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**Constellation Energy Group**

June 7, 2004

U. S. Nuclear Regulatory Commission
Washington, DC 20555

ATTENTION: Document Control Desk

SUBJECT: Calvert Cliffs Nuclear Power Plant
Unit Nos. 1 & 2; Docket Nos. 50-317 & 50-318
License Amendment Request: Use of Alternate Decay Heat Removal in Mode 6 Refueling

REFERENCE: (a) Letter from Mr. R. H. Bryan (WOG) to Document Control Desk (NRC), dated May 12, 2003, Transmittal of Report WCAP-15872 (Non-Proprietary), "Use of Alternate Decay Heat Removal in Mode 6 Refueling," Revision 00, January 2003

The Calvert Cliffs Nuclear Power Plant, Inc. hereby requests an Amendment to its Renewed Operating License Nos. DPR-53 and DPR-69 for Calvert Cliffs Unit Nos. 1 and 2, respectively, with the submittal of the proposed changes to the Technical Specifications.

This change proposes to revise Calvert Cliffs Nuclear Power Plant Technical Specification 3.9.4, "Shutdown Cooling (SDC) and Coolant Circulation-High Water Level," to incorporate the use of an alternate cooling method to function as a path for decay heat removal when in Mode 6 with the refueling pool fully flooded. The spent fuel pool cooling system is the alternative cooling method intended to be used as a substitute for the SDC system during refueling operations, including during fuel movement. In the alternate cooling method, decay heat is transferred by natural convection circulation from the reactor cavity into the refueling pool, then by forced convection into the cooling system aligned via the alternate cooling method. This proposed amendment is based on the justification and methods contained in Westinghouse Topical Report currently under review by the Nuclear Regulatory Commission (Reference a).

An alternate refueling pool heat removal path permits certain maintenance activities to be performed on the SDC system in parallel with other plant operations while in Mode 6, refueling. Such capability provides flexibility in scheduling and performing maintenance and can avoid entry into Technical Specification action statements. The resulting benefits include better utilization of plant resources, outage flexibility, reduced personnel exposure, and increased safety.

The technical basis and significant hazards consideration for this proposed change are provided in Attachment (1). Marked up pages of the affected Technical Specifications are provided in

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Attachment (2). Typed Technical Specification pages are provided in Attachment (3). Note that amendments approved by the Nuclear Regulatory Commission during the review period for this request may change these typed pages. The Technical Specification Bases will be changed as appropriate to support this amendment.

This proposed change to the Technical Specifications and our determination of significant hazards have been reviewed by our Plant Operations and Safety Review Committee and Nuclear Safety Review Board, and they have concluded that implementation of these changes will not result in an undue risk to the health and safety of the public.

We plan to use the proposed decay heat removal alignment in our upcoming refueling outage scheduled to begin in early February 2005. To that end, we request that this change be approved by December 1, 2004, with a 60-day implementation period to allow adequate time for the required procedural changes and outage schedule adjustment.

Should you have questions regarding this matter, we will be pleased to discuss them with you.

Very truly yours,

**STATE OF MARYLAND** :
: **TO WIT:**
**COUNTY OF CALVERT** :

I, Kevin J. Nietmann, being duly sworn, state that I am Plant General Manager - Calvert Cliffs Nuclear Power Plant, Inc. (CCNPP), and that I am duly authorized to execute and file this License Amendment Request on behalf of CCNPP. To the best of my knowledge and belief, the statements contained in this document are true and correct. To the extent that these statements are not based on my personal knowledge, they are based upon information provided by other CCNPP employees and/or consultants. Such information has been reviewed in accordance with company practice and I believe it to be reliable.

Subscribed and sworn before me, a Notary Public in and for the State of Maryland and County of Calvert, this 7 day of June, 2004.

