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CHAPTER B 3.9

REFUELING OPERATIONS

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B 3.9 REFUELING OPERATIONS

B 3.9.1 Boron Concentration

BASES

BACKGROUND

The limit on the boron concentration of filled portions of the Reactor Coolant System (RCS) and the refueling pool that have direct access to the reactor vessel during refueling ensures that the reactor remains subcritical during MODE 6. Refueling boron concentration is the soluble boron concentration in the coolant in each of these volumes having direct access to the reactor core during refueling.

The soluble boron concentration offsets the core reactivity and is measured by chemical analysis of a representative sample of the coolant in each of the volumes. The refueling boron concentration is sufficient to maintain Shutdown Margin (SDM) with the most adverse conditions of fuel assembly and control rod position allowed by plant procedures. The boron concentration that is maintained in MODE 6 is sufficient to maintain $k_{eff} \leq 0.95$ with the most reactive rod control cluster assembly completely removed from its fuel assembly.

GDC 26 of 10 CFR 50, Appendix A, requires that two independent reactivity control systems of different design principles be provided (Ref. 1). One of these systems must be capable of holding the reactor core subcritical under cold conditions. The Chemical and Volume Control System (CVCS) is the main system capable of maintaining the reactor subcritical in cold conditions by maintaining the boron concentration.

The reactor is brought to shutdown conditions before beginning operations to open the reactor vessel for refueling. After the RCS is cooled and depressurized and the vessel head is unbolted, the head is slowly removed to form the refueling cavity. The refueling cavity is then flooded to form the refueling pool. Typically, the refueling pool is flooded with borated water from the refueling water storage tank through the open reactor vessel by the use of the Residual Heat Removal (RHR) System pumps or gravity feeding.

The pumping action of the RHR System in the RCS and the natural circulation due to thermal driving heads in the reactor vessel and refueling pool mix the added concentrated boric acid with the water in the refueling pool. The RHR System is in operation during refueling (see LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation - High Water Level," and LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation - Low Water Level") to provide forced circulation in the RCS

(continued)

BASES

BACKGROUND (continued)

and assist in maintaining uniform boron concentrations in the RCS and the refueling pool above the LCO limits. Administrative controls will limit the volume of unborated water that can be added to the refueling pool for decontamination activities in order to prevent diluting the refueling pool below the specified limits (Ref. 3).

APPLICABLE SAFETY ANALYSES

The boron concentration LCO limits are based on the core reactivity at the beginning of each fuel cycle (the end of refueling) and includes an uncertainty allowance.

The required boron concentration and the plant refueling procedures that verify the correct fuel loading plan (including full core mapping) ensure that the k_{eff} of the core will remain ≤ 0.95 during the refueling operation. Hence, at least a 5% $\Delta k/k$ margin of safety is established during refueling. Safety analyses assume a B-10 abundance of 19.9 atom % (Ref. 4). Administrative controls ensure that the reactivity insertion from the reactor coolant system and the refueling pool reflects this assumption.

During refueling, the water volume in the refueling pool and the reactor vessel form a single mass. As a result, the soluble boron concentration is relatively the same in each of these volumes having direct access to the reactor vessel.

The limiting boron dilution accident analyzed occurs in MODE 5 (Ref. 2). Boron dilution accidents are precluded in MODE 6 by isolating potential dilution flow paths. See LCO 3.9.2, "Unborated Water Source Isolation Valves." Unacceptable dilution from refueling pool decontamination activities is precluded by the following (Ref. 3):

1. The maximum allowable amount of unborated reactor makeup water that may be added to the refueling pool for decontamination activities is calculated for each refueling and will not cause the refueling pool boron concentration to fall below the LCO limits. This maximum allowable volume is based on initial pool boron concentration and one-half the RCS volume at mid-loop.

2. The refueling pool is drained to approximately one foot above the reactor cavity seal/shield ring. The refueling pool is then drained via the reactor coolant drain tank pumps or other available means (excluding the RHR system) until the level is below the seal/shield ring. This directs potentially diluted water at the top of the pool away from the reactor vessel and core.

(continued)

BASES

APPLICABLE SAFETY ANALYSES (continued)

3. After the level has been lowered to below the cavity seal/shield ring, further draining of the area enclosed by the inside diameter of the ring is performed via the RHR connection to the Chemical and Volume Control letdown line.

The RCS boron concentration satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

LCO

The LCO requires that a minimum boron concentration be maintained in the filled portions of the RCS and the refueling pool, that have direct access to the reactor vessel while in MODE 6. The boron concentration limit ensures that a core k_{eff} of ≤ 0.95 is maintained during fuel handling operations, and shall in all cases be ≥ 2000 ppm. Violation of the LCO could lead to an inadvertent criticality during MODE 6.

APPLICABILITY

This LCO is applicable in MODE 6 to ensure that the fuel in the reactor vessel will remain subcritical. The required boron concentration ensures a $k_{eff} \leq 0.95$. Above MODE 6, LCO 3.1.1, "SHUTDOWN MARGIN (SDM), LCO 3.1.5, "Shutdown Bank Insertion Limits," and LCO 3.1.6, "Control Bank Insertion Limits," ensure that an adequate amount of negative reactivity is available to shut down the reactor and maintain it subcritical.

This Specification has no LCO 3.0.4.c exception and LCO 3.0.4 places no restrictions on MODE changes that are part of the shutdown of the unit. However, since this Specification has Required Actions with immediate Completion Times, entering MODE 6 will not be permitted unless the boron concentration limits of this LCO are met. This will assure that the core reactivity is maintained within limits during fuel handling operations. The risk assessments of LCO 3.0.4.b may only be utilized for systems and components, not Criterion 2 values or parameters such as Mode 6 Boron Concentration. Therefore, a risk assessment per LCO 3.0.4.b to allow MODE changes with single or multiple system/equipment inoperabilities may not be used to allow a MODE change into this LCO while not meeting the Mode 6 Boron Concentration limits, even if the risk assessment specifically includes consideration of the Mode 6 Boron Concentration.

ACTIONS

A.1 and A.2

Continuation of CORE ALTERATIONS or positive reactivity additions (including actions to reduce boron concentration) is contingent upon maintaining the unit in compliance with the LCO. If the boron concentration of any coolant volume in the filled portions of the RCS and

(continued)

BASES

ACTIONS

A.1 and A.2 (continued)

the refueling pool that have direct access to the reactor vessel, is less than its limit, all operations involving CORE ALTERATIONS or positive reactivity additions must be suspended immediately.

Suspension of CORE ALTERATIONS and positive reactivity additions shall not preclude moving a component to a safe position. Operations that individually add limited positive reactivity (e.g., temperature fluctuations, inventory addition, or temperature control fluctuations), but when combined with all other operations affecting core reactivity (e.g., intentional boration) result in overall net negative reactivity addition, are not precluded by this action.

A.3

In addition to immediately suspending CORE ALTERATIONS and positive reactivity additions, boration to restore the concentration must be initiated immediately.

