Original question: #77 006G2.4.9

006G2.4.9
Question 77

Recommend DELETING question 77

Reason:

The stem of the question does not provide all the necessary information in that it does not bound the question to a specific Technical Specification. UOP-1.1 (see pages 5 through 8) references both Tech Spec 3.4.6 and 3.5.3 in the body of the procedure. Since the stem does not specify which Tech Spec to evaluate and uses the words "RHR system(s) is/are OPERABLE", it is reasonable to evaluate either Tech Spec for the given situation. The ambiguity of the stem caused five (5) of ten (10) students to incorrectly diagnose the question's intent.

Applicants stated in the exam review they did not ask any questions about question 77 because when they read the stem they either understood it as referring to Tech Spec 3.4.6 **or** Tech Spec 3.5.3, based on the wording in the stem that captured their attention.
For example:
Case #1
If the applicant read the wording "ECCS alignment" and assumed the ECCS alignment is being evaluated, **then** they chose "ONLY the 1A RHR system is OPERABLE". Tech Spec 3.5.3 and the Notes and Cautions of UOP-1.1 say that the associated train of ECCS is inoperable if any RHR pump is operated with RCS temperatures >225°F.
Case #2
If the applicant read the wording "RHR system(s)", and looking at the stem information saw two RCPs running, **then** they chose "BOTH RHR systems are OPERABLE". Tech Spec 3.4.6 says the RHR systems are operable if they are "capable of providing forced flow to an OPERABLE RHR heat exchanger. RCPs and RHR pumps are OPERABLE if they are capable of being powered and are able to provide forced flow if required."

Background:
The RHR system has several functions.
Function 1:
RHR is typically referred to as the Residual Heat Removal system and is used to remove heat (either decay heat or RCP heat) from the RCS. It can be procedurally operated up to 350°F but is typically secured prior to 225°F to ensure the ECCS trains are operable.
Function 2:
The RHR system is also referred to as Low Head safety injection and is part of the ECCS system. Tech Spec bases (see page 20) refers to RHR as the "residual heat removal (RHR)(low head)" system. (page B3.5.3-1)

The system can be OPERABLE for one function and INOPERABLE for the other function, as is the case in this question.
There are two Tech Specs that involve the RHR system when in MODE 4.

Tech Spec 3.4.6: (see pages 10 and 11) RCS Loops—MODE 4, Two loops consisting of any combination of RCS loops and residual heat removal (RHR) loops shall be OPERABLE, and one loop shall be in operation.
This Tech Spec is always in effect in Mode 4 and is evaluated every 12 hours. The evaluation of the RHR loops per Bases is that the RHR pump(s) is/are **capable** of providing forced flow to an OPERABLE RHR heat exchanger if required. This means capable of being aligned to the RCS

and started exactly as the 1B RHR pump is started in the question stem. Since there is no evidence of cavitation and no mention of any problems, the applicant would evaluate the 1B RHR system is OPERABLE. Since the 1A RHR system is in the ECCS alignment, it, too, is capable of being aligned in the shutdown cooling mode and is therefore OPERABLE as well.
If the stem is evaluated for the RCS Loops—MODE 4 per Tech Spec 3.4.6, BOTH RHR systems are OPERABLE.

Tech Spec 3.5.3: (see pages 17 and 19) ECCS—Shutdown, One ECCS train shall be OPERABLE in MODE 4.
This Tech Spec is always in effect in Mode 4 and evaluated continuously. Starting the 1B RHR pump causes the suction piping to fill with hot (330°F) water. IF a LOCA were to occur and the 1B RHR system was subsequently re-aligned for ECCS operation (**permitted by TS 3.5.3**), the suction pressure would be below the saturation conditions for the 330°F water and risk vapor binding the LHSI pump. (see page 9) This makes the 1B RHR pump INOPERABLE for the ECCS function.
If the stem is evaluated for the ECCS function per Tech Spec 3.5.3, then only the 1A RHR system is OPERABLE.

Depending on which Tech Spec is evaluated and **which function** the RHR system is being evaluated for, either answer of **BOTH** or **ONLY 1A** is correct.

Further information:
We removed the Tech Spec reference that bounded the question during the exam prep week (see form 401-9). The reason the Tech Spec reference was originally provided was to point the applicant to the Tech Spec that was to be evaluated for the mode change.
The feedback section of the question does not include LCO 3.4.6 since the original intent was NOT to evaluate this Tech Spec. Validations up to this point had a Tech Spec reference that guided them to the ECCS Tech Spec for evaluation and bounded the answer choices. After the question was changed five (5) SROs validated the question. These were very experienced SROs who had a clearer understanding of the RHR suction temperature issues due to CR 2010106118 (see page 9), and having to evaluate and apply that guidance to RHR and subsequent mode changes during the 2010 Fall outage. Since this OE was fresh on their minds, they were potentially biased when they validated the question and all selected either C or D, "ONLY the 1A" choice. All people involved were preconditioned as to what the stem was evaluating and missed the important connection of the function of RHR to Tech Spec 3.4.6.