**WITNESS** my Hand and Notarial Seal: Notary Public

My Commission Expires: 7/1/06
Date

KJN/GT/bjd

Attachments: (1) Technical Basis and Significant Hazards Consideration
(2) Marked up Technical Specification Pages
(3) Final Technical Specification Pages

cc: J. Petro, Esquire
J. E. Silberg, Esquire
Director, Project Directorate I-1, NRC
G. S. Vissing, NRC
H. J. Miller, NRC
Resident Inspector, NRC
R. I. McLean, DNR

## ATTACHMENT (1)

# TECHNICAL BASIS AND

# SIGNIFICANT HAZARDS CONSIDERATION

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## 1.0 DESCRIPTION

This letter is a request to amend Renewed Operating License Numbers DPR-53 and DPR-69 for Calvert Cliffs Units 1 and 2. The proposed amendment involves a revision to Calvert Cliffs Nuclear Power Plant (CCNPP) Technical Specification 3.9.4, "Shutdown Cooling (SDC) and Coolant Circulation-High Water Level," to incorporate the use of an alternate cooling method to function as a path for decay heat removal when in Mode 6 with the refueling pool fully flooded. The spent fuel pool cooling system is the alternative cooling method intended to be used as a substitute for the SDC system during refueling operations, including during fuel movement.

## 2.0 PROPOSED CHANGE

Technical Specification Limiting Condition for Operation (LCO) 3.9.4 requires that one SDC loop shall be OPERABLE and operating when in Mode 6, with water level ≥ 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel. This amendment request proposes to add the option of using spent fuel pool cooling loop for LCO 3.9.4 in lieu of a SDC loop. The marked-up pages in Attachment (2) contain the detailed proposed changes.

## 3.0 BACKGROUND

The purposes of the SDC system in Mode 6 (Refueling) are to remove decay heat and other residual heat from the Reactor Coolant System (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.

The proposed alternate heat removal alignment is a specific alignment of existing plant systems to substitute for conventional decay heat removal as performed by the SDC system. When aligned in the alternate heat removal alignment, the plant can remove the SDC system from service for any purpose. In the CCNPP alternate cooling alignment, the spent fuel pool cooling pump takes suction from the refueling pool, then after passing through the spent fuel pool heat exchanger, the flow is directed back into the refueling pool. This flow is directed into the refueling pool through piping near the bottom of the pool. The suction from the refueling pool to the spent fuel pool cooling line is through a drain in the bottom of the refueling pool, at the side of the reactor cavity opposite the inlet point. This arrangement results in cooled inventory drawn across the pool region directly above the open vessel. Natural convection and mixing are used to transfer decay heat from the reactor core to the refueling pool water.

By incorporating the use of an alternate cooling method as a stand-alone heat removal system in Mode 6 with the refueling pool fully flooded, outage flexibility can be greatly enhanced. The following are some of the benefits:

- Fewer full core off-loads when encountering shutdown cooling related problems (e.g., a stuck safety injection valve requiring that shutdown cooling flow be secured for repairs).
- Conducting leak rate tests on common valves on SDC lines in Mode 6 without time restriction for securing SDC.

- Avoiding the need for immediate Containment closure if shutdown cooling operability is lost and an alternate heat removal method is operable.

## 4.0 TECHNICAL ANALYSIS

Only one SDC loop is required for decay heat removal in Mode 6, with water level $\geq$ 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel. The volume of water above the irradiated fuel assemblies seated in the reactor vessel provides backup decay heat removal capability. The proposed amendment would allow the replacement of the one required SDC loop for decay heat removal in Mode 6, with water level $\geq$ 23 ft above the top of the irradiated fuel assemblies with one spent fuel pool cooling loop. Current CCNPP Technical Specification 3.9.5 already allows replacement of one of the two required SDC loops by one spent fuel pool cooling loop during Mode 6 operation, with water level $\leq$ 23 ft, provided the core heat generation rate is less than the heat removal capacity of the spent fuel cooling loop.

