RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**481-8546**
Review Section:	**16 – Technical Specifications**
Application Section:	**16.3.4, 16.3.5, 16.3.6, 16.3.7, 16.3.9**
Date of RAI Issue:	**05/12/2016**

Question No. 16-149

1. The staff considered the response to Item 4 incomplete for the following reason.

In the original RAI, the staff raised the Item 4 issue as follows:

> "The TS 3.6.7 Bases do not provide sufficient supporting information with regard to the need for LCO 3.6.7 requirements. The LCO 3.6.7 statement reads almost the same as the one for LCO 3.9.3. Since the scope of "Applicability" for LCO 3.6.7 is different from the one for LCO 3.9.3, the staff expects to see a change to LCO 3.6.7.c.1 with respect to the term "equivalent " used in LCO 3.9.3 to mean "a HVAC or vapor barrier" which is not capable to support a pressurized containment condition as shown in the low-powerand-shutdown (LPSD) analysis. The applicant is requested to address the above staff's concerns and revise TS 3.6.7 and its associated bases accordingly."

In the response the applicant provided the following information:

> "The closure of a containment penetration during reduced inventory operations requires different design criteria than during refueling operations. Since the explained term of equivalent in LCO 3.9.3 for refueling operations may not be adequate for reduced inventory operations, that alternative for isolation will be deleted from Technical Specification 3.6.7 as indicated in Attachment 4. Unlike the Bases for LCO 3.9.3, the Bases for 3.6.7 does not include clarification for the term 'equivalent' and, therefore, no change to the Bases for 3.6.7 is necessary."

The applicant is requested to revise the Background section of the Bases for TS 3.6.7 to include a discussion of operating experiences of currently operating PWR plants during Mid-Loop operations as documented in Generic Letter (GL) 88-17, "Loss of Decay Heat Removal."

2. The staff found the response to RAI-Question 16-25, Item 5 acceptable; however, the applicant is requested to address additional questions related to the proposed requirements of generic TS Subsections that apply during the shutdown condition of REDUCED RCS INVENTORY (RCS level < 127 ft ¼ in). For each Subsection, the MODE 5 and MODE 6 applicabilities are listed.

- 3.4.8, "RCS Loops – MODE 5 (Loops Not Filled)," Required Action B.3
  Applicability: MODE 5 with RCS loops not filled.
  (RCS highest elevation is top of SG tubes, which is an RCS Level of 162 ft 4.2 in.)

- 3.5.3, "Safety Injection System (SIS) – Shutdown"
  Applicability: MODE 5,
  MODE 6 with RCS level < 130 ft 0 in.
  (RCS level of 130 ft 0 in is ¼ in below top of reactor vessel (RV) flange.)

- 3.5.4, "In-Containment Refueling Water Storage Tank (IRWST)"
  Applicability: MODE 5,
  MODE 6 with RCS level < 130 ft 0 in.

- 3.6.7, "Containment Penetrations – REDUCED RCS INVENTORY Operations"
  Applicability: MODE 5 with REDUCED RCS INVENTORY,
  MODE 6 with REDUCED RCS INVENTORY.
  (REDUCED RCS INVENTORY corresponds to an RCS level of 127 ft ¼ in.)
  (RCS level of 127 ft ¼ in corresponds to 3 ft below top of RV flange.)

- 3.9.5, "Shutdown Cooling System (SCS) and Coolant Circulation – Low Water Level"
  LCO 3.9.5.a
  Applicability: MODE 6 with the water level < 23 ft above the top of RV flange.
  (Refueling pool level of 23 ft above top of RV flange is an elevation of 153 ft ¼ in.)
  LCO 3.9.5.b
  Applicability: MODE 6 with REDUCED RCS INVENTORY.

In Technical Report (TR) APR1400-E-N-NR-14005-P, "Shutdown Evaluation Report," Appendix A, "Procedural Guidance to Support Reduced Reactor Coolant System Inventory Operations," the applicant identifies the following high-risk scheduled maintenance activities that are performed when the RCS water level is maintained at lower than the elevation mark for "REDUCED INVENTORY" (3 ft below the top of the reactor vessel flange):

- Installation and removal of steam generator (SG) cold leg nozzle dams
- Installation and removal of SG hot leg nozzle dams
- Reactor Coolant Pump (RCP) seal housing removal and installation
- DVI nozzle 2A or 2B valve maintenance

The staff also considers as high-risk the removal and the re-installation of the RV head and installation activities that are performed when the RCS water level is maintained at slightly below the reactor vessel flange. Due to the estimated short time period following a loss of shutdown cooling (decay heat removal) until the reactor coolant in the RV begins to boil (time-to-boil) when RCS inventory is less than normal (MODE 5 with RCS loops not filled, or

MODE 6 with refueling pool level < 23 ft above RV flange), the requirements of the above LCOs may need to be applicable at an RCS water level > 127 ft ¼ in, the REDUCED RCS INVENTORY elevation threshold, and even an RCS water level > 130 ft ¼ in; i.e., above the top of the RV flange, to adequately address the safety concerns of GL 88-17.