Conclusion:
The stem of the question does not provide enough information to allow the applicant to properly evaluate the RHR system functions. In one specified system function the RHR system is OPERABLE and in the other specified system function the RHR system is INOPERABLE. These two viewpoints are diametrically opposed, containing conflicting information as described in NUREG-1021, ES-403 page 3 and 4 of 6; section D.1.c and this question should be deleted.

Original question:

#77 006G2.4.9
Unit 1 is in MODE 4, the following conditions exist:

- RCS temperature is 330°F and rising.
- RCS pressure is 350 psig.
- 1A and 1B RCPs are running.
- Both RHR pumps are secured with the following alignment:
  — 1A RHR is in the ECCS alignment.
  — 1B RHR is aligned for shutdown cooling.

The OATC starts the 1B RHR pump to stop the RCS temperature rise.

Which one of the following completes the statements below per UOP-1.1, Startup of Unit from Cold Shutdown to Hot Standby?

_(1)_ RHR system(s) is/are OPERABLE.

A mode change from Mode 4 to Mode 3 _(2)_ currently allowed.

	(1)	(2)
A.	BOTH	IS
B.	BOTH	is NOT
C.	ONLY the 1A	IS
D.	ONLY the 1A	is NOT

Feedback:

UOP-1.1, ver 92, P&L 3.2 provides the following information:
RHR pumps shall NOT be operated in cooldown operation at RCS temperatures >225°F. If any RHR pump is **operated** in cooldown operation with RCS temperature **>225°F, then declare the associated train of ECCS inoperable and do not enter Mode 3 until all portions of RHR piping is <225°F.** One train of ECCS must be operable in Mode 4. (TS 3.5.3) (CR 2010106118)

A. Incorrect 1) See above. Starting the 1B RHR pump causes the suction piping to fill with warm water. IF a LOCA were to occur and the 1B RHR system subsequently re-aligned for ECCS operation (**permitted by TS 3.5.3**), the suction pressure would be below the saturation conditions for the 225°F and risk vapor binding the LHSI pump.
Plausible: TS 3.5.3 contains an amplifying NOTE which states that, "**An RHR train may be considered OPERABLE during alignment and operation for decay heat removal**, if capable of **being manually realigned to the ECCS mode of operation.**"
2) See C.2, This would be correct if 1B RHR is shutdown and permitted to cool <225°F per UOP-1.1, P&L 3.2.
Plausible **if Part 1 were incorrectly assessed** as OPERABLE, then one might consider MODE 3 entry permitted.

B. Incorrect 1) See A.1
2) TS 3.5.3 requires Both trains to be aligned for ECCS operation (automatic start) to be considered operable. This condition must be met prior to MODE change.
Plausible: IF one were to incorrectly assess operability of 1B RHR per UOP-1.1 guidance with regard to TS 3.5.3, but recognize that 1B RHR must first be aligned to ECCS mode of operation and the autostart capability restored (SOP-7.0 Appendix 11).

C. Incorrect 1) see D.1
2) TS 3.5.2 requires both trains to be operable to satisfy MODE 3 entry.
Plausible: A candidate might select this answer choice under **a common misapplication of TS 3.0.4.b** and the NOTE within SOP-0.13, v24.0 section 3.1.5 provides a NOTE which states:

> **"LCO 3.0.4a. and 13.0.4a allows mode transition for inoperable equipment when the TS/TR associated actions to be entered** permit continued operation in the mode or other specified condition for an unlimited period of time. **TIA 2009-005 states that completion of those actions prior to entering the mode is not a requirement for compliance with LCO 3.0.4a or 13.0.4a.** (Ref: CR 2010106781)

— ONE might believe that although 1B is inoperable, for auto start, manual alignment could easily be achieved within the Completion time of Condition A.1 (72 hours) of LCO 3.5.2.

D. Correct 1) The 1B RHR system is **inoperable due to running the pump >225°F. IF operated in Cooldown alignment at this temp,** the RHR pump is in danger of being vapor bound **IF re-aligned for ECCS cooling.**
2) UOP-1.1, P&L3.2 specifically prevents advancing to MODE 3 until all RHR components have cooled to <225°F. Further, MODE 3 TS 3.5.2 requires BOTH trains to be aligned in the ECCS mode of operation and capable of AUTO-START from an SI signal. While aligned in the SOP-7.0, shutdown cooling mode of operation, the RHR pump Auto-start feature is disabled (SOP-7.0, Appendix 11).

