B 3.9 REFUELING OPERATIONS

B 3.9.1 Boron Concentration

BASES

BACKGROUND

The limit on the boron concentrations of the Reactor Coolant System (RCS) and refueling pool 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 that have 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 limit is specified in the Core Operating Limits Report (COLR). Unit procedures ensure the specified boron concentration in order to maintain an overall core reactivity of $k_{eff} \leq 0.95$ during fuel handling, with control element assemblies and fuel assemblies assumed to be in the most adverse configuration (least negative reactivity) allowed by unit procedures. The negative worth of the CEAs may be credited when determining the refueling boron concentrations. Unit procedures maintain the number and position of credited CEAs during fuel handling operations.

Reference 1, Appendix 1C, Criterion 27, requires that two independent reactivity control systems of different design principles be provided. One of these systems must be capable of holding the reactor core subcritical under cold conditions. The Chemical and Volume Control System is the 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 pool. The refueling pool is then flooded with borated water from the refueling water tank into the open reactor vessel by gravity feeding or by the use of the Shutdown Cooling (SDC) System pumps.

The pumping action of the SDC System in the RCS and the natural circulation due to thermal driving heads in the reactor vessel and the refueling pool mix the added concentrated boric acid with the water in the RCS. The SDC System is in operation during refueling [see Limiting Condition of Operation (LCO) 3.9.4 and LCO 3.9.5], to provide forced circulation in the RCS and assist in maintaining the boron concentrations in the RCS and the refueling pool above the COLR limit.

The COLR includes a MODE 6 temperature limitation of $\leq$ 140°F. This restriction ensures assumptions made for calculating boron concentration and assumptions made in the boron dilution analysis for MODE 6 are preserved.

APPLICABLE SAFETY ANALYSES

During refueling operations, the reactivity condition of the core is consistent with the initial conditions assumed for the boron dilution accident in the accident analysis and is conservative for MODE 6.

The required boron concentration and the unit refueling procedures that demonstrate the correct fuel loading plan (including full core mapping) ensure the k_{eff} of the core will remain $\leq$ 0.95 during the refueling operation. Hence, at least a 5% $\Delta k/k$ margin of safety is established during refueling. The boron concentration limit specified in the COLR includes an uncertainty allowance.

During refueling, the water volume in the spent fuel pool, the transfer tube, 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.

The limiting boron dilution accident analyzed occurs in MODE 5 (Reference 1, Chapter 14). A detailed discussion of this event is provided in B 3.1.1.

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

LCO

The LCO requires that a minimum boron concentration be maintained in the RCS and refueling pool while in MODE 6. The boron concentration limit specified in the COLR ensures a core k_{eff} of ≤ 0.95 is maintained during fuel handling operations. 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} ≤ 0.95. Above MODE 6, LCO 3.1.1 ensures that an adequate amount of negative reactivity is available to shut down the reactor and to maintain it subcritical.

ACTIONS

A.1

Continuation of 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 RCS or the refueling pool is less than its limit, all operations involving positive reactivity additions must be suspended immediately.

Suspension of positive reactivity additions shall not preclude moving a component to a safe position.

A.2

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

In determining the required combination of boration flow rate and concentration, there is no unique design basis event that 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 boration is initiated, it 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 Surveillance Requirement (SR) ensures the coolant boron concentration in the RCS and the refueling pool is within the COLR limits. The coolant boron concentration in each volume is determined periodically by chemical analysis.

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

REFERENCES

1. Updated Final Safety Analysis Report (UFSAR)

B 3.9 REFUELING OPERATIONS

B 3.9.2 Nuclear Instrumentation

BASES

BACKGROUND	The source range monitors (SRMs) are used during refueling operations to monitor the core reactivity condition. The installed SRMs are part of the wide range nuclear instrumentation which are part of the Nuclear Instrumentation System. These detectors are located external to the reactor vessel and detect neutrons leaking from the core. The use of portable detectors is permitted, provided the LCO requirements are met. The installed SRMs are fission chambers. The detectors monitor the neutron flux in counts per second. The instrument range (shutdown monitors) covers five decades of neutron flux (1E+5 cps) with at least a ± 5% instrument accuracy. The detectors also provide continuous visual indication in the Control Room and an audible indication in the Control Room and Containment to alert operators to a possible dilution accident. The Nuclear Instrumentation System is designed in accordance with the criteria presented in Reference 1, Appendix 1C. If used, portable detectors should be functionally equivalent to the Nuclear Instrumentation System SRMs.
APPLICABLE SAFETY ANALYSES	Two OPERABLE SRMs are required to provide a signal to alert the operator to unexpected changes in core reactivity such as by a boron dilution accident or an improperly loaded fuel assembly. The safety analysis of the uncontrolled boron dilution accident is described in Reference 1, Chapter 14. The analysis of the uncontrolled boron dilution accident shows that normally available SHUTDOWN MARGIN would be reduced, but there is sufficient time for the operator to take corrective actions. The SRMs satisfy 10 CFR 50.36(c)(2)(ii), Criterion 3.
LCO	This LCO requires two SRMs OPERABLE to ensure that redundant monitoring capability is available to detect changes in core reactivity.

