NUREG-0800
(Formerly NUREG-75/087)

U.S. NUCLEAR REGULATORY COMMISSION

STANDARD REVIEW PLAN

OFFICE OF NUCLEAR REACTOR REGULATION

6.2.4 CONTAINMENT ISOLATION SYSTEM

REVIEW RESPONSIBILITIES

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

Secondary - None

I. AREAS OF REVIEW

The design objective of the containment isolation system is to allow the normal or emergency passage of fluids through the containment boundary while preserving the ability of the boundary to prevent or limit the escape of fission products that may result from postulated accidents. This Standard Review Plan (SRP)[2] section, therefore, is concerned with the isolation of fluid systems which penetrate the containment boundary, including the design and testing requirements for isolation barriers and actuators. Isolation barriers include valves, closed piping systems, and blind flanges.

The ~~CSB~~SCSB[3] review of the applicant's safety analysis report (SAR) regarding containment isolation provisions covers the following aspects:

1. The design of containment isolation provisions, including:

   a. The number and location of isolation valves, i.e., the isolation valve arrangements and the physical location of isolation valves with respect to the containment.

   b. The actuation and control features for isolation valves.

c. The positions of isolation valves for normal plant operating conditions (including shutdown), postaccident conditions, and in the event of valve operator power failures.

d. The valve actuation signals.

e. The basis for . The mechanical redundancy of isolation devices.

g. The acceptability of closed piping systems inside containment as isolation barriers.

2. The protection provided for containment isolation provisions against loss of function of missiles, pipe whip, and earthquakes.

3. The environmental conditions inside and outside the containment that were considered in the design of isolation barriers.

4. The design criteria applied to isolation barriers and piping.

5. The provisions for detecting a possible need to isolate remote-manual- controlled systems, such as engineered safety features systems.

6. The design provisions for and technical specifications pertaining to operability and leakage rate testing of the isolation barriers.

7. The calculation of containment atmosphere released prior to isolation valve closure for lines that provide a direct path to the environs.

8. The containment purging/venting design features provided to minimize purging time consistent with ALARA principles for occupational exposure.[4]

9. The reliability of the purge system to isolate under accident conditions.[5]

10. The containment isolation and valve indication provisions in the event of a station blackout (SBO).[6]

Review Interfaces[7]

~~CSB~~SCSB[8] will coordinate other branch evaluations that interface with the overall review of the containment isolation system, as follows:

A.[9] The Mechanical Engineering Branch ~~(MEB)~~(EMEB)[10] will review the system seismic design and quality group classification as part of its primary review responsibility for SRP Sections 3.2.1 and 3.2.2, respectively.

MEBEMEB[11] will review the mechanical design of the containment isolation system as part of its primary review responsibility for SRP Section 3.9 to ensure adequate protection against a breach of integrity, missiles, pipe whip, and jet impingement.

EMEB will review the postulated pipe rupture locations, the containment penetration exclusion area, and related dynamic effects on containment isolation capability as part of its primary review responsibility for SRP Section 3.6.2.[12]

MEBEMEB[13] will evaluate the qualification test program for electric valve operators and the operability assurance program for containment isolationpurge and vent[14] valves as part of its primary review responsibility for SRP Section 3.10.

B. The Structural Engineering Branch (SEB)Civil Engineering and Geosciences Branch (ECGB)[15] will review the structural design of the containment isolation system as part of its primary review responsibility for SRP Section 3.8 to ensure adequate protection against earthquakes.

C. The Instrumentation and Control Systems Branch (ICSB)Instrumentation & Controls Branch (HICB)[16] will evaluate the actuation and control features for isolation valves as part of its primary responsibility for SRP Section 7.5.

The Equipment Qualification Branch (EQB)HICB[17] will also review sensing and actuation instrumentation of the plant protection system located both inside and outside of containment as part of its primarysecondary[18] review responsibility for SRP Sections 3.10 and 3.11.

D. The Accident Evaluation Branch (AEB)Emergency Preparedness and Radiation Protection Branch (PERB)[19] will review the radiological dose consequence analysis for the release of containment atmosphere prior to closure of containment isolation valves in lines that provide a direct path to the environs, as part of its secondaryprimary[20] review responsibility for SRP Section 15.6.5, Appendix A.[21]

E. The Reactor Systems Branch (RSB)(SRXB)[22] will review the closure time for containment isolation valves in lines that provide a direct path to the environs with respect to the prediction of onset of accident-induced fuel failure as part of its primary review responsibility for SRP Section 15.6.5.

F. The review of proposed technical specifications pertaining to operability and leakage-rate testing of the isolation barriers, and the closure time for containment isolation valves, is performed by the Licensing Guidance Branch (LGB)Technical Specifications Branch (TSB)[23] at the operating license stage of review, as part of its primary review responsibility for SRP Section 16.0.

G. The Electrical Engineering Branch (EELB) will review the power sources for containment isolation valve operators in each line penetrating the containment to ensure that no single fault can prevent isolation of the line as part of its primary review responsibility for SRP Sections 8.3.1 and 8.3.2.[24] In addition, the EELB, as part of its review responsibility for SRP Section 8.4 (proposed), reviews the capability to withstand or cope with, and recover from an SBO and coordinates with the review of containment isolation system to ensure appropriate functioning of the system for an SBO.[25]

H. For new plant applicants, the Probabilistic Safety Assessment Branch (SPSB) will review containment integrity issues during shutdown and low-power operations under the systematic assessment of shutdown risk as part of its primary review responsibility for SRP Section 19.1 (proposed).[26]

For those areas of review identified above as ~~being reviewed as~~ part of the primary responsibility of other branches, the acceptance criteria and methods of application are contained in the referenced SRP section ~~of the corresponding primary branch~~.[27]

II. ACCEPTANCE CRITERIA

The ~~CSB~~SCSB[28] will accept the containment isolation system design if the relevant requirements of General Design Criteria l, 2, 4, 16, 54, 55, 56, and 57, Appendix K to 10 CFR Part 50, additional TMI-related requirements in 10 CFR 50.34(f)(2)(xiv)[29] and (xv),[30] and the station blackout requirements of 10 CFR 50.63(a)(2),[31] are met. The relevant requirements are as follows:

1. General Design Criteria 1, 2, and 4, as they relate to systems important to safety being designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety function to be performed; systems being designed to withstand the effects of natural phenomena (e.g., earthquakes) without loss of capability to perform their safety functions; and systems being designed to accommodate postulated environmental conditions and protected against dynamic effects (e.g., missiles, pipe whip, and jet impingement), respectively.

2. General Design Criterion 16 (GDC 16),[32] as it relates to a system, in concert with the reactor containment, being provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment.

3. General Design Criterion 54 (GDC 54),[33] as it relates to piping systems penetrating the containment being provided with leak detection, isolation, and containment capabilities having redundant and reliable performance capabilities, and as it relates to design provision incorporated to permit periodic operability testing of the containment isolation system, and leak-rate testing of isolation valves.

4. General Design Criteria 55 and 56 as ~~it~~ they relate~~s~~[34] to lines that penetrate the primary containment boundary and either are part of the reactor coolant pressure boundary or connect directly to the containment atmosphere being provided with isolation valves as follows:

a. One locked-closed isolation valve[1] inside and one locked-closed isolation valve outside containment; or

b. One automatic isolation valve[2] inside and one locked-closed isolation valve outside containment; or

c. One locked-closed isolation valve inside and one automatic isolation valve outside containment; or

d. One automatic isolation valve inside and one automatic isolation valve outside containment.

5. General Design Criterion 57 (GDC 57),[35] as it relates to lines that penetrate the primary containment boundary and are neither part of the reactor coolant pressure boundary nor connected directly to the containment atmosphere being provided with at least one locked-closed, remote-manual, or automatic isolation valve[3] outside containment.

6. ~~Appendix K to 10 CFR Part 50 as it relates to the determination of the extent of fuel failure (source term) used in the radiological calculations.~~[36]

The General Design Criteria identified above establish requirements for the design, testing, and functional performance of isolation barriers in lines penetrating the primary containment boundary and, in general, require that two isolation valves[37] in series be used to ensure that the isolation function is maintained assuming any single active failure in the containment isolation provisions. However, containment isolation provisions that differ from the explicit requirements of General Design Criteria 55 and 56 are acceptable if the basis for the difference is justified.

Specific criteria necessary to meet the relevant requirements of the regulations identified above and guidelines for acceptable alternate containment isolation provisions for certain classes of lines are as follows:

a. Regulatory Guide 1.11 describes acceptable containment isolation provisions for instrument lines. In addition, instrument lines that are closed both inside and outside containment, are designed to withstand the pressure and temperature conditions following a loss-of-coolant accident (LOCA),[38] and are designed to withstand dynamic effects, are acceptable without isolation valves.

---

[1] Locked-closed isolation valves are defined as sealed closed barriers (see paragraph II.f)

[2] A simple check valve is not normally an acceptable automatic isolation valve for this application.

[3] A simple check valve is not normally an acceptable automatic isolation valve for this application.

b. Containment isolation provisions for lines in engineered safety feature or engineered safety feature-related systems may include remote-manual valves, but provisions should be made to detect possible leakage from these lines outside containment.

c. Containment isolation provisions for lines in systems needed for safe shutdown of the plant (e.g., liquid poison system, reactor core isolation cooling system, and isolation condenser system) may include remote-manual valves, but provisions should be made to detect possible leakage from these lines outside containment.

d. Containment isolation provisions for lines in the systems identified in items b and c above normally consist of one isolation valve inside, and one isolation valve outside containment. If it is not practical to locate a valve inside containment (for example, the valve may be under water as a result of an accident), both valves may be located outside containment. For this type of isolation valve arrangement, the valve nearest the containment and the piping between the containment and the valve should be enclosed in a leak-tight or controlled leakage housing. If, in lieu of a housing, conservative design of the piping and valve is assumed to preclude a breach of piping integrity, the design should conform to the requirements of SRP Section 3.6.2. Design of the valve and/or the piping compartment should provide the capability to detect leakage from the valve shaft and/or bonnet seals and terminate the leakage.

e. Containment isolation provisions for lines in engineered safety feature or engineered safety feature-related systems normally consist of two isolation valves in series. A single isolation valve will be acceptable if it can be shown that the system reliability is greater with only one isolation valve in the line, the system is closed outside containment, and a single active failure can be accommodated with only one isolation valve in the line. The closed system outside containment should be protected from missiles, designed to seismic Category I and Group B quality standards (Refs. 10 and 11),~~classified Safety Class 2 (Ref. 9),~~[39] and should have a design temperature and pressure rating at least equal to that for the containment. The closed system outside containment should be leak-tested, unless it can be shown that the system integrity is being maintained during normal plant operations. For this type of isolation valve arrangement the valve is located outside containment, and the piping between the containment and the valve should be enclosed in a leak-tight or controlled-leakage housing. If, in lieu of a housing, conservative design of the piping and valve is assumed to preclude a breach of piping integrity, the design should conform to the requirements of SRP Section 3.6.2. Design of the valve and/or the piping compartment should provide the capability to detect leakage from the valve shaft and/or bonnet seals and terminate the leakage.

f. Sealed-closed barriers may be used in place of automatic isolation valves. Sealed-closed barriers include blind flanges and sealed-closed isolation valves which may be closed manual valves, closed remote-manual valves, and closed automatic valves which remain closed after a ~~loss-of-coolant accident~~ LOCA.[40] Sealed-closed isolation valves should be under administrative control to ensure that they cannot be inadvertently opened. Administrative control includes mechanical devices to seal or lock the valve closed, or to prevent power from being supplied to the valve operator.

g. Relief valves may be used as isolation valves provided the relief setpoint is greater than 1.5 times the containment design pressure.

h. Item II.E.4.2 of NUREG-0737 and NUREG-071810 CFR 50.34(f)(2)(xiv)[41] requires that systems penetrating the containment be classified as either essential or nonessential. Regulatory Guide 1.141 will containReference 23 contains[42] guidance on the classification of essential and nonessential systems. Essential systems, such as those described in items b and c above, may include remote-manual containment isolation valves, but provisions should be made to detect possible leakage from the lines outside containment. Item II.E.4.2 of NUREG-0737 and NUREG-071810 CFR 50.34(f)(2)(xiv)[43] also requires that nonessential systems be automatically isolated by the containment isolation signal.

i. Isolation valves outside containment should be located as close to the containment as practical, as required by General Design Criteria 55, 56, and 57.

j. In meeting the requirements of General Design Criteria 55 and 56, upon loss of actuating power, automatic isolation valves should take the position that provides greater safety. The position of an isolation valve for normal and shutdown plant operating conditions and postaccident conditions depends on the fluid system function. If a fluid system does not have a postaccident function, the isolation valves in the lines should be automatically closed. For engineered safety features or engineered safety feature-related systems, isolation valves in the lines may remain open or be opened. The position of an isolation valve in the event of power failure to the valve operator should be the "safe" position. Normally this position would be the postaccident valve position. For lines equipped with motor-operated valves, a loss of actuating power will leave the affected valve in the "as is" position, which may be the open position; however, redundant isolation barriers ensure that the isolation function for the line is satisfied. All power-operated isolation valves should have position indication in the main control room.

k. To improve the reliability of the isolation function, which is addressed in General Design Criterion GDC 54,[44] Item II.E.4.2 of NUREG-0737 and NUREG-071810 CFR 50.34(f)(2)(xiv)[45] requires that the containment setpoint pressure that initiates containment isolation for nonessential penetrations be reduced to the minimum value compatible with normal operating conditions.

l. There should be diversity in the parameters sensed for the initiation of containment isolation to satisfy the requirement of General Design Criterion GDC 54 for reliable isolation capability.

m. To improve the reliability of the isolation function, which is addressed in General Design Criterion 5456 (GDC 56),[46] system lines which provide an open path from the containment to the environs (e.g., purge and vent lines which are addressed in Item II.E.4.2 of NUREG-0737 and NUREG-071810 CFR 50.34(f)(2)(xiv)[47]) should be equipped with radiation monitors that are capable of isolating these lines upon a high radiation signal. A high radiation signal should not be considered one of the diverse containment isolation parameters.

n. In meeting the requirements of General Design Criterion GDC 54, the performance capability of the isolation function should reflect the importance to safety of isolating system lines. Consequently, containment isolation valve closure times should be selected to ensure rapid isolation of the containment following postulated accidents. The valve closure time is the time it takes for a power-operated valve to be in the fully closed position after the actuator power has reached the operator assembly; it does not include the time to reach actuation signal setpoints or instrument delay times, which should be considered in determining the overall time to close a valve. System design capabilities should be considered in establishing valve closure times. For lines which provide an open path from the containment to the environs, e.g., the containment purge and vent lines, isolation valve closure times on the order of 5 seconds or less may be necessary. The closure times of these valves should be established on the basis of minimizing the release of containment atmosphere to the environs, to mitigate the offsite radiological consequences, and ensure that emergency core cooling system (ECCS) effectiveness is not degraded by a reduction in the containment backpressure. Analyses of the radiological consequences and the effect on the containment backpressure due to the release of containment atmosphere should be provided to justify the selected valve closure time. Additional guidance on the design and use of containment purge systems which may be used during the normal plant operating modes (i.e., startup, power operation, hot standby and hot shutdown) is provided in Branch Technical Position CSB 6-4 (Ref. 13).[48] For plants under review for operating licenses or plants for which the Safety Evaluation Report for construction permit application was issued prior to July 1, 1975, the methods described in Section B, Items B.1.a, b, d, e, 9, f, and 9, B.2 through B.4, and B.5.b, c, and d of Branch Technical Position CSB 6-4 should be implemented. For these plants, BTP Items B.1.c and B.5.a, regarding the size of the purge system used during normal plant operation and the justification by acceptable dose consequence analysis, may be waived if the applicant commits to limit the use of the purge system to less than 90 hours per year while the plant is in the startup, power, hot standby and hot shutdown modes of operations. This commitment should be incorporated into the Technical Specifications used in the operation of the plant.[49]

Item II.E.4.2 of NUREG-0737 and NUREG-0718 requires that containmentContainment[50] purge valves that do not satisfy the operability criteria set forth in Branch Technical Position CSB 6-4 or the Staff Interim Position of October 23, 1979[51] must be sealed closed as defined in SRP Section 6.2.4, Item II.3.fII.f,[52] during operational conditions 1, 2, 3, and 4 (Ref. 23).[53] Furthermore, these valves must be verified to be closed at least every 31 days. (A copy of the Staff Interim Position appears as Attachment 1 to Item II.E.4.2 in NUREG-0737.)[54]These requirements should be incorporated into the technical specifications for operation of the plant.[55]

o. The use of a closed system inside containment as one of the isolation barriers will be acceptable if the design of the closed system satisfies the following requirements:

1. The system does not communicate with either the reactor coolant system or the containment atmosphere.

2. The system is protected against missiles and pipe whip.

3. The system is designated seismic Category I.

4. The system is classified ~~Safety Class 2~~Quality Group B (Ref. ~~12~~10).[56]

5. The system is designed to withstand temperatures at least equal to the containment design temperature.

6. The system is designed to withstand the external pressure from the containment structure acceptance test.

7. The system is designed to withstand the ~~loss-of-coolant accident~~ LOCA transient and environment.

Insofar as ~~CSB~~SCSB[57] is concerned with the structural design of containment internal structures and piping systems, the protection of isolation barriers against loss of function from missiles, pipe whip, and earthquakes will be acceptable if isolation barriers are located behind missile barriers, pipe whip was considered in the design of pipe restraints and the location of piping penetrating the containment, and the isolation barriers, including the piping between isolation valves, are designated seismic Category I, i.e., designed to withstand the effects of the safe-shutdown earthquake, as recommended by Regulatory Guide 1.29.

p. In meeting the requirements of General Design Criteria 1, 2, 4, and 54, appropriate reliability and performance considerations should be included in the design of isolation barriers to reflect the importance to safety of ~~assuring~~ ensuring[58] their integrity, i.e., containment capability, under accident conditions. The design criteria applied to components performing a containment isolation function, including the isolation barriers and the piping between them, or the piping between the containment and the outermost isolation barrier, are acceptable if:

1. Group B quality standards as defined in Regulatory Guide 1.26 are applied to the components, unless the service function dictates that Group A quality standards be applied.

2. The components are designated seismic Category I, in accordance with Regulatory Guide 1.29.

q. ~~General Design Criterion~~GDC 54 requires reliable isolation capability. Therefore, when considering remote-manual isolation valves, the design of the containment isolation system is acceptable if provisions are made to allow the operator in the main control room to know when to isolate fluid systems that are equipped with remote-manual isolation valves. Such provisions may include instruments to measure flow rate, sump water level, temperature, pressure, and radiation level.

r. ~~General Design Criterion~~GDC 54 specifies the requirements for the containment isolation system. Therefore, to satisfy ~~General Design Criterion~~ GDC 54, provisions should be made in the design of the containment isolation system for operability testing of the containment isolation valves and leakage rate testing of the isolation barriers. The isolation valve testing program should be consistent with that proposed for other engineered safety features. The acceptance criteria for the leakage rate testing program for containment isolation barriers are presented in SRP Section 6.2.6.

s. ~~General Design Criterion~~GDC 54 requires reliable isolation capability. To satisfy this requirement, provisions should be made in the design of the containment isolation system to reduce the possibility of isolation valves reopening inadvertently following isolation. In this regard, ~~Item II.E.4.2 of NUREG-0737 and NUREG-0718~~10 CFR 50.34(f)(2)(xiv)[59] requires that the design of the control systems for automatic containment isolation valves be such that resetting the isolation signal will not result in the automatic reopening of containment isolation valves. Reopening of containment isolation valves should require deliberate operator action. In addition, ganged reopening of containment isolation valves is not acceptable. Reopening of isolation valves must be performed on a valve-by-valve basis, or on a line-by-line basis, provided that electrical independence and other single-failure criterion continue to be satisfied.

Administrative provisions to close all isolation valves manually before resetting the isolation signals is not an acceptable method of meeting this design requirement.

t. In meeting the requirements of 10 CFR 50.34(f)(2)(xv) regarding purging, the regulatory guidance contained in BTP CSB 6-4, "Containment Purging During Normal Plant Operations," should be used to establish compliance with this regulation.[60]

u. Regulatory Guide 1.155, "Station Blackout," Regulatory Position C.3.2.7, provides guidance for meeting the requirements of the station blackout rule, 10 CFR 50.63(a)(2), with respect to containment isolation valves and valve position indication.[61]

v. Appendix K to 10 CFR Part 50 provides guidance for the determination of the extent of fuel failure (source term) used in the radiological calculations.[62]

Technical Rationale

The technical rationale for application of these acceptance criteria to reviewing the containment isolation system is discussed in the following paragraphs:[63]

1. Compliance with General Design Criterion 1 (GDC 1), "Quality Standards and Records," requires that structures, systems, and components important to safety be designed, fabricated, erected, and tested to quality standards commensurate with the safety functions to be performed.

   This SRP section defines appropriate reliability and performance standards for the design of the containment isolation system. These standards reflect the importance of forming a barrier that is essentially leaktight and that will prevent the release of fission products in the event of an accident. Regulatory Guide 1.26 specifies quality standards that are applicable to components in the containment isolation system. This SRP section also contains TMI-related requirements regarding containment isolation dependability, containment purging/venting during plant operation, and purge/vent valves.

Meeting the requirements of GDC 1 provides assurance that the containment isolation system will perform its safety function, thereby preventing the release of radioactive materials to the environment.[64]

2. Compliance with General Design Criterion 2 (GDC 2), "Design Bases for Protection against Natural Phenomena," requires that structures, systems, and components important to safety be designed to withstand the effects of natural phenomena such as earthquake, tornado, hurricane, flooding, tsunami, and seiche without loss of capability to perform their safety functions.

GDC 2 applies to this SRP section because the reviewer evaluates the containment isolation system to ensure its capability to isolate the containment under accident conditions (e.g., LOCA) combined with applicable severe natural phenomena. Regulatory Guide 1.29 provides guidance acceptable to the staff for developing designs with the capability to withstand earthquakes.

Meeting the requirements of GDC 2 provides assurance that the containment will act as a barrier that is essentially leaktight, thereby preventing the release of radioactive materials to the environment under all credible conditions.[65]

3. Compliance with General Design Criterion 4 (GDC 4), "Environmental and Dynamic Effects Design Bases," requires that structures, systems, and components important to safety (a) be designed to accommodate the effects of, and be compatible with, environmental conditions associated with normal operation, maintenance, testing, and postulated accidents (including LOCAs) and (b) be appropriately protected against dynamic effects (including those of missiles, pipe whipping, and discharging fluids) that may result from equipment failures and from events and conditions outside the nuclear power unit.

GDC 4 applies to this SRP section because the reviewer evaluates the containment isolation system to ensure its capability to perform its isolation function at all times. This application includes the capability to perform its function in any environmental condition to which the system's components may be exposed, including dynamic effects. BTP CSB 6-4 provides guidance related to dynamic effects that should be considered in the design of containment purge and vent valves.

Meeting the requirements of GDC 4 provides assurance that the containment isolation system will have the capability to perform its safety function of containment isolation, thereby preventing the release of radioactive materials to the environment. Meeting these requirements will also ensure that containment purge and vent valves are designed to provide reliable isolation under accident conditions.[66]

4. Compliance with GDC 16, "Containment Design," requires that the reactor containment and its associated systems establish an essentially leaktight barrier against the uncontrolled release of radioactive materials to the environment.

   GDC 16 applies to this SRP section because the reviewer evaluates the containment isolation system to determine whether it allows the normal or emergency passage of fluids through the containment boundary while it preserves the capability of the boundary to prevent or limit the escape of fission products that may result from postulated accidents. This SRP section provides guidance related to design requirements for containment isolation provisions, including the number and location of isolation valves, the actuation and control features for isolation valves, redundancy, valve actuation signals, and closure times.

   Meeting the requirements of GDC 16 provides assurance that the containment and its associated systems will act as an essentially leaktight barrier to prevent the uncontrolled release of radioactive materials to the environment in the event of an accident.[67]

5. Compliance with GDC 54, "Piping Systems Penetrating Containment," requires that piping systems that penetrate the primary reactor containment be provided with leak detection, isolation, and containment capabilities having redundancy, reliability, and performance capabilities that reflect the importance to safety of isolating these piping systems.

   GDC 54 applies to this SRP section because the reviewer evaluates the containment isolation system to ensure that valves in piping systems that penetrate the containment are designed to close reliably under accident conditions, thereby preventing the uncontrolled release of radioactive materials. To ensure the reliability these valves, SRP Section 6.2.4 provides guidance related to leak detection, redundancy, leakage testing, and functional testing. Regulatory Guides 1.11 and 1.141 provide guidance acceptable to the staff for isolating instrument lines that penetrate the containment and for fluid systems, respectively. Nonessential lines are automatically isolated by the containment isolation signal.

   Meeting the requirements of GDC 54 provides assurance that the containment isolation system will reliably isolate piping systems penetrating containment, as required.[68]

6. Compliance with General Design Criterion (GDC 55), "Reactor Coolant Pressure Boundary Penetrating Containment," requires that each line belonging to the reactor coolant pressure boundary and penetrating the primary reactor containment meet specified criteria relative to the use and positioning of isolation valves.

   GDC 55 applies to this SRP section because the reviewer evaluates the containment isolation system to ensure that there is no direct communication between the primary coolant and the plant environs. This assurance is provided by specifying requirements for isolation valves (i.e., locked-closed, automatic, or a combination of locked-closed and automatic) on both sides of the containment barrier. Isolation valves outside the containment should be located as close to the containment as is practical. Upon loss of actuating power, automatic valves are to take the position that provides greater safety. Other requirements (e.g., those related to higher quality in design, additional inservice inspection, and protection against severe natural phenomena) may be imposed based on the use and physical characteristics of the plant-site environs.

Meeting the requirements of GDC 55 provides assurance that lines penetrating the containment and connected to the reactor coolant system will not be a source of excessive offsite radiation doses due to either line rupture or failure of a valve to close.[69]

7. Compliance with GDC 56, "Primary Containment Isolation," requires that each line that connects directly to the containment atmosphere and penetrates the primary reactor containment must meet specified criteria relative to the use and positioning of isolation valves.

GDC 56 applies to this SRP because the reviewer evaluates the containment isolation system to ensure (a) that there is no direct communication between the containment atmosphere and the plant environs or (b) if there is direct communication (such as that which occurs during containment purging or venting), that the line in question can be reliably isolated. This assurance is provided by specifying requirements for isolation valves (i.e., locked-closed, automatic, or a combination of locked-closed and automatic) on both sides of the containment barrier. Isolation valves outside the containment should be located as close to the containment as is practical. Upon loss of actuating power, automatic valves are to take the position that provides greater safety. BTP CSB 6-4 contains specific requirements for containment purge and vent valves, providing a high degree of assurance that these valves will isolate reliably under accident conditions.

Meeting the requirements of GDC 56 provides assurance that lines penetrating the containment and connected to the containment atmosphere will not be a source of excessive offsite radiation doses due to either line rupture or failure of a valve to close.[70]

8. Compliance with GDC 57, "Closed System Isolation Valves," requires that each line penetrating the primary reactor containment which is neither part of the reactor coolant pressure boundary nor connected directly to the containment atmosphere must have at least one containment isolation valve that is automatic, locked-closed, or capable of remote-manual operation. Isolation valves must be located on the outside of the containment barrier as close to the containment as is practical.

GDC 57 applies to this SRP section because the reviewer evaluates the containment isolation system to ensure that there is no direct communication between the fluids in the closed system and the plant environment. This assurance is provided by specifying requirements for a closed system and for an isolation valve that is locked-closed, automatic, or capable of remote-manual operation. A single valve is specified because the system is closed; hence, failure of the valve to close would not, by itself, allow communication between fluids in the closed system and the plant environment.

Meeting the requirements of GDC 57 provides assurance that lines penetrating the containment and connected to closed systems will not be a source of excessive offsite radiation doses due to either line rupture or failure of a valve to close.[71]

9. 10 CFR 50.63 requires that all light-water-cooled nuclear power plants be able to withstand and recover from a station blackout and that necessary systems be capable of ensuring that the core is cooled and that appropriate containment integrity is maintained in the event of a station blackout. Guidance for compliance with 10 CFR 50.63 is provided in Regulatory Guide 1.155. Since many safety systems necessary to support safe operation and shutdown of the reactor are dependent on ac power, the consequences of a station blackout could be severe, particularly if the integrity of barriers to prevent the release of fission products (e.g., fuel cladding, reactor coolant pressure boundary, containment) are not maintained throughout the event and its associated recovery period. The containment isolation system, including its provisions for control, indication, and performance under loss/restoration of power conditions, is instrumental in ensuring that integrity of the containment barrier is maintained without undue interference with flow paths essential for cooling the reactor core. Compliance with 10 CFR 50.63 and the positions of Regulatory Guide 1.155 regarding the performance of the containment isolation system for a station blackout therefore provides additional defense-in-depth against unacceptable offsite radiological consequences should both offsite and onsite emergency ac power systems fail concurrently, by ensuring that containment integrity will be maintained for such an event.

III. REVIEW PROCEDURES

The procedures described below provide guidance on review of the containment isolation 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 containment isolation common to a class of containments, or by adopting the results of previous reviews of plants with essentially the same containment isolation provisions.

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

The ~~CSB~~SCSB[72] determines the acceptability of the containment isolation system by comparing the system design criteria to the design requirements for an engineered safety feature. The quality standards and the seismic design classification of the containment isolation provisions, including the piping penetrating the containment, are compared ~~to~~ with[73] Regulatory Guides 1.26 and 1.29, respectively.

The ~~CSB~~SCSB[74] also ascertains that no single fault can prevent isolation of the containment. This is accomplished by reviewing the containment isolation provisions for each line penetrating the containment to determine that two isolation barriers in series are provided, and in conjunction with the ~~PSB~~EELB[75] by reviewing the power sources to the valve operators.

The CSBSCSB[76] reviews the information in the SAR justifying containment isolation provisions which differ from the explicit requirements of General Design Criteria 55, 56, and 57. The CSBSCSB[77] judges the acceptability of these containment isolation provisions based on a comparison with the acceptance criteria given in subsection II of this SRP section.

The CSBSCSB[78] reviews the position of isolation valves for normal and shutdown plant operating conditions, postaccident conditions, and valve operator power failure conditions as listed in the SAR. The position of an isolation valve for each of the above conditions depends on the system function. In general, pPower-operated[79] valves in fluid systems which do not have a postaccident safety function (nonessential systems), as defined in Regulatory Guide 1.141)[80] should close automatically. In the event of power failure to a valve operator, the valve position should be the position of greater safety, which is normally the postaccident position. However, special cases may arise and these will be considered on an individual basis in determining the acceptability of the prescribed valve positions. The CSBSCSB[81] also ascertains from the SAR that all power-operated isolation valves have position indication capability in the main control room.

The CSBSCSB[82] reviews the signals obtained from the plant protection system to initiate containment isolation. In general, there should be a diversity of parameters sensed; e.g., abnormal conditions in the reactor coolant system, the secondary coolant system, and the containment, which generate containment isolation signals. Since plant designs differ in this regard and many different combinations of signals from the plant protection system are used to initiate containment isolation, the CSBSCSB[83] considers the arrangement proposed on an individual basis in determining the overall acceptability of the containment isolation signals. The CSBSCSB[84] will use the guidance presented in Item II.E.4.2. of NUREG-0737 for its review ofreviews[85] the containment setpoint pressure that initiates containment isolation for nonessential penetrations. This pressure setpoint should be the minimum value that is compatible with normal operating conditionsoperation,[86]. as required by 10 CFR 50.34(f)(2)(xiv)(D). Additional guidance for review of this setpoint is contained in Item II.E.4.2 of NUREG-0737.[87]

The CSBSCSB[88] reviews isolation valve closure times. In general, valve closure times should be less than one minute, regardless of valve size. (See the acceptance criteria for valve closure times in subsection II of this SRP section.) Valves in lines that provide a direct path to the environs, e.g., the containment purge and ventilation system lines and main steam lines for direct cycle plants, may have to close in times much shorter than one minute. Closure times for these valves may be dictated by radiological dose analyses or ECCS performance considerations. The CSBSCSB[89] will request the AEBPERB[90] or RSBSRXB[91] to review analyses justifying valve closure times for these valves as necessary.

The CSBSCSB[92] determines the acceptability of the use of closed systems inside containment as isolation barriers by comparing the system designs to the acceptance criteria specified in subsection II of this SRP section.

The MEBEMEB[93] and SEBECGB[94] have review responsibility for the structural design of the containment internal structures and piping systems, including restraints, to ensure that the containment isolation provisions are adequately protected against missiles, pipe whip, and earthquakes. The CSBSCSB[95] determines that for all containment isolation provisions, missile protection and protection against loss of function from pipe whip and earthquakes were design considerations. The CSBSCSB[96] reviews the system drawings (which should show the locations of missile barriers relative to the containment isolation provisions) to determine that the isolation provisions are protected from missiles. The CSBSCSB[97] also reviews the design criteria applied to the containment isolation provisions to determine that protection against dynamic effects, such as pipe whip and earthquakes, was considered in the design. The CSBSCSB[98] will request the MEBEMEB[99] to review the design adequacy of piping and valves for which conservative design is assumed to preclude possible breach of system integrity in lieu of providing a leak-tight housing.

Systems having a postaccident safety function (essential systems), as defined in Regulatory Guide 1.141)[100] may have remote-manual isolation valves in the lines penetrating the containment. The CSBSCSB[101] reviews the provisions made to detect leakage from these lines outside containment and to allow the operator in the main control room to isolate the system train should leakage occur. Leakage detection provisions may include instrumentation for measuring system flow rates, or the pressure, temperature, radiation, or water level in areas outside the containment such as valve rooms or engineered safeguards areas. The CSBSCSB[102] bases its acceptance of the leakage detection provisions described in the SAR on the capability to detect leakage and identify the lines that should be isolated.

The CSBSCSB[103] determines that the containment isolation provisions are designed to allow the isolation barriers to be individually leak-tested. This information should be tabulated in the safety analysis reportSAR[104] to facilitate the CSBSCSB[105] review.

The CSBSCSB[106] determines from the descriptive information in the SAR that provisions have been made in the design of the containment isolation system to allow periodic operability testing of the power-operated isolation valves and the containment isolation system. At the operating license stage of review, the CSBSCSB[107] determines that the content and intent of proposed technical specifications pertaining to operability and leak-testing of containment isolation equipment is in agreement with requirements developed by the staff. In particular, technical specifications should exist for the following: containment purge or vent valves that do not satisfy the operability criteria set forth in BTP CSB 6-4 must be sealed closed as defined in Item II.f above and verified sealed closed at least every 31 days during all operational conditions, except cold shutdown and refueling; purging or venting time should be minimized consistent with ALARA principles for occupational exposure; and containment purge or vent valves with resilient seals must be subjected to leakage-testing and periodic resilient seal replacement.[108]

The CSBSCSB[109] verifies that the design of the control system for automatic containment isolation valves is such that resetting the isolation signal will not result in the automatic reopening of containment isolation valves, and that ganged reopening of isolation valves is not possible.

The SCSB evaluates the design features of the purging/venting system that are provided to minimize purging time and verifies that there is a high degree of assurance that the purge system will reliably isolate under accident conditions.[110]

The SCSB verifies that appropriate containment integrity is maintained in the event of a station blackout. This means that adequate containment integrity is ensured by providing the capability, independent of the preferred and blacked-out unit's onsite emergency ac power supplies, for valve position indication and closure for containment isolation valves that may be in the open position at the onset of a station blackout. Certain containment isolation valves are excluded from consideration, as discussed in Regulatory Guide 1.155.[111]

For PWRs, the SCSB verifies that sufficient procedures and controls are in place that will reasonably assure that containment closure (as defined in reference 24) is possible during reduced inventory conditions. Containment closure must be achieved prior to the time at which an uncovered core could result from a loss of decay heat removal coupled with an inability to initiate alternate cooling or addition of water to the RCS inventory. These controls should be in use:

(a) prior to entering a reduced RCS inventory condition for NSSSs supplied by Combustion Engineering or Westinghouse, and

(b) prior to entering an RCS condition wherein the water level is lower than four inches below the top of the flow area of the hot legs at the junction of the hot legs to the RV for NSSSs supplied by Babcock and Wilcock.[112]

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.[113]

IV. EVALUATION FINDINGS

The information provided and the ~~CSB~~SCSB[114] review should support concluding statements similar to the following, to be included in the staff's safety evaluation report (SER):[115]

> The staff concludes that the containment isolation system[116] functional design is acceptable and meets the requirements of General Design Criteria 1, 2, 4, 16, 54, 55, 56, and 57, Appendix K to 10 CFR Part 50, the additional TMI-related requirements 10 CFR 50.34(f)(2)(xiv)[117] and (xv),[118] and the station blackout requirements of 10 CFR 50.63(a)(2).[119] 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 the regulation being discussed):

a. meeting the regulatory positions in NUREG ___________ and/or Regulatory Guide(s) _____;

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 have 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 have 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.[120]

V. IMPLEMENTATION

The following is intended to provide guidance to applicants and licensees regarding the NRC staff 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.[121] 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.[122]

Implementation schedules for conformance to parts of the method discussed herein are contained in the referenced regulatory guides and NUREGs.

VI. REFERENCES

1. 10 CFR Part 50, Appendix A, General Design Criterion 1, "Quality Standards and Records."

2. 10 CFR Part 50, Appendix A, General Design Criterion 2, "Design Bases for Protection Against Natural Phenomena."

3. 10 CFR Part 50, Appendix A, General Design Criterion 4, "Environmental and Missile Design Basis."

4. 10 CFR Part 50, Appendix A, General Design Criterion 16, "Containment Design."

5. 10 CFR Part 50, Appendix A, General Design Criterion 54, "Piping Systems Penetrating Containment."

6. 10 CFR Part 50, Appendix A, General Design Criterion 55, "Reactor Coolant Pressure Boundary Penetrating Containment."

7. 10 CFR Part 50, Appendix A, General Design Criterion 56, "Primary Containment Isolation."

8. 10 CFR Part 50, Appendix A, General Design Criterion 57, "Closed System Isolation Valves."

9. Regulatory Guide 1.11, "Instrument Lines Penetrating Primary Reactor Containment."

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

11. Regulatory Guide 1.29, "Seismic Design Classification."

12. Regulatory Guide 1.141, "Containment Isolation Provisions for Fluid Systems."

13. Branch Technical Position CSB 6-4, "Containment Purging During Normal Plant Operations," attached to this SRP section.

14. 10 CFR Part 100, "Reactor Site Criteria."

15. 10 CFR Part 50, Appendix K, "ECCS Evaluation Models."

16. NUREG-0737, "~~Classifications~~Clarification[123] of TMI Action Plan Requirements."

17. NUREG-0718, "Licensing Requirements for Pending Application for Construction Permits and Manufacturing License."

18. 10 CFR 50.34(f), "Additional TMI-Related Requirements," subparagraph (2)(xiv), regarding TMI Action Plan Item II.E.4.2, "Containment Isolation Dependability."[124]

19. 10 CFR 50.34(f), "Additional TMI-Related Requirements," subparagraph (2)(xv), regarding TMI Action Plan Item II.E.4.4, "Purging."[125]

20. Regulatory Guide 1.155, "Station Blackout."[126]

21. 10 CFR 50.63, "Loss of All Alternating Current Power," subparagraph (a)(2), regarding containment integrity in the event of a station blackout.[127]

22. NRC Generic Letter 83-02, "NUREG-0737 Technical Specifications," January 10, 1983.[128]

23. Item II.E.4.2, "Containment Isolation Dependability," in NUREG-0737 and NUREG-0718.[129]

24. NRC Letter to all Holders of Operating Licenses and Construction Permits for Pressurized Water Reactors (PWRs), “Loss of Decay Heat Removal (Generic Letter 88-17),” October 17, 1988.[130]

25 NUREG-1449, "Shutdown and Low-Power Operation at Commercial Nuclear Power Plants in the United States," Final Report, Office of Nuclear Reactor Regulation, U.S. Nuclear Regulatory Commission, September 1993.[131]

Branch Technical Position CSB 6-4

(Currently the responsibility of the Containment Systems
and Severe Accident Branch, SCSB)

CONTAINMENT PURGING DURING NORMAL PLANT OPERATIONS

A. BACKGROUND

This branch technical position pertains to system lines which can provide an open path from the containment to the environs during normal plant operation, e.g., the lines associated with the containment purge and vent systems. It supplements the position taken in SRP Section 6.2.4.

While the containment purge and vent systems provide plant operational flexibility, their designs must consider the importance of minimizing the release of containment atmosphere to the environs following a postulated loss-of-coolant accident. Therefore, plant designs must not rely on their use on a routine basis.

The need for purging has not always been anticipated in the design of plants, and therefore design criteria for the containment purge system have not been fully developed. The purging experience at operating plants varies considerably from plant to plant. Some plants do not purge during reactor operation, some purge intermittently for short periods and some purge continuously. There is similar disparity in the need for, and use of, containment vent systems at operating plants.

Containment purge systems have been used in a variety of ways; for example, to alleviate certain operational problems, such as excess air leakage into the containment from pneumatic controllers, for reducing the airborne activity within the containment to facilitate personnel access during reactor power operation, and for controlling the containment pressure, temperature and relative humidity. Containment vent systems are typically used to relieve the initial containment pressure buildup caused by the heat load imposed on the containment atmosphere during reactor power ascension, or to periodically relieve the pressure buildup due to the operation of pneumatic controllers. However, the purge and vent lines provide an open path from the containment to the environs. Should a LOCA occur during containment purging when the reactor is at power, the calculated accident doses should be within 10 CFR Part 100 guidelines values.

The sizing of the purge lines in most plants has been based on the need to control the containment atmosphere during refueling operations. This need has resulted in very large lines penetrating the containment (about 42 inches in diameter). Since these lines are normally the only ones provided that will permit some degree of control over the containment atmosphere to facilitate personnel access, some plants have used them for containment purging during normal plant operation. Under such conditions, calculated accident doses could be significant. Therefore, the use of these large containment purge and vent lines should be restricted to cold shutdown conditions and refueling operations and they must be sealed closed in all other operational modes.

The design and use of the purge and vent lines should be based on the premise of achieving acceptable calculated offsite radiological consequences and assuring ensuring that emergency core cooling (ECCS) effectiveness is not degraded by a reduction in the containment backpressure.

Purge system designs that are acceptable for use on a nonroutine basis during normal plant operation can be achieved by providing additional purge lines.

The size of these lines should be limited such that in the event of a loss-of- coolant accident, assuming the purge valves are open and subsequently close, the radiological consequences calculated in accordance with Regulatory Guides 1.3 and 1.4 would not exceed the 10 CFR Part 100 guideline values. Also, the maximum time for valve closure should not exceed five seconds to ensure that the purge valves would be closed before the onset of fuel failures following a LOCA. Similar concerns apply to vent system designs.

The size of the purge lines should be about eight inches in diameter for PWR plants. This line size may be overly conservative from a radiological viewpoint for the Mark III BWR plants and the HTGR plants because of containment and/or core design features. Therefore, larger line sizes may be justified. However, for any proposed line size, the applicant must demonstrate that the radiological consequences following a loss-of-coolant accident would be within 10 CFR Part 100 guideline values. In summary, the acceptability of a specific line size is a function of the site meteorology, containment design, and radiological source term for the reactor type, e.g., BWR, PWR, or HTGR.

B. BRANCH TECHNICAL POSITION

The systems used to purge the containment for the reactor operational modes of power operation, startup, hot standby and hot shutdown, i.e., the on-line purge system, should be independent of the purge system used for the reactor operational modes of cold shutdown and refueling.

1. The on-line purge system should be designed in accordance with the following criteria:

   a. General Design Criterion 54 requires that the reliability and performance capabilities of containment isolation valves reflect the importance of safety of isolating the systems penetrating the containment boundary. Therefore, the performance and reliability of the purge system isolation valves should be consistent with the operability assurance program outlinedcontained[132] in Branch Technical Position MEB-2, "Pump and Valve Operability Assurance Program." (Also see SRP Section 3.10.)SRP Section 3.10.[133] The design basis for the valves and actuators should include the buildup of containment pressure for the LOCA break spectrum, and the supply line and exhaust line flows as a function of time up to and during valve closure.

   b. The number of supply and exhaust lines that may be used should be limited to one supply line and one exhaust line, to improve the reliability of the isolation function as required by General Design Criterion 54, and to facilitate compliance with the requirements of Appendix K to 10 CFR Part 50 regarding the containment pressure used in the evaluation of the emergency core cooling system effectiveness and 10 CFR Part 100 regarding offsite radiological consequences.

c. The size of the lines should not exceed about eight inches in diameter, unless detailed justification for larger line sizes is provided, to improve the reliability and performance capability of the isolation and containment functions as required by General Design Criterion 54, and to facilitate compliance with the requirements of Appendix K to 10 CFR Part 50 regarding the containment pressure used in evaluating the emergency core cooling system effectiveness and 10 CFR Part 100 regarding the offsite radiological consequences.

d. As required by General Design Criterion 54, the containment isolation provisions for the purge system lines should meet the standards appropriate to engineered safety features, i.e., quality, redundancy, testability and other appropriate criteria, to reflect the importance to safety of isolating these lines. General Design Criterion 56 establishes explicit requirements for isolation barriers in purge system lines.

e. To improve the reliability of the isolation function, which is addressed in General Design Criterion 54, instrumentation and control systems provided to isolate the purge system lines should be independent and actuated by diverse parameters, e.g., containment pressure, safety injection actuation, and containment radiation level. Furthermore, if energy is required to close the valves, at least two diverse sources or energy shall be provided, either of which can effect the isolation function.

f. Purge system isolation valve closure times, including instrumentation delays, should not exceed five seconds, to facilitate compliance with 10 CFR Part 100 regarding offsite radiological consequences.

g. Provisions should be made to ensure that isolation valve closure will not be prevented by debris which could potentially become entrained in the escaping air and steam.

2. The purge system should not be relied on for temperature and humidity control within the containment.

3. Provisions should be made to minimize the need for purging of the containment by providing containment atmosphere cleanup systems within the containment.

4. Provisions should be made for testing the availability of the isolation function and the leakage rate of the isolation valves during reactor operation.

5. The following analyses should be performed to justify the containment purge system design:

   a. An analysis of the radiological consequences of a loss-of-coolant accident. The analysis should be done for a spectrum of break sizes, and the instrumentation and setpoints that will actuate the purge valves closed should be identified. The source term used in the radiological calculations should be based on a calculation under the terms of Appendix K to determine the extent of fuel failure and the concomitant release of fission products, and the fission product activity in the primary coolant. A pre-existing iodine spike should be considered in determining primary coolant activity. The volume of containment in which fission products are mixed should be justified, and the fission products from the above sources should be assumed to be released through the open purge valves during the maximum interval required for valve closure. The radiological consequences should be within 10 CFR Part 100 guideline values.

   b. An analysis which demonstrates the acceptability of the provisions made to protect structures and safety-related equipment, e.g., fans, filters, and ductwork, located beyond the purge system isolation valves against loss of function from the environment created by the escaping air and steam.

   c. An analysis of the reduction in the containment pressure resulting from the partial loss of containment atmosphere during the accident for ECCS backpressure determination.

   d. The maximum allowable leak rate of the purge isolation valves should be specified on a case-by-case basis giving appropriate consideration to valve size, maximum allowable leakage rate for the containment (as defined in Appendix J to 10 CFR Part 50), and where appropriate, the maximum allowable bypass leakage fraction for dual containments.

SRP Draft Section 6.2.4

Attachment A - Proposed Changes in Order of Occurrence

Item numbers in the following table correspond to superscript numbers in the redline/strikeout copy of the draft SRP section.

Item	Source	Description
1.	Current primary review branch and designation	Changed PRB to Severe Accident Branch (SCSB).
2.	Editorial	Defined "SRP" as "Standard Review Plan."
3.	Current primary review branch designation	Changed PRB to SCSB.
4.	Integrated Impact No. 376	Added a sentence from 10 CFR 50.34(f)(2)(xv) to indicate that AREAS OF REVIEW includes a review of design features to minimize purging time.
5.	Integrated Impact No. 376	Added a sentence from 10 CFR 50.34(f)(2)(xv) to indicate that AREAS OF REVIEW includes a review of the reliability of the purge system to isolate under accident conditions.
6.	Integrated Impact No. 377	Added a sentence to AREAS OF REVIEW to indicate that the review includes containment isolation provisions for station blackout.
7.	SRP-UDP format item	Added "Review Interfaces" to AREAS OF REVIEW.
8.	Current primary review branch designation	Changed PRB to SCSB.
9.	SRP-UDP format item	Divided the existing paragraph into subsections under "Review Interfaces." The existing text and order were preserved, except where branch titles and abbreviations were changed to agree with the new organization.
10.	Current review interface branch designation	Changed review interface branch to EMEB.
11.	Current review interface branch designation	Changed review interface branch to EMEB.
12.	Editorial	Added an additional review for EMEB under "Review Interfaces" because a review of SRP Section 3.6.2 was assigned under ACCEPTANCE CRITERIA, but there was no corresponding assignment under "Review Interfaces."
13.	Current review interface branch designation	Changed review interface branch to EMEB.
14.	Editorial	Changed the text to refer to the operability assurance program for containment purge and vent valves per SRP Section 3.10.
15.	Current review interface branch designation	Changed review interface branch to ECGB.

Item	Source	Description
16.	Current review interface branch name and designation	Changed review interface branch to Instrumentation and Controls Branch (HICB).
17.	Current review interface branch designation	Changed review interface branch to HICB.
18.	Current review interface branch responsibility	Changed HICB review responsibility for cited SRP sections from primary to secondary.
19.	Current review interface branch name and designation	Changed review interface branch to Emergency Preparedness and Radiation Protection Branch (PERB).
20.	Editorial	PERB still reviews radiological consequences in SRP 15.6.5, but is now a secondary reviewer.
21.	Editorial	Revised to indicate that the PERB has primary review responsibility for Appendix A of SRP Section 15.6.5 which deals explicitly with leakage from containment purge valves during closure.
22.	Current review interface branch designation	Changed review interface branch to SRXB.
23.	Current review interface branch name and designation	Changed review interface branch to Technical Specifications Branch (TSB).
24.	Editorial	Added EELB to "Review Interfaces" because a review was assigned them under REVIEW PROCEDURES, but there was no corresponding assignment under "Review Interfaces."
25.	Integrated Impact 377	Added an interface to reflect new SRP Section 8.4 (proposed) covering overall review of station blackout issues.
26.	Integrated Impact 1474	This review interface identifies reviews conducted to satisfy SECY 93-087 and ABWR FSER Staff guidance on Shutdown and Low Power Operations. The staff requested that design certification applicants complete an assessment of shutdown and low-power risk. The shutdown and low-power risk assessment must identify design-specific vulnerabilities and weaknesses and document consideration and incorporation of design features that minimize such vulnerabilities. In the shutdown risk analysis an evaluation of containment integrity issues during shutdown and low-power conditions is conducted. Consideration of containment integrity in the shutdown and low-power risk assessment is the responsibility of the SPSB and will be included in the proposed SRP Section 19.1 on risk assessments.
27.	Editorial	Simplified for clarity and readability.

SRP Draft Section 6.2.4
Attachment A - Proposed Changes in Order of Occurrence

Item	Source	Description
28.	Current primary review branch designation	Changed PRB to SCSB.
29.	Editorial	Added a reference to 10 CFR 50.34(f)(2)(xiv) for completeness. The requirements for this regulation derive from NUREG-0737 Item II.E.4.2 and were added to SRP Section 6.2.4 by Revision 2 - July 1981.
30.	Integrated Impact No. 376	Added a reference to 10 CFR 50.34(f)(2)(xv) under ACCEPTANCE CRITERIA.
31.	Integrated Impact No. 377	Added a phrase to the introductory sentence of ACCEPTANCE CRITERIA to indicate that acceptance of the design includes meeting the requirements of the station blackout rule.
32.	Editorial	Introduced "GDC 16" as abbreviation for "General Design Criterion 16."
33.	Editorial	Introduced "GDC 54" as abbreviation for "General Design Criterion 54."
34.	Editorial	Changed "it relates" to "they relate" to provide number agreement.
35.	Editorial	Introduced "GDC 57" as abbreviation for "General Design Criterion 57."
36.	SRP-UDP format item	Moved criterion for a source term determination (Appendix K to 10 CFR Part 50) to a more appropriate location under specific criteria.
37.	Editorial	Added the missing word "valves."
38.	Editorial	Provided "LOCA" as abbreviation for "loss-of-coolant accident."
39.	Editorial	Deleted the term "Safety Class 2," since the ANSI standard which defines this term applies only to PWRs (ANSI N18.2-1973) and it has been superseded by Regulatory Guide 1.26 which defines Quality Groups. Substituted Quality Group B for Safety Class 2. Added appropriate references for the definitions of the terms "seismic Category I" and "Quality Group B." Also deleted the citation to "(Ref. 9)" since the subject of Ref. 9 did not relate to the text (the term "Safety Class").
40.	Editorial	Replaced "loss-of-coolant accident" with "LOCA" as specified above (global change for this section).
41.	SRP-UDP format item	Deleted a reference to a NUREG-0737 item and substituted a reference to the corresponding TMI regulation in accordance with SRP-UDP guidance.

Item	Source	Description
42.	Integrated Impact 1433	Regulatory Guide 1.141 does not contain guidance on the classification of essential and nonessential systems. Some guidance is contained in NUREG-0737, Item II.E.4.2 (Reference 23).
43.	SRP-UDP format item	Deleted a reference to a NUREG-0737 item and substituted a reference to the corresponding TMI regulation in accordance with SRP-UDP guidance.
44.	Editorial	Changed "General Design Criterion" to "GDC" as introduced for each criterion (Global change for this section).
45.	SRP-UDP format item	Deleted a reference to a NUREG-0737 item and substituted a reference to the corresponding TMI regulation in accordance with SRP-UDP guidance.
46.	Editorial	Corrected the GDC number to "56." Introduced "GDC 56" as abbreviation for "General Design Criterion 56."
47.	SRP-UDP format item	Deleted a reference to a NUREG-0737 item and substituted a reference to the corresponding TMI regulation in accordance with SRP-UDP guidance.
48.	SRP-UDP format item	Deleted unnecessary reference citation: "(Ref. 13)."
49.	Editorial	The deleted sentences relate to the applicability of Branch Technical Position CSB 6-4 to plants under review for operating licenses and plants for which the Safety Evaluation Report for the construction permits were issued prior to July 1, 1975. The deleted sentences would not be applicable to any new application.
50.	Editorial	Moved the citation to NUREG-0737 Item II.E.4.2 to the References section.
51.	Editorial	Deleted the reference to the Staff Interim Position of October 23, 1979, since it is considered to be out-of-date.
52.	Editorial	The correct referenced paragraph is II.f.
53.	Editorial	Moved the citation to Item II.E.4.2 of NUREG-0737 and NUREG-0718 to the list of references. Added Ref. 23.
54.	Editorial	Deleted the reference to the Staff Interim Position of October 23, 1979, since it is considered to be out-of-date.
55.	Integrated Impact No. 375	Added a sentence stating that the technical specifications should contain the requirement that containment purge and vent valves that are not qualified for closing during a LOCA should be sealed closed and checked every 31 days.

Item	Source	Description
56.	Editorial	Deleted the term "Safety Class 2," since the ANSI standard which defines this term applies only to PWRs (ANSI N18.2-1973) and it has been superseded by Regulatory Guide 1.26 which defines Quality Groups. Substituted Quality Group B for Safety Class 2. Added a reference for the definition of the term "Quality Group B." Also deleted the citation to "(Ref. 12)" since the subject of Ref. 12 did not relate to the text (the term "Safety Class").
57.	Current primary review branch designation	Changed PRB to SCSB.
58.	Editorial	Changed "assuring" to "ensuring" (global change for this section).
59.	SRP-UDP format item	Deleted a reference to a NUREG-0737 item and substituted a reference to the corresponding TMI regulation in accordance with SRP-UDP guidance.
60.	Integrated Impact No. 376	Added new paragraph t. to state that BTP CSB 6-4 is to be used to establish compliance with 10 CFR 50.34(f)(2)(xv).
61.	Integrated Impact No. 377	Added a new paragraph u. to state that Regulatory Guide 1.155 is to be used for guidance with respect to the station blackout rule.
62.	SRP-UDP format item	Moved criterion for a source term determination (Appendix K to 10 CFR Part 50) to this more appropriate location (paragraph v) under specific criteria.
63.	SRP-UDP format item	Added "Technical Rationale" subsection and introductory paragraph to ACCEPTANCE CRITERIA.
64.	SRP-UDP format item	Added technical rationale related to GDC 1, Quality Standards and Records.
65.	SRP-UDP format item	Added technical rationale for GDC 2.
66.	SRP-UDP format item	Added technical rationale for GDC 4.
67.	SRP-UDP format item	Added technical rationale for GDC 16.
68.	SRP-UDP format item	Added technical rationale for GDC 54.
69.	SRP-UDP format item	Added technical rationale for GDC 55.
70.	SRP-UDP format item	Added technical rationale for GDC 56.
71.	SRP-UDP format item	Added technical rationale for GDC 57.
72.	Current primary review branch designation	Changed PRB to SCSB.

Item	Source	Description
73.	Editorial	Changed "compared to" to "compared with," as appropriate for scientific usage.
74.	Current primary review branch designation	Changed PRB to SCSB.
75.	Current review interface branch designation	Changed review interface branch to EELB.
76.	Current primary review branch designation	Changed PRB to SCSB.
77.	Current primary review branch designation	Changed PRB to SCSB.
78.	Current primary review branch designation	Changed PRB to SCSB.
79.	Editorial	Deleted "In general," since 10 CFR 50.34(f)(2)(xiv)(A) does not provide for any exceptions. It states "Ensure all nonessential systems are isolated automatically by the containment isolation system."
80.	Integrated Impact 1433	Regulatory Guide 1.141 does not define nonessential systems.
81.	Current primary review branch designation	Changed PRB to SCSB.
82.	Current primary review branch designation	Changed PRB to SCSB.
83.	Current primary review branch designation	Changed PRB to SCSB.
84.	Current primary review branch designation	Changed PRB to SCSB.
85.	Editorial	Moved the cite to II.E.4.2 to the end of the paragraph.
86.	Editorial	Revised the wording to agree exactly with the words in the cited regulation.
87.	Editorial	Added a citation to the appropriate TMI regulation, but retained the reference to TMI Action Plan Item II.E.4.2 because it contains additional review guidance.
88.	Current primary review branch designation	Changed PRB to SCSB.
89.	Current primary review branch designation	Changed PRB to SCSB.
90.	Current review interface branch designation	Changed review interface branch to PERB.

Item	Source	Description
91.	Current review interface branch designation	Changed review interface branch to SRXB.
92.	Current primary review branch designation	Changed PRB to SCSB.
93.	Current review interface branch designation	Changed review interface branch to EMEB.
94.	Current review interface branch designation	Changed review interface branch to ECGB.
95.	Current primary review branch designation	Changed PRB to SCSB.
96.	Current primary review branch designation	Changed PRB to SCSB.
97.	Current primary review branch designation	Changed PRB to SCSB.
98.	Current primary review branch designation	Changed PRB to SCSB.
99.	Current review interface branch designation	Changed review interface branch to EMEB.
100.	Integrated Impact 1433	Regulatory Guide 1.141 (current version) does not contain guidance defining essential systems.
101.	Current primary review branch designation	Changed PRB to SCSB.
102.	Current primary review branch designation	Changed PRB to SCSB.
103.	Current primary review branch designation	Changed PRB to SCSB.
104.	Editorial	Changed "safety analysis report" to "SAR," as defined above.
105.	Current primary review branch designation	Changed PRB to SCSB.
106.	Current primary review branch designation	Changed PRB to SCSB.
107.	Current primary review branch designation	Changed PRB to SCSB.

Item	Source	Description
108.	Integrated Impact No. 375	Added a sentence stating that the review should ensure that the technical specifications contain (1) requirements that unqualified purge or vent valves be sealed closed and verified closed every 31 days; (2) purging or venting time should be minimized consistent with ALARA principles for occupational exposure; and (3) containment purge or vent valves with resilient seals should be subjected to leakage testing and periodic resilient seal replacement.
109.	Current primary review branch designation	Changed PRB to SCSB.
110.	Integrated Impact No. 376	Added the requirements of 10 CFR 50.34(f)(2)(xv) to REVIEW PROCEDURES.
111.	Integrated Impact No. 377	Added a paragraph to REVIEW PROCEDURES regarding station blackout.
112.	Integrated Impact 1474	Added a Review Procedure consistent with the guidance contained in Generic Letter 88-17 regarding containment closure during reduced inventory operations for PWRs.
113.	SRP-UDP Guidance, Implementation of 10 CFR 52	Added standard paragraph to address application of Review Procedures in design certification reviews.
114.	Current primary review branch designation	Changed PRB to SCSB.
115.	Editorial	Provided "SER" as abbreviation for "safety evaluation report."
116.	Editorial	Added the words "isolation system" to make it clear that the findings relate to the containment isolation system, not the containment functional design.
117.	Editorial	Added a reference to 10 CFR 50.34(f)(2)(xiv) for completeness. The requirements for this regulation derive from NUREG-0737 Item II.E.4.2 and were added to SRP Section 6.2.4 by Revision 2 - July 1981.
118.	Integrated Impact No. 376	Added a reference to 10 CFR 50.34(f)(2)(xv) under EVALUATION FINDINGS.
119.	Integrated Impact No. 377	Added a reference to the blackout rule, 10 CFR 50.62(a)(2), to EVALUATION FINDINGS.
120.	SRP-UDP Format Item, Implement 10 CFR 52 Related Changes	To address design certification reviews a new paragraph was added to the end of the Evaluation Findings. This paragraph addresses design certification specific items including ITAAC, DAC, site interface requirements, and combined license action items relevant to SRP 6.2.4.

Item	Source	Description
121.	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.
122.	SRP-UDP Guidance	Added standard paragraph to indicate applicability of this section to reviews of future applications.
123.	Editorial	Corrected the title of NUREG-0737.
124.	Editorial	Added a reference to 10 CFR 50.34(f)(2)(xiv) for completeness under REFERENCES. The requirements for this regulation derive from NUREG-0737 Item II.E.4.2 and were added to SRP Section 6.2.4 by Revision 2 - July 1981.
125.	Integrated Impact No. 376	Added a reference to 10 CFR 50.34(f)(2)(xv) under REFERENCES.
126.	Integrated Impact No. 377	Added Regulatory Guide 1.155, Station Blackout, to REFERENCES.
127.	Integrated Impact No. 377	Added 10 CFR 50.63, Loss of All Alternating Current Power, to REFERENCES.
128.	Integrated Impact No. 375	Added NRC Generic Letter 83-02 to the REFERENCES.
129.	Editorial	Moved the citation to Item II.E.4.2 from the text to REFERENCES.
130.	Integrated Impact 1474	Added a reference to Generic Letter 88-17 to support the new Review Procedure covering containment integrity during reduced inventory operations for PWRs.
131.	Integrated Impact 1474	Added a reference to NUREG-1449 which documents the NRC staff's evaluation and recommendations for shutdown and low-power operations.
132.	Editorial	The operability assurance program is contained in SRP Section 3.10, not just outlined there.
133.	Editorial	BTP MEB-2 has been superseded by SRP Section 3.10.

[This Page Intentionally Left Blank]

SRP Draft Section 6.2.4

Attachment B - Cross Reference of Integrated Impacts

Integrated Impact No.	Issue	SRP Subsections Affected
375	Add technical specifications for relevant items defined in NRC Generic Letter 83-02.	II.n, III, VI
376	Add requirements related to TMI item II.E.4.4 (10 CFR 50.34(f)(2)(xv), purging.	I.8, I.9, II, II.t, III, IV, VI
377	Add requirements related to the station blackout rule, 10 CFR 50.63.	I.10, I.G, II, II.u, III, IV, VI
1433	Revise text to indicate that Regulatory Guide 1.141 does not contain guidance on defining essential and non-essential systems for purposes of containment isolation.	II.h, III (2 places)
1474	Add a Review Procedure incorporating staff guidance in NUREG 1449 on shutdown and low power operations.	I.H, III, VI