 100 volume percent per day, an exfiltration analysis should be provided.

5. The following leakage barriers in paths which do not terminate within the secondary containment should be considered potential bypass leakage paths around the leakage collection and filtration systems of the secondary containment:

   a. Isolation valves in piping which penetrates both the primary and secondary containment barriers.

   b. Seals and gaskets on penetrations which pass through both the primary and secondary containment barriers.

   c. Welded joints on penetrations (e.g., guard pipes) which pass through both the primary and secondary containment barriers.

6. The total leakage rate for all potential bypass leakage paths, as identified in item 5 above, should be determined in a realistic manner, considering equipment design limitations and test sensitivities. This value should be used in calculating the offsite radiological consequences of postulated loss-of-coolant accidents and in setting technical specification limits with margin for bypass leakage.

7. Provisions should be made to permit preoperational and periodic leakage rate testing in a manner similar to the Type B or C tests of Appendix J to 10 CFR Part 50 for each bypass leakage path listed in item 5 above. An acceptable alternative for local leakage rate testing for welded joints would be to conduct a soap bubble test of the welds concurrently with the integrated (Type A) leakage test of the primary containment required by Appendix J. Any detectable leakage determined in this manner would require repair of the joint.

8. If air or water sealing systems or leakage control systems are proposed to process or eliminate leakage through valves, these systems should be designed, to the extent practical, using the guidelines for leakage control systems given in Regulatory Guide 1.96 ~~(Ref. 4)~~[77].

9. If a closed system is proposed as a leakage boundary to preclude bypass leakage, then the system should:

   a. Either (1) not directly communicate with the containment atmosphere, ~~of~~or[78] (2) not directly communicate with the environment, following a loss-of-coolant accident.

   b. Be designed in accordance with Quality Group B standards, as defined by Regulatory Guide 1.26. (Systems designed to Quality Group C or D standards that qualify as closed systems to preclude bypass leakage will be considered on a case-by-case basis.)

   c. Meet seismic Category I design requirements.

d. Be designed to at least the primary containment pressure and temperature design conditions.

e. Be designed for protection against pipe whip, missiles, and jet forces in a manner similar to that for engineered safety features.

f. Be tested for leakage, unless it can be shown that during normal plant operations the system integrity is maintained.[79]

C. REFERENCES

1. 10 CFR Part 50, Appendix J, "Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors."

2. Regulatory Guide 1.26, "Quality Group Classification and Standards for Water-, Steam-, and Radioactive-Waste-Containing Components of Nuclear Power Plants."

3. Regulatory Guide 1.52, "Design, Testing, and Maintenance Criteria for Atmosphere Cleanup System Air Filtration and Adsorption Units of Light-Water-Cooled Nuclear Power Plants."

4. Regulatory Guide 1.96, "Design of Main Steam Isolation Valve Leakage Control Systems for Boiling Water Reactor Nuclear Power Plants."

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## SRP Draft Section 6.2.3
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 PRB names and abbreviations | Editorial change made to reflect the current PRB name, abbreviation, and responsibility for SRP Section 6.2.3. |
| 2. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 3. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 4. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 5. | SRP-UDP format item | Added Review Interface subsection of Areas of Review to be consistent with SRP-UDP required format so that reviews performed by the SRP Section 6.2.3 PRB in other SRP Sections which are relevant to the overall review of secondary containment functional design are detailed in their own subsection. |
| 6. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB responsibility for SRP Section 6.2.6. |
| 7. | SRP-UDP format item | Added Review Interface subsection of Areas of Review using numbered paragraphs to be consistent with SRP-UDP required format so that reviews performed by other PRBs in other SRP Sections which are relevant to the overall review of secondary containment functional design are detailed in their own subsection. |
| 8. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB name, abbreviation, and responsibility for SRP Section 3.6.1. |
| 9. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Sections 6.5.1 and 6.5.3. |
| 10. | Editorial | Replaced ambiguous reference to SRP Section 6.5 (which does not exist) with specific references to SRP Sections 6.5.1 and 6.5.3 where depressurization and filtration systems are reviewed. Also deleted reference to SRP Section 6.2.6 based upon the review interface identified in Note 6. |
| 11. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.5.3. |

| Item | Source | Description |
|---|---|---|
| 12. | Potential Impacts 22863 and 22870 | Added a review interface with SRP Section 6.4 to reflect the ABWR FSER treatment of secondary containment functional design issues as they relate to GDC 19 requirements for radiation protection for control room personnel in the event of accidents. |
| 13. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB name, abbreviation, and responsibility for SRP Sections 7.1 through 7.5. Also added plural of "Sections" since a range of sections are discussed. |
| 14. | Editorial | Revised spelling. |
| 15. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 3.6.2. |
| 16. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB name, abbreviation, and responsibility for SRP Section 16.0. |
| 17. | Editorial | Standard SRP-UDP change to address design certification reviews where specific OL or CP reviews are discussed. |
| 18. | Editorial | Added review interface with SRP Section 15.6.5 Appendices A, B, and D based upon the interfaces between CSB and AEB relating to radiological consequence analyses, which are described in SRP Section 6.2.3, Revision 2, subsection III, paragraphs 5-7. The Emergency Preparedness and Radiation Protection Branch (PERB) is the current PRB for SRP Section 15.6.5 Appendices A, B, and D. |
| 19. | Editorial | Revised to reflect standard review interface subsection wording from SRP-UDP format guidance. |
| 20. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 21. | Editorial | Corrected reference to "45" since GDC 43, not GDC 45, is Acceptance Criterion II.C. |
| 22. | Editorial | Added actual wording from GDC 4 for clarity. |
| 23. | Editorial | Added punctuation. |
| 24. | Editorial | Removed plural for grammatical improvement. |
| 25. | Editorial | Revised to reflect actual wording of GDC 43. |
| 26. | Editorial | Added punctuation and removed conjunction for grammatical improvement. |

| Item | Source | Description |
|---|---|---|
| 27. | Editorial | 10 CFR 50 Appendix J does not explicitly provide design requirements for secondary containment testability. Appendix J also does not explicitly provide requirements for secondary containment preoperational testing. 10 CFR 50 Appendix J requires that structures of multiple barrier or subatmospheric containments (e.g., secondary containments for boiling water reactors and shield buildings for pressurized water reactors that enclose the entire primary reactor containment or portions thereof) shall be subject to individual tests in accordance with the procedures specified in the technical specifications, or associated bases. Also clarified, based upon the leakage rate testing requirements of Appendix J, that the purpose of leakage rate testing is not only to identify leakage paths but to determine leakage rates. |
| 28. | SRP-UDP format item. | Format change to make the citation of references consistent with the SRP-UDP format guidance. Also updated the reference number to reflect added references. |
| 29. | Editorial | Corrected error, probably typographical. |
| 30. | SRP-UDP format item, Metrication policy implementation | The existing criteria of 0.25 inches (water) for pressure differential was converted to 0.063 kPa using the guidance of Federal Standard 376B. See enclosed conversion documentation. |
| 31. | Editorial | Revised to reflect that neither 10 CFR 50 Appendix J nor GDC 43 explicitly provide requirements for secondary containment inspection. Appendix J provides testing requirements applicable to the secondary containment. |
| 32. | SRP-UDP format item. | Format change to make the citation of references consistent with the SRP-UDP format guidance. Also updated the reference number to reflect added references. |
| 33. | Editorial | Revised to reflect that 10 CFR 50 Appendix J requires that structures of multiple barrier or subatmospheric containments (e.g., secondary containments for boiling water reactors and shield buildings for pressurized water reactors that enclose the entire primary reactor containment or portions thereof) be subject to individual tests in accordance with the procedures specified in the technical specifications, or associated bases. |

| Item | Source | Description |
|---|---|---|
| 34. | SRP-UDP format item. | Technical Rationale were developed and added for the following Acceptance Criteria: GDCs 4, 16, and 43 and 10 CFR 50 Appendix J. The SRP-UDP program requires that Technical Rationale be developed for the Acceptance Criteria. |
| 35. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 36. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 37. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 38. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 39. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 40. | **Integrated Impact 384** | Added a review procedure for new applications verifying that analyses of the ability to draw a negative pressure on the secondary containment volume following a LOCA assume that all lines that do not receive an isolation signal are open and that the worst-case secondary containment isolation valve fails to close. |
| 41. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 42. | SRP-UDP format item. | Format change to make the citation of references consistent with the SRP-UDP format guidance. Also updated the reference numbers to reflect added reference for the CONTEMPT-LT28 computer code. |
| 43. | No change proposed, Potential Impact 24449, Reference Verification | Several updated versions of CONTEMPT4 were identified from NUREG-0933 Issue B-15, "CONTEMPT Computer Code Maintenance" references and from SRP-UDP Recall index of NUREG Abstracts. It could not be determined with certainty that CONTEMPT-LT code limitations discussed have been resolved. Note that in the ABWR FSER, Section 6.2.1.2, it is indicated that the staff performed independent confirmatory analyses with the CONTEMPT-LT28 computer code (See Potential Impact 24449). No discussion of CONTEMPT-LT28 computer code limitations for calculating long-term containment responses were discussed in conjunction with the above. If the current version of the CONTEMPT-LT code is not subject to the limitations discussed, consideration should be given to deleting discussion of these limitations. |

| Item | Source | Description |
|---|---|---|
| 44. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 45. | Current PRB names and abbreviations | Editorial change made to reflect the current abbreviation for the PRB responsible for reviewing radiological consequences analyses (Emergency Preparedness and Radiation Protection Branch) in SRP Section 15.6.5 Appendices A, B, and D. |
| 46. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 47. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 48. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 49. | Current PRB names and abbreviations | Editorial change made to reflect the current abbreviation for the PRB responsible for reviewing radiological consequences analyses (Emergency Preparedness and Radiation Protection Branch) in SRP Section 15.6.5 Appendices A, B, and D. |
| 50. | Current PRB names and abbreviations | Editorial change made to reflect the current abbreviation for the PRB responsible for reviewing technical specifications (Technical Specifications Branch) under SRP Section 16.0. |
| 51. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 52. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 53. | Current PRB names and abbreviations | Editorial change made to reflect the current abbreviation for the PRB responsible for reviewing radiological consequences analyses (Emergency Preparedness and Radiation Protection Branch) in SRP Section 15.6.5 Appendices A, B, and D. |
| 54. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 55. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 56. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 57. | Current PRB names and abbreviations | Editorial change made to reflect the current abbreviation for the PRB responsible for reviewing technical specifications (Technical Specifications Branch) under SRP Section 16.0. |

| Item | Source | Description |
|---|---|---|
| 58. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 59. | Current PRB names and abbreviations | Editorial change made to reflect the current PRB abbreviation and responsibility for SRP Section 6.2.3. |
| 60. | SRP-UDP Guidance, Implementation of 10 CFR 52 | Added standard paragraph to address application of Review Procedures in design certification reviews. |
| 61. | Editorial | Corrected spelling. |
| 62. | Editorial | Since 10 CFR Part 50, Appendix J is cited as Acceptance Criteria for SRP Section 6.2.3, provisions for findings of compliance with relevant requirements of Appendix J were added. |
| 63. | SRP-UDP Format Item | Editorial, standard change made to Evaluation Findings to address design certification reviews. |
| 64. | 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. |
| 65. | SRP-UDP Guidance | Added standard paragraph to indicate applicability of this section to reviews of future applications. |
| 66. | Editorial | Updated to reflect current title of the referenced regulation. |
| 67. | Editorial | Added 10 CFR Part 50, Appendix J as a reference since its is cited in section II, Acceptance Criteria, (see II.D). |
| 68. | Editorial | Added Regulatory Guide 1.52 as a reference since its is cited in section II, Acceptance Criteria, specific criteria item 3.a. |
| 69. | Editorial | Renumbering to reflect reordering per SRP-UDP format and addition of references. |
| 70. | Editorial | Renumbering to reflect reordering per SRP-UDP format and addition of references. |

| Item | Source | Description |
|---|---|---|
| 71. | Editorial, Potential Impact 24449 | Added updated Reference for the version of the CONTEMPT Computer Code that is apparently used by SCSB for containment accident response analyses. The updated reference information was identified from the SRP-UDP Recall index of NUREG Abstracts. Note that in the ABWR FSER, Section 6.2.1.2, the staff indicates that in its calculation of the short-term and long-term containment pressure-temperature response to postulated high-energy line breaks, GE used the same analytical models and conservative assumptions that were presented and reviewed for the Mark III containment in General Electric Standard Safety Analysis Report (GESSAR) II (NUREG-0979). The staff found these to be acceptable, using independent confirmatory analyses with the CONTEMPT-LT28 computer code (See Potential Impact 24449). |
| 72. | Editorial | Added identification of the current branch responsible for this BTP. |
| 73. | SRP-UDP format item, Metrication policy implementation | The existing criteria of -0.25 in. w.g. (water gauge) for pressure was converted to -0.063 kPa using the guidance of Federal Standard 376B. See enclosed conversion documentation. |
| 74. | SRP-UDP format item, Metrication policy implementation | The existing criteria of -0.25 in. w.g. for pressure was converted to -0.063 kPa using the guidance of Federal Standard 376B. See enclosed conversion documentation. |
| 75. | Editorial | Corrected punctuation. |
| 76. | SRP-UDP format item, Metrication policy implementation | The existing criteria of -0.25 in. w.g. for pressure was converted to -0.063 kPa using the guidance of Federal Standard 376B. See enclosed conversion documentation. |
| 77. | SRP-UDP format item. | Format change to make the citation of references consistent with the SRP-UDP format guidance. Regulatory Guides typically are not identified by reference number where cited. |
| 78. | Editorial | Corrected grammar. |
| 79. | No change proposed. | This note identifies information/positions for which the SRP-UDP could not verify the source document and/or regulatory basis. Note that in item 9.a, it is clear that bypass leakage following a LOCA is at issue, however item 9.f indicates that a closed system proposed as a leakage boundary to preclude bypass leakage should be tested for leakage unless it can be shown that during normal plant operations the system integrity is maintained. |

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## SRP Draft Section 6.2.3

Attachment B - Cross Reference of Integrated Impacts

| Integrated Impact No. | Issue | SRP Subsections Affected |
|---|---|---|
| 384 | Revise the SRP to address staff requested assumptions in reviews of new plant secondary containment functional capabilities to maintain negative pressure following a LOCA. | SRP 6.2.3, subsection III, Review Procedures, 3rd paragraph. |