The applicant is requested to consider the following recommendations:

A. Remove the definition of REDUCED RCS INVENTORY from generic TS Section 1.1.

B. Instead of using “REDUCED RCS INVENTORY,” use the associated elevation threshold value of 127' ¼" in generic TS Subsections 3.4.8, 3.5.3, 3.5.4, 3.6.7, 3.9.3, and 3.9.5; and associated Bases subsections. Suggest renaming Subsection 3.6.7 to “Containment Penetrations – Shutdown.” Also, please either consistently use, or do not use, “EL” when referring to an RCS water level in terms of height above the reference level (or elevation); this is a global comment for the entire DCD Chapter 16.

C. Since Subsection 3.4.8 attempts to address concerns about the risk of activities involving low RCS water level conditions in MODE 5, it is logical to provide default action requirements in the event the SCS requirements of LCO 3.4.8 are not met and the actions to restore compliance with LCO 3.4.8 are not met. Therefore, the applicant is requested to consider the following changes to the Actions table of Subsection 3.4.8.

   Note that these suggested changes are the staff’s attempt to craft action requirements to

   - Limit the time that low inventory conditions are permitted with no shutdown cooling flow through the core to avoid onset of boiling in the core while in mid-loop operation;

   - Allow reasonable time to recover from a maintenance activity during mid-loop conditions (e.g., complete installation of nozzle dams or close the steam generator manway) and establish an intermediate reactor vessel level, such as > 127 ft ¼ in., following a loss of shutdown cooling, to increase the time to core uncovery; and

   - If shutdown cooling is not restored, require initiating action to increase level until RCS loops are filled, which exits the MODE of applicability for Specification 3.4.8; or transitioning to MODE 6 and raising level to 23 ft above the top of the reactor vessel flange, which also exits the MODE of Applicability for Specification 3.4.8.

   The applicant is requested to identify appropriate completion times for the suggested action requirements, and explain why those times are acceptable. The staff considers the below completion times are for illustration only, and do not constitute their approval by the staff.

Suggested changes to action requirements for Generic TS Subsection 3.4.8:
ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One SC train inoperable.	A.1 ~~Initiate action to restore~~ Restore SC train to OPERABLE status. **AND** **A.2 Raise RCS level to > 39.7 m (130 ft 0 in).**	**4 hours**~~Immediately~~ **4 hours**
B. Two SC trains inoperable. OR NO SC train in operation.	B.1 Suspend ~~all~~ operations ~~involving Reduction of~~ **that would cause introduction of coolant into the** RCS **with** boron concentration **less than required to meet SDM of LCO 3.1.1**. AND B.2 ~~Initiate actions to restore~~ **Restore** one SC train to OPERABLE status and operation. AND B.3 ~~Initiate actions to raise~~ **Raise** RCS level to > **39.7 m (130 ft 0 in)** ~~EL 38.72 m (127 ft 1/4 in).~~	Immediately **1 hours** ~~Immediately~~ **1 hours** ~~Immediately~~

C. Core outlet temperature > 57.2°C (135°F) with RCS level ≤ 38.72 m (127 ft 1/4 in). **OR** **RCS level ≤ 38.72 m (127 ft 1/4 in) with < 96 hours since reactor was last critical.**	**C.1**	**Restore core outlet temperature to ≤ 57.2°C (135°F).**	**1 hour**
	AND		
	C.2	**Raise RCS level to > 38.72 m (127 ft 1/4 in).**	**2 hours**
D. Required Action and associated Completion Time not met.	**D.1**	**Initiate action to comply with LCO 3.4.7, "RCS Loops – MODE 5 (Loops Filled)."**	**Immediately**
	OR		
	D.2	**Initiate action to be in MODE 6 and comply with LCO 3.9.4, "SCS and Coolant Circulation – High Water Level."**	**Immediately**

D. Revise generic TS 3.4.8 LCO Notes, by adding Note 4, which states:

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

4. RCS level ≤ EL 38.72 m (127 ft 1/4 in) is allowed if the time since the reactor was last critical is ≥ 96 hours and core outlet temperature is maintained ≤ 57.2 °C (135 °F).

This proposed Note 4 is meant to replace a change to the Subsection 3.4.8 Applicability statement proposed by the applicant in response to **RAI 232-7864 - Question 19-6**, which added the following sentence in parenthesis to “MODE 5 with RCS loops not filled.”

> MODE 5 with RCS loops not filled (Mid-loop operation shall be started at least 4 days after shutdown and equal to or less than 57.2 °C (135 °F of initial hot leg temperature.)

The applicant's proposed restrictions on elapsed time after shutdown and initial hot leg temperature for initiating mid-loop operation (RCS level = 119 ft 1 in) do not belong in the Applicability statement, but should be a part of the LCO statement in the form of an LCO Note. Using the REDUCED RCS INVENTORY level elevation threshold instead of the (~ 8 feet lower) level elevation at the top of the hot leg junction with the reactor vessel, as the water level entry condition in Note 4, is more consistent with Required Action B.3. Use of core outlet temperature instead of hot leg temperature is preferred because it is consistent with Note 1.a.

In addition, replace generic TS LCO 3.4.7 Note 1.a and LCO 3.4.8 Note 1.b with the language of the equivalent Notes in STS LCO 3.4.7 and LCO 3.4.8:

> No operations are permitted that would cause introduction of coolant into the RCS with boron concentration less than required to meet the SDM of LCO 3.1.1; and

The applicant is also requested to make appropriate conforming changes to the Bases.

E. Since a reactor coolant temperature of ≤ 57.2°C (135°F) is a condition for reducing reactor vessel level to ≤ 119 ft 1 in, there needs to be a corresponding Condition in the Actions table of Subsection 3.4.8; for example, see Condition C in the above suggested Actions table in Question item 2.C.

There also needs to be a corresponding surveillance in the Surveillance Requirements table of Subsection 3.4.8; for example, insert the following SR and renumber SR 3.4.8.2 and SR 3.4.8.3 as SR 3.4.8.3 and SR 3.4.8.4:

	SURVEILLANCE	FREQUENCY
SR 3.4.8.2	----------NOTE---------- Only required to be met when RCS level is ≤ EL 38.72 m (127 ft 1/4 in). ---------- Verify core outlet temperature is ≤ 57.2°C (135°F).	12 hours

The applicant is also requested to make appropriate conforming changes to the Bases for Subsection 3.4.8.

F. The applicant is requested to consider using the RCS level corresponding to just below the reactor vessel flange (130 ft) in place of the level of 127 ft 1/4 in, as proposed in the above suggested LCO 3.4.8 Note 4 (item 2.D) and Required Actions A.2, B.3, and C.2 (item 2.C) because of the resulting greater reactor vessel water volume to mitigate a loss of decay heat removal event.

G. Suggest renaming generic TS Subsection 3.6.7 to Containment Penetrations Shutdown; also, revise Subsection 3.6.7 Applicability statement to say:

MODE 5 with RCS loops not filled,
MODE 6 with the water level < 7.0 m (23 ft) above the top of reactor vessel flange.

H. Revise the generic TS 3.5.3, "SIS – Shutdown," Applicability statement to say:

MODES 4 and 5,
MODE 6 with ~~RCS level < 39.7 m (130 ft 0 in)~~ **water level < 7.0 m (23 ft) above the top of reactor vessel flange**.

Likewise, revise the required action that requires increasing water level to 0.25 inches below the RV flange (130 ft) to require increasing water level to 23 ft above the top of the RV flange.

I. Judging by the required actions, it appears that Condition B of Specification 3.5.3 is really only meaningful with the unit initially in MODE 6; therefore it is suggested that the applicant revise the actions consistent with the suggested ACTIONS table below, and with the revised applicability as suggested in item 2.H above.

With the unit in MODE 4, if LCO 3.5.3 is not met and no required SIS train is restored to operable status within 1 hour per Required Action A.1, the expected remedial action seems to be placing the unit in MODE 5 within 37 hours per LCO 3.0.3. In MODE 5, the shutdown cooling and LTOP operability requirements of LCO 3.4.7, 3.4.8, and 3.4.11 must be met. However, LCO 3.5.3 is still not met, and since LCO 3.0.3 provides no additional action, what additional remedial measures should be specified? The applicant is requested to revise the actions consistent with the suggested ACTIONS table below.

The applicant is requested to identify appropriate completion times for the suggested action requirements, and explain why those times are acceptable. The staff considers the below completion times are for illustration only, and do not constitute their approval by the staff.

Suggested changes to LCO and action requirements for Generic TS Subsection 3.5.3:

LCO Two ~~trains of~~ SIS **trains** shall be OPERABLE and diagonally oriented with respect to reactor vessel.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. **One** ~~R~~required SIS train inoperable.	A.1 Restore required SIS train to OPERABLE status.	**6 hours** ~~1 hour~~
B. ~~Required Action and associated Completion Time of Condition A not met.~~	~~B.1.1 Verify RCS level ≥ 39.7 m (130 ft 0 in).~~ ~~OR~~ ~~B.1.2 Initiate actions to restore RCS level to ≥ 39.7 m (130 ft 0 in).~~ ~~AND~~ ~~B.2 Reduce RCS cold leg temperature to < 57.2°C (135°F).~~	~~Immediately~~ ~~Immediately~~ ~~24 hours~~
B. Two required SIS trains inoperable.	B.1 Restore one required SIS train to OPERABLE status.	1 hour
C. Required Action and associated Completion Time of Condition A or B not met in MODE 4.	C.1 Be in MODE 5. AND C.2 Reduce RCS cold leg temperature to < 57.2°C (135°F).	24 hours 24 hours
D. Required Action and associated Completion Time of Condition A or B not met in MODE 5 with RCS loops filled.	D.1 Reduce RCS cold leg temperature to < 57.2°C (135°F).	24 hours
E. Required Action and associated Completion Time of Condition A or B not met in MODE 5 with RCS loops not filled.	E.1 Initiate actions to restore unit to RCS loops filled condition. AND E.2 Reduce RCS cold leg temperature to < 57.2°C (135°F).	Immediately 24 hours
F. Required Action and	F.1 Initiate actions to	Immediately

CONDITION	REQUIRED ACTION	COMPLETION TIME
associated Completion Time of Condition A or B not met in MODE 6.	restore water level to ≥ 7 m (23 ft) above the top of reactor vessel flange. AND F.2 Reduce RCS cold leg temperature to < 57.2°C (135°F).	 24 hours

J. Two manual SIS actuation Function divisions need to be OPERABLE to support the two required SIS trains in MODES 5 and 6. This is Function 1.d, SIAS Manual Trip of GTS Table 3.3.6-1. It may also include Function 7.a, Diverse Manual ESF Actuation

K. Regarding generic TS Subsections 3.4.7 and 3.4.8, the Bases do not explain what constitutes the RCS loops filled condition and RCS loops not filled condition. Do the means of satisfying LCO 3.4.11, LTOP, (either using SC system operable suction relief valves, or an operable RCS vent flow path) enter into this explanation? That is, can the RCS be open (e.g., a vent fow path) and still be in the RCS loops filled condition?

L. Revise the generic TS 3.5.4, In-Containment Refueling Water Storage Tank (IRWST), Applicability statement to say:

> MODES 1, 2, 3, 4, and 5,
> MODE 6 with RCS level < 39.7 m (130 ft 0 in) **water level < 7.0 m (23 ft) above the top of reactor vessel flange.**

Likewise, revise the Action that requires increasing water level to 0.25 inches below the RV flange (130 ft) to either require restoring the unit to the RCS loops filled condition (if in MODE 5) or increasing refueling pool water level to 23 ft above the top of the RV flange (if in MODE 6), as follows.

M. Revise the generic TS 3.9.5, SCS and Coolant Circulation Low Water Level Required Actions B.3 and D.1 to read Initiate actions to establish ≥ 7.0 m (23 ft) of water above the top of reactor vessel flange.

Response

1. The BACKGROUND section for BASES 3.6.7 will be revised as indicated in Attachment 1.

2.A The Definition of Reduced RCS Inventory will be removed. The APR1400 Technical Specification will be revised as indicated in the Attachment 2.

2.B The following will be incorporated in the APR1400 Technical Specification.

- "REDUCED RCS INVENTORY" will be removed from the APR1400 Technical Specification as indicated in the Attachments 1and 2.
- Subsection 3.6.7 will be renamed as indicated in the Attachment 1.
- The "EL" in terms of height above the reference level will be deleted and not be used as indicated in the Attachments 1, 2, 4 and 5.

2.C KHNP has reviewed the NRC's suggestions on Technical Specification subsection 3.4.8. The results are as follows;

2.C-1 Response to the changing completion time (Conditions A & B)

- The NRC suggested limiting the time for low inventory conditions without shutdown cooling flow to avoid onset of boiling in the core while in mid-loop operation. And allowing a reasonable time for recovering from a maintenance activity (installation of nozzle dams or close the SG manway) to establish an intermediate reactor vessel level following a loss of shutdown cooling.

  A safety analysis has been performed as documented in the Shutdown Evaluation Report, APR1400-E-N-NR-14005-P. In the analysis, the initial conditions are the same as those of mid-loop operating condition assuming the decay heat of 4 days after the reactor shutdown and core exit temperature of 57.2 ^{o}C (135 ^{o}F). The assumptions are based on realistic operational status but considering 2-sigma uncertainty to the decