

CHAPTER TABLE OF CONTENTS

CHAPTER B 3.6

CONTAINMENT SYSTEMS

<u>Section</u>	<u>Page</u>
B 3.6.1	Containment B 3.6.1-1
	BACKGROUND B 3.6.1-1
	APPLICABLE SAFETY ANALYSES B 3.6.1-2
	LCO B 3.6.1-2
	APPLICABILITY B 3.6.1-3
	ACTIONS B 3.6.1-3
	SURVEILLANCE REQUIREMENTS B 3.6.1-4
	REFERENCES B 3.6.1-4
B 3.6.2	Containment Air Locks B 3.6.2-1
	BACKGROUND B 3.6.2-1
	APPLICABLE SAFETY ANALYSES B 3.6.2-1
	LCO B 3.6.2-2
	APPLICABILITY B 3.6.2-2
	ACTIONS B 3.6.2-2
	SURVEILLANCE REQUIREMENTS B 3.6.2-6
	REFERENCES B 3.6.2-7
B 3.6.3	Containment Isolation Valves B 3.6.3-1
	BACKGROUND B 3.6.3-1
	APPLICABLE SAFETY ANALYSES B 3.6.3-2
	LCO B 3.6.3-4
	APPLICABILITY B 3.6.3-4
	ACTIONS B 3.6.3-5
	SURVEILLANCE REQUIREMENTS B 3.6.3-11
	REFERENCES B 3.6.3-15
B 3.6.4	Containment Pressure B 3.6.4-1
	BACKGROUND B 3.6.4-1
	APPLICABLE SAFETY ANALYSES B 3.6.4-1
	LCO B 3.6.4-2
	APPLICABILITY B 3.6.4-2
	ACTIONS B 3.6.4-2

CHAPTER TABLE OF CONTENTS (Continued)

<u>Section</u>	<u>Page</u>
SURVEILLANCE REQUIREMENTS	B 3.6.4-3
REFERENCES	B 3.6.4-3
B 3.6.5 Containment Air Temperature	B 3.6.5-1
BACKGROUND	B 3.6.5-1
APPLICABLE SAFETY ANALYSES	B 3.6.5-1
LCO	B 3.6.5-2
APPLICABILITY	B 3.6.5-3
ACTIONS	B 3.6.5-3
SURVEILLANCE REQUIREMENTS	B 3.6.5-3
REFERENCES	B 3.6.5-4
B 3.6.6 Containment Spray and Cooling Systems	B 3.6.6-1
BACKGROUND	B 3.6.6-1
APPLICABLE SAFETY ANALYSES	B 3.6.6-3
LCO	B 3.6.6-4
APPLICABILITY	B 3.6.6-5
ACTIONS	B 3.6.6-5
SURVEILLANCE REQUIREMENTS	B 3.6.6-7
REFERENCES	B 3.6.6-11
B 3.6.7 Recirculation Fluid pH Control System	B 3.6.7-1
BACKGROUND	B 3.6.7-1
APPLICABLE SAFETY ANALYSES	B 3.6.7-2
LCO	B 3.6.7-2
APPLICABILITY	B 3.6.7-2
ACTIONS	B 3.6.7-2
SURVEILLANCE REQUIREMENTS	B 3.6.7-3
REFERENCES	B 3.6.7-4

B 3.6 CONTAINMENT SYSTEMS

B 3.6.1 Containment

BASES

BACKGROUND

The containment consists of the concrete reactor building, its steel liner, and the penetrations through this structure. The structure is designed to contain radioactive material that may be released from the reactor core following a design basis Loss of Coolant Accident. Additionally, this structure provides shielding from the fission products that may be present in the containment atmosphere following accident conditions.

The containment is a prestressed reinforced concrete structure with a cylindrical wall, a flat foundation mat with a reactor cavity pit projection, and a hemispherical dome roof. The inside surface of the containment is lined with a carbon steel liner to ensure a high degree of leak tightness during operating and accident conditions.

The vertical cylinder wall is provided with a system of vertical and horizontal (hoop) tendons. Vertical tendons are continuous to form inverted U's that extend over the dome. The configuration of the tendons in the dome is based on a three-way system consisting of two groups of vertical tendons oriented at 90 degrees with respect to each other and a horizontal (hoop) group extending from the spring line to approximately 45 degrees from the horizontal. Hoop tendons in both the wall and the dome are placed in a 240 degree system in which three tendons form two complete rings using three buttresses for anchoring the tendons.

The concrete reactor building is required for structural integrity of the containment under Design Basis Accident (DBA) conditions. The steel liner and its penetrations establish the leakage limiting boundary of the containment. Maintaining the containment OPERABLE limits the leakage of fission product radioactivity from the containment to the environment. SR 3.6.1.1 leakage rate requirements comply with 10 CFR 50, Appendix J, Option B (Ref. 1), as modified by approved exemptions.

The isolation devices for the penetrations in the containment boundary are a part of the containment leak tight barrier. To maintain this leak tight barrier:

- a. All penetrations required to be closed during accident conditions are either:
 1. capable of being closed by an OPERABLE automatic containment isolation system, or

(continued)

BASES

BACKGROUND
(continued)

2. closed by manual valves, blind flanges, or de-activated automatic valves secured in their closed positions, except as provided in [LCO 3.6.3](#), "Containment Isolation Valves"
 - b. Each air lock is OPERABLE, except as provided in [LCO 3.6.2](#), "Containment Air Locks";
 - c. All equipment hatches are closed and sealed; and
 - d. The sealing mechanism associated with each penetration (e.g., welds, bellows, or O-rings) is OPERABLE.
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APPLICABLE
SAFETY
ANALYSES

The safety design basis for the containment is that the containment must withstand the pressures and temperatures of the limiting DBA without exceeding the design leakage rate.

The DBAs that result in a challenge to containment OPERABILITY from high pressures and temperatures are a loss of coolant accident (LOCA) and a steam line break ([Ref. 2](#)). In addition, release of significant fission product radioactivity within containment can occur from a LOCA. In the DBA analyses, it is assumed that the containment is OPERABLE such that, for the DBAs involving release of fission product radioactivity, release to the environment is controlled by the rate of containment leakage. The containment was designed with an allowable leakage rate of 0.2% of containment air weight per day for the first 24 hours and 0.1% of containment air weight per day for the remainder of the accident ([Ref. 3](#)). This leakage rate, used to evaluate offsite doses resulting from accidents, is defined in 10 CFR 50, Appendix J, Option B ([Ref. 1](#)), as L_a : the maximum allowable containment leakage rate at the calculated peak containment internal pressure (P_a) resulting from the limiting design bases LOCA. The allowable leakage rate represented by L_a forms the basis for the acceptance criteria imposed on all containment leakage rate testing. L_a is assumed to be 0.2% of containment air weight per day at $P_a = 48.1$ psig. This is a conservative value for P_a since the calculated peak containment pressure for LOCA is 47.8 psig.

Satisfactory leakage rate test results are a requirement for the establishment of containment OPERABILITY.

The containment satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

Containment OPERABILITY is maintained by limiting leakage to $\leq 1.0 L_a$, except prior to the first startup after performing a required Containment Leakage Rate Testing Program leakage test. At this time, the applicable leakage limits must be met.

(continued)

BASES

LCO
(continued)

Compliance with this LCO will ensure a containment configuration, including equipment hatches, that is structurally sound and that will limit leakage to those leakage rates assumed in the safety analysis.

Individual leakage rates specified for the containment air lock (LCO 3.6.2) and containment shutdown and mini-purge valves with resilient seals (LCO 3.6.3) are not specifically part of the acceptance criteria of 10 CFR 50, Appendix J, Option B. These leakage rates are specified in the Containment Leakage Rate Testing Program. Therefore, leakage rates exceeding these individual limits only result in the containment being inoperable when the leakage results in exceeding the overall acceptance criteria of 1.0 L_a.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material into containment. In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, containment is not required to be OPERABLE in MODE 5 to prevent leakage of radioactive material from containment. The requirements for containment during MODE 6 are addressed in LCO 3.9.4, "Containment Penetrations."

ACTIONS

A.1

In the event containment is inoperable, containment must be restored to OPERABLE status within 1 hour. The 1 hour Completion Time provides a period of time to correct the problem commensurate with the importance of maintaining containment during MODES 1, 2, 3, and 4. This time period also ensures that the probability of an accident (requiring containment OPERABILITY) occurring during periods when containment is inoperable is minimal.

B.1 and B.2

If containment cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

(continued)

BASES (Continued)

SURVEILLANCE
REQUIREMENTS

SR 3.6.1.1

Maintaining the containment OPERABLE requires compliance with the visual examinations and leakage rate test requirements of the Containment Leakage Rate Testing Program. The containment concrete visual examinations may be performed during either power operations, or during a maintenance/refueling outage. The visual examinations of the steel liner plate inside containment are performed during maintenance or refueling outages as this is the only time the liner plate is fully accessible.

Failure to meet air lock and purge valve with resilient seal leakage limits specified in [LCO 3.6.2](#) and [LCO 3.6.3](#) does not invalidate the acceptability of these overall leakage determinations unless their contribution to overall Type A, B, and C leakage causes that to exceed limits. As left leakage prior to the first startup after performing a required Containment Leakage Rate Testing Program leakage test is required to be $< 0.6 L_a$ for combined Type B and C leakage and $< 0.75 L_a$ for overall Type A leakage. At all other times between required leakage rate tests, the acceptance criteria is based on an overall Type A leakage limit of $\leq 1.0 L_a$. At $\leq 1.0 L_a$ the offsite dose consequences are bounded by the assumptions of the safety analysis.

SR Frequencies are as required by the Containment Leakage Rate Testing Program. These periodic testing requirements verify that the containment leakage rate does not exceed the leakage rate assumed in the safety analysis.

SR 3.6.1.2

This SR ensures that the structural integrity of the containment will be maintained in accordance with the provisions of the Containment Tendon Surveillance Program. Testing and Frequency are in accordance with ASME Code Section XI, subsection IWL (Ref. 4), and applicable addenda as required by 10 CFR 50.55a.

REFERENCES

1. 10 CFR 50, Appendix J, Option B.
 2. [FSAR, Chapter 15.](#)
 3. [FSAR, Section 6.2.](#)
 4. ASME Code Section XI, subsection IWL.
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B 3.6 CONTAINMENT SYSTEMS

B 3.6.2 Containment Air Locks

BASES

BACKGROUND

Containment air locks form part of the containment pressure boundary and provide a means for personnel access during all MODES of operation.

The personnel air lock is nominally a right circular cylinder, approximately 10 ft in diameter, with a door at each end. The emergency air lock is approximately 5 ft 9 in inside diameter with a 2 ft 6 in door at each end. On both air locks, doors are interlocked to prevent simultaneous opening. During periods when containment is not required to be OPERABLE, the door interlock mechanism may be disabled, allowing both doors of an air lock to remain open for extended periods when frequent containment entry is necessary. Each air lock door has been designed and tested to certify its ability to withstand a pressure in excess of the maximum expected pressure following a Design Basis Accident (DBA) in containment. As such, closure of a single door supports containment OPERABILITY. Each of the doors contains double gasketed seals and local leakage rate testing capability to ensure pressure integrity. To effect a leak tight seal, the air lock design uses pressure seated doors (i.e., an increase in containment internal pressure results in increased sealing force on each door).

Each personnel air lock is provided with limit switches on both doors that provide local indication of door position.

The containment air locks form part of the containment pressure boundary. As such, air lock integrity and leak tightness is essential for maintaining the containment leakage rate within limit in the event of a DBA. Not maintaining air lock integrity or leak tightness may result in a leakage rate in excess of that assumed in the safety analyses.

APPLICABLE SAFETY ANALYSES

The DBA that result in a release of radioactive material within containment is a loss of coolant accident (Ref. 2). In the analysis of this accident, it is assumed that containment is OPERABLE such that release of fission products to the environment is controlled by the rate of containment leakage. The containment was designed with an allowable leakage rate of 0.2% of containment air weight per day (Ref. 2). This leakage rate is defined in 10 CFR 50, Appendix J, Option B, (Ref. 1) L_a as the maximum allowable containment leakage rate at the calculated peak containment internal pressure, $P_a = 48.1$ psig following a design basis LOCA (see the Applicable Safety Analysis [Bases for LCO 3.6.1](#), "Containment."). This

(continued)

BASES

APPLICABLE
SAFETY
ANALYSES
(continued)

allowable leakage rate forms the basis for the acceptance criteria imposed on the SRs associated with the air locks.

The containment air locks satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

Each containment air lock forms part of the containment pressure boundary. As part of the containment pressure boundary, the air lock safety function is related to control of the containment leakage rate resulting from a DBA. Thus, each air lock's structural integrity and leak tightness are essential to the successful mitigation of such an event.

Each air lock is required to be OPERABLE. For the air lock to be considered OPERABLE, the air lock interlock mechanism must be OPERABLE, the air lock must be in compliance with the Type B air lock leakage test, and both air lock doors must be OPERABLE. The interlock allows only one air lock door of an air lock to be opened at one time. This provision ensures that a gross breach of containment does not exist when containment is required to be OPERABLE. Closure of a single door in each air lock is sufficient to provide a leak tight barrier following postulated events. Nevertheless, both doors are kept closed when the air lock is not being used for normal entry into or exit from containment.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment. In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES.

Therefore, the containment air locks are not required in MODE 5 to prevent leakage of radioactive material from containment. The requirements for the containment air locks during MODE 6 are addressed in [LCO 3.9.4](#), "Containment Penetrations."

ACTIONS

The ACTIONS are modified by a Note that allows entry and exit to perform repairs on the affected air lock component. If the outer door is inoperable, then it may be easily accessed for most repairs. It is preferred that the air lock be accessed from inside primary containment by entering through the other OPERABLE air lock. However, if this is not practicable, or if repairs on either door must be performed from the barrel side of the door then it is permissible to enter the air lock through the OPERABLE door, which means there is a short time during which the containment boundary may not be intact (during access through the OPERABLE door). The ability to open the OPERABLE door, even if it means the containment boundary is temporarily not intact, is acceptable

(continued)

BASES

ACTIONS (continued)

due to the low probability of an event that could pressurize the containment during the short time in which the OPERABLE door is expected to be open. After each entry and exit, the OPERABLE door must be immediately closed. If ALARA conditions permit, entry and exit should be via an OPERABLE air lock.

A second Note has been added to provide clarification that, for this LCO, separate Condition entry is allowed for each air lock. This is acceptable, since the Required Actions for each Condition provide appropriate compensatory actions for each inoperable air lock. Complying with the Required Actions may allow for continued operation, and a subsequent inoperable air lock is governed by subsequent Condition entry and application of associated Required Actions.

In the event the air lock leakage results in exceeding the overall containment leakage rate, Note 3 directs entry into the applicable Conditions and Required Actions of [LCO 3.6.1](#), "Containment."

A.1, A.2, and A.3

With one air lock door in one or more containment air locks inoperable, the OPERABLE door must be verified closed (Required Action A.1) in each affected containment air lock. This ensures that a leak tight containment barrier is maintained by the use of an OPERABLE air lock door. This action must be completed within 1 hour. This specified time period is consistent with the ACTIONS of [LCO 3.6.1](#), which requires containment be restored to OPERABLE status within 1 hour.

In addition, the affected air lock penetration must be isolated by locking closed the OPERABLE air lock door within the 24 hour Completion Time. The 24 hour Completion Time is reasonable for locking the OPERABLE air lock door, considering the OPERABLE door of the affected air lock is being maintained closed.

Required Action A.3 verifies that an air lock with an inoperable door has been isolated by the use of a locked and closed OPERABLE air lock door. This ensures that an acceptable containment leakage boundary is maintained. The Completion Time of once per 31 days is based on engineering judgment and is considered adequate in view of the low likelihood of a locked door being mispositioned and other administrative controls. Required Action A.3 is modified by a Note that applies to air lock doors located in high radiation areas and allows these doors to be verified locked closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since

(continued)

BASES

ACTIONS

A.1, A.2, and A.3 (continued)

access to these areas is typically restricted. Therefore, the probability of misalignment of the door, once it has been verified to be in the proper position, is small.

The Required Actions have been modified by two Notes. Note 1 ensures that only the Required Actions and associated Completion Times of Condition C are required if both doors in the same air lock are inoperable. With both doors in the same air lock inoperable, an OPERABLE door is not available to be closed. Required Actions C.1 and C.2 are the appropriate remedial actions. The exception of Note 1 does not affect tracking the Completion Time from the initial entry into Condition A; only the requirement to comply with the Required Actions. Note 2 allows use of the air lock for entry and exit for 7 days under administrative controls if both air locks have an inoperable door. This 7 day restriction begins when the second air lock is discovered inoperable. Containment entry may be required on a periodic basis to perform Technical Specifications (TS) Surveillances and Required Actions, as well as other activities on equipment inside containment that are required by TS or activities on equipment that support TS-required equipment. This Note is not intended to preclude performing other activities (i.e., non-TS-required activities) if the containment is entered, using the inoperable air lock, to perform an allowed activity listed above. This allowance is acceptable due to the low probability of an event that could pressurize the containment during the short time that the OPERABLE door is expected to be open.

B.1, B.2, and B.3

With an air lock interlock mechanism inoperable in one or more air locks, the Required Actions and associated Completion Times are consistent with those specified in Condition A.

The Required Actions have been modified by two Notes. Note 1 ensures that only the Required Actions and associated Completion Times of Condition C are required if both doors in the same air lock are inoperable. With both doors in the same air lock inoperable, an OPERABLE door is not available to be closed. Required Actions C.1 and C.2 are the appropriate remedial actions. Note 2 allows entry into and exit from containment under the control of a dedicated individual stationed at the air lock to ensure that only one door is opened at a time (i.e., the individual performs the function of the interlock).

(continued)

BASES

ACTIONS

B.1, B.2, and B.3 (continued)

Required Action B.3 is modified by a Note that applies to air lock doors located in high radiation areas and allows these doors to be verified locked closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since access to these areas is typically restricted. Therefore, the probability of misalignment of the door, once it has been verified to be in the proper position, is small.

C.1, C.2, and C.3

With one or more air locks inoperable for reasons other than those described in Condition A or B, Required Action C.1 requires action to be initiated immediately to evaluate previous combined leakage rates using current air lock test results. An evaluation is acceptable, since it is overly conservative to immediately declare the containment inoperable if both doors in an air lock have failed a seal test or if the overall air lock leakage is not within the limits as specified in the Containment Leakage Rate Testing Program. In many instances (e.g., only one seal per door has failed), containment remains OPERABLE, yet only 1 hour (per LCO 3.6.1) would be provided to restore the air lock door to OPERABLE status prior to requiring a plant shutdown. In addition, even with both doors failing the seal test, the overall containment leakage rate can still be within limits.

Required Action C.2 requires that one door in the affected containment air lock must be verified to be closed within the 1 hour Completion Time. This specified time period is consistent with the ACTIONS of LCO 3.6.1, which requires that containment be restored to OPERABLE status within 1 hour.

Additionally, the affected air lock(s) must be restored to OPERABLE status within the 24 hour Completion Time. The specified time period is considered reasonable for restoring an inoperable air lock to OPERABLE status, assuming that at least one door is maintained closed in each affected air lock.

D.1 and D.2

If the inoperable containment air lock cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based

(continued)

BASES

ACTIONS

D.1 and D.2 (continued)

on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE
REQUIREMENTS

SR 3.6.2.1

Maintaining containment air locks OPERABLE requires compliance with the leakage rate test requirements of the Containment Leakage Rate Testing Program. This SR reflects the leakage rate testing requirements with regard to air lock leakage (Type B leakage tests). The acceptance criteria were established during initial air lock and containment OPERABILITY testing. The periodic testing requirements verify that the air lock leakage does not exceed the allowed fraction of the overall containment leakage rate. The Frequency is required by the Containment Leakage Rate Testing Program.

The SR has been modified by two Notes. Note 1 states that an inoperable air lock door does not invalidate the previous successful performance of the overall air lock leakage test. This is considered reasonable since either air lock door is capable of providing a fission product barrier in the event of a DBA. Note 2 has been added to this SR requiring the results to be evaluated against the acceptance criteria which is applicable to [SR 3.6.1.1](#). This ensures that air lock leakage is properly accounted for in determining the combined Type B and C containment leakage rate.

SR 3.6.2.2

The air lock interlock is designed to prevent simultaneous opening of both doors in a single air lock. Since both the inner and outer doors of an air lock are designed to withstand the maximum expected post accident containment pressure, closure of either door will support containment OPERABILITY. Thus, the door interlock feature supports containment OPERABILITY while the air lock is being used for personnel transit in and out of the containment. Periodic testing of this interlock demonstrates that the interlock will function as designed and that simultaneous opening of the inner and outer doors will not inadvertently occur. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

(continued)

BASES (Continued)

- REFERENCES
1. 10 CFR 50, Appendix J, Option B.
 2. [FSAR, Section 3.8, 6.2, and 15.](#)
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B 3.6 CONTAINMENT SYSTEMS

B 3.6.3 Containment Isolation Valves

BASES

BACKGROUND

The containment isolation valves form part of the containment pressure boundary and provide a means for fluid penetration flow paths not serving accident consequence limiting systems to be provided with two isolation barriers that are closed on a containment isolation signal. These isolation devices are either passive or active (automatic). Manual valves, de-activated automatic valves secured in their closed position (including check valves with flow through the valve secured), blind flanges, and closed systems are considered passive devices. Check valves, or other automatic valves designed to close without operator action following an accident, are considered active devices. Two barriers in series are provided for each penetration flow path so that no single credible failure or malfunction of an active component can result in a loss of isolation or leakage that exceeds limits assumed in the safety analyses. One of these barriers may be a closed system. These barriers (A listing of containment isolation valves is provided in FSAR Sections 6.2 and 16.6) make up the Containment Isolation System (Refs. 2 and 6).

Automatic isolation signals are produced during accident conditions. Containment Phase "A" isolation occurs upon receipt of a safety injection signal. The Phase "A" isolation signal isolates nonessential process lines in order to minimize leakage of fission product radioactivity. Containment Phase "B" isolation occurs upon receipt of a containment pressure High-3 signal and isolates the remaining process lines, except systems required for accident mitigation. In addition to the Phase "A" isolation signal listed above, the Containment purge and exhaust valves receive a Containment Purge Isolation signal on a containment high radiation condition. Either purge and exhaust valves or blind flanges are capable of isolating the penetration flow paths. As a result, the containment isolation valves (and/or blind flanges) help ensure that the containment atmosphere will be isolated from the environment in the event of a release of fission product radioactivity to the containment atmosphere as a result of a Design Basis Accident (DBA).

The OPERABILITY requirements for containment isolation valves help ensure that containment is isolated within the time limits assumed in the safety analyses. Therefore, the OPERABILITY requirements provide assurance that the containment function assumed in the safety analyses will be maintained.

(continued)

BASES

BACKGROUND
(continued)

The containment purge system includes two subsystems: the shutdown purge system and the mini-purge system. Containment purge isolation instrumentation closes the containment isolation valves in the mini-purge system and the shutdown purge system. The mini-purge system is typically used during reactor operation, but may have limited use during plant conditions other than reactor operation. The shutdown purge system is used when the reactor is shutdown.

Containment Shutdown Purge System (36-inch purge valves)

The containment shutdown purge system operates to supply outside air into the containment for ventilation and cooling or heating needed for prolonged containment access following a shutdown and during refueling. The system may also be used to reduce the concentration of noble gases within containment prior to and during personnel access. The supply and exhaust lines each contain two isolation valves. Because of their large size, the 36-inch containment purge and exhaust valves are not qualified for automatic closure from their open position under DBA conditions. Therefore, either the 36-inch containment shutdown purge supply and exhaust isolation valves are normally maintained closed and blind flanges are installed or sealed closed in MODES 1, 2, 3, and 4 to ensure the containment boundary is maintained.

Containment Mini-purge System (18-inch purge valves)

The containment mini-purge system operates to:

- a. Reduce the concentration of noble gases within containment prior to and during personnel access, and
- b. Equalize containment internal and external pressures.

Since the 18-inch valves used in the mini-purge system are designed to meet the requirements for automatic containment isolation valves, these valves may be opened as needed in MODES 1, 2, 3, and 4. Further, because the mini-purge system may have limited use during plant conditions other than reactor operation, these valves may also be opened as needed during such conditions.

APPLICABLE
SAFETY
ANALYSES

The containment isolation valve LCO was derived from the assumptions related to minimizing the loss of reactor coolant inventory and establishing the containment boundary during major accidents. As part of the containment boundary, containment isolation valve OPERABILITY

(continued)

BASES

APPLICABLE
SAFETY
ANALYSES
(continued)

supports leak tightness of the containment. Therefore, the safety analyses of any event requiring isolation of containment is applicable to this LCO.

The DBAs that result in a release of radioactive material within containment are a loss of coolant accident (LOCA) and a rod ejection accident (Ref. 1). In the analyses for each of these accidents, it is assumed that containment isolation valves are either closed or function to close within the required isolation time following event initiation. This ensures that potential paths to the environment through containment isolation valves (including containment shutdown purge and mini-purge valves) are minimized. The safety analyses assume that the 36 inch Containment Shutdown Purge and 18 inch Mini-Purge valves are closed at event initiation, however, the penetration flow paths may be isolated by blind flanges.

The DBA analysis assumes that isolation of the containment is complete and leakage terminated except for the design leakage rate, L_a .

The LOCA offsite dose analysis assumes leakage from the containment at a maximum leak rate of 0.20 percent of the containment air weight per day for the first 24 hours, and at 0.10 percent of the containment air weight per day for the duration of the accident.

The single failure criterion required to be imposed in the conduct of plant safety analyses was considered in the original design of the 18 inch containment mini-purge valves. Two valves in series on each purge line provide assurance that both the supply and exhaust lines could be isolated even if a single failure occurred. The inboard and outboard isolation valves are pneumatically operated spring closed valves that will fail closed on the loss of air.

The 36 inch Containment Shutdown Purge and exhaust valves may be unable to close against containment pressure following a LOCA. Therefore, either each of the Containment Shutdown Purge and exhaust valves is required to remain sealed closed during MODES 1, 2, 3, and 4 or closed and blind flanges must be installed. The Containment Shutdown Purge system valve design precludes a single failure from compromising the containment boundary as long as the system is operated in accordance with the subject LCO.

The containment isolation valves satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

(continued)

BASES (Continued)

LCO

Containment isolation valves form a part of the containment boundary. The containment isolation valves' safety function is related to minimizing the loss of reactor coolant inventory and establishing the containment boundary during a DBA.

The automatic power operated isolation valves are required to have isolation times within limits and to actuate on an automatic isolation signal. The 36 inch Containment Purge valves must be maintained sealed closed or closed and have the blind flanges installed. The valves covered by this LCO are listed along with their associated stroke times in the FSAR (Ref. 2).

The normally closed containment isolation valves are considered OPERABLE when manual valves are closed, automatic valves are de-activated and secured in their closed position, blind flanges are in place, and closed systems are intact. These passive isolation valves/devices are those listed in References 2 and 6. They include the normally closed, solenoid-operated, automatic containment isolation valves associated with the containment hydrogen monitoring system, which to be considered OPERABLE are maintained closed and secured in the closed position (i.e., deactivated).

Purge valves with resilient seals must meet additional leakage rate requirements. The other containment isolation valve leakage rates are addressed by LCO 3.6.1, "Containment," as Type C testing.

This LCO provides assurance that the containment isolation valves and the Containment purge valves will perform their designed safety functions to minimize the loss of reactor coolant inventory and establish the containment boundary during accidents.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment. In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, the containment isolation valves are not required to be OPERABLE in MODE 5. The requirements for containment isolation valves during MODE 6 are addressed in LCO 3.9.4, "Containment Penetrations."

(continued)

BASES (Continued)

ACTIONS

The ACTIONS are modified by a Note allowing penetration flow paths, except for 36 inch Containment Shutdown Purge valve penetration flow paths, to be unisolated intermittently under administrative controls. These administrative controls consist of stationing a dedicated operator at the valve controls, who is in continuous communication with the control room. In this way, the penetration can be rapidly isolated when a need for containment isolation is indicated. Due to the size of the containment purge line penetration and the fact that those penetrations exhaust directly from the containment atmosphere to the environment via the unit vent, the penetration flow path containing these valves may not be opened under administrative controls. A single purge valve in a penetration flow path may be opened to effect repairs to an inoperable valve, as allowed by [SR 3.6.3.1](#).

A second Note has been added to provide clarification that, for this LCO, separate Condition entry is allowed for each penetration flow path. This is acceptable, since the Required Actions for each Condition provide appropriate compensatory actions for each inoperable containment isolation valve. Complying with the Required Actions may allow for continued operation, and subsequent inoperable containment isolation valves are governed by subsequent Condition entry and application of associated Required Actions.

The ACTIONS are further modified by a third Note, which ensures appropriate remedial actions are taken, if necessary, if the affected systems are rendered inoperable by an inoperable containment isolation valve.

In the event the containment isolation valve leakage results in exceeding the overall containment leakage rate acceptance criteria, Note 4 directs entry into the applicable Conditions and Required Actions of [LCO 3.6.1](#).

A.1 and A.2

In the event one containment isolation valve in one or more penetration flow paths is inoperable except for Containment Shutdown purge and mini-purge valve leakage not within limit, the affected penetration flow path must be isolated. The method of isolation must include the use of at least one isolation barrier that cannot be adversely affected by a single active failure. (For penetrations and their associated containment isolation valves that are Type C tested in accordance with 10 CFR 50 Appendix J, the method of isolation must include the use of at least one Type C tested isolation barrier that cannot be adversely affected by a single active failure.) Isolation barriers that meet this criterion are a closed and de-

(continued)

BASES

ACTIONS

A.1 and A.2 (continued)

activated automatic valve (which may be de-activated locally or by use of a main control board power isolate switch when available), a closed manual valve, a blind flange, or a check valve with flow through the valve secured. Securing flow through a check valve may be effected, for example, by administrative control of a pump and discharge line to preclude flow through the check valve or by closing another valve immediately upstream or downstream of the check valve in order to secure flow through the check valve. For a penetration flow path isolated in accordance with Required Action A.1, the device used to isolate the penetration should be the closest available one to containment.

Required Action A.1 must be completed within 4 hours. The 4 hour Completion Time is reasonable, considering the time required to isolate the penetration and the relative importance of supporting containment OPERABILITY during MODES 1, 2, 3, and 4.

For affected penetration flow paths that cannot be restored to OPERABLE status within the 4 hour Completion Time and that have been isolated in accordance with Required Action A.1, the affected penetration flow paths must be verified to be isolated on a periodic basis. This is necessary to ensure that containment penetrations required to be isolated following an accident and no longer capable of being automatically isolated will be in the isolation position should an event occur. This Required Action does not require any testing or device manipulation. Rather, it involves verification, through a system walkdown (which may include the use of local or remote indicators), that those isolation devices outside containment and capable of being mispositioned are in the correct position.

The Completion Time of "once per 31 days for isolation devices outside containment" is appropriate considering the fact that the devices are operated under administrative controls and the probability of their misalignment is low. For the isolation devices inside containment, the time period specified as "prior to entering MODE 4 from MODE 5 if not performed within the previous 92 days" is based on engineering judgment and is considered reasonable in view of the inaccessibility of the isolation devices and the use of administrative controls that ensure isolation device misalignment is an unlikely possibility.

Condition A has been modified by a Note indicating that this Condition is only applicable to those penetration flow paths with two containment isolation valves. For penetration flow paths with only one containment isolation valve and a closed system, Condition C provides the appropriate actions.

(continued)

BASES

ACTIONS

A.1 and A.2 (continued)

Required Action A.2 is modified by two Notes. Note 1 applies to isolation devices located in high radiation areas and allows these devices to be verified closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since access to these areas is typically restricted. Note 2 applies to isolation devices that are locked, sealed, or otherwise secured in position and allows these devices to be verified closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since the function of locking, sealing, or securing components is to ensure that these devices are not inadvertently repositioned. Therefore, the probability of misalignment of these devices once they have been verified to be in the proper position, is small.

A second Note has been added to Required Action A.2 to provide clarification that the action to periodically verify the affected penetration flow path is isolated may be verified administratively for blind flanges and closed manual valves that are locked, sealed, or otherwise secured. This is acceptable since these were verified to be in the correct position prior to locking, sealing, or securing.

B.1

With two containment isolation valves in one or more penetration flow paths inoperable, the affected penetration flow path must be isolated within 1 hour. The method of isolation must include the use of at least one isolation barrier that cannot be adversely affected by a single active failure. (For penetrations and their associated containment isolation valves that are Type C tested in accordance with 10 CFR 50 Appendix J, the method of isolation must include the use of at least one Type C tested isolation barrier that cannot be adversely affected by a single active failure.) Isolation barriers that meet this criterion are a closed and de-activated automatic valve, a closed manual valve (this includes power operated valves with power removed), and a blind flange. (A remote manual valve's Main Control Board power isolate switch may be used to deactivate the valve.) The 1 hour Completion Time is consistent with the ACTIONS of LCO 3.6.1. In the event the affected penetration is isolated in accordance with Required Action B.1, the affected penetration must be verified to be isolated on a periodic basis per Required Action A.2, which remains in effect. This periodic verification is necessary to assure leak tightness of containment and that penetrations requiring isolation following an accident are isolated. The Completion Time of once per 31 days for verifying each affected penetration flow path is isolated is appropriate considering the

(continued)

BASES

ACTIONS

B.1 (continued)

fact that the valves are operated under administrative control and the probability of their misalignment is low.

Condition B is modified by a Note indicating this Condition is only applicable to penetration flow paths with two containment isolation valves. Condition A of this LCO addresses the condition of one containment isolation valve inoperable in this type of penetration flow path.

C.1 and C.2

When one or more penetration flow paths with one containment isolation valve inoperable, the inoperable valve flow path must be restored to OPERABLE status or the affected penetration flow path must be isolated. The method of isolation must include the use of at least one isolation barrier that cannot be adversely affected by a single active failure. Isolation barriers that meet this criterion are a closed and de-activated automatic valve, a closed manual valve, and a blind flange. A check valve may not be used to isolate the affected penetration flow path.

Required Action C.1 must be completed within the 72 hour Completion Time. The specified time period is reasonable considering the relative stability of the closed system (hence, reliability) to act as a penetration isolation boundary and the relative importance of maintaining containment OPERABILITY during MODES 1, 2, 3, and 4. The closed system must meet the requirements of Reference 2. The Containment Spray System and the ECCS are closed ESF-grade systems outside containment, which meet the requirements of Reference 2, and serve as the second containment isolation barrier (Ref. 7). This applies to those specific penetrations for which a single containment isolation valve is credited per flow path, i.e., penetrations P-13 and P-16 for the containment spray system, and penetrations P-14, P-15, P-52 and P-79 for the ECCS.

In the event the affected penetration flow path is isolated in accordance with Required Action C.1, the affected penetration flow path must be verified to be isolated on a periodic basis. This periodic verification is necessary to assure that containment penetrations requiring isolation following an accident are isolated. The Completion Time of once per 31 days for verifying that each affected penetration flow path is isolated is appropriate because the valves are operated under administrative controls and the probability of their misalignment is low.

Condition C is modified by a Note indicating that this Condition is only applicable to those penetration flow paths with only one containment

(continued)

BASES

ACTIONS

C.1 and C.2 (continued)

isolation valve and a closed system. This Note is necessary since this Condition is written specifically to address these penetration flow paths. For penetration flow paths with two containment isolation valves, Conditions A and B provide the appropriate Required Actions.

Required Action C.2 is modified by two Notes. Note 1 applies to valves and blind flanges located in high radiation areas and allows these devices to be verified closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since access to these areas is typically restricted. Note 2 applies to isolation devices that are locked, sealed, or otherwise secured in position and allows these devices to be verified closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since the function of locking, sealing, or securing components is to ensure that these devices are not inadvertently repositioned. Therefore, the probability of misalignment of these valves, once they have been verified to be in the proper position is small.

D.1, D.2, and D.3

In the event one or more Containment Shutdown or Mini-Purge valves in one or more penetration flow paths are not within leakage limits, leakage must be reduced to within limits, or the affected penetration flow path must be isolated. The method of isolation must be by the use of at least one isolation barrier that cannot be adversely affected by a single active failure. Isolation barriers that meet this criterion are a closed and de-activated automatic valve or blind flange. A Containment Shutdown Purge or Mini-Purge valve with resilient seals utilized to satisfy Required Action D.1 must have been demonstrated to meet the leakage requirements of [SR 3.6.3.6](#) or [SR 3.6.3.7](#). The specified Completion Time is reasonable, considering that one containment purge valve remains closed so that a gross breach of containment does not exist.

In accordance with Required Action D.2, this penetration flow path must be verified to be isolated on a periodic basis. The periodic verification is necessary to ensure that containment penetrations required to be isolated following an accident, which are no longer capable of being automatically isolated, will be in the isolation position should an event occur. This Required Action does not require any testing or valve manipulation. Rather, it involves verification, through a system walkdown (which may include the use of local or remote indicators), that those isolation devices outside containment capable of being mispositioned are in the correct position. For the isolation devices inside containment, the time period

(continued)

BASES

ACTIONS

D.1, D.2, and D.3 (continued)

specified as "prior to entering MODE 4 from MODE 5 if not performed within the previous 92 days" is based on engineering judgment and is considered reasonable in view of the inaccessibility of the isolation devices and other administrative controls that will ensure that isolation device misalignment is an unlikely possibility.

For the Containment Shutdown or Mini-Purge valve with resilient seal that is isolated in accordance with Required Action D.1, [SR 3.6.3.6](#) or [SR 3.6.3.7](#) must be performed at least once every 92 days. This assures that degradation of the resilient seal is detected and confirms that the leakage rate of the containment purge valve does not increase during the time the penetration is isolated. The normal Frequency for SR 3.6.3.7 is based on the Surveillance Frequency Control Program. Since more reliance is placed on a single valve while in this Condition, it is prudent to perform the SR more often. Therefore, a Frequency of once per 92 days was chosen and has been shown to be acceptable based on operating experience.

Required Action D.2 is modified by two Notes. Note 1 applies to isolation devices located in high radiation areas and allows these devices to be verified closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since access to these areas is typically restricted. Note 2 applies to isolation devices that are locked, sealed, or otherwise secured in position and allows these devices to be verified closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since the function of locking, sealing, or securing components is to ensure that these devices are not inadvertently repositioned.

E.1 and E.2

If the Required Actions and associated Completion Times are not met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

(continued)

BASES (Continued)

SURVEILLANCE
REQUIREMENTS

SR 3.6.3.1

Each 36 inch Containment Shutdown Purge valve outside containment is required to be verified sealed closed or closed with blind flange installed. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program. Each 36 inch Containment Shutdown Purge valve inside containment must be verified sealed closed or blind flange installed prior to entering Mode 4 from Mode 5, if the surveillance has not been performed in the previous 92 days. This Surveillance is designed to ensure that a gross breach of containment is not caused by an inadvertent or spurious opening of a Containment Shutdown Purge valve. Detailed analysis of the purge valves failed to conclusively demonstrate their ability to close during a LOCA in time to limit offsite doses. Therefore, these valves are required to be in the sealed closed position or closed with blind flange installed during MODES 1, 2, 3, and 4. A Containment Shutdown Purge valve that is sealed closed must have motive power to the valve operator removed. This can be accomplished by de-energizing the source of electric power or by removing the air supply to the valve operator. In this application, the term "sealed" has no connotation of leak tightness. In the event Containment Shutdown Purge valve leakage requires entry into Condition D, the Surveillance permits opening one purge valve in a penetration flow path to perform repairs. A blind flange installed to isolate a Containment Shutdown Purge valve must meet the leakage rate testing requirements of [SR 3.6.3.6](#).

SR 3.6.3.2

This SR ensures that the mini-purge valves are closed as required or, if open, open for an allowable reason. If a mini-purge valve is open in violation of this SR, the valve is considered inoperable. If the inoperable valve is not otherwise known to have excessive leakage when closed, it is not considered to have leakage outside of limits. The SR is not required to be met when the mini-purge valves are open for the reasons stated. The valves may be opened for pressure control, ALARA or air quality considerations for personnel entry, or for Surveillances that require the valves to be open. The mini-purge valves are capable of closing in the environment following a LOCA. Therefore, these valves are allowed to be open for limited periods of time. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

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BASES

SURVEILLANCE
REQUIREMENTS
(continued)

SR 3.6.3.3

This SR requires verification that each containment isolation manual valve and blind flange located outside containment and not locked, sealed, or otherwise secured and required to be closed during accident conditions is closed. The SR helps to ensure that post accident leakage of radioactive fluids or gases outside of the containment boundary is within design limits. This SR does not require any testing or valve manipulation. Rather, it involves verification, through a system walkdown (which may include the use of local or remote indicators), that those containment isolation valves outside containment and capable of being mispositioned are in the correct position. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program. The SR specifies that containment isolation valves that are open under administrative controls are not required to meet the SR during the time the valves are open. This SR does not apply to valves that are locked, sealed, or otherwise secured in the closed position, since these valves were verified to be in the current position upon locking, sealing, or securing.

The Note applies to valves and blind flanges located in high radiation areas and allows these devices to be verified closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since access to these areas is typically restricted during MODES 1, 2, 3 and 4 for ALARA reasons. Therefore, the probability of misalignment of these containment isolation valves, once they have been verified to be in the proper position, is small.

SR 3.6.3.4

This SR requires verification that each containment isolation manual valve and blind flange located inside containment and not locked, sealed, or otherwise secured and required to be closed during accident conditions is closed. The SR helps to ensure that post accident leakage of radioactive fluids or gases outside of the containment boundary is within design limits. For containment isolation valves inside containment, the Frequency of "prior to entering MODE 4 from MODE 5 if not performed within the previous 92 days" is appropriate since these containment isolation valves are operated under administrative controls and the probability of their misalignment is low. The SR specifies that containment isolation valves that are open under administrative controls are not required to meet the SR during the time they are open. This SR does not apply to valves that are locked, sealed, or otherwise secured in the closed position, since

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BASES

SURVEILLANCE
REQUIREMENTS

SR 3.6.3.4 (continued)

these valves were verified to be in the current position upon locking, sealing, or securing.

A Note has been added that allows valves and blind flanges located in high radiation areas to be verified closed by use of administrative means. Allowing verification by administrative means is considered acceptable, since access to these areas is typically restricted during MODES 1, 2, 3, and 4, for ALARA reasons. Therefore, the probability of misalignment of these containment isolation valves, once they have been verified to be in their proper position, is small.

SR 3.6.3.5

Verifying that the isolation time of each automatic power operated containment isolation valve is within limits is required to demonstrate OPERABILITY. An automatic power operated containment isolation valve is a containment isolation valve which is closed by an automatic (i.e., other than operator manual) actuation signal and is powered by other than manual actuation (e.g. by a pneumatic, solenoid, or motor operator). The isolation time test ensures the valve will isolate in a time period less than or equal to that assumed in the safety analyses. The isolation time and Frequency of this SR are in accordance with the INSERVICE TESTING PROGRAM.

SR 3.6.3.6

Leakage integrity tests with a maximum allowable leakage rate for containment shutdown purge supply and exhaust isolation valves will provide early indication of resilient material seal degradation and will allow opportunity for repair before gross leakage failures could develop.

This SR is modified by a Note indicating that the SR is only required to be performed when the containment shutdown purge valve blind flanges are installed.

If the blind flange is installed, leakage rate testing of the valve and its associated blind flange must be performed. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program. Leakage rate testing must also be performed following each reinstallation of the blind flange.

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BASES

SURVEILLANCE
REQUIREMENTS

SR 3.6.3.6 (continued)

The combined leakage rate for the containment shutdown purge supply and exhaust isolation valves, when pressurized to P_a , and included with all Type B and C penetrations is less than $0.60 L_a$.

SR 3.6.3.7

For containment mini-purge and shutdown purge valves with resilient seals, additional leakage rate testing beyond the test requirements of 10 CFR 50, Appendix J, Option B is required to ensure OPERABILITY. Operating experience has demonstrated that this type of seal has the potential to degrade in a shorter time period than do other seal types. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

Additionally, this SR must be performed within 92 days after opening the valve. The 92 day Frequency was chosen recognizing that cycling the valve could introduce additional seal degradation (beyond that occurring to a valve that has not been opened).

The SR is modified by a Note indicating that the SR is only required to be performed for the containment shutdown purge valves when the associated blind flange is removed.

The measured leakage rate for each containment mini-purge supply and exhaust isolation valve with resilient seals is less than $0.05 L_a$ when pressurized to P_a .

The combined leakage rate for the containment shutdown purge supply and exhaust isolation valves, when pressurized to P_a , and included with all Type B and C penetration is less than $.60 L_a$.

SR 3.6.3.8

Automatic containment isolation valves close on a containment isolation signal to prevent leakage of radioactive material from containment following a DBA. This SR ensures that each automatic containment

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BASES

SURVEILLANCE
REQUIREMENTS

SR 3.6.3.8 (continued)

isolation valve will actuate to its isolation position on a containment isolation signal. These isolation signals are Phase A Isolation signal, Phase B Isolation signal, and Containment Purge Isolation signal. This surveillance is not required for valves that are locked, sealed, or otherwise secured in the required position under administrative controls. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

REFERENCES

1. [FSAR, Section 15.](#)
 2. [FSAR, Section 6.2.](#)
 3. Standard Review Plan 6.2.4.
 4. Multi-Plant Action MPA-B020, "Containment Leakage Due to Seal Deterioration."
 5. Multi-Plant Action MPA-B024, "Venting and Purging Containments While at Full Power and Effect of LOCA."
 6. [FSAR Section 16.6.](#)
 7. NUREG 0830, "Safety Evaluation Report related to the Operation of Callaway Plant Unit No. 1," Section 6.2.3, October, 1981.
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B 3.6 CONTAINMENT SYSTEMS

B 3.6.4 Containment Pressure

BASES

BACKGROUND

The containment pressure is limited during normal operation to preserve the initial conditions assumed in the accident analyses for a loss of coolant accident (LOCA) or main steam line break (MSLB). These limits also prevent the containment pressure from exceeding the containment design negative pressure differential with respect to the outside atmosphere in the event of inadvertent actuation of the Containment Spray System.

Containment pressure is a process variable that is monitored and controlled. The containment pressure limits are derived from the input conditions used in the containment functional analyses and the containment structure external pressure analysis. Should operation occur outside these limits coincident with a Design Basis Accident (DBA), post accident containment pressures could exceed calculated values.

APPLICABLE SAFETY ANALYSES

Containment internal pressure is an initial condition used in the DBA analyses to establish the maximum peak containment internal pressure. The limiting DBAs considered, relative to containment pressure, are the LOCA and MSLB, which are analyzed using computer codes developed to predict the containment pressure transients. The worst case LOCA generates larger mass and energy release than the worst case MSLB. Thus, the LOCA event bounds the MSLB event from the containment peak pressure standpoint.

The initial pressure condition used in the containment analysis are 16.2 psia (1.5 psig). This resulted in a calculated peak pressure from a MSLB occurring at 2% power of 46.2 psig. The containment analysis shows that the peak calculated containment pressure results from the limiting LOCA. The calculated containment pressure resulting from the worst case LOCA, 47.8 psig, does not exceed the containment design pressure, 60 psig. P_a , as specified in Administrative Control Specification [5.5.16.b](#), will be left at 48.1 psig. Design basis evaluations will continue to cite this value and the peak pressure reported in the FSAR will continue to be 48.1 psig.

The containment was also designed for an external pressure load equivalent to -3 psig. The inadvertent actuation of the Containment Spray System was analyzed to determine the resulting reduction in containment pressure. The initial pressure condition used in this analysis was 14.4 psia. This resulted in a minimum pressure inside containment of -2.98 psig, which is less than the design load.

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BASES

APPLICABLE
SAFETY
ANALYSES
(continued)

For certain aspects of transient accident analyses, maximizing the calculated containment pressure is not conservative. In particular, the cooling effectiveness of the Emergency Core Cooling System during the core reflood phase of a LOCA analysis increases with increasing containment backpressure. Therefore, for the reflood phase, the containment backpressure is calculated in a manner designed to conservatively minimize, rather than maximize, the containment pressure response in accordance with 10 CFR 50, Appendix K (Ref. 2).

Containment pressure satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

Maintaining containment pressure at less than or equal to the LCO upper pressure limit ensures that, in the event of a DBA, the resultant peak containment accident pressure will remain below the containment design pressure. Maintaining containment pressure at greater than or equal to the LCO lower pressure limit ensures that the containment will not exceed the design negative differential pressure following the inadvertent actuation of the Containment Spray System.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment. Since maintaining containment pressure within limits is essential to ensure initial conditions assumed in the accident analyses are maintained, the LCO is applicable in MODES 1, 2, 3 and 4.

In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, maintaining containment pressure within the limits of the LCO is not required in MODE 5 or 6.

ACTIONS

A.1

When containment pressure is not within the limits of the LCO, it must be restored to within these limits within 1 hour. The Required Action is necessary to return operation to within the bounds of the containment analysis. The 1 hour Completion Time is consistent with the ACTIONS of LCO 3.6.1, "Containment," which requires that containment be restored to OPERABLE status within 1 hour.

B.1 and B.2

If containment pressure cannot be restored to within limits within the required Completion Time, the plant must be brought to a MODE in which

(continued)

BASES

ACTIONS

B.1 and B.2 (continued)

the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE
REQUIREMENTS

SR 3.6.4.1

Verifying that containment pressure is within limits ensures that unit operation remains within the limits assumed in the containment analysis. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

REFERENCES

1. [FSAR, Section 6.2.](#)
 2. 10 CFR 50, Appendix K.
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B 3.6 CONTAINMENT SYSTEMS

B 3.6.5 Containment Air Temperature

BASES

BACKGROUND The containment structure serves to contain radioactive material that may be released from the reactor core following a Design Basis Accident (DBA). The containment average air temperature is limited during normal operation to preserve the initial conditions assumed in the accident analyses for a loss of coolant accident (LOCA) or main steam line break (MSLB).

The containment average air temperature limit is derived from the input conditions used in the containment functional analyses and the containment structure external pressure analyses. This LCO ensures that initial conditions assumed in the analysis of containment response to a DBA are not violated during unit operations. The total amount of energy to be removed from containment by the Containment Spray and Cooling systems during post accident conditions is dependent upon the energy released to the containment due to the event, as well as the initial containment temperature and pressure. The higher the initial temperature, the more energy that must be removed, resulting in higher peak containment pressure and temperature. Exceeding containment design pressure may result in leakage greater than that assumed in the accident analysis. Operation with containment temperature in excess of the LCO limit violates an initial condition assumed in the accident analysis.

APPLICABLE SAFETY ANALYSES Containment average air temperature is an initial condition used in the DBA analyses that establishes the containment environmental qualification operating envelope for both pressure and temperature. The limit for containment average air temperature ensures that operation is maintained within the assumptions used in the DBA analyses for containment ([Ref. 1](#)).

The limiting DBAs considered relative to containment OPERABILITY are the LOCA and MSLB. The DBA LOCA and MSLB are analyzed using computer codes designed to predict the resultant containment pressure transients. No two DBAs are assumed to occur simultaneously or consecutively. The postulated DBAs are analyzed with regard to Engineered Safety Feature (ESF) systems, assuming the worst case single active failure. A spectrum of MSLBs was analyzed.

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BASES

APPLICABLE
SAFETY
ANALYSES
(continued)

The limiting DBA for the maximum peak containment air temperature is an MSLB occurring at 102% RATED THERMAL POWER (full power +2% uncertainty). The initial containment average air temperature assumed in the design basis analyses (Ref. 1) is 120°F. This resulted in a maximum calculated containment air temperature of 345.4°F (assuming the failure of an MSIV to close). Design basis evaluations will continue to cite 384.9°F and the peak temperature reported in the FSAR will continue to be 384.9°F. The design temperature is 320°F.

The spectrum of MSLBs cases are used to establish the environmental qualification operating envelope for containment. The performance of required safety-related equipment, including the containment structure itself, is evaluated against this operating envelope to ensure the equipment can perform its safety function. The maximum peak containment air temperature was calculated to exceed the containment design temperature for only a few seconds during the transient. The basis of the containment design temperature, however, is to ensure the performance of safety related equipment inside containment (Ref. 2). Thermal analyses showed that the time interval during which the containment air temperature exceeded the containment design temperature was short enough that the equipment surface temperatures remained below the design temperature. Therefore, it is concluded that the calculated transient containment air temperature is acceptable for the DBA MSLB (Ref. 3).

The temperature limit is also used in the Containment external pressure analyses to ensure that the minimum pressure limit is maintained following an inadvertent actuation of the Containment Spray System (Ref. 1).

The containment pressure transient is sensitive to the initial air mass in containment and, therefore, to the initial containment air temperature. The limiting DBA for establishing the maximum peak containment internal pressure is a LOCA. The temperature limit is used in this analysis to ensure that in the event of an accident the maximum containment internal pressure will not be exceeded.

Containment average air temperature satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

During a DBA, with an initial containment average air temperature less than or equal to the LCO temperature limit, the resultant peak accident temperature is maintained below the maximum containment temperature analyzed in Ref. 3. As a result, the ability of containment to perform its design function is ensured.

(continued)

BASES (Continued)

APPLICABILITY In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment. In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, maintaining containment average air temperature within the limit is not required in MODE 5 or 6.

ACTIONS

A.1

When containment average air temperature is not within the limit of the LCO, it must be restored to within limit within 8 hours. This Required Action is necessary to return operation to within the bounds of the containment analysis. The 8 hour Completion Time is acceptable considering the sensitivity of the analysis to variations in this parameter and provides sufficient time to correct minor problems.

B.1 and B.2

If the containment average air temperature cannot be restored to within its limit within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

**SURVEILLANCE
REQUIREMENTS**

SR 3.6.5.1

Verifying that containment average air temperature is within the LCO limit ensures that containment operation remains within the limit assumed for the containment analyses. In order to determine the containment average air temperature, an arithmetical average is calculated using four temperature measurements, on fixed or portable instruments. The temperature measurements are taken at the following locations: a) Containment Cooler Inlet located near NNE wall (Elevation 2068'-8"); b) Containment Cooler Inlet located near West wall (Elevation 2068'-8"); c) Containment Cooler Inlet located near NNW wall (Elevation 2068'-8"); d) Containment Cooler Inlet located near East wall (Elevation 2068'-8"). The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

(continued)

BASES (Continued)

- REFERENCES
1. [FSAR, Section 6.2.](#)
 2. 10 CFR 50.49.
 3. [FSAR Section 6.2.1.4.3.3.](#)
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B 3.6 CONTAINMENT SYSTEMS

B 3.6.6 Containment Spray and Cooling Systems

BASES

BACKGROUND

The Containment Spray and Containment Cooling system provides containment atmosphere cooling to limit post accident pressure and temperature (see B 3.6.5) in containment to less than the design values. Reduction of containment pressure and the iodine removal and retention capability of the spray reduces the release of fission product radioactivity from containment to the environment, in the event of a Design Basis Accident (DBA), to within limits. The Containment Spray and Containment Cooling system are designed to meet the requirements of 10 CFR 50, Appendix A, GDC 38, "Containment Heat Removal," GDC 39, "Inspection of Containment Heat Removal Systems," GDC 40, "Testing of Containment Heat Removal Systems," GDC 41, "Containment Atmosphere Cleanup," GDC 42, "Inspection of Containment Atmosphere Cleanup Systems," GDC 43, "Testing of Containment Atmosphere Cleanup Systems" and GDC 50, "Containment Design Basis" (Ref. 1).

The Containment Cooling System and Containment Spray System are Engineered Safety Feature (ESF) systems. They are designed to ensure that the heat removal capability required during the post accident period can be attained. The Containment Spray System and the Containment Cooling System provide complementary methods to limit and maintain post accident conditions to less than the containment design values.

Containment Spray System

The Containment Spray System consists of two separate trains of equal capacity, each capable of meeting the design bases. Each train includes a containment spray pump, spray headers, nozzles, valves, and piping. Each train is powered from a separate ESF bus. The refueling water storage tank (RWST) supplies borated water to the Containment Spray System during the injection phase of operation. In the recirculation mode of operation, containment spray pump suction is transferred from the RWST to the containment sumps.

The Containment Spray System provides a spray of borated water mixed with trisodium phosphate from the Recirculation Fluid pH Control baskets into the upper regions of containment to reduce the containment pressure and temperature and to reduce fission products from the containment atmosphere during a DBA. The RWST solution temperature is an important factor in determining the temperature and pressure reducing

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BASES

BACKGROUND Containment Spray System (continued)

capability of the Containment Spray System during the injection phase. In the recirculation mode of operation, heat is removed from the containment sump water by the residual heat exchangers. Each train of the Containment Spray System provides adequate spray coverage to meet the system design requirements for containment heat removal.

The Recirculation Fluid pH Control System dissolves trisodium phosphate into the spray solution during the recirculation mode of operation. The resulting alkaline pH of the spray enhances the ability of the spray to scavenge elemental iodine fission products from the containment atmosphere. The TSP added in the spray ensures an alkaline pH for the solution recirculated in the containment sump. The alkaline pH of the containment sump water minimizes the evolution of volatile iodine species and minimizes the occurrence of chloride and caustic stress corrosion on mechanical systems and components exposed to the fluid.

The Containment Spray System is actuated either automatically by a containment High-3 pressure signal or manually. An automatic actuation opens the containment spray pump discharge valves, starts the two containment spray pumps, and begins the injection phase. A manual actuation of the Containment Spray System requires the operator to actuate two separate switches on the main control board to begin the same sequence. The injection phase continues until an RWST level Low-Low-2 alarm is received. The Low-Low-2 level alarm for the RWST signals the operator to manually align the system to the recirculation mode. The Containment Spray System in the recirculation mode maintains an equilibrium temperature between the containment atmosphere and the recirculated sump water. Operation of the Containment Spray System in the recirculation mode is controlled by the operator in accordance with the emergency operating procedures.

Containment Cooling System

Two trains of containment cooling, each of sufficient capacity to supply 100% of the design cooling requirement, are provided. Each train of two fan units is supplied with cooling water from a separate train of essential service water (ESW). Air is drawn into the coolers through the fan and discharged to the steam generator compartments, pressurizer compartment, and instrument tunnel, and outside the secondary shield in the lower areas of containment.

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BASES

BACKGROUND Containment Cooling System (continued)

During normal operation, all four fan units may be operating. The fans are normally operated at high speed with Service Water supplied to the cooling coils. The Containment Cooling System, operating in conjunction with the Containment Ventilation system, is designed to limit the ambient containment air temperature during normal unit operation to less than the limit specified in [LCO 3.6.5](#), "Containment Air Temperature." This temperature limitation ensures that the containment temperature does not exceed the initial temperature conditions assumed for the DBAs.

In post accident operation following an actuation signal, the Containment Cooling System fans are designed to start automatically in slow speed if not already running. If running in high (normal) speed, the fans automatically shift to slow speed. The fans are operated at the lower speed during accident conditions to prevent motor overload from the higher mass atmosphere. The temperature of the ESW is an important factor in the heat removal capability of the fan units.

APPLICABLE
SAFETY
ANALYSES

The Containment Spray System and Containment Cooling System limits the temperature and pressure that could be experienced following a DBA. The limiting DBAs considered are the loss of coolant accident (LOCA) and the steam line break (SLB). The LOCA and SLB are analyzed using computer codes designed to predict the resultant containment pressure and temperature transients. No DBAs are assumed to occur simultaneously or consecutively. The postulated DBAs are analyzed with regard to ESF systems, assuming the worst case single active failure.

The analysis and evaluation show that under the worst case scenario, the highest calculated containment pressure is 47.8 psig (experienced during a LOCA). The analysis shows that the calculated containment temperature is 345.4°F (experienced during an SLB occurring at 102% RATED THERMAL POWER). Both results meet the intent of the design basis which is evaluated against peak values of 48.1 psig and 384.9°F as reported in the FSAR. (See the [Bases for LCO 3.6.4](#), "Containment Pressure," and [LCO 3.6.5](#) for a detailed discussion.) The analyses and evaluations assume a power level of 102%, the failure of one containment spray train and one containment cooling train (for LOCA), the failure of one MSIV to close (for MSLB), and initial (pre-accident) containment conditions of 120°F and 1.5 psig. The analyses assume a response time delayed initiation to provide conservative peak calculated containment pressure and temperature responses.

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BASES

APPLICABLE
SAFETY
ANALYSES
(continued)

For certain aspects of transient accident analyses, maximizing the calculated containment pressure is not conservative. In particular, the effectiveness of the Emergency Core Cooling System during the core reflood phase of a LOCA analysis increases with increasing containment backpressure. For these calculations, the containment backpressure is calculated in a manner designed to conservatively minimize, rather than maximize, the calculated transient containment pressures in accordance with 10 CFR 50, Appendix K (Ref. 2).

The effect of an inadvertent containment spray actuation has been analyzed. An inadvertent spray actuation results in a -2.98 psig containment pressure and is associated with the sudden cooling effect in the interior of the leak tight containment. Additional discussion is provided in the [Bases for LCO 3.6.4](#).

The modeled Containment Spray System actuation from the containment analysis is based on a response time associated with exceeding the containment High-3 pressure setpoint to achieving full flow through the containment spray nozzles. The Containment Spray System total response time includes diesel generator (DG) startup (for loss of offsite power), sequenced loading of equipment, containment spray pump startup, and spray line filling ([Ref. 4](#)).

Containment cooling train performance for post accident conditions is given in [Reference 4](#). The result of the analysis is that each train can provide 100% of the required peak cooling capacity during the post accident condition. The train post accident cooling capacity under varying containment ambient conditions, required to perform the accident analyses, is also shown in [Reference 4](#).

The modeled Containment Cooling System actuation from the containment analysis is based upon a response time associated with exceeding the containment High-3 pressure setpoint to achieving full Containment Cooling System air and safety grade cooling water flow. The Containment Cooling System total response time includes signal delay, DG startup (for loss of offsite power), and Essential Service Water pump startup times.

The Containment Spray System and the Containment Cooling System satisfies Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

During a DBA, a minimum of one containment cooling train and one containment spray train are required to maintain the containment peak pressure and temperature below the design limits ([Refs. 3](#)). Additionally, one containment spray train is also required to remove iodine from the

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BASES

LCO
(continued)

containment atmosphere and retain volatile iodine species in the sumps, consistent with the safety analysis. To ensure that these requirements are met, two containment spray trains and two containment cooling trains must be OPERABLE. Therefore, in the event of an accident, at least one train in each system operates, assuming the worst case single active failure occurs.

A Containment Spray train typically includes a spray pump, spray headers, nozzles, valves, piping, instruments, and controls to ensure an OPERABLE flow path capable of taking suction from the RWST upon an ESF actuation signal and manually transferring to the containment sump. In addition, management of gas voids is important to Containment Spray System OPERABILITY. The containment Spray System is OPERABLE when it is sufficiently filled with water to perform its specified safety function.

A Containment Cooling train typically includes cooling coils, dampers, two fans, instruments, and controls to ensure an OPERABLE flow path.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment and an increase in containment pressure and temperature requiring the operation of the containment spray trains and containment cooling trains.

In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Thus, the Containment Spray System and the Containment Cooling System are not required to be OPERABLE in MODES 5 and 6.

ACTIONS

A.1

With one containment spray train inoperable, the inoperable containment spray train must be restored to OPERABLE status within 72 hours. In this Condition, the remaining OPERABLE spray and cooling trains are adequate to perform the iodine removal and containment cooling functions. The 72 hour Completion Time takes into account the redundant temperature and pressure reducing capability afforded by the Containment Spray System, reasonable time for repairs, and low probability of a DBA occurring during this period.

The 10 day portion of the Completion Time for Required Action A.1 is based upon engineering judgment. It takes into account the low

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BASES

ACTIONS

A.1 (continued)

probability of coincident entry into two Conditions in this Specification coupled with the low probability of an accident occurring during this time.

Refer to [Section 1.3](#), "Completion Times," for a more detailed discussion of the purpose of the "from discovery of failure to meet the LCO" portion of the Completion Time.

B.1 and B.2

If the inoperable containment spray train cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 84 hours. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems. The extended interval to reach MODE 5 allows additional time for attempting restoration of the containment spray train and is reasonable when considering the driving force for a release of radioactive material from the Reactor Coolant System is reduced in MODE 3.

C.1

With one of the containment cooling trains inoperable, the inoperable containment cooling train must be restored to OPERABLE status within 7 days. The remaining OPERABLE containment spray and cooling components provide iodine removal capabilities and are capable of providing at least 100% of the heat removal needs. The 7 day Completion Time was developed taking into account the complementary heat removal capabilities afforded by combinations of the Containment Spray System and Containment Cooling System and the low probability of DBA occurring during this period.

The 10 day portion of the Completion Time for Required Action C.1 is based upon engineering judgment. It takes into account the low probability of coincident entry into two Conditions in this Specification coupled with the low probability of an accident occurring during this time. Refer to [Section 1.3](#) for a more detailed discussion of the purpose of the "from discovery of failure to meet the LCO" portion of the Completion Time.

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BASES

ACTIONS
(continued)

D.1 and D.2

If the Required Action and associated Completion Time of Condition C of this LCO are not met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

E.1 and E.2

With two containment spray trains or two containment cooling trains inoperable, the unit is in a condition outside the accident analysis. Therefore, the plant must be brought to a mode in which the LCO does not apply. To achieve this status, the plant must be brought to MODE 3 within six hours and to MODE 5 within 36 hours. The allowed Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

SURVEILLANCE
REQUIREMENTS

SR 3.6.6.1

Verifying the correct alignment for manual, power operated, and automatic valves in the containment spray flow path provides assurance that the proper flow paths will exist for Containment Spray System operation. This SR does not apply to valves that are locked, sealed, or otherwise secured in position, since these were verified to be in the correct position prior to locking, sealing, or securing. A valve that receives an actuation signal is allowed to be in a nonaccident position provided the valve will automatically reposition within the proper stroke time. This SR does not require any testing or valve manipulation. Rather, it involves verification, through a system walkdown (which may include the use of local or remote indicators), that those valves outside containment and capable of potentially being mispositioned are in the correct position. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program. This SR does not apply to valves that cannot be inadvertently misaligned, such as check valves and relief valves. Additionally, vent and drain valves are not within the scope of this SR.

The Surveillance is modified by a Note which exempts system vent flow paths opened under administrative control. The administrative control

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BASES

SURVEILLANCE
REQUIREMENTS

SR 3.6.6.1 (continued)

should be proceduralized and include stationing a dedicated individual at the system vent flow path who is in continuous communication with the operators in the control room. This individual will have a method to rapidly close the system vent flow path if directed.

SR 3.6.6.2

Operating each containment cooling train fan unit for ≥ 15 minutes ensures that all fan units are OPERABLE. It also ensures that abnormal conditions or degradation of the fan unit can be detected for corrective action. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.6.6.3

Verifying that each containment cooling train ESW cooling flow rate is ≥ 2200 gpm provides assurance that the design flow rate assumed in the safety analyses will be achieved (Ref. 3). The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.6.6.4

Verifying each containment spray pump's developed head at the flow test point is greater than or equal to the required developed head ensures that spray pump performance has not degraded during the cycle. Flow and differential pressure are normal tests of centrifugal pump performance required by the ASME Code (Ref. 5). Since the containment spray pumps cannot be tested with flow through the spray headers, they are tested on recirculation flow. This test ensures that each pump develops a discharge pressure of greater than or equal to 250 psig. This test confirms one point on the pump design curve and is indicative of overall performance. Such inservice tests confirm component OPERABILITY, trend performance, and detect incipient failures by abnormal performance. The Frequency of the SR is in accordance with the INSERVICE TESTING PROGRAM.

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BASES

SURVEILLANCE
REQUIREMENTS

SR 3.6.6.5 and SR 3.6.6.6

These SRs require verification that each automatic containment spray valve actuates to its correct position and that each containment spray pump starts upon receipt of an actual or simulated actuation of a containment High-3 pressure signal.

This Surveillance is not required for valves that are locked, sealed, or otherwise secured in the required position under administrative controls. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.6.6.7

This SR requires verification that each containment cooling train actuates upon receipt of an actual or simulated safety injection signal. Upon actuation the fans start in slow speed or, if operating, shift to slow speed and the cooling flow rate increases to a value that enables each train of Containment Coolers to remove the heat load credited in the current Licensing Bases Containment Analysis. Currently, each train of Containment Coolers is credited to remove 100E6 BTU/hr under post-accident conditions. The determination of each train's heat removal capacity will be based upon flow, micro-fouling and macro-fouling. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.6.6.8

With the containment spray inlet valves closed and the spray header drained of any solution, low pressure air or smoke can be blown through test connections. This SR ensures that each spray nozzle is unobstructed and provides assurance that spray coverage of the containment during an accident is not degraded. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.6.6.9

Containment Spray System piping and components have the potential to develop voids and pockets of entrained gases. Preventing and managing gas intrusion and accumulation is necessary for proper operation of the

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BASES

SURVEILLANCE
REQUIREMENTS

SR 3.6.6.1 (continued)

containment spray trains and may also prevent water hammer and pump cavitation.

Selection of Containment Spray System locations susceptible to gas accumulation is based on a review of system design information, including piping and instrumentation drawings, isometric drawings, plan and elevation drawings, and calculations. The design review is supplemented by system walkdowns to validate the system high points and to confirm the location and orientation of important components that can become sources of gas or could otherwise cause gas to be trapped or difficult to remove during system maintenance or restoration. Susceptible locations depend on plant and system configuration.

The Containment Spray System is OPERABLE when it is sufficiently filled with water. Acceptance criteria are established for the volume of accumulated gas at susceptible locations. If accumulated gas is discovered that exceeds the acceptance criteria for the susceptible location (or the volume of accumulated gas at one or more susceptible locations exceeds acceptance criteria for gas volume at the suction or discharge of a pump), the Surveillance is not met. If it is determined by subsequent evaluation that the Containment Spray System is not rendered inoperable by the accumulated gas (i.e., the system is sufficiently filled with water), the Surveillance may be declared met. Accumulated gas should be eliminated or brought within the acceptance criteria limits.

Containment Spray System locations susceptible to gas accumulation are monitored, and if gas is found, the gas volume is compared to the acceptance criteria for the location. Susceptible locations in the same system flow path which are subject to the same gas intrusion mechanisms may be verified by monitoring a representative subset of susceptible locations. Monitoring may not be practical for locations that are inaccessible due to radiological or environmental conditions, the plant configuration, or personnel safety. For these locations alternative methods (e.g., operating parameters, remote monitoring) may be used to monitor the susceptible location. Monitoring is not required for susceptible locations where the maximum potential accumulated gas void volume has been evaluated and determined to not challenge system OPERABILITY. The accuracy of the method used for monitoring the susceptible locations and trending of the results should be sufficient to assure system OPERABILITY during the Surveillance interval.

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program. The Surveillance Frequency may vary by location susceptible to gas accumulation.

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BASES (Continued)

- REFERENCES
1. 10 CFR 50, Appendix A, GDC 38, GDC 39, GDC 40, GDC 41, GDC 42, GDC 43 and GDC 50.
 2. 10 CFR 50, Appendix K.
 3. [FSAR, Section 6.2.1.](#)
 4. [FSAR, Section 6.2.2.](#)
 5. ASME Code for Operation and Maintenance of Nuclear Power Plants.
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B 3.6 CONTAINMENT SYSTEMS

B 3.6.7 Recirculation Fluid pH Control System

BASES

BACKGROUND

The Recirculation Fluid pH Control System (RFPC) is a subsystem of the Containment Spray System that assists in reducing the iodine fission product inventory in the containment atmosphere resulting from a Design Basis Accident (DBA).

Radioiodine in its various forms is the fission product of primary concern in the evaluation of a DBA. It is absorbed by the spray from the containment atmosphere. To enhance the iodine absorption capacity of the recirculated spray and to maximize retention of volatile iodine species in the sumps, the sump solution is adjusted to a minimum equilibrium sump pH of 7.1. A pH of greater than 7.0 minimizes the evolution of volatile iodine species from the sump solution as well as the occurrence of chloride and caustic stress corrosion on mechanical systems and components.

The RFPC System includes stainless steel baskets containing trisodium phosphate crystalline (TSP-C). Baskets are located within the recirculation paths of each containment recirculation sump. The baskets contain sufficient TSP-C to ensure a minimum equilibrium sump pH of 7.1. Each basket is designed to contain a maximum of 7150 lbm of TSP-C (basis for the maximum depth of 36.8" of TSP-C in each basket) whereas a minimum depth of 30", corresponding to 4500 lbm, must be contained in each basket to ensure an equilibrium sump pH of at least 7.1. The baskets are located at an elevation that will ensure dissolution by the sump fluids. The baskets have a stainless steel frame with walls constructed of stainless steel grating and lined with #100 wire mesh stainless steel screening. Inside nominal dimensions of each basket is 80" x 56" x 38". The calculation of the minimum and maximum depths of TSP-C includes conservative allowances for compaction, density variations, and the limited transformation of TSP-C into disodium triphosphate which is a weaker base (expected to have a small impact in the outer surface layer). The minimum equilibrium sump pH of 7.1 corresponds to a minimum of 9000 lbm of TSP-C in the baskets and a maximum sump boron concentration of 2500 ppm. If the maximum of 14,300 lbm of TSP-C were contained in the baskets at the end of cycle the maximum equilibrium sump pH would be less than 8.1.

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BASES (Continued)

APPLICABLE
SAFETY
ANALYSES

The RFPC System is essential to the removal and retention of airborne iodine within containment following a DBA.

Following the assumed release of radioactive materials into containment, the containment is assumed to leak at its design value volume following the accident. The analysis assumes that more than 90% of containment is covered by the spray (Ref. 1).

The DBA response time assumed for the RFPC System is the same as for the Containment Spray System and is discussed in the **Bases for LCO 3.6.6**, "Containment Spray and Cooling Systems."

The DBA analyses assume that one train of the Containment Spray System is inoperable.

The RFPC System satisfies Criteria 2 and 3 of 10 CFR 50.36(c)(2)(ii).

LCO

The RFPC System is necessary to reduce the release of radioactive material to the environment in the event of a DBA. To be considered OPERABLE, the volume of TSP-C must be sufficient to raise the average long term containment sump solution pH to a level conducive to iodine removal and retention, namely, to greater than 7.1. This pH level maximizes the effectiveness of the iodine removal and retention mechanisms without introducing conditions that may induce caustic stress corrosion cracking of mechanical system components.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment requiring the operation of the RFPC System. The RFPC System assists in reducing the iodine fission product inventory prior to release to the environment.

In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations in these MODES. Thus, the RFPC System is not required to be OPERABLE in MODE 5 or 6.

ACTIONS

A.1

If the RFPC System is inoperable, it must be restored to OPERABLE within 72 hours. The pH adjustment of the Containment Spray System flow for corrosion protection and iodine removal/retention enhancement is reduced in this condition. The Containment Spray System would still be available and would remove some iodine from the containment

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BASES

ACTIONS

A.1 (continued)

atmosphere in the event of a DBA. The 72 hour Completion Time takes into account the redundant flow path capabilities and the low probability of the worst case DBA occurring during this period.

B.1 and B.2

If the RFPC System cannot be restored to OPERABLE status within the required Completion Time, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be brought to at least MODE 3 within 6 hours and to MODE 5 within 84 hours. The allowed Completion Time of 6 hours is reasonable, based on operating experience, to reach MODE 3 from full power conditions in an orderly manner and without challenging plant systems. The extended interval to reach MODE 5 allows additional time for attempting restoration of the RFPC System and is reasonable when considering the driving force for the release of radioactive material from the Reactor Coolant System is reduced in MODE 3.

SURVEILLANCE
REQUIREMENTS

SR 3.6.7.1

This SR verifies that the TSP-C baskets are in place and there is no evidence of structural distress or abnormal corrosion.

The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.6.7.2

Periodic determination of the amount of TSP-C in containment must be performed due to the possibility of leaking valves and components in the containment building that could cause dissolution of the TSP-C during normal operation. This SR determines visually, by TSP-C level in each basket, that a minimum total amount of 9000 pounds of TSP-C is contained in the storage baskets and that the maximum amount of TSP-C in each basket does not exceed the structural integrity. Meeting this SR ensures that there is an adequate amount of TSP-C to adjust the pH of the post LOCA sump solution to a value ≥ 7.1 .

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BASES

SURVEILLANCE
REQUIREMENTS

SR 3.6.7.2 (continued)

The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

REFERENCES

1. [FSAR, Chapter 6.5](#), and [6.2.2](#).
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