In determining the required combination of boration flow rate and concentration, no unique Design Basis Event must be satisfied. The only requirement is to restore the boron concentration to its required value as soon as possible. In order to raise the boron concentration as soon as possible, the operator should begin boration with the best source available for unit conditions.

Once actions have been initiated, they must be continued until the boron concentration is restored. The restoration time depends on the amount of boron that must be injected to reach the required concentration.

SURVEILLANCE REQUIREMENTS

SR 3.9.1.1

This SR ensures that the coolant boron concentration in the filled portions of the RCS and the refueling pool that have direct access to the reactor vessel, is within the LCO limits. The boron concentration of the coolant in each required volume is determined periodically by chemical analysis.

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 A, GDC 26.
2. FSAR, Chapter 15, Section 15.4.
3. Amendment 97 to Facility Operating License No. NPF-30, Callaway Unit 1, dated March 31, 1995.
4. Callaway Plant Request for Resolution 17070.

B 3.9 REFUELING OPERATIONS

B 3.9.2 Unborated Water Source Isolation Valves

BASES

BACKGROUND

During MODE 6 operations, all unborated water source isolation valves that are connected to the Reactor Coolant System (RCS) must be closed to prevent unplanned boron dilution of the reactor coolant. The isolation valves must be secured in the closed position.

Boron dilution in Mode 6 could occur from reactor makeup water sources containing unborated water or boron dilution could also occur from ion exchange resin contained within the CVCS and BTRS for water chemistry control. Note the CVCS resin vessels include the resin vessels of its subsystem the BTRS. While the purpose of the resin is to control water impurity levels and clarity, it may remove a slight amount of boron from the system's water stream when the resin is initially placed in service. The purified water stream is returned to the RCS at a slightly lower boron concentration until the resin reaches chemical equilibrium and is no longer a dilution source. Operations involving the conditioning and management of resin are permitted in Mode 6 because the amount of global RCS boron removed from the RCS during the equilibrium period can be calculated beforehand. As such, these operations are conducted as planned dilutions using administrative controls.

In Mode 6, operation of the CVCS letdown gamma radiation detector SJRE0001 is not required. However, flushing the detector with unborated water for maintenance during Mode 6 would be performed as a planned dilution using administrative controls.

Some unborated water sources, that are not connected to the RCS in their as-built configuration, can be temporarily configured (ex. flexible hose connected) to provide a direct path for unborated water into the RCS. A routine Mode 6 activity requiring this temporary configuration is decontamination of the refueling pool. However, administrative controls will limit the volume of unborated water that can be added to the refueling pool for decontamination or planned dilution activities, in order to prevent diluting the refueling pool and RCS below the specified limits (Ref. 3). (See the Bases for LCO 3.9.1, "Boron Concentration".)

Callaway reactivity management provides systematic direction to control activities that impact plant reactivity. This means precluding unplanned or uncontrolled occurrences impacting reactivity (positive or negative), including inadvertent boron dilution events.

(continued)

BASES

BACKGROUND (continued)	Plant operations may require planned boron management evolutions. Reactivity management provides provisions that any planned activities and evolutions with the potential to impact reactivity are identified; are conducted in a controlled manner; are evaluated to ensure the effects of reactivity changes are known and monitored; and are performed by plant personnel briefed so that any anomalous indications are met with conservative action. Specifically, administrative controls include: (1) adherence to approved procedures: (2) planned evolutions and briefings; (3) calculations for the impact on boron concentrations prior to evolutions; (4) reviews by licensed operators; (5) valve identification with temporary tagging; and (6) prompt verification that unborated water source isolation valves are closed and secured after completion of any planned dilution activities.
APPLICABLE SAFETY ANALYSES	The possibility of an inadvertent boron dilution event (Ref. 1) occurring during MODE 6 refueling operations is precluded by adherence to this LCO, which requires that potential dilution sources be isolated. Closing the required valves during refueling operations prevents the flow of unborated water to the filled portion of the RCS. The valves are used to isolate unborated water sources that are connected to the RCS. These valves have the potential to indirectly allow dilution of the RCS boron concentration in MODE 6. By isolating all unborated water sources, a safety analysis for an uncontrolled boron dilution accident in accordance with the Standard Review Plan (Ref. 2) is not required for MODE 6. The RCS boron concentration satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).
LCO	This LCO requires that unborated water source flow paths connected to the RCS be isolated to prevent unplanned boron dilution during MODE 6 and thus avoid a reduction in SDM. The unborated water source isolation valves must be closed and secured. Isolation valves connected to the RCS include: (1) unborated reactor makeup water (BGV0178 and BGV0601), (2) CVCS resin vessels configured with resin for dilution during normal operation (BG8522A, BG8522B, BGV0039, BGV0043, BGV0051, and BGV0055) and (3) unborated flushing water for the CVCS letdown radiation monitor (SJV0703). Some unborated water sources, that are not connected to the RCS in their as-built configuration, can be temporarily configured (ex. flexible hose connected) to provide a direct path for unborated water into the RCS. Isolation valves not connected to the RCS, but modified via temporary

(continued)

BASES

LCO (continued)

configuration to provide a direct path for unborated water into the RCS include: (1) BLV0078, (2) BLV0079 and (3) BLV0055.

This LCO is modified by a NOTE to allow unborated water sources to be unisolated under administrative controls for planned boron dilution evolutions. The NOTE also permits unborated water sources, not connected to the RCS in their as-built configuration, but temporarily configured (ex. flexible hose connected) to provide a direct path for unborated water into the RCS, to be used under administrative controls for planned boron dilution evolutions.

During refueling activities, it may be necessary for an unborated water source to be unisolated. Based on License Amendment 97, administrative controls are used to limit the volume of unborated water which can be added to the refueling pool for decontamination activities in order to prevent diluting the refueling pool boron concentration below TS limits. The administraive controls in this case are identified in TS Bases 3.9.1 and are applicable to the LCO NOTE exception for the following specific isolation valves: BLV0078, BLV0079 and BLV0055.

In Mode 6, other plant activities may require unborated water sources to be unisolated under administrative controls for planned boron dilution evolutions. The LCO NOTE allows an isolation exception for use of the reactor makeup water system, for operation of CVCS resin vessels, and for mainenance to flush the CVCS letdown gamma radiation detector SJRE0001 with unborated reactor makeup water. The administrative controls include plant reactivity management requirements and operational awareness and are described in the TS Bases 3.9.2 Background. These requirements are applicalbe to the LCO NOTE exception for the following specific isolation valves: BGV0178, BGV0601, BG8522A, BG8522B, BGV0039, BGV0043, BGV0051, BGV0055, and SJV0703.

APPLICABILITY

In MODE 6, this LCO is applicable to prevent an inadvertent boron dilution event by ensuring isolation of all sources of unborated water to the RCS.

For all other MODES, the boron dilution accident was analyzed and was found to be capable of being mitigated.

ACTIONS

The ACTIONS table has been modified by a Note that allows separate Condition entry for each unborated water source isolation valve.

(continued)

BASES

ACTIONS (continued)

A.1

Continuation of CORE ALTERATIONS is contingent upon maintaining the unit in compliance with this LCO. With any valve used to isolate unborated water sources not secured in the closed position, all operations involving CORE ALTERATIONS must be suspended immediately. The Completion Time of "immediately" for performance of Required Action A.1 shall not preclude completion of movement of a component to a safe position.

Condition A has been modified by a Note to require that Required Action A.3 be completed whenever Condition A is entered.

A.2

Preventing inadvertent dilution of the reactor coolant boron concentration is dependent on maintaining the unborated water source isolation valves closed and secured. Securing the valves in the closed position, under administrative controls, ensures that the valves are not inadvertently opened. The Completion Time of "immediately" requires an operator to initiate actions to close an open valve and secure the isolation valve in the closed position immediately. Once actions are initiated, they must be continued until the valves are secured in the closed position.

A.3

Due to the potential of having diluted the boron concentration of the reactor coolant, SR 3.9.1.1 (verification of boron concentration) must be performed whenever Condition A is entered to demonstrate that the required boron concentration exists. The Completion Time of 4 hours is sufficient to obtain and analyze a reactor coolant sample for boron concentration.

SURVEILLANCE REQUIREMENTS

SR 3.9.2.1

Isolation valves for unborated reactor makeup water (BGV0178 and BGV0601), CVCS resin vessels configured with resin for dilution during normal operation (BG8522A, BG8522B, BGV0039, BGV0043, BGV0051, and BGV0055), and the purge line used during flushing of CVCS letdown radiation monitor (SJV0703) are to be secured closed to isolate possible dilution paths.

(continued)

BASES

SURVEILLANCE REQUIREMENTS	<u>SR 3.9.2.1</u> (continued) The likelihood of a significant reduction in the boron concentration during MODE 6 operations is remote due to the large mass of borated water in the refueling pool after flood-up and the fact that all unborated water sources are isolated, precluding a dilution. The boron concentration is checked periodically during MODE 6 under SR 3.9.1.1. This Surveillance demonstrates that the valves are closed through a system walkdown. 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 15.4.6. 2. NUREG-0800, Section 15.4.6. 3. Amendment 97 to Facility Operating License No. NPF-30, Callaway Unit 1, dated March 31, 1995.

B 3.9 REFUELING OPERATIONS

B 3.9.3 Nuclear Instrumentation

BASES

BACKGROUND

The source range neutron flux monitors are used during refueling operations to monitor the core reactivity condition. The installed source range neutron flux monitors are part of the Nuclear Instrumentation System (NIS). These detectors are located external to the reactor vessel and detect neutrons leaking from the core.

There are two sets of source range neutron flux monitors;
(1) Westinghouse Source Range Neutron Flux Monitors, and
(2) Gamma-Metrics Source Range neutron flux monitors.

The Westinghouse source range neutron flux monitors (SE-NI-0031 and SE-NI-0032) are BF_3 detectors operating in the proportional region of the gas filled detector characteristic curve. The detectors monitor the neutron flux in counts per second. The instrument range covers six decades of neutron flux (1 to 1E+6 cps). The detectors also provide continuous visual indication in the control room. The NIS is designed in accordance with the criteria presented in Reference 1.

The Gamma-Metrics Source range monitors provide continuous visual indication in the control room to allow operators to monitor core flux.

APPLICABLE SAFETY ANALYSES

Two OPERABLE source range neutron flux monitors are required to provide continuous indication to alert the operator to unexpected changes in core reactivity such as an improperly loaded fuel assembly.

The source range neutron flux monitors satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

This LCO requires that two source range neutron flux monitors be OPERABLE to ensure that redundant monitoring capability is available to detect changes in core reactivity. To be operable, each monitor must provide visual indication in the control room.

The Westinghouse monitors are the normal source range monitors used during refueling activities. Gamma-Metrics Source Range Neutron Flux

(continued)

BASES

LCO (continued)

Monitor(s) are acceptable equivalent control room indication(s) for Westinghouse Source Range Neutron Flux Monitor(s) in MODE 6, including CORE ALTERATIONS, with the complete fuel assembly inventory set within the reactor vessel or with the Gamma Metrics Source Range Neutron Flux Monitor(s) coupled to the core. Reactor Engineering shall determine whether each monitor is coupled to the core.

APPLICABILITY

In MODE 6, the source range neutron flux monitors must be OPERABLE to determine changes in core reactivity. In other modes, the source range monitors are governed by LCO 3.3.1, LCO 3.3.3, LCO 3.3.4, and LCO 3.3.9.

ACTIONS

A.1 and A.2

With only one source range neutron flux monitor OPERABLE, redundancy has been lost. Since these instruments are the only direct means of monitoring core reactivity conditions, CORE ALTERATIONS and introduction of coolant into the RCS with boron concentration less than required to meet the minimum boron concentration of LCO 3.9.1 must be suspended immediately. Suspending positive reactivity additions that could result in failure to meet the minimum boron concentration limit is required to assure continued safe operation. Introduction of coolant inventory must be from sources that have a boron concentration greater than that required in the RCS for minimum refueling boron concentration. This may result in an overall reduction in RCS boron concentration, but provides acceptable margin to maintaining subcritical operation. Performance of Required Action A.1 shall not preclude completion of movement of a component to a safe position.

B.1

With no source range neutron flux monitor OPERABLE, action to restore a monitor to OPERABLE status shall be initiated immediately. Once initiated, action shall be continued until a source range neutron flux monitor is restored to OPERABLE status.

B.2

With no source range neutron flux monitor OPERABLE, there are no direct means of detecting changes in core reactivity. However, since CORE ALTERATIONS and boron concentration changes inconsistent with Required Action A.2 are not to be made, the core reactivity condition is

(continued)

ACTIONS

B.2 (continued)

stabilized until the source range neutron flux monitors are OPERABLE. This stabilized condition is determined by performing SR 3.9.1.1 to ensure that the required boron concentration exists.

The Completion Time of once per 12 hours is sufficient to obtain and analyze a reactor coolant sample for boron concentration and ensures that unplanned changes in boron concentration would be identified. The 12 hour Frequency is reasonable, considering the low probability of a change in core reactivity during this time period.

SURVEILLANCE REQUIREMENTS

SR 3.9.3.1

SR 3.9.3.1 is the performance of a CHANNEL CHECK, which is a comparison of the parameter indicated on one channel to a similar parameter on other channels. It is based on the assumption that the two indication channels should be consistent with core conditions. Changes in fuel loading and core geometry can result in significant differences between source range channels, but each channel should be consistent with its local conditions.