Basis for meeting K/A:
a) This involves the ECCS alignment of the LHSI system. When changing modes and coming up in temperature the LHSI system (ECCS) suction piping has to remain <225°F to prevent voiding in the pump impeller.
b) This is a key part of the operability of the system. In mode 4 there only has to be one pump operable, and credit can be taken for Manual alignment to the ECCS mode of operation, whereas in mode 3 there has to be 2 LHSI pumps operable and each must be aligned for automatic ECCS mode of operation. This question tests the operability call for the LHSI pumps during shutdown conditions (which is the mitigation strategy) and a subsequent mode change determination.
c) **The accident mitigation strategy is to keep at least ONE RHR LOOP operable while in MODE 4 (or to prevent entering a MODE where the strategy could not be met),** such that upon the initiation of an accident (LOCA) the ECCS system could be aligned to makeup to the RCS.

2.10 The N-16 Primary to Secondary Leak Detection System has been placed in service per FNP-1-SOP-69.0, N-16 Primary to Secondary Leak Detection System.

_____

_____ / _____

2.11 Verify 1F 600V MCC aligned to Unit 1.

_____

_____ / _____

3.0 Precautions and Limitations

3.1 Prior to any mode change a formal brief will be conducted to ensure all mode change requirements have been met. (AI-2004202290)

3.2 RHR pumps shall NOT be operated in cooldown operation at RCS temperatures >225°F. If any RHR pump is operated in cooldown operation with RCS temperature >225°F, then declare the associated train of ECCS inoperable and do not enter Mode 3 until all portions of RHR piping is <225°F. One train of ECCS must be operable in Mode 4. (TS 3.5.3) (CR 2010106118)

3.3 Prior to starting any RCP, consideration should be given to raising applicable bus voltage to the upper limit of its acceptable band (3900 – 4200 volts). This consideration is due in part to a known issue with the RCP motor protective relaying causing inappropriate trips during motor starting. This issue is exaggerated when bus voltage is low and/or other large loads are already in service on the applicable bus and/or transformer, i.e. Circ Water Motors. (AI 2010200391)

3.4 Temperatures and Pressures:

3.4.1 The RHR system must be isolated from the RCS before the following:

- RCS temperature reaches 350°F, Or
- RCS pressure reaches 427 psig, Or
- The pressurizer temperature reaches 475°F.

3.4.2 Do not isolate RHR from the RCS until all RCS cold legs are > 325°F.

3.4.3 Power must be removed from B Train RCS loop isolation valves when RCS temperature > 350°F due to the potential for a fire induced cable failure opening both valves.(CR 2005103659)

3.4.4 Do not operate the RCPs when the number 1 seal differential pressure is less than 210 psid or VCT pressure is less than 18 psig.

3.4.5 Do not exceed RCP seal injection temperature of 130°F.

3.4.6 Maintain RCS heatup rates within limits of the Pressure Temperature Limits Report, Figure 2-1.

3.4.7 The maximum allowable heatup rate for the pressurizer is 100°F/hr.

4.5 Mode 5 (loops filled) RHR requirements:

- Two trains of RHR are OPERABLE with one train in service.
- An alternative to this requirement allowed by Technical Specifications is "Three filled Reactor Coolant loops and at least two Steam Generator levels greater than or equal to 75% of wide range indication may be substituted for one operable RHR loop."
- The RCS loops must be intact (capable of being pressurized) and filled, otherwise gases can come out of solution and accumulate in the SG U-bend region preventing natural circulation cooling capability, which is the basis for this alternative.
- RCS loop operability requirements per Tech. Spec. 3.4.7 require a Steam Generator wide range level of greater than or equal to 75% wide range indication.

4.6 When in Mode 3 reactor coolant pump seal injection flow shall be within Technical Specification 3.5.5 limits.

4.7 In Mode 3, Tech Spec 3.3.3 requires 2 channels of RCS Hot Leg Temperature and RCS Cold Leg Temperature to be operable. The performance of RTD cross calibration testing makes the associated channel RCS temperature instruments inoperable. Tech Spec 3.3.4 requires Loop A RCS Hot Leg Temperature and RCS Cold Leg Temperature to be operable in Mode 3.

4.8 Operation of a train of RHR aligned in cooldown operation with RCS temperatures >225°F will result in inoperability of the associated train of ECCS. One train of ECCS is required while in Mode 4. Mode 3 entry will be prohibited until all portions of RHR piping is <225°F. One train of ECCS must be operable in Mode 4. (TS 3.5.3) (CR 2010106118)

5.12.23.4 **Verify** the following valves CLOSED:

- 1A RHR HX TO CVCS LETDOWN ISO 1-RHR-V-8720A (Q1E11V013A). _____
- 1B RHR HX TO CVCS LETDOWN ISO 1-RHR-V-8720B (Q1E11V013B). _____

5.12.24 **Stop** the running RHR pump(s) if desired. _____

_____ / _____

NOTE

Operation of a train of RHR in cool down operation when RCS temperature is between 225°F and 350°F will result in the associated train of ECCS being declared inoperable. One train of ECCS must be operable in Mode 4. (TS 3.5.3) (CR 2010106118).