BASES

APPLICABILITY

In MODE 6, the SRMs must be OPERABLE to determine changes in core reactivity. There is no other direct means available to check core reactivity levels.

In MODEs 2, 3, 4, and 5, the installed source range detectors and circuitry are required to be OPERABLE by LCO 3.3.2.

ACTIONS

A.1 and A.2

With only one SRM OPERABLE, redundancy has been lost. Since these instruments are the only direct means of monitoring core reactivity conditions, positive reactivity additions and introduction of water into the RCS with a boron concentration less than that 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 the 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 SRM OPERABLE, action to restore a monitor to OPERABLE status shall be initiated immediately. Once initiated, action shall be continued until an SRM is restored to OPERABLE status.

B.2

With no SRM OPERABLE, there is no direct means of detecting changes in core reactivity. However, since positive reactivity additions are not to be made, the core reactivity condition is stabilized until the SRMs are OPERABLE. This stabilized condition is determined by performing SR 3.9.1.1 to verify that the required boron concentration exists.

BASES

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 period.

SURVEILLANCE REQUIREMENTS

SR 3.9.2.1

Surveillance Requirement 3.9.2.1 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 controlled under the Surveillance Frequency Control Program.

SR 3.9.2.2

Surveillance Requirement 3.9.2.2 is the performance of a CHANNEL CALIBRATION. This SR is modified by a Note stating that neutron detectors are excluded from the CHANNEL CALIBRATION. This is because generating a meaningful test signal is difficult; the detectors are of simple construction, and any failures in the detectors will be apparent as a change in channel output. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

REFERENCES

1. UFSAR

B 3.9 REFUELING OPERATIONS

B 3.9.3 Containment Penetrations

BASES

BACKGROUND

During movement of irradiated fuel assemblies within the Containment Structure, a release of fission product radioactivity within the Containment Structure 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. In MODE 6, the potential for containment pressurization as a result of an accident is not likely; therefore, requirements to isolate the containment atmosphere 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 filtered or unfiltered escape paths are closed or capable of being closed. Since there is no design basis accident potential for containment pressurization, the Appendix J leakage criteria and tests are not required.

The Containment Structure 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 50.67. Additionally, the Containment Structure provides radiation shielding from the fission products that may be present in the containment atmosphere following accident conditions.

The containment equipment hatch opening provides a means for moving large equipment and components into and out of the Containment Structure. During movement of irradiated fuel assemblies within Containment, the equipment hatch must be held in place by at least four bolts or the containment outage door must be capable of being closed. Good engineering practice dictates that the bolts required by this LCO be approximately equally spaced.

The containment air locks, which are part of the containment pressure boundary, provide a means for personnel access during MODEs 1, 2, 3, and 4 operation in accordance with LCO 3.6.2. Each air lock has a door at both ends. The doors are normally interlocked to prevent simultaneous opening when Containment OPERABILITY is required.

In other situations, the potential for containment pressurization as a result of an accident is not present, therefore, less stringent requirements are needed to isolate the containment atmosphere from the outside atmosphere. Both containment personnel air lock doors and the containment outage door may be open during the movement of irradiated fuel assemblies in containment; provided one air lock door and the containment outage door are OPERABLE, the plant is in MODE 6 with at least 23 ft of water above the fuel, and a designated individual is continuously available to close each door. The designated individuals must be stationed at the Auxiliary Building side of the outer air lock door and near the containment equipment hatch. OPERABILITY of a containment personnel air lock door requires that the door is capable of being closed, that the door is unblocked, and no cables or hoses are run through the doorway. OPERABILITY of the containment outage door requires that the door is capable of being closed, that the door is unblocked (i.e., capable of being closed within 30 minutes), and no cables and hoses are run through the doorway. Containment outage door grating or truck ramps may be installed if the grating or truck ramps can be removed with the use of a forklift and the door closed within 30 minutes. Penetration flow paths with direct access from the containment atmosphere to the outside atmosphere may be unisolated under administrative control during movement of irradiated fuel assemblies in Containment provided that the appropriate personnel are aware of the open status and are designated and readily available to isolate the flow path in the event of a fuel handling accident. During movement of irradiated fuel assemblies in containment, the requirement for at least 23 ft of water above the fuel, ensures that there is sufficient time to close the personnel air lock, the containment outage door, and penetration flow paths following a loss of SDC before boiling occurs and minimizes activity release after a fuel handling accident. The personnel air lock door, the containment outage door, and penetration flow paths may be operated independently of each other (i.e., they do not have to be open or shut at the same time).

The requirements on containment penetration closure, ensure that a release of fission product radioactivity within the Containment Structure will be restricted to within regulatory limits.

The Containment Purge Valve Isolation System, for the purposes of compliance with LCO 3.9.3, item d.2, includes a 48 inch purge penetration and a 48 inch exhaust penetration. For the purposes of compliance with LCO 3.9.3, the containment vent isolation valves are not considered part of the Containment Purge Valve Isolation System since they may not be capable of being closed automatically. The containment vent, includes a four inch purge penetration and a four inch exhaust penetration. During MODEs 1, 2, 3, and 4, the normal purge and exhaust penetrations are isolated (via a blind flange, if installed or by the purge valves). The containment vent valves can be opened intermittently, but are closed automatically by the Engineered Safety Features Actuation System. Neither of the subsystems is subject to a Specification in MODE 5.

In MODE 6, large air exchanges are desired to conduct refueling operations. The normal 48 inch purge system is used for this purpose and all valves are closed by the Engineered Safety Features Actuation System in accordance with LCO 3.3.7.

The containment vent isolation valves are required to be closed during movement of irradiated fuel assemblies within Containment. These valves are connected to the penetration room Technical Specification emergency air cleanup systems, which exhaust to the outside atmosphere through high efficiency particulate air and charcoal filters.

The other containment penetrations that provide direct access from containment atmosphere to outside atmosphere through a filtered or unfiltered pathway 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 in accordance with appropriate American Society of Mechanical Engineers / American National Standards Institute Codes, and may include use of a material that can provide a temporary ventilation barrier for the other containment penetrations during fuel movements.

APPLICABLE SAFETY ANALYSES

During movement of irradiated fuel assemblies within the Containment Structure, 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 (Reference 1). The fuel handling accident, described in Reference 1, includes dropping a single irradiated fuel assembly which would then rotate to a horizontal position, strike a protruding structure, and rupture the fuel pins. The requirements of LCO 3.9.6, and the minimum decay time of 72 hours prior to movement of irradiated fuel assemblies, ensure that the release of fission product radioactivity, subsequent to a fuel handling accident, results in doses that are within the acceptance limits given in Reference 1.

Containment penetrations satisfy 10 CFR 50.36(c)(2)(ii), Criterion 3.

LCO

This LCO limits the consequences of a fuel handling accident in Containment Structure, by limiting the potential escape paths for fission product radioactivity released within Containment. The LCO requires any penetration providing direct access from the Containment Structure atmosphere to the outside atmosphere through a filtered or unfiltered pathway (including the containment vent isolation valves) to be closed, except for the OPERABLE containment purge and exhaust penetrations, the containment personnel air locks and the containment outage door. For the OPERABLE containment purge and exhaust penetrations, this LCO ensures that these penetrations are isolable by the Containment Purge Valve Isolation System. The OPERABILITY requirements for this LCO ensure that the automatic purge and exhaust valve closure times specified in the UFSAR can be achieved, and therefore meet the assumptions used in the safety analysis to ensure releases through the valves are terminated, such that the radiological doses are within the acceptance limit.

Both containment personnel air lock doors and the containment outage door may be open under administrative controls during movement of irradiated fuel assemblies in Containment provided that one OPERABLE personnel air lock door and an OPERABLE containment outage door are capable of being closed in the event of a fuel handling accident. The administrative controls consist of designated individuals available immediately outside the personnel air lock and near the containment outage door to close the OPERABLE doors. Should a fuel handling accident occur inside the Containment Structure, one personnel air lock door and the containment outage door will be closed following an evacuation of the Containment Structure.

The LCO is modified by a Note which allows the emergency air lock temporary closure device to replace an emergency air lock door. The temporary closure device provides an adequate barrier to shield the environment from the containment atmosphere in case of a design basis event that does not create a pressure increase inside Containment.

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 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.

APPLICABILITY

The containment penetration requirements are applicable during movement of irradiated fuel assemblies within the Containment Structure because this is when there is a potential for a fuel handling accident. In MODEs 1, 2, 3, and 4, containment penetration requirements are addressed by LCO 3.6.1. In MODEs 5 and 6, when movement of irradiated fuel assemblies within the Containment Structure 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

<u>A.1</u>

With the containment equipment hatch, air locks, or any containment penetration that provides direct access from the containment atmosphere to the outside atmosphere through a filtered or unfiltered pathway not in the required status, (including the Containment Purge and Exhaust Isolation System not capable of automatic actuation when the purge and exhaust valves are open) the unit must be placed in a condition in which the isolation function is not needed. This is accomplished by immediately suspending movement of irradiated fuel assemblies within the Containment Structure. Performance of these actions shall not preclude completion of movement of a component to a safe position.

SURVEILLANCE REQUIREMENTS

SR 3.9.3.1

This SR demonstrates that each of the containment penetrations required to be in its closed position, is in that position. The surveillance test on the open purge and exhaust valves will demonstrate that the valves are not blocked from closing. Also, the surveillance test will demonstrate that each purge and exhaust valve operator has motive power, which will ensure each valve is capable of being closed by an OPERABLE automatic Containment Purge Valve Isolation System.

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 3.9.3.2

This SR demonstrates that each containment purge and exhaust valve actuates to its isolation position on manual initiation or on an actual or simulated high radiation signal. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program. These surveillance tests performed during MODE 6 will ensure that the valves are capable of closing after a postulated fuel handling accident to limit a release of fission product radioactivity from the Containment Structure.

REFERENCES

1. UFSAR, Section 14.18, "Fuel Handling Incident"

B 3.9 REFUELING OPERATIONS

B 3.9.4 Shutdown Cooling (SDC) and Coolant Circulation-High Water Level

BASES

BACKGROUND

The purposes of the SDC System in MODE 6 are to remove decay heat and other residual heat from the RCS, to provide mixing of borated coolant, to provide sufficient coolant circulation to minimize the effects of a boron dilution accident, and to prevent boron stratification (Reference 1). Heat is removed from the RCS by circulating reactor coolant through the SDC heat exchanger(s), where the heat is transferred to the Component Cooling Water System via the SDC heat exchanger(s). The coolant is then returned to the RCS via the RCS cold leg(s). Operation of the SDC 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 SDC heat exchanger(s) and bypassing the heat exchanger(s). Mixing of the reactor coolant is maintained by this continuous circulation of reactor coolant through the SDC 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 inadequate cooling of the reactor fuel due to a resulting loss of coolant in the reactor vessel. Additionally, boiling of the reactor coolant could lead to a reduction in boron concentration in the coolant, due to the boron plating out on components near the areas of the boiling activity, and due to the possible addition of water to the reactor vessel with a lower boron concentration than is required to keep the reactor subcritical. The loss of reactor coolant and the reduction of boron concentration in the reactor coolant would eventually challenge the integrity of the fuel cladding, which is a fission product barrier. One loop of the SDC System is required to be operational in MODE 6, with the water level ≥ 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel, to prevent this challenge. The LCO does permit de-energizing of the SDC pump for short durations under the condition that the boron concentration is not diluted. This conditional de-energizing of the SDC pump does not result in a challenge to the fission product barrier.

Shutdown cooling and Coolant Circulation-High Water Level satisfies 10 CFR 50.36(c)(2)(ii), Criterion 2.

LCO

Only one SDC loop is required for decay heat removal in MODE 6, with water level ≥ 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel. Only one SDC loop is required because the volume of water above the irradiated fuel assemblies seated in the reactor vessel provides backup decay heat removal capability. At least one SDC loop must be OPERABLE and in operation to provide:

a. Removal of decay heat;

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

c. Indication of reactor coolant temperature.

An OPERABLE SDC loop includes an SDC pump, a heat exchanger, valves, piping, instruments, and controls to ensure an OPERABLE flow path, and to determine the low end temperature. An OPERABLE SDC loop is supported by a functional saltwater and component cooling water subsystem. Note that one functional saltwater and component cooling water subsystem may support both OPERABLE SDC loops, if its heat removal capacity is sufficient. The flow path starts in one of the RCS hot legs and is returned to the RCS cold legs.

The LCO is modified by a Note that allows the required operating SDC loop not to be in operation for up to one hour in each eight hour period, provided no operations are permitted that would cause the introduction of water into the RCS with a boron concentration less than that required to meet the minimum boron concentration of LCO 3.9.1. Boron concentration reduction with water at boron concentrations less than that required to meet the minimum boron concentration of LCO 3.9.1 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 SDC isolation valve testing. During this one hour period, decay heat is removed by natural convection to the large mass of water in the refueling pool.

A second Note also allows both SDC loops not to be in operation during the time required for local leak rate testing of Containment Penetration Number 41 pursuant to the requirements of SR 3.6.1.1 or to permit maintenance on valves located in the common SDC suction line. In addition to the requirement in Note 1 regarding control of boron concentration, movement of fuel assemblies is suspended within Containment and all containment penetrations must be in the status described in LCO 3.9.3. This allowance is necessary to perform required maintenance and testing.

APPLICABILITY

One SDC loop must be in operation in MODE 6, with the water level $\geq$ 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel, to provide decay heat removal. The 23 ft level was selected because it corresponds to the 23 ft requirement established for fuel movement in LCO 3.9.6.

Requirements for the SDC System in other MODEs are covered by LCOs in Section 3.4 and Section 3.5. Shutdown cooling loop requirements in MODE 6, with the water level < 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel, are located in LCO 3.9.5.

ACTIONS

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

A.1

If one required SDC loop is inoperable or not in operation, action shall be immediately initiated and continued until the SDC loop is restored to OPERABLE status and to operation. An immediate Completion Time is necessary for an operator to initiate corrective actions.

A.2

If SDC 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 the minimum refueling boron concentration. This may result in an overall reduction in RCS boron concentration, but provides an acceptable margin to maintaining subcritical operation. In addition, to ensure compliance with the action is maintained, the charging pumps shall be de-energized and charging flow paths closed as part of Required Action A.2.

<u>A.3</u>

If SDC loop requirements are not met, actions shall be taken immediately to suspend loading 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 water level of 23 ft above the irradiated fuel assemblies seated in the reactor vessel provides an adequate available heat sink. Suspending any operation that would increase the decay heat load, such as loading a fuel assembly, is a prudent action under this condition.

<u>A.4.1, A.4.2, A.5, A.6.1, and A.6.2</u>

If no SDC is in operation, the following actions must be taken:

a. the equipment hatch must be closed and secured with a minimum of four bolts or the containment outage door must be closed;

b. one door in each air lock must be closed; and

c. each penetration providing direct access from the containment atmosphere to the outside atmosphere must be either closed by a manual or automatic isolation valve, blind flange, or equivalent, or verified to be capable of being closed by an OPERABLE containment purge valve isolation system. This requirement is to be applied to each penetration separately. The decision to apply A.6.1 or A.6.2 is made for each penetration, depending on whether or not that penetration has an OPERABLE containment purge valve isolation system.

BASES

With SDC loop requirements not met, the potential exists for the coolant to boil and release radioactive gas to the containment atmosphere. Performing the actions described above ensure that all containment penetrations are either closed or can be closed so that the dose limits are not exceeded.

The Completion Time of four hours allows fixing of most SDC problems and is reasonable, based on the low probability of the coolant boiling in that time.

The emergency air lock temporary closure device cannot be credited for containment closure for a loss of shutdown cooling event. At least one door in the emergency air lock must be closed to satisfy this action statement.

SURVEILLANCE REQUIREMENTS

SR 3.9.4.1

This SR demonstrates that the SDC 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 controlled under the Surveillance Frequency Control Program.

REFERENCES

1. UFSAR, Section 9.2, "Shutdown Cooling System"

B 3.9 REFUELING OPERATIONS

B 3.9.5 Shutdown Cooling (SDC) and Coolant Circulation-Low Water Level

BASES

BACKGROUND

The purposes of the SDC System in MODE 6 are to remove decay heat and other residual heat from the RCS, to provide mixing of borated coolant, to provide sufficient coolant circulation to minimize the effects of a boron dilution accident, and to prevent boron stratification (Reference 1). Heat is removed from the RCS by circulating reactor coolant through the SDC heat exchanger(s), where the heat is transferred to the Component Cooling Water System via the SDC heat exchanger(s). The coolant is then returned to the RCS via the RCS cold leg(s). Operation of the SDC 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 SDC heat exchanger(s) and bypassing the heat exchanger(s). Mixing of the reactor coolant is maintained by this continuous circulation of reactor coolant through the SDC 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 inadequate cooling of the reactor fuel due to the resulting loss of coolant in the reactor vessel. Additionally, boiling of the reactor coolant could lead to a reduction in boron concentration in the coolant due to the boron plating out on components near the areas of the boiling activity, and due to the possible addition of water to the reactor vessel with a lower boron concentration than is required to keep the reactor subcritical. The loss of reactor coolant and the reduction of boron concentration in the reactor coolant would eventually challenge the integrity of the fuel cladding, which is a fission product barrier. Two loops of the SDC System are required to be OPERABLE, and one loop is required to be in operation in MODE 6, with the water level < 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel, to prevent this challenge.

Shutdown cooling and Coolant Circulation-Low Water Level satisfies 10 CFR 50.36(c)(2)(ii), Criterion 2.

LCO

In MODE 6, with the water level < 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel, both SDC loops must be OPERABLE. Additionally, one loop of the SDC System must be in operation in order to provide:

a. Removal of decay heat;

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

c. Indication of reactor coolant temperature.

An OPERABLE SDC loop consists of an SDC pump, a heat exchanger, valves, piping, instruments, and controls to ensure an OPERABLE flow path and to determine the low end temperature. An OPERABLE SDC loop is supported by a functional saltwater and component cooling water subsystem. Note that one functional saltwater and component cooling water subsystem may support both OPERABLE SDC loops, if its heat removal capacity is sufficient. The flow path starts in one of the RCS hot legs and is returned to the RCS cold legs. Both SDC pumps may be aligned to the Refueling Water Tank to support filling the refueling pool or for performance of required testing.

The LCO is modified by a note that allows one required SDC loop to be replaced by one spent fuel pool cooling loop when it is lined up to provide cooling flow to the irradiated fuel assemblies in the reactor core, and the heat generation rate of the core is below the heat removal capacity of the spent fuel cooling loop.

This LCO is modified by a Note that allows one SDC loop to be inoperable for a period of two hours provided the other loop is OPERABLE and in operation. Prior to declaring the loop inoperable, consideration should be given to the existing plant configuration. This consideration should include that the core time to boil is short, there is no draining operation to further reduce RCS water level and that the capability exists to inject borated water into the reactor vessel. This permits surveillance tests to be performed on the inoperable loop during a time when these tests are safe and possible.

This LCO is modified by a Note that permits the SDC pumps to be deenergized for ≤ 15 minutes when switching from one train to another. The circumstances for stopping both SDC pumps are to be limited to situations when the pump outage time is short and the core outlet temperature is maintained > 10°F below saturation temperature. The Note prohibits introduction of water with a boron concentration less than that required by LCO 3.9.1 or draining operations when SDC forced flow is stopped.

APPLICABILITY

Two SDC loops are required to be OPERABLE, and one SDC loop must be in operation in MODE 6, with the water level < 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel, to provide decay heat removal. Requirements for the SDC System in other MODEs are covered by LCOs in Section 3.4. MODE 6 requirements, with a water level ≥ 23 ft above the irradiated fuel assemblies seated in the reactor vessel, are covered in LCO 3.9.4.

ACTIONS

A.1 and A.2

If one SDC loop is inoperable, action shall be immediately initiated and continued until the SDC loop is restored to OPERABLE status and is in operation, or until the water level is ≥ 23 ft above the irradiated fuel assemblies seated in the reactor vessel. When the water level is established at ≥ 23 ft above the irradiated fuel assemblies seated in the reactor vessel, the Applicability will change to that of LCO 3.9.4, and only one SDC 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 SDC loop is in operation or no SDC loops are OPERABLE, 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 the minimum refueling boron concentration. This may result in an overall reduction in RCS boron concentration, but provides an acceptable margin to maintaining subcritical operation. In addition, to ensure compliance with the action is maintained, the charging pumps shall be de-energized and charging flow paths closed as part of Required Action B.1.

B.2

If no SDC loop is in operation or no SDC loops are OPERABLE, action shall be initiated immediately and continued without interruption to restore one SDC loop to OPERABLE status and operation. Since the unit is in Conditions A and B concurrently, the restoration of two OPERABLE SDC loops and one operating SDC loop should be accomplished expeditiously.

B.3.1, B.3.2, B.4, B.5.1, and B.5.2

If no SDC is in operation, the following actions must be taken:

a. the equipment hatch must be closed and secured with a minimum of four bolts or the containment outage door must be closed;

b. one door in each air lock must be closed; and

c. each penetration providing direct access from the containment atmosphere to the outside atmosphere must be either closed by a manual or automatic isolation valve, blind flange, or equivalent, or verified to be capable of being closed by an OPERABLE containment purge valve isolation system. This requirement is to be applied to each penetration separately. The decision to apply B.5.1 or B.5.2 is made for each penetration, depending on whether or not that penetration has an OPERABLE containment purge valve isolation system.

With SDC loop requirements not met, the potential exists for the coolant to boil and release radioactive gas to the containment atmosphere. Performing the actions described above ensure that all containment penetrations are either closed or can be closed so that the dose limits are not exceeded.

BASES

The Completion Time of four hours allows fixing of most SDC problems and is reasonable, based on the low probability of the coolant boiling in that time.

The emergency air lock temporary closure device cannot be credited for containment closure for a loss of shutdown cooling event. At least one door in the emergency air lock must be closed to satisfy this action statement.

SURVEILLANCE REQUIREMENTS

SR 3.9.5.1

This SR demonstrates that one SDC loop is operating 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. This SR also demonstrates that the other SDC loop is OPERABLE.

In addition, during operation of the SDC loop with the water level in the vicinity of the reactor vessel nozzles, the SDC loop flow rate determination must also consider the SDC pump suction requirements. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

SR 3.9.5.2

This SR demonstrates that the SDC 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 controlled under the Surveillance Frequency Control Program.

SR 3.9.5.3

Verification that the required pump and valves are OPERABLE ensures that an additional SDC loop 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 and valves. The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

BASES

REFERENCES	1.	UFSAR, Section 9.2, "Shutdown Cooling System"

B 3.9 REFUELING OPERATIONS

B 3.9.6 Refueling Pool Water Level

BASES

BACKGROUND	The movement of irradiated fuel assemblies within the Containment Structure requires a minimum water level of 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel. During refueling this maintains sufficient water level in the fuel transfer canal, the refueling pool, and the spent fuel pool. Sufficient water is necessary to retain iodine fission product activity in the water in the event of a fuel handling accident (References 1 and 2). Sufficient iodine activity would be retained to limit offsite doses from the accident to within the acceptance criteria given in Reference 2.
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 the fuel handling accident in the Containment Structure, postulated by Reference 1. A minimum water level of 23 ft allows a decontamination factor of 200 (Appendix B, Section 2 of Reference 1) to be used in the accident analysis for iodine. This relates to the assumption that 99.5% of the total iodine released from the pellet to cladding gap of all the dropped fuel assembly rods, is retained by the refueling pool water. The fuel pellet to cladding gap is assumed to contain 16% of I-131 and 10% of all other iodines (Reference 2). The fuel handling accident analysis inside the Containment Structure 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 within allowable limits (Reference 2). Refueling pool water level satisfies 10 CFR 50.36(c)(2)(ii), Criterion 2.
LCO	A minimum refueling pool water level of 23 ft above the irradiated fuel assemblies seated in the reactor vessel is required to ensure that the radiological consequences of a postulated fuel handling accident inside the Containment

BASES

Structure are within the acceptable limits given in Reference 2.

APPLICABILITY

LCO 3.9.6 is applicable when moving irradiated fuel assemblies in the Containment Structure. The LCO minimizes the possibility of a fuel handling accident in the Containment Structure that is beyond the assumptions of the safety analysis. If irradiated fuel is not present in the Containment Structure, 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 3.7.13.

ACTIONS

A.1

With a water level of < 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel, all operations involving movement of irradiated fuel assemblies, shall be suspended immediately to ensure that a fuel handling accident cannot occur.

The suspension of fuel movement shall not stop the movement of a component to a safe position.

SURVEILLANCE REQUIREMENTS

SR 3.9.6.1

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

The Surveillance Frequency is controlled under the Surveillance Frequency Control Program.

REFERENCES

1. Regulatory Guide 1.183, Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors, July 2000
2. UFSAR, Section 14.18, "Fuel Handling Incident"