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

SR 3.9.3.2

SR 3.9.3.2 is the performance of a CHANNEL CALIBRATION. This SR is modified by a Note stating that neutron detectors are excluded from the CHANNEL CALIBRATION. Neutron detectors are excluded from the CHANNEL CALIBRATION because it is impractical to set up a test that demonstrates and adjusts neutron detector response to known values of the parameter (neutron flux) that the channel monitors. Depending on which source range channels are used to satisfy the LCO, the Note applies to the source range proportional counters in the Westinghouse Nuclear Instrumentation System (NIS) or to the Gamma-Metrics fission chambers, as discussed in the Background and LCO sections above. The CHANNEL CALIBRATION of the Westinghouse NIS source range neutron flux channels consists of obtaining integral bias curves, evaluating those curves, and comparing the curves previous data. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control

(continued)

BASES

SURVEILLANCE REQUIREMENTS	SR 3.9.3.2 (continued) Program. The other remaining portions of the CHANNEL CALIBRATION may be performed either during a plant outage or during plant operation.
REFERENCES	1. 10 CFR 50, Appendix A, GDC 13, GDC 26, GDC 28, and GDC 29. 2. FSAR, Section 15.4.6.

B 3.9 REFUELING OPERATIONS

B 3.9.4 Containment Penetrations

BASES

BACKGROUND

During CORE ALTERATIONS or movement of irradiated fuel assemblies within containment, a release of fission product radioactivity within containment will be restricted from escaping to the environment when the LCO requirements are met. In MODES 1, 2, 3, and 4, this is accomplished by maintaining containment OPERABLE as described in LCO 3.6.1, "Containment." In MODE 6, the potential for containment pressurization as a result of an accident is not likely; therefore, requirements to isolate the containment from the outside atmosphere can be less stringent. The LCO requirements are referred to as "containment closure" rather than "containment OPERABILITY." Containment closure means that all potential escape paths are closed or capable of being closed. Since there is no potential for containment pressurization, the 10 CFR 50 Appendix J leakage criteria and tests are not required.

The containment serves to contain fission product radioactivity that may be released from the reactor core following an accident, such that offsite radiation exposures are maintained well within the requirements of 10 CFR 100. Additionally, the containment provides radiation shielding from the fission products that may be present in the containment atmosphere following accident conditions.

The containment equipment hatch, which is part of the containment pressure boundary, provides a means for moving large equipment and components into and out of containment. During CORE ALTERATIONS or movement of irradiated fuel assemblies within containment and if closed, the containment equipment hatch must be held in place by at least four bolts. Alternatively, the equipment hatch can be open provided it can be installed with a minimum of four bolts holding it in place. Good engineering practice dictates that the bolts required by this LCO be approximately equally spaced.

The containment air locks, which are also part of the containment pressure boundary, provide a means for personnel access during MODES 1, 2, 3, and 4 unit operation in accordance with LCO 3.6.2, "Containment Air Locks." 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. The doors are normally interlocked to prevent simultaneous opening when containment OPERABILITY is required. During periods of unit shutdown when containment closure is not required, the door interlock mechanism may be disabled, allowing both

(continued)

BASES

BACKGROUND (continued)

doors of an air lock to remain open for extended periods when frequent containment entry is necessary. During CORE ALTERATIONS or movement of irradiated fuel assemblies within containment, containment closure is required under administrative controls. The door interlock mechanism may remain disabled; however, one personnel air lock door and one emergency air lock door must be capable of being closed.

The requirements for containment penetration closure ensure that a release of fission product radioactivity within containment will be restricted from escaping to the environment. The closure restrictions are sufficient to restrict fission product radioactivity release from containment due to a fuel handling accident during refueling.

The containment purge system includes two subsystems. The shutdown purge subsystem includes a 36-inch supply penetration and a 36-inch exhaust penetration. The second subsystem, a minipurge system, includes an 18-inch supply penetration and an 18-inch exhaust penetration. During MODES 1, 2, 3, and 4, the two valves in each of the shutdown purge supply and exhaust penetrations are secured in the closed position or blind flanged. The two valves in each of the two minipurge penetrations can be opened intermittently, but are closed automatically by the Engineered Safety Features Actuation System (ESFAS). Neither of the subsystems is subject to a Specification in MODE 5 or MODE 6, excluding CORE ALTERATIONS or movement of irradiated fuel in containment.

In MODE 6, large air exchanges are necessary to conduct refueling operations. The shutdown purge system is used for this purpose, and all four valves are capable of being closed by the ESFAS in accordance with LCO 3.3.6, "Containment Purge Isolation Instrumentation," during CORE ALTERATIONS or movement of irradiated fuel in containment.

The mini-purge system is typically used during reactor operation, but may have limited use during plant conditions other than reactor operation.

The other containment penetrations that provide direct access from containment atmosphere to outside atmosphere must be isolated on at least one side. Isolation may be achieved by an OPERABLE automatic isolation valve, or by a manual isolation valve, blind flange, or equivalent. Equivalent isolation methods must be approved and may include use of a material that can provide a temporary, atmospheric pressure, ventilation barrier (such as a valve, flange, or penetration sealing mechanism) for the other containment penetrations during fuel movements.

(continued)

BASES

BACKGROUND (continued)	"Direct access from the containment atmosphere" is defined as: Theaction of the containment atmosphere proceeding from containment to the outside atmosphere without deviation or interruption and having no impairing element.
APPLICABLE SAFETY ANALYSES	During CORE ALTERATIONS or movement of irradiated fuel assemblies within containment, the most severe radiological consequences result from a fuel handling accident. The fuel handling accident is a postulated event that involves damage to irradiated fuel (Ref. 2). The fuel handling accident (in containment) analyzed in Reference 2 consists of dropping a single irradiated fuel assembly onto other irradiated fuel assemblies. The requirements of LCO 3.9.7, "Refueling Pool Water Level," and the minimum decay time of 72 hours prior to CORE ALTERATIONS ensure that the release of fission product radioactivity, subsequent to a fuel handling accident, results in doses that are well within the guideline values specified in 10 CFR 100. Standard Review Plan, Section 15.7.4, Rev. 1 (Ref. 3), defines "well within" 10 CFR 100 to be 25% or less of the 10 CFR 100 values. The acceptance limits for offsite radiation exposure will be 25% of 10 CFR 100 values. Containment penetrations satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).
LCO	This LCO limits the consequences of a fuel handling accident in containment by limiting the potential escape paths for fission product radioactivity released within containment. The LCO requires any penetration providing direct access from the containment atmosphere to the outside atmosphere to be closed except for the OPERABLE containment purge penetrations and the personnel air lock, the emergency air lock, and the equipment hatch, which must be capable of being closed. For the OPERABLE containment purge penetrations, this LCO ensures that these penetrations are isolable by the Containment Purge Isolation System to ensure that releases through the valves are terminated, such that radiological doses are within the acceptance limit. During CORE ALTERATIONS or during movement of irradiated fuel assemblies within containment, Containment Purge Isolation valves are OPERABLE if they are capable of being closed by manual actuation. For the containment personnel air lock and emergency air lock, one air lock door must be capable of being closed. Thus both containment personnel air lock and emergency air lock doors may be open during movement of irradiated fuel assemblies within containment or CORE ALTERATIONS, provided an air lock door for each air lock is capable of being closed. Administrative controls ensure that 1) appropriate personnel are aware

(continued)

LCO (continued)

that both personnel air lock and emergency air lock doors are open, 2) a specified individual(s) is designated and available to close the air lock(s)

following a required evacuation of containment, and 3) any obstruction(s) (e.g. cables and hoses) that could prevent closure of an open air lock can be quickly removed (Ref. 1).

The containment equipment hatch may be open during movement of irradiated fuel assemblies within containment or CORE ALTERATIONS provided the hatch is capable of being closed and the water level in the refueling pool is maintained in accordance with FSAR Section 16.9.4 or TS 3.9.7. FSAR 16.9.4 requires that at least 23 feet of water is maintained over the top of the irradiated fuel assemblies within the reactor pressure vessel while in MODE 6 and during movement of control rods within the reactor pressure vessel. TS 3.9.7 requires the refueling pool water level to be maintained ≥ 23 feet above the top of the reactor vessel flange during the movement of irradiated fuel assemblies within containment.

Administrative controls include 1) appropriate personnel are aware of the open status of the containment during movement of irradiated fuel assemblies within containment or CORE ALTERATIONS, 2) specified individuals are designated and readily available to close the containment equipment hatch following an evacuation that would occur in the event of a fuel handling accident, and 3) any obstructions (e.g., cables and hoses) that would prevent rapid closure of the containment equipment hatch can be quickly removed. Administrative controls also ensure that during CORE ALTERATIONS or during the movement of irradiated fuel assemblies within containment and when the containment equipment hatch is open, the Containment Purge and Exhaust System is in service; the trip setpoint function for the purge radiation monitor detectors GTRE0022 and GTRE0033 is bypassed; and the requirements of TS 3.3.7, CREVS Actuation Instrumentation, are met.

To support the accident analyses and dose consequences for the postulated fuel handling accident (FHA) inside containment and to isolate containment, closure of the containment equipment hatch is required in the event of the postulated FHA inside containment. Closure is defined as the containment equipment hatch installed with four bolts.

Off-Normal plant procedures dictate the Control Room response to a Fuel Handling Accident and direct the operators to manually initiate a Control Room Ventilation Isolation. The Containment Purge and Exhaust System is not secured until the containment equipment hatch, the emergency

(continued)

BASES

LCO (continued)

airlock, and the personnel airlock are closed. The following sequence of actions occur:

<u>If the Equipment Hatch is open at the time of the FHA inside containment:</u>

- Manually initiate CRVIS
- Close Containment Hatches in the following order:
  - Equipment Hatch
  - Emergency Airlock
  - Personnel Airlock
- Following closure of the Personnel Airlock, Manually Initiate CPIS

<u>If the Equipment Hatch is closed at the time of the FHA inside containment</u>:

- Manually initiate CRVIS
- Close Containment Hatches in the following order:
  - Emergency Airlock
  - Personnel Airlock
- Following closure of the Personnel Airlock, Manually Initiate CPIS

Continued service of the Containment Purge and Exhaust System during the time interval between the fuel handling accident in containment and closure of the containment equipment hatch, the emergency airlock, and the personnel airlock will not result in any decrease or increase of calculated radiological consequences determined by the Licensing Bases radiological consequences analyses. It ensures that all post-accident releases are monitored.

In addition, Section 3.8.2.1.1 of the FSAR states that the containment equipment hatch missile shield (missile shield) is provided to protect the containment equipment hatch. Normally, the containment equipment hatch and the missile shield are closed during CORE ALTERATIONS or during movement of irradiated fuel inside containment. However, when the containment equipment hatch is open under administrative controls, the missile shield is not required to be closed.

(continued)

BASES

LCO (continued)

When severe weather conditions are within the plant monitoring radius and for thunderstorms or tornadoes that are determined to be moving toward the plant, the missile shield is required to be closed for protection against weather generated missiles being propelled inside containment. Plant administrative controls require that the missile shield is positioned toprovide adequate protection upon the arrival of threatening weather conditions that could generate missiles.

The containment equipment hatch is closed from inside containment and the missile shield is closed from outside containment. The containment equipment hatch and the missile shield are not interlocked, so that closure sequence is not a factor. The containment equipment hatch and the missile shield closing may be sequenced at the same time.

The LCO is modified by a NOTE allowing penetration flow paths with direct access from the containment atmosphere to the outside atmosphere to be unisolated under administrative controls. Administrative controls ensure that 1) appropriate personnel are aware of the open status of the penetration flow path during CORE ALTERATIONS or movement of irradiated fuel assemblies within containment, and 2) specified individuals are designated and readily available to isolate the flow path in the event of a fuel handling accident (Ref. 4).

APPLICABILITY

The containment penetration requirements are applicable during CORE ALTERATIONS or movement of irradiated fuel assemblies within containment because this is when there is a potential for a fuel handling accident. Proper installation and removal of the upper internals with irradiated fuel in the reactor vessel does not constitute a CORE ALTERATION or a movement of irradiated fuel. Therefore, this LCO is not applicable during installation and removal of the reactor vessel upper internals.

In MODES 1, 2, 3, and 4, containment penetration requirements are addressed by LCO 3.6.1, "Containment." In MODES 5 and 6, when CORE ALTERATIONS or movement of irradiated fuel assemblies within containment are not being conducted, the potential for a fuel handling accident does not exist. Therefore, under these conditions no requirements are placed on containment penetration status.

ACTIONS

A.1 and A.2

If the containment equipment hatch, air locks, or any containment penetration that provides direct access from the containment atmosphere

(continued)

BASES

ACTIONS

A.1 and A.2 (continued)

to the outside atmosphere is not in the required status, including the Containment Purge Isolation System not capable of manual actuation when the isolation valves are open, the unit must be placed in a condition where the isolation function is not needed. This is accomplished by immediately suspending CORE ALTERATIONS and movement of irradiated fuel assemblies within containment. Performance of these actions shall not preclude completion of movement of a component to a safe position.

SURVEILLANCE REQUIREMENTS

SR 3.9.4.1

This Surveillance demonstrates that each of the containment penetrations required to be in its closed position is in that position. For the open purge isolation valves, this Surveillance ensures that each valve is not blocked from closing, each valve operator has motive power, and that SR 3.3.6.4 and SR 3.9.4.3 have been performed and met within their specified Frequencies such that the Containment Purge Isolation Signal circuitry is known to be OPERABLE.

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

SR 3.9.4.2

This Surveillance demonstrate that the necessary hardware, tools, and equipment are available to install the equipment hatch. The equipment hatch is provided with a set of hardware, tools, and equipment for moving the hatch from its storage location and installing it in the opening. The required set of hardware, tools, and equipment shall be inspected to ensure that they can perform the required functions.

The Surveillance is performed during CORE ALTERATIONS or movement of irradiated fuel assemblies within the containment. The Surveillance is modified by a Note that only requires that the Surveillance be met for an open equipment hatch. If the equipment hatch is installed in its opening, the availability of the means to install the hatch is not required. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.9.4.3

This Surveillance demonstrates that each containment purge isolation valve actuates to its isolation position on manual initiation. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program. SR 3.6.3.5 demonstrates that the isolation time of each valve is in accordance with the Inservice Testing Program requirements. These Surveillances will ensure that the valves are capable of being manually closed after a postulated fuel handling accident to limit a release of fission product radioactivity from the containment.

REFERENCES

1. Amendment 114 to Facility Operating License No. NPF-30, Callaway Unit 1, dated July 15, 1996.

2. FSAR, Section 15.7.4.

3. NUREG-0800, Section 15.7.4, Rev. 1, July 1981.

4. Amendment 138 to Facility Operating License No. NPF-30, Callaway Unit 1, dated September 26, 2000.

B 3.9 REFUELING OPERATIONS

B 3.9.5 Residual Heat Removal (RHR) and Coolant Circulation - High Water Level

BASES

BACKGROUND

The purpose of the RHR System in MODE 6 is to remove decay heat and the stored thermal energy of the reactor coolant system, as required by GDC 34, to provide mixing of borated coolant and to prevent boron stratification (Ref. 1). Heat is removed from the RCS by circulating reactor coolant through the RHR heat exchanger(s), where the heat is transferred to the Component Cooling Water System (The heat sink for the Component Cooling Water Systeni is in turn normally provided by the Service Water System or Essential Service Water System, as determined by system availability). The coolant is then returned to the RCS via the RCS cold leg(s). Operation of the RHR System for normal cooldown or decay heat removal is manually accomplished from the control room. The heat removal rate is adjusted by controlling the flow of reactor coolant through the RHR heat exchanger(s) and the bypass lines. Mixing of the reactor coolant is maintained by this continuous circulation of reactor coolant through the RHR System.

APPLICABLE SAFETY ANALYSES

If the reactor coolant temperature is not maintained below 200°F, boiling of the reactor coolant could result. This could lead to a loss of coolant in the reactor vessel. Additionally, boiling of the reactor coolant could lead to boron plating out on components near the areas of the boiling activity. The loss of reactor coolant and the plate out of boron would eventually challenge the integrity of the fuel cladding, which is a fission product barrier. One train of the RHR System is required to be operational in MODE 6, with the water level ≥ 23 ft above the top of the reactor vessel flange, to prevent this challenge. The LCO does permit de-energizing the RHR pump for short durations, under the condition that the boron concentration is not diluted. This conditional de-energizing of the RHR pump does not result in a challenge to the fission product barrier.

The RHR System is retained as a Specification because it meets Criterion 4 of 10 CFR 50.36(c)(2)(ii).

LCO

Only one RHR loop is required for decay heat removal in MODE 6, with the water level ≥ 23 ft above the top of the reactor vessel flange. Only one RHR loop is required to be OPERABLE, because the volume of water above the reactor vessel flange provides backup decay heat removal

(continued)

BASES

LCO (continued)

capability. At least one RHR loop must be OPERABLE and in operation to provide:

a. Removal of decay heat;

b. Mixing of borated coolant to minimize the possibility of criticality; and

c. Indication of reactor coolant temperature.

An OPERABLE RHR loop includes an RHR pump, a heat exchanger, valves, piping, instruments, and controls to ensure an OPERABLE flow path and to determine the RCS temperature. The flow path starts in one of the RCS hot legs and is returned to the RCS cold legs. In addition, management of gas voids is important to RHR System OPERABILITY. The RHR System is OPERABLE when it is sufficiently filled with water to perform its specified safety function.

If both RHR loops are OPERABLE, either RHR loop may be the operating loop. Electrical power source and distribution requirements for the RHR loop(s) are as specified per LCO 3.8.2, "AC Sources – Shutdown"; LCO 3.8.5, "DC Sources – Shutdown"; LCO 3.8.8, "Inverters – Shutdown," and LCO 3.8.10, "Distribution Systems - Shutdown," consistent with the Bases for those Technical Specifications for reduced requirements during shutdown conditions, subject to the provisions and limitations described in the Bases. The standby RHR train may be aligned to the Refueling Water Storage Tank to support filling or draining the refuel pool or for the performance of required testing.

The LCO is modified by a Note that allows the required operating RHR loop to be removed from service for up to 1 hour per 8 hour period, provided no operations are permitted that would dilute the RCS boron concentration with coolant at boron concentrations less than required to meet the minimum boron concentration of LCO 3.9.1. Boron concentration reduction with coolant at boron concentrations less than required to assure the minimum required RCS boron concentration is maintained is prohibited because uniform concentration distribution cannot be ensured without forced circulation. This permits operations such as core mapping or alterations in the vicinity of the reactor vessel hot leg nozzles and RCS to RHR isolation valve testing. During this 1 hour period, decay heat is removed by natural convection to the large mass of water in the refueling pool.

(continued)

BASES (Continued)

APPLICABILITY

One RHR loop must be OPERABLE and in operation in MODE 6, with the water level ≥ 23 ft above the top of the reactor vessel flange, to provide decay heat removal. The 23 ft water level was selected because it corresponds to the 23 ft requirement established for fuel movement in LCO 3.9.7, "Refueling Pool Water Level." Requirements for the RHR System in other MODES are covered by LCOs in Section 3.4, "Reactor Coolant System (RCS)," and Section 3.5, "Emergency Core Cooling Systems (ECCS)." RHR loop requirements in MODE 6 with the water level < 23 ft are located in LCO 3.9.6, "Residual Heat Removal (RHR) and Coolant Circulation - Low Water Level." Additional RHR loop requirements in MODE 6 with the water level ≥ 23 feet above the top of the reactor vessel flange are located in FSAR 16.1.2.1, "Flow Path-Shutdown Limiting Condition For Operation."

ACTIONS

RHR loop requirements are met by having one RHR loop OPERABLE and in operation, except as permitted in the Note to the LCO.

A.1

If RHR loop requirements are not met, there will be no forced circulation to provide mixing to establish uniform boron concentrations. Suspending positive reactivity additions that could result in failure to meet the minimum boron concentration limit is required to assure continued safe operation. Introduction of coolant inventory must be from sources that have a boron concentration greater than that required in the RCS for minimum refueling boron concentration. This may result in an overall reduction in RCS boron concentration, but provides acceptable margin to maintaining subcritical operation. Administrative controls are placed on refueling decontamination activities (See Bases for LCO 3.9.1).

A.2

If RHR loop requirements are not met, actions shall be taken immediately to suspend loading of irradiated fuel assemblies in the core. With no forced circulation cooling, decay heat removal from the core occurs by natural convection to the heat sink provided by the water above the core. A minimum refueling pool water level of 23 ft above the reactor vessel flange provides an adequate available heat sink. Suspending any operation that would increase decay heat load, such as loading a fuel assembly, is a prudent action under this condition. Performance of Required Action A.2 shall not preclude completion of movement of a component to a safe condition.

(continued)

BASES

ACTIONS (continued)

A.3

If RHR loop requirements are not met, actions shall be initiated and continued in order to satisfy RHR loop requirements. With the unit in MODE 6 and the refueling water level ≥ 23 ft above the top of the reactor vessel flange, corrective actions shall be initiated immediately.

A.4

If RHR loop requirements are not met, all containment penetrations providing direct access from the containment atmosphere to the outside atmosphere must be closed within 4 hours. With the RHR loop requirements not met, the potential exists for the coolant to boil and release radioactive gas to the containment atmosphere. Closing containment penetrations that are open to the outside atmosphere ensures dose limits are not exceeded.

The Completion Time of 4 hours is reasonable, based on the low probability of the coolant boiling in that time.

SURVEILLANCE REQUIREMENTS

SR 3.9.5.1

This Surveillance demonstrates that the RHR loop is in operation and circulating reactor coolant. The flow rate is determined by the flow rate necessary to provide sufficient decay heat removal capability and to prevent thermal and boron stratification in the core. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.9.5.2

RHR 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 required RHR loop and may also prevent water hammer, pump cavitation, and pumping of noncondensible gas into the reactor vessel.

Selection of RHR 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

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.9.5.2 (continued)

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, such as standby versus operating conditions.

The RHR 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 RHR 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.

RHR 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.

REFERENCES

1. FSAR, Section 5.4.7.

B 3.9 REFUELING OPERATIONS

B 3.9.6 Residual Heat Removal (RHR) and Coolant Circulation - Low Water Level

BASES

BACKGROUND

The purpose of the RHR System in MODE 6 is to remove decay heat and the stored thermal energy of the reactor coolant system, as required by GDC 34, to provide mixing of borated coolant, and to prevent boron stratification (Ref. 1). Heat is removed from the RCS by circulating reactor coolant through the RHR heat exchangers where the heat is transferred to the Component Cooling Water System (The heat sink for the Component Cooling Water System is in turn normally provided by the Service Water System or Essential Service Water System, as determined by system availability). The coolant is then returned to the RCS via the RCS cold leg(s). Operation of the RHR System for normal cooldown decay heat removal is manually accomplished from the control room. The heat removal rate is adjusted by controlling the flow of reactor coolant through the RHR heat exchanger(s) and the bypass lines. Mixing of the reactor coolant is maintained by this continuous circulation of reactor coolant through the RHR System.

APPLICABLE SAFETY ANALYSES

If the reactor coolant temperature is not maintained below 200°F, boiling of the reactor coolant could result. This could lead to a loss of coolant in the reactor vessel. Additionally, boiling of the reactor coolant could lead to boron plating out on components near the areas of the boiling activity. The loss of reactor coolant and the subsequent plate out of boron will eventually challenge the integrity of the fuel cladding, which is a fission product barrier. Two trains of the RHR System are required to be OPERABLE, and one train in operation, in order to prevent this challenge.

The RHR System is retained as a Specification because it meets Criterion 4 of 10 CFR 50.36(c)(2)(ii).

LCO

In MODE 6, with the water level < 23 ft above the top of the reactor vessel flange, both RHR loops must be OPERABLE.

Additionally, one loop of RHR must be in operation in order to provide:

a. Removal of decay heat;

b. Mixing of borated coolant to minimize the possibility of criticality; and

(continued)

LCO (continued)

c. Indication of reactor coolant temperature.

An OPERABLE RHR loop consists of an RHR pump, a heat exchanger, valves, piping, instruments and controls to ensure an OPERABLE flow path and to determine the RCS temperature. The flow path starts in one of the RCS hot legs and is returned to the RCS cold legs. An OPERABLE RHR loop must be capable of being realigned to provide an OPERABLE flow path. In addition, management of gas voids is important to RHR System OPERABILITY. The RHR System is OPERABLE when it is sufficientlly filled with water to perform its specified safety function.

The standby RHR train may be aligned to the Refueling Water Storage Tank to support filling or draining the refuel pool or for the performance of required testing as long as the motor-operated valves EJHV8716A and EJHV8809A are maintained OPERABLE for Train A OPERABILITY and EJHV8716B and EJHV8809B are maintained OPERABLE for Train B OPERABILITY during refuel pool draining. These respective valves plus EJHV8840 must be maintained OPERABLE during refuel pool filling. The standby RHR train may be considered OPERABLE with BN8717 (RHR return to RWST) open as long as it can be isolated by EJHV8716A or B and EJHV8809A or B can be opened to realign the pump discharge to the RCS cold legs. Caution must be exercised whenever BN8717 is open to ensure the operating RHR train's EJHV8716 valve is maintained closed. This is to prevent draining the RCS to the RWST. See Reference 3.

Electrical power source and distribution requirements for the RHR loops are as specified per LCO 3.8.2, "AC Sources – Shutdown"; LCO 3.8.5, "DC Sources – Shutdown"; LCO 3.8.8, "Inverters – Shutdown," and LCO 3.8.10, "Distribution Systems – Shutdown," consistent with the Bases for those Technical Specifications for reduced requirements during shutdown conditions, subject to the provisions and limitations described in the Bases.

APPLICABILITY

Two RHR loops are required to be OPERABLE, and one RHR loop must be in operation in MODE 6, with the water level < 23 ft above the top of the reactor vessel flange, to provide decay heat removal. Requirements for the RHR System in other MODES are covered by LCOs in Section 3.4, Reactor Coolant System (RCS), and Section 3.5, "Emergency Core Cooling Systems (ECCS)." RHR loop requirements in MODE 6 with the water level ≥ 23 ft are located in LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation - High Water Level." Additional RHR loop requirements in MODE 6 with the water level ≥ 23 feet above the top of the reactor vessel flange are located in FSAR 16.1.2.1, “Flow Path-Shutdown Limiting Condition For Operation.”

(continued)

BASES

APPLICABILITY (continued)

Since LCO 3.9.6 contains Required Actions with immediate Completion Times related to the restoration of the degraded decay heat removal function, it is not permitted to enter this LCO from either MODE 5 or from LCO 3.9.5, "RHR and Coolant Circulation-High Water Level" unless the requirements of LCO 3.9.6 are met.

ACTIONS

A.1 and A.2

If less than the required number of RHR loops are OPERABLE, action shall be immediately initiated and continued until the RHR loop is restored to OPERABLE status and restored to operation in accordance with the LCO or until ≥ 23 ft of water level is established above the reactor vessel flange. When the water level is ≥ 23 ft above the reactor vessel flange, the Applicability changes to that of LCO 3.9.5, and only one RHR loop is required to be OPERABLE and in operation. An immediate Completion Time is necessary for an operator to initiate corrective actions.