### 4.1 Qualification of CCNPP's Alternate Heat Removal Capacity

Reference (2), which was benchmarked with CCNPP specific data, establishes the technical bases for the adequacy of the CCNPP spent fuel pool cooling system heat removal capacity for decay heat removal in Mode 6, with water level $\geq$ 23 ft. The alternate heat removal alignment functions by circulating the refueling pool water through a pump and heat exchanger before returning the cooled water to the refueling pool. Natural convection and mixing are used to transfer decay heat from the reactor core to the refueling pool water. Natural circulation cooling of the reactor core while the refueling cavity is flooded and the normal SDC system not in-service will result in a thermal plume centered approximately above the reactor vessel. This plume will mix with the refueling pool water resulting in a thermal distribution that varies depending on the refueling pool fluid temperature and local flow velocities within the refueling pool resulting from the alternate cooling alignment.

Reference (2) contains a model that was developed to calculate the natural convection flow between the core and the refueling pool. The natural circulation function of the alternate heat removal alignment already exists in that this passive process is inherently brought into play to remove decay heat from the core each time the shutdown cooling system is deliberately secured when in a refueling mode as allowed by Technical Specification 3.9.4. The resulting natural circulation flow rates through the core are found to be as much as the traditional shutdown cooling flow rate of 3000 gpm, which ensures adequate core cooling. Mixing of the forced cooling flow from the spent fuel pool cooling system through the refueling pool with the thermal plume from the core assures adequate heat removal.

Controlled tests of the alternate heat removal system alignment in operation at CCNPP Unit 2 were performed and data collected during the spring 2001 refueling outage. As described in Reference (2), these tests were used to verify theoretical predictions of the refueling cavity temperatures when using the alternate heat removal alignment. The results showed good agreement with predictions, thus confirming the technical bases for the alternate heat removal alignment.

The limits on the use of the alternate alignment for the removal of decay heat while removing shutdown cooling from service and moving fuel, depend on the temperatures in the refueling pool. The refueling pool temperature, in turn, depends on the ability of the aligned cooling systems to reject heat to the ultimate heat sink. This heat rejection is a function of the performance of the heat exchangers used to reject the heat and the heat sink temperature. The limiting condition for use of the alternate heat removal system will be when the decay heat is first low enough to satisfy the refueling pool temperature limit for a given heat sink temperature. The CCNPP operating limit for the refueling pool is 140°F. With a 90°F ultimate heat sink temperature, a minimum decay time of at least five days is required to maintain the refueling pool at or below the operating limit using a spent fuel pool cooling loop. A minimum decay heat value of ~ 3.0 MW is also required to maintain enough natural circulation to provide sufficient mixing of borated coolant to minimize the effects of boron dilution accident and to prevent boron stratification.

### 4.2 Qualitative Risk Assessment

Loss of Circulation

The risk of losing cooling is less when using a spent fuel pool cooling loop as an alternate to SDC due to its simplicity. Its operational simplicity and reliability for alternate heat removal use have been well established at CCNPP, including the documented test results from the Spring 2001 outage where decay heat removal was via alternate heat removal system for several days (Reference 2). A loss of circulation has never occurred at CCNPP when using the spent fuel pool cooling system for alternate heat removal. An operable shutdown cooling loop requires successful operation of an air operated flow control valve and a separate air operated temperature flow control valve. The spent fuel pool cooling system is throttled via a hand valve and no automatic operation is required.

Loss of Inventory

Given the large inventory available when the refueling pool is filled, and the low decay heat, the only credible sequences that lead to core damage involve loss of inventory. In Mode 6, the potential for gross inventory loss can exist for conditions such as failure of the reactor vessel flange seal or any of the steam generator nozzle dams. Gross inventory loss can also occur due to inadvertent draindown during plant evolutions which involve cooling loop alignments or draining the RCS (and the refueling pool). When using the alternate heat removal system, the consequences of a large loss of inventory event are significant since alternate heat removal needs the refueling pool inventory to function. However, CCNPP has permanent reactor vessel cavity seals installed in both units. The nozzle dam used at CCNPP is provided with backup to the air supplies for the bladders. Accordingly, a large loss of inventory event is a very low probability event. Moreover, as mentioned above, current CCNPP Technical Specifications allow use of spent fuel pool cooling system for decay heat removal. The only change is that SDC will not be required as a backup. Thus, the probability and consequence of an inadvertent draindown is not increased. Further, plant procedures require monitoring of the refueling pool and spent fuel pool levels on initiation of alternate cooling, preventing a significant inadvertent draindown of either pool.

Boron Dilution

A boron dilution event is caused by malfunction or an inadvertent operation of Chemical and Volume Control System that results in a dilution of the active portion of the RCS. The proposed amendment does not involve a physical alteration of the plant or change the plant configuration that impacts the operation of the Chemical and Volume Control System. In the alternate heat removal alignment, natural circulation flow through the core and forced cooling flow from the spent fuel pool system provide sufficient mixing of borated coolant to minimize the effects of boron dilution accident and to prevent boron stratification. Therefore, the use of alternate heat removal alignment to remove decay heat does not change the probability or consequence of a boron dilution event.

Time to Boil

The time to boil the water in the RCS is the basis for Technical Specification LCO 3.9.4 that only a single shutdown cooling loop needs to be operable when the refueling pool is fully flooded. Following a loss of shutdown cooling, the time to boil when the refueling pool is flooded varies from approximately 16 hours at 15 days after shutdown, to nearly 20 hours at 25 days after shutdown. For comparison, the time to boil after loss of alternate heat removal with the refueling pool flooded ranges from approximately 13 hours at

15 days after shutdown, to nearly 17 hours at 25 days after shutdown. Using alternate heat removal results in a shorter time to boil since the refueling pool temperature is predicted to be warmer when using an alternate heat removal alignment than when the SDC system is in operation. If decay heat removal is not restored, the time to core uncovery by boiling is measured in days for either loss of shutdown cooling or loss of alternate heat removal. Thus, the few hours difference in time to boil resulting from loss of alternate heat removal as compared with loss of shutdown cooling is not significant in terms of the total time to core uncovery.

Fuel Bundle Handling

When using alternate heat removal, fuel handling is simplified when moving bundles in the vicinity of a hot leg as there is no shutdown cooling flow. Fluid currents in the refueling pool of approximately one foot/second may exist when using alternate heat removal; such currents are larger than the essentially zero flow rate in the refueling pool when using shutdown cooling. The flow-induced horizontal hydrodynamic forces on a fuel bundle (estimated at ~10 pounds) when using alternate heat removal is insignificant when compared to the approximate 1100 pound wet weight of a bundle. On this basis, the risks of a fuel handling accident caused by hydrodynamic loads in either the refueling pool or the reactor vessel under either method of decay heat removal are judged essentially equal.

Visibility of Refueling Pool Cavity Water

Thermal gradients within the refueling pool ("heat waves") may diffract light, thereby introducing an optical distortion that could affect the operator's view when identifying fuel bundles. However, experience to date with the alternate heat removal alignment at CCNPP has shown such optical distortion to be minor and has not caused operational problems. Based on these observations, visibility when using the alternate heat removal alignment will not hinder fuel movement.

## 5.0 NO SIGNIFICANT HAZARDS CONSIDERATION

The proposed changes have been evaluated against the standards in 10 CFR 50.92 and have been determined to not involve a significant hazards consideration in that operation of the facility in accordance with the proposed amendments:

1. *Would not involve a significant increase in the probability or consequences of an accident previously evaluated.*

   This license amendment request proposes to incorporate the use of an alternate cooling method to function as a path for decay heat removal when in Mode 6, with water level ≥ 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel. The spent fuel pool cooling system is the alternative cooling method intended to be used as a substitute for the shutdown cooling (SDC) system during refueling operations, including during fuel movement. Current Calvert Cliffs Nuclear Power Plant Technical Specifications already allow replacement of one of the two required SDC loops by one spent fuel pool cooling loop during Mode 6 operation, with water level less than 23 feet. The only change is that SDC will not be required as a backup since the proposed amendment would allow the replacement of the one required SDC loop with one spent fuel pool cooling loop, with the fully flooded refueling pool providing backup decay heat removal capability as it currently does. Since the spent fuel pool cooling system has proven reliable with less than 23 feet of water over the fuel, using the system with ≥ 23 feet of water over the fuel does not increase the probability or consequence of an accident previously evaluated.

   The impact of using spent fuel pool cooling on fuel handling accidents has been evaluated. During fuel movement, fluid currents in the refueling pool of approximately one foot/second may exist when using alternate heat removal; such currents are larger than the essentially zero flow rate in the refueling pool when using shutdown cooling. However, the flow-induced horizontal hydrodynamic forces on a fuel bundle (estimated at ~10 pounds) when using alternate heat removal is insignificant when compared to the approximate 1100 pound wet weight of a bundle. Therefore, this change does not involve a significant increase in the probability of fuel handling accident previously evaluated. The consequences of a fuel handling accident previously evaluated is not impacted by this change.

A boron dilution event is caused by malfunction or an inadvertent operation of Chemical and Volume Control System that results in a dilution of the active portion of the RCS. The proposed amendment does not involve a physical alteration of the plant or change the plant configuration that impacts the operation of the Chemical and Volume Control System. In the alternate heat removal alignment, natural circulation flow through the core and forced cooling flow from the spent fuel pool system provide sufficient mixing of borated coolant to minimize the effects of boron dilution accident and to prevent boron stratification. Therefore, the use of alternate heat removal alignment to remove decay heat does not change the probability or consequence of a boron dilution event.

Therefore, this proposed license amendment does not significantly increase the probability or consequences of an accident previously evaluated.

2. *Would not create the possibility of a new or different type of accident from any accident previously evaluated.*

The proposed amendment does not involve a physical alteration of the plant or change the plant configuration. As described in Item 1 above, current Calvert Cliffs Nuclear Power Plant Technical Specifications already allow use of the proposed alternate heat removal method; therefore, it does not require any new or unusual operator actions. The amendment does not alter the way any structure, system, or component functions and does not alter the manner in which the plant is operated. It does not introduce any new failure modes.

Therefore, this proposed license amendment does not create the possibility of a new or different type of accident from any accident previously evaluated.

3. *Would not involve a significant reduction in the margin of safety.*

As described in Item 1 above, current Technical Specifications already allow use of spent fuel pool cooling for decay heat removal in Mode 6. The only change is, in the proposed amendment, a spent fuel pool cooling system is allowed to be used as an alternative to SDC when only a fully flooded refueling pool is credited as a backup for decay heat removal. Using alternate heat removal results in a shorter time (~3 hours) to boil since the refueling pool temperature is predicted to be slightly warmer when using the spent fuel pool cooling alignment than when the SDC system is in operation. If decay heat removal is not restored, the time to core uncovery by boiling is measured in days for either loss of shutdown cooling or loss of alternate heat removal. Thus, the few hours difference in time to boil resulting from loss of alternate heat removal as compared with loss of shutdown cooling is not significant in terms of the total time to core uncovery.

Therefore, this proposed license amendment does not involve a significant reduction in the margin of safety.

## 6.0 ENVIRONMENTAL CONSIDERATION

We have determined that operation with the proposed amendment would not result in any significant change in the types or amounts of any effluents that may be released offsite, nor would it result in any significant increase in individual or cumulative occupational radiation exposure. Therefore, the proposed amendment is eligible for categorical exclusion as set forth in 10 CFR 51.22(c)(9). Pursuant to 10 CFR 51.22(b), no environmental impact statement or environmental assessment is needed in connection with the proposed amendment.

## 7.0 PRECEDENT

None.

## 8.0 REFERENCES

1. Calvert Cliffs Nuclear Power Plant, Updated Final Safety Analysis Report, Revision 34
2. WCAP-15872 (Non-Proprietary), "Use of Alternate Decay Heat Removal in Mode 6 Refueling," Revision 00, January 2003, transmitted by letter from R. H. Bryan (WOG) to Document Control Desk (NRC), dated May 12, 2003

## ATTACHMENT (2)

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## MARKED UP TECHNICAL SPECIFICATION PAGES

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3.9.4-1

3.9.4-3

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Calvert Cliffs Nuclear Power Plant, Inc.
June 7, 2004

## 3.9 REFUELING OPERATIONS

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

LCO 3.9.4 One SDC loop shall be OPERABLE and in operation.

---------------------------- NOTES ----------------------------

~~1.~~ 2 The required SDC loop may be not in operation for ≤ 1 hour per 8 hour period, provided no operations are permitted that would cause introduction of coolant into the Reactor Coolant System with boron concentration less than that required to meet the minimum boron concentration of LCO 3.9.1.

~~2.~~ 3 The shutdown cooling pumps may be removed from 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, provided:

a. no operations are permitted that would cause introduction of coolant into Reactor Coolant System with boron concentration less than that required to meet the minimum boron concentration of LCO 3.9.1,

b. CORE ALTERATIONS are suspended, and

c. all containment penetrations are in the status described in LCO 3.9.3.

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APPLICABILITY: MODE 6 with the water level ≥ 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel.

1. The required SDC loop is not required to be OPERABLE or in operation provided a spent fuel pool cooling loop is in operation providing cooling to irradiated fuel in the reactor vessel and is capable of removing the generated decay heat, and providing sufficient mixing of borated coolant

Required

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.9.4.1 | Verify one SDC loop is in operation and circulating reactor coolant at a flow rate of ≥ 1500 gpm. | 12 hours<br>12 hours |
| SR 3.9.4.2 | Verify one required spent fuel pool cooling loop is in operation capable of maintaining refueling pool water bulk temperature to ≤ 140°F and providing sufficient mixing of borated coolant. | |

# ATTACHMENT (3)

## FINAL TECHNICAL SPECIFICATION PAGES

## 3.9 REFUELING OPERATIONS

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

LCO 3.9.4 One SDC loop shall be OPERABLE and in operation.

-------------------------- NOTES --------------------------

1. The required SDC loop is not required to be OPERABLE or in operation provided a spent fuel pool cooling loop is in operation providing cooling to irradiated fuel in the reactor vessel and is capable of removing the generated decay heat, and providing sufficient mixing of borated coolant.

2. The required SDC loop may be not in operation for ≤ 1 hour per 8 hour period, provided no operations are permitted that would cause introduction of coolant into the Reactor Coolant System with boron concentration less than that required to meet the minimum boron concentration of LCO 3.9.1.

3. The shutdown cooling pumps may be removed from 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, provided:

   a. no operations are permitted that would cause introduction of coolant into Reactor Coolant System with boron concentration less than that required to meet the minimum boron concentration of LCO 3.9.1,

   b. CORE ALTERATIONS are suspended, and

   c. all containment penetrations are in the status described in LCO 3.9.3.

-----------------------------------------------------------

APPLICABILITY: MODE 6 with the water level ≥ 23 ft above the top of the irradiated fuel assemblies seated in the reactor vessel.

ACTIONS

| CONDITION | REQUIRED ACTION | COMPLETION TIME |
|---|---|---|
| A. One required SDC loop inoperable or not in operation. | A.1 Initiate action to restore SDC loop to OPERABLE status and operation. | Immediately |
| | AND | |
| | A.2 Suspend operations that would cause introduction of coolant into the RCS with boron concentration less than required to meet the boron concentration of LCO 3.9.1. | Immediately |
| | AND | |
| | A.3 Suspend loading of irradiated fuel assemblies in the core. | Immediately |
| | AND | |
| | A.4 Close all containment penetrations providing direct access from containment atmosphere to outside atmosphere. | 4 hours |

SURVEILLANCE REQUIREMENTS

| SURVEILLANCE | | FREQUENCY |
|---|---|---|
| SR 3.9.4.1 | Verify one required SDC loop is in operation and circulating reactor coolant at a flow rate of ≥ 1500 gpm. | 12 hours |
| SR 3.9.4.2 | Verify one required spent fuel pool cooling loop is in operation capable of maintaining refueling pool water bulk temperature to ≤ 140°F and providing sufficient mixing of borated coolant. | 12 hours |