5.12.25 **Defeat** the RHR Pump SI auto start per FNP-1-SOP-7.0, RESIDUAL HEAT REMOVAL SYSTEM for one RHR Pump.

- 1A RHR Pump _____

_____ / _____

- 1B RHR Pump _____

_____ / _____

NOTE

If the current shutdown was for a refueling outage, a Hydrogen atmosphere in the VCT should not be established until after completion of FNP-1-STP-32.1, Accumulator Discharge Check Valves Leakage Test.

5.13 WHEN plant conditions permit, THEN **establish** a Hydrogen atmosphere in the VCT as follows:

5.13.1.1 **Verify** that FNP-1-STP-32.1, Accumulator Discharge Check Valves Leakage Test, has been completed satisfactorily, or is not required for the current shutdown. _____

_____ / _____

5.13.1.2 **Coordinate** with Chemistry AND **establish** a hydrogen atmosphere in the VCT per FNP-1-SOP-2.5, RCS Chemical Addition, VCT Gas Control and Demineralizer Operation. _____

_____ / _____

APPENDIX 1
STEAM GENERATOR DRAINING AND REFILLING
FOR CHEMICAL CONTAMINANT REMOVAL
(Page 1 of 2)

1.0 Purpose

To provide guidance for Steam Generator draining and refilling for chemical contaminant removal during shutdown of Unit.

2.0 Initial Conditions

2.1 The version of this appendix has been verified to be the current version. (OR 1-98-498) _____

2.2 The version of this appendix has been verified to be the correct unit for the task. (OR 1-98-498) _____

3.0 Draining Steam Generators

3.1 **Verify** SGBD is in operation per FNP-1-SOP-16.1, Steam Generator Blowdown Processing System. _____

3.2 **Verify** SG wide range LT 477, LT 487 and LT 497 are in service and indicating on LR 477. _____

3.3 **Verify** the following have been defeated by completing Appendix 3:

3.3.1 AFW pump auto start. _____

3.3.2 SGBD isolation signals. _____

3.4 MSIVs are CLOSED per FNP-1-SOP-17.0, Main and Reheat Steam. _____

3.5 **Ensure** RHR loop and RCS loop operability requirements are met per Tech. Spec. 3.4.6 and 3.4.7. _____

NOTE

The following steps may be performed in any order

3.6 IF nitrogen addition is desired, THEN **Go To** FNP-1-SOP-16.3, the section for establishing and removing nitrogen pressure from steam generator 1A (1B, 1C). _____

Condition Report Summary

CR Number	Responsible Person/Dept	Disc. Date	Due Date	Associated CR Type	Building	Unit	Location	Reportable?
2010106118	Douglas ONeal Hobson Farley - Operations	04/30/2010	7/4/2010		AUX BLDG *Mode Restraint:* N/A	FS		N

Discovered By: Milton D. Stephens **SL:** 5

Current Status Ready to Transmit

Description Westinghouse Nuclear Safety Advisory Letter (NSAL) 09-8 identified the potential for steam voiding in the RHR system in the ECCS injection mode after realigning the system from shutdown cooling of the RCS to ECCS injection mode lineup. FNP is one of the affected plants listed in the NSAL. In the event of a LOCA occurring during mode 3 or 4, the RHR pump suction piping water could still be hot and result in steam voiding and water hammer, regardless of whether the pumps are aligned to the RWST or the containment sump. Steam voiding/water hammer could prevent the RHR system from performing its safety function.

Westinghouse has performed an evaluation (see RER C101206101) which indicates that steam voiding and water hammer will not occur if the RHR water temperature is at or below 232 F, regardless of whether suction is from the RWST or containment sumps, and regardless of the sequence time for restarting the RHR pumps after sump alignment. SNC has added instrument uncertainty for instruments Q1/2E11TE0604A & B and an additional margin to conservatively further reduce this temperature to 225 F.

FNP to revise the appropriate plant operating procedures to ensure that one train of RHR will remain in standby until the RCS temperature is 225 F or less during plant shutdown (only one ECCS train required to be operable during shutdown - Tech Spec 3.5.3 & Tech Spec Bases B3.5.3). During plant startup, ensure that both trains of RHR will be secured before exceeding a RCS temperature of 225 F (both trains of ECCS must be operable during startup). This action should be accomplished before plant startup.

References:
CR 2008108809
AI 2008206366
AI 2008206367
FNP-1/2-SOP-7.0
FNP-1/2-UOP-1.1
FNP-1/2-UOP-2.2
RER C101206101

How Discovered Westinghouse NSAL 09-8; Westinghouse Letter ALA-10-70 dated 4/30/10 with attached report FAI/10-166, Revision 0, determined the limiting RCS temperature to prevent RHR pump suction voiding (see RER 101206101).

What Was Affected Q1/2E11P001A/B

Event Codes 10--10N-10N8 Other Events/Others/Operating Experience

Comp. Action OPS tracking equipment status and requirements to secure RHR trains based on plant conditions (loop temperatures) to maintain operability. This is being performed under previous communications, with a temperature of 212 degrees being used.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.6 RCS Loops — MODE 4

LCO 3.4.6 Two loops consisting of any combination of RCS loops and residual heat removal (RHR) loops shall be OPERABLE, and one loop shall be in operation.

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

1. All reactor coolant pumps (RCPs) and RHR pumps may not be in operation for ≤ 2 hours per 8 hour period provided:

   a. No operations are permitted that would cause reduction of the RCS boron concentration; and

   b. Core outlet temperature is maintained at least 10°F below saturation temperature.

2. No RCP shall be started with any RCS cold leg temperature ≤ 325°F unless:

   a. The secondary side water temperature of each steam generator (SG) is < 50°F above each of the RCS cold leg temperatures; or

   b. The pressurizer water volume is less than 770 cubic feet (24% of wide range, cold, pressurizer level indication).

APPLICABILITY: MODE 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required RCS loop inoperable. AND Two RHR loops inoperable.	A.1 Initiate action to restore a second loop to OPERABLE status.	Immediately

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
B. One required RHR loop inoperable. AND Two required RCS loops inoperable.	B.1 Be in MODE 5.	24 hours
C. Required RCS or RHR loops inoperable. OR No RCS or RHR loop in operation.	C.1 Suspend all operations involving a reduction of RCS boron concentration. AND C.2 Initiate action to restore one loop to OPERABLE status and operation.	Immediately Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.4.6.1	Verify one RHR or RCS loop is in operation.	12 hours
SR 3.4.6.2	Verify SG secondary side water levels are ≥ 75% (wide range) for required RCS loops.	12 hours
SR 3.4.6.3	Verify correct breaker alignment and indicated power are available to the required pump that is not in operation.	7 days

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.6 RCS Loops — MODE 4

BASES

BACKGROUND

In MODE 4, the primary function of the reactor coolant is the removal of decay heat and the transfer of this heat to either the steam generator (SG) secondary side coolant or the component cooling water via the residual heat removal (RHR) heat exchangers. The secondary function of the reactor coolant is to act as a carrier for soluble neutron poison, boric acid.

The reactor coolant is circulated through three RCS loops connected in parallel to the reactor vessel, each loop containing an SG, a reactor coolant pump (RCP), and appropriate flow, pressure, level, and temperature instrumentation for control, protection, and indication. The RCPs circulate the coolant through the reactor vessel and SGs at a sufficient rate to ensure proper heat transfer and to prevent boric acid stratification.

In MODE 4, either RCPs or RHR loops can be used to provide forced circulation. The intent of this LCO is to provide forced flow from at least one RCP or one RHR loop for decay heat removal and transport. The flow provided by one RCP loop or RHR loop is adequate for decay heat removal. The other intent of this LCO is to require that two paths be available to provide redundancy for decay heat removal.

APPLICABLE SAFETY ANALYSES

In MODE 4, RCS circulation is considered in the determination of the time available for mitigation of the accidental boron dilution event. The RCS and RHR loops provide this circulation.

RCS Loops — MODE 4 have been identified in the NRC Policy Statement as important contributors to risk reduction.

LCO

The purpose of this LCO is to require that at least two loops be OPERABLE in MODE 4 and that one of these loops be in operation. The LCO allows the two loops that are required to be OPERABLE to

(continued)

BASES

LCO
(continued)

consist of any combination of RCS loops and RHR loops. Any one loop in operation provides enough flow to remove the decay heat from the core with forced circulation. An additional loop is required to be OPERABLE to provide redundancy for heat removal.

Note 1 permits all RCPs or RHR pumps to not be in operation for ≤ 2 hours per 8 hour period. The purpose of the Note is to permit tests that are designed to validate various accident analyses values. One of the tests performed during the startup testing program is the validation of rod drop times during cold conditions, both with and without flow. The no flow test may be performed in MODE 3, 4, or 5 and requires that the pumps be stopped for a short period of time. The Note permits the stopping of the pumps in order to perform this test and validate the assumed analysis values. If changes are made to the RCS that would cause a change to the flow characteristics of the RCS, the input values must be revalidated by conducting the test again. The 2 hour time period is adequate to perform the test, and operating experience has shown that boron stratification is not a problem during this short period with no forced flow.

Utilization of Note 1 is permitted provided the following conditions are met along with any other conditions imposed by initial startup test procedures:

a. No operations are permitted that would dilute the RCS boron concentration, therefore maintaining the margin to criticality. Boron reduction is prohibited because a uniform concentration distribution throughout the RCS cannot be ensured when in natural circulation; and

b. Core outlet temperature is maintained at least 10°F below saturation temperature, so that no vapor bubble may form and possibly cause a natural circulation flow obstruction.

Note 2 requires that the secondary side water temperature of each SG be < 50°F above each of the RCS cold leg temperatures or that the pressurizer water volume is less than 770 cubic feet (24% of wide range, cold, pressurizer level indication) before the start of an RCP with any RCS cold leg temperature ≤ 325°F. This restraint is to prevent a low temperature overpressure event due to a thermal transient when an RCP is started.

(continued)

BASES

LCO (continued)

An OPERABLE RCS loop comprises an OPERABLE RCP and an OPERABLE SG, which has the minimum water level specified in SR 3.4.6.2. This assumes steam removal capability and the availability of a makeup water source (if necessary for extended use of the SG) as required to remove decay heat.

Similarly for the RHR System, an OPERABLE RHR loop comprises an OPERABLE RHR pump capable of providing forced flow to an OPERABLE RHR heat exchanger. RCPs and RHR pumps are OPERABLE if they are capable of being powered and are able to provide forced flow if required.

APPLICABILITY

In MODE 4, this LCO ensures forced circulation of the reactor coolant to remove decay heat from the core and to provide proper boron mixing. One loop of either RCS or RHR provides sufficient circulation for these purposes. However, two loops consisting of any combination of RCS and RHR loops are required to be OPERABLE to meet single failure considerations.

Operation in other MODES is covered by:

LCO 3.4.4, "RCS Loops — MODES 1 and 2";
LCO 3.4.5, "RCS Loops — MODE 3";
LCO 3.4.7, "RCS Loops — MODE 5, Loops Filled";
LCO 3.4.8, "RCS Loops — MODE 5, Loops Not Filled";
LCO 3.9.4, "Residual Heat Removal (RHR) and Coolant Circulation — High Water Level" (MODE 6); and
LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation — Low Water Level" (MODE 6).

ACTIONS

A.1

If one required RCS loop is inoperable and two RHR loops are inoperable, redundancy for heat removal is lost. Action must be initiated to restore a second RCS or RHR loop to OPERABLE status. The immediate Completion Time reflects the importance of maintaining the availability of two paths for heat removal.

(continued)

BASES

ACTIONS (continued)

B.1

If one required RHR loop is OPERABLE and in operation and there are no RCS loops OPERABLE, an inoperable RCS or RHR loop must be restored to OPERABLE status to provide a redundant means for decay heat removal.

If the parameters that are outside the limits cannot be restored, the unit must be brought to MODE 5 within 24 hours. Bringing the unit to MODE 5 is a conservative action with regard to decay heat removal. With only one RHR loop OPERABLE, redundancy for decay heat removal is lost and, in the event of a loss of the remaining RHR loop, it would be safer to initiate that loss from MODE 5 ($\leq$ 200°F) rather than MODE 4 (200 to 350°F). The Completion Time of 24 hours is a reasonable time, based on operating experience, to reach MODE 5 from MODE 4 in an orderly manner and without challenging plant systems.

C.1 and C.2

If no loop is OPERABLE or in operation, except during conditions permitted by Note 1 in the LCO section, all operations involving a reduction of RCS boron concentration must be suspended and action to restore one RCS or RHR loop to OPERABLE status and operation must be initiated. Boron dilution requires forced circulation for proper mixing, and the margin to criticality must not be reduced in this type of operation. The immediate Completion Times reflect the importance of maintaining operation for decay heat removal. The action to restore must be continued until one loop is restored to OPERABLE status and operation.

SURVEILLANCE REQUIREMENTS

SR 3.4.6.1

This SR requires verification every 12 hours that one RCS or RHR loop is in operation. Verification includes flow rate, temperature, or pump status monitoring, which help ensure that forced flow is providing heat removal. The Frequency of 12 hours is sufficient considering other indications and alarms available to the operator in the control room to monitor RCS and RHR loop performance.

(continued)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.6.2

SR 3.4.6.2 requires verification of SG OPERABILITY. SG OPERABILITY is verified by ensuring that the secondary side wide range water level is ≥ 75%. If the SG secondary side wide range water level is < 75%, the tubes may become uncovered and the associated loop may not be capable of providing the heat sink necessary for removal of decay heat. The 12 hour Frequency is considered adequate in view of other indications available in the control room to alert the operator to the loss of SG level.

SR 3.4.6.3

Verification that the required pump is OPERABLE ensures that an additional RCS or 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 Frequency of 7 days is considered reasonable in view of other administrative controls available and has been shown to be acceptable by operating experience.

REFERENCES

None.

3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

3.5.3 ECCS — Shutdown

LCO 3.5.3 One ECCS train shall be OPERABLE.

---NOTES---

1. An RHR train may be considered OPERABLE during alignment and operation for decay heat removal, if capable of being manually realigned to the ECCS mode of operation.

2. Upon entry into MODE 4 from MODE 3, the breaker or disconnect device to the valve operators for MOVs 8706A and 8706B may be closed for up to 4 hours to allow for repositioning from MODE 3 requirements.

APPLICABILITY: MODE 4.

ACTIONS

---NOTE---

LCO 3.0.4b is not applicable to ECCS centrifugal charging subsystem.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. Required ECCS residual heat removal (RHR) subsystem inoperable.	A.1 Initiate action to restore required ECCS RHR subsystem to OPERABLE status.	Immediately
B. Required ECCS centrifugal charging subsystem inoperable. AND At least 100% of the ECCS flow equivalent to a single OPERABLE ECCS train available.	B.1 Restore required ECCS centrifugal charging subsystem to OPERABLE status.	72 hours

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Required ECCS centrifugal charging subsystem inoperable.	C.1 Restore required ECCS centrifugal charging subsystem to OPERABLE status.	1 hour
D. Required Action and associated Completion Time of Condition B or C not met. AND At least one RHR subsystem OPERABLE.	D.1 Be in MODE 5.	24 hours

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.5.3.1	The following SRs are applicable for all equipment required to be OPERABLE: SR 3.5.2.2 SR 3.5.2.6 SR 3.5.2.3 SR 3.5.2.7	In accordance with applicable SRs

SURVEILLANCE REQUIREMENTS

SURVEILLANCE				FREQUENCY
SR 3.5.3.2	Verify the following valves are in the listed position with power to the valve operator removed.			31 days
	Number	Position	Function	
	8706A, 8706B	Closed	RHR pump discharge to centrifugal charging pump suction	
	8884, 8886	Closed	Centrifugal charging pump discharge to RCS hot legs	

B 3.5 EMERGENCY CORE COOLING SYSTEMS (ECCS)

B 3.5.3 ECCS — Shutdown

BASES

BACKGROUND

The Background section for Bases 3.5.2, "ECCS — Operating," is applicable to these Bases, with the following modifications.

In MODE 4, only one ECCS train consisting of two separate subsystems: centrifugal charging (high head) and residual heat removal (RHR) (low head) is required operable.

The ECCS flow paths consist of piping, valves, heat exchangers, and pumps such that water from the refueling water storage tank (RWST) can be injected into the Reactor Coolant System (RCS) following the accidents described in Bases 3.5.2.

APPLICABLE SAFETY ANALYSES

The Applicable Safety Analyses section of Bases 3.5.2 also applies to this Bases section.

Due to the stable conditions associated with operation in MODE 4 and the reduced probability of occurrence of a Design Basis Accident (DBA), the ECCS operational requirements are reduced. It is understood in these reductions that certain automatic safety injection (SI) actuation is not available. In this MODE, sufficient time exists for manual actuation of the required ECCS to mitigate the consequences of a DBA.

Only one train of ECCS is required for MODE 4. This requirement dictates that single failures are not considered during this MODE of operation. The ECCS trains satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

In MODE 4, one of the two independent (and redundant) ECCS trains is required to be OPERABLE to ensure that sufficient ECCS flow is available to the core following a DBA.

In MODE 4, an ECCS train consists of a centrifugal charging subsystem and an RHR subsystem. Each train includes the piping, instruments,

(continued)

LCO (continued)

and controls to ensure an OPERABLE flow path capable of taking suction from the RWST and transferring suction to the containment sump.

During an event requiring ECCS actuation, a flow path is required to provide an abundant supply of water from the RWST to the RCS via the ECCS pumps and their respective supply headers to each of the three cold leg injection nozzles. In the long term, this flow path may be switched to take its supply from the containment sump and to deliver its flow to the RCS hot and cold legs.

This LCO is modified by two notes. Note 1 allows a RHR train to be considered OPERABLE during alignment and operation for decay heat removal, if capable of being manually realigned (remote or local) to the ECCS mode of operation and not otherwise inoperable. This allows operation in the RHR mode during MODE 4.

Note 2 provides an allowance of up to 4 hours to reposition the state of the power supplies for the RHR discharge to centrifugal charging pump suction valves 8706A and 8706B when transitioning from MODE 3 into MODE 4. This allowance is necessary since the required state of the power supplies for these two valves in MODE 3 is opposite the required state in MODE 4 and time is necessary to remove power from the valves when entering MODE 4 from MODE 3.

APPLICABILITY

In MODES 1, 2, and 3, the OPERABILITY requirements for ECCS are covered by LCO 3.5.2.

In MODE 4 with RCS temperature below 350°F, one OPERABLE ECCS train is acceptable without single failure consideration, on the basis of the stable reactivity of the reactor and the limited core cooling requirements.

In MODES 5 and 6, plant conditions are such that the probability of an event requiring ECCS injection is extremely low. Core cooling requirements in MODE 5 are addressed by LCO 3.4.7, "RCS Loops — MODE 5, Loops Filled," and LCO 3.4.8, "RCS Loops — MODE 5, Loops Not Filled." MODE 6 core cooling requirements are addressed by LCO 3.9.4, "Residual Heat Removal (RHR) and Coolant Circulation — High Water Level," and LCO 3.9.5, "Residual Heat Removal (RHR) and Coolant Circulation — Low Water Level."

ACTIONS

A Note prohibits the application of LCO 3.0.4b to an inoperable ECCS centrifugal charging subsystem when entering MODE 4. There is an increased risk associated with entering MODE 4 from MODE 5 with an inoperable ECCS centrifugal charging subsystem and the provisions of LCO 3.0.4b, which allow entry into a MODE or other specified condition in the Applicability with the LCO not met after performance of a risk assessment addressing inoperable systems and components, should not be applied in this circumstance.

A.1

With no ECCS RHR subsystem OPERABLE, the plant is not prepared to respond to a loss of coolant accident or to continue a cooldown using the RHR pumps and heat exchangers. The Completion Time of immediately to initiate actions that would restore at least one ECCS RHR subsystem to OPERABLE status ensures that prompt action is taken to restore the required cooling capacity. Normally, in MODE 4, reactor decay heat is removed from the RCS by an RHR loop. If no RHR loop is OPERABLE for this function, reactor decay heat must be removed by some alternate method, such as use of the steam generators. The alternate means of heat removal must continue until the inoperable RHR loop components can be restored to operation so that decay heat removal is continuous.

With both RHR pumps and heat exchangers inoperable, it would be unwise to require the plant to go to MODE 5, where the only available heat removal system is the RHR. Therefore, the appropriate action is to initiate measures to restore one ECCS RHR subsystem and to continue the actions until the subsystem is restored to OPERABLE status.

B.1

With the required ECCS centrifugal charging subsystem inoperable, and at least 100% of the ECCS flow equivalent to a single OPERABLE ECCS train available, the inoperable components must be returned to OPERABLE status within 72 hours. The 72 hour Completion Time is acceptable when the unit is in MODES 1, 2, and 3 (Ref. 5). Since MODE 4 represents less severe conditions for the initiation of a LOCA, the 72 hour Completion Time is also acceptable for MODE 4. An ECCS train is inoperable if it is not capable of delivering design flow to the RCS. Individual components are inoperable if they are not capable of performing their design function or supporting systems are not available. The intent of this Condition is

(continued)

ACTIONS

B.1 (continued)

to maintain a combination of equipment such that 100% of the ECCS flow equivalent to a single operable ECCS train remains available. This allows increased flexibility in plant operations under circumstances when components in the required subsystem may be inoperable, but the ECCS remains capable of delivering 100% of the required flow equivalent.

C.1

With no ECCS centrifugal charging subsystem OPERABLE, due to the inoperability of the centrifugal charging pump or flow path from the RWST, the plant is not prepared to provide high pressure response to Design Basis Events requiring SI. The 1 hour Completion Time to restore at least one ECCS centrifugal charging subsystem to OPERABLE status ensures that prompt action is taken to provide the required cooling capacity or to initiate actions to place the plant in MODE 5, where an ECCS train is not required.

D.1

When the Required Actions of Condition B or C cannot be completed within the required Completion Time, a controlled shutdown should be initiated provided that adequate RHR cooling capacity exists to support reaching and maintaining MODE 5 conditions safely. With both RHR subsystems inoperable, it would be unwise to require the plant to go to MODE 5, where the only available heat removal system is the RHR. Therefore, the appropriate action is to initiate measures to restore at least one ECCS RHR subsystem and to continue the actions until the subsystem is restored to OPERABLE status. Only then would it be safe to go to MODE 5. Twenty-four hours is a reasonable time, based on operating experience, to reach MODE 5 in an orderly manner and without challenging plant systems or operators.

SURVEILLANCE REQUIREMENTS

SR 3.5.3.1

The applicable Surveillance descriptions from Bases 3.5.2 apply.

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.5.3.2

Verification of proper valve alignment ensures that the flow path from the ECCS pumps to the RCS is maintained. Misalignment of these valves could render the required ECCS trains inoperable. Securing these valves in position by removal of power by locking open the breaker or disconnect device for the valve operator ensures that they cannot change position as a result of an active failure or be inadvertantly misaligned. A 31 day frequency is considered reasonable in view of other administrative controls that will ensure a mispositioned valve is unlikely and this frequency has been shown to be acceptable by operating experience.

REFERENCES

The applicable references from Bases 3.5.2 apply.