B.1

If no RHR loop is in operation, there will be no forced circulation to provide mixing to establish uniform boron concentrations. Suspending positive reactivity additions that could result in failure to meet the minimum boron concentration limit is required to assure continued safe operation. Introduction of coolant inventory must be from sources that have a boron concentration greater than that required in the RCS for minimum refueling boron concentration. This may result in an overall reduction in RCS boron concentration, but provides acceptable margin to maintaining a subcritical operation. Administrative controls are placed on refueling decontamination activities (See Bases for LCO 3.9.1).

B.2

If no RHR loop is in operation, actions shall be initiated immediately, and continued, to restore one RHR loop to operation. Since the unit is in Conditions A and B concurrently, the restoration of two OPERABLE RHR loops and one operating RHR loop should be accomplished expeditiously.

(continued)

BASES

ACTIONS (continued)

B.3

If no RHR loop is in operation, all containment penetrations providing direct access from the containment atmosphere to the outside atmosphere must be closed within 4 hours. With the RHR loop requirements not met, the potential exists for the coolant to boil and release radioactive gas to the containment atmosphere. Closing containment penetrations that are open to the outside atmosphere ensures that dose limits are not exceeded.

The Completion Time of 4 hours is reasonable at water levels above reduced inventory, based on the low probability of the coolant boiling in that time. At reduced inventory conditions, additional actions are taken to provide containment closure in a reduced period of time (Reference 2). Reduced inventory is defined as RCS level lower than 3 feet below the reactor vessel flange.

SURVEILLANCE REQUIREMENTS

SR 3.9.6.1

This Surveillance demonstrates that one RHR loop is in operation and circulating reactor coolant. The flow rate is determined by the flow rate necessary to provide sufficient decay heat removal capability and to prevent thermal and boron stratification in the core. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.9.6.2

Verification that the required pump is OPERABLE ensures that an additional RHR pump can be placed in operation, if needed, to maintain decay heat removal and reactor coolant circulation. Verification is performed by verifying proper breaker alignment and power available to the required pump. The Surveillance Frequency is based on operating experience, equipment reliability, and plant risk and is controlled under the Surveillance Frequency Control Program.

SR 3.9.6.3

RHR 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 RHR loops and

(continued)

BASES

SURVEILLANCE REQUIREMENTS

SR 3.9.6.3 (continued)

may also prevent water hammer, pump cavitation, and pumping of noncondensible gas into the reactor vessel.

Selection of RHR 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, such as standby versus operating conditions.

The RHR 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 RHR 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.

RHR 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.

(continued)

BASES

SURVEILLANCE REQUIREMENTS	SR 3.9.6.3 (continued) The Surveillance Frequency is controlled under the Surveillance Frequency Control Program. The Surveillance Frequency may vary by location susceptible to gas accumulation.
REFERENCES	1. FSAR, Section 5.4.7. 2. Generic Letter No. 88-17, "Loss of Decay Heat Removal." 3. RFR-15632A.

B 3.9 REFUELING OPERATIONS

B 3.9.7 Refueling Pool Water Level

BASES

BACKGROUND

The movement of irradiated fuel assemblies within containment requires a minimum water level of 23 ft above the top of the reactor vessel flange. During refueling, this maintains sufficient water level in the fuel transfer canal, refueling pool and spent fuel pool. Sufficient water is necessary to retain iodine fission product activity in the water in the event of a fuel handling accident (Refs. 1 and 2). Sufficient iodine activity would be retained to limit offsite doses from the accident to < 25% of 10 CFR 100 limits, as provided by the guidance of Reference 3 and acceptance in Reference 6.

APPLICABLE SAFETY ANALYSES

During movement of irradiated fuel assemblies, the water level in the refueling pool is an initial condition design parameter in the analysis of a fuel handling accident in containment, as postulated by Regulatory Guide 1.25 (Ref. 1). The reactor is assumed to have been subcritical for 72 hours prior to movement of irradiated fuel in the reactor vessel. A minimum water level of 23 ft (Regulatory Position C.1.c of Ref. 1) allows a decontamination factor of 100 (Regulatory Position C.1.g of Ref. 1) to be used in the accident analysis for iodine. This relates to the assumption that 99% of the total iodine released from the pellet to cladding gap of the damaged rods is retained by the refueling pool water. In addition, for the analyses for the accident in the reactor building, the dropped assembly is assumed to damage 20% of the rods of a different assembly. The fission product release point is assumed to be at the point of impact at the top of the reactor vessel flange. The fuel pellet to cladding gap is assumed to contain 10% of the total fuel rod iodine inventory (Ref. 1).

The fuel handling accident analysis inside containment is described in Reference 2. With a minimum water level of 23 ft and a minimum decay time of 72 hours prior to fuel handling, the analysis and test programs demonstrate that the iodine release due to a postulated fuel handling accident is adequately captured by the water and offsite doses are maintained well within the limits of 10 CFR 100 (Refs. 4, 5, and 6).

Refueling pool water level satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii).

(continued)

BASES (Continued)

LCO

A minimum refueling pool water level of 23 ft above the top of the reactor vessel flange is required to ensure that the radiological consequences of a postulated fuel handling accident inside containment are within acceptable limits, as provided by the guidance of Reference 3.

APPLICABILITY

LCO 3.9.7 is applicable when moving irradiated fuel assemblies within containment. Proper removal and reinstallation of the upper internals with irradiated fuel in the vessel does not constitute movement of irradiated fuel, therefore, this LCO is not applicable during installation and removal of the reactor vessel upper internals.

The LCO minimizes the possibility of a fuel handling accident in containment that is beyond the assumptions of the safety analysis. If irradiated fuel assemblies are not present in containment, there can be no significant radioactivity release as a result of a postulated fuel handling accident. Requirements for fuel handling accidents in the spent fuel pool are covered by LCO 3.7.15, "Fuel Storage Pool Water Level."

ACTIONS

A.1

With a water level of < 23 ft above the top of the reactor vessel flange, movement of irradiated fuel assemblies within the containment shall be suspended immediately to ensure that a fuel handling accident cannot occur.

The suspension of fuel movement shall not preclude completion of movement of a component to a safe position.

SURVEILLANCE REQUIREMENTS

SR 3.9.7.1

Verification of a minimum water level of 23 ft above the top of the reactor vessel flange ensures that the design basis for the analysis of the postulated fuel handling accident during refueling operations is met. Water at the required level above the top of the reactor vessel flange limits the consequences of damaged fuel rods that are postulated to result from a fuel handling accident inside containment (Ref. 2).

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. Regulatory Guide 1.25, March 23, 1972.
2. FSAR, Section 15.7.4.
3. NUREG-0800, Rev. 1, July 1981, Section 15.7.4.
4. 10 CFR 100.11.
5. Malinowski, D. D., Bell, M. J., Duhn, E., and Locante, J., WCAP-828, Radiological Consequences of a Fuel Handling Accident, December 1971.
6. NUREG-0830, Safety Evaluation Report, Callaway Plant, Unit No. 1, October 1981, Section 15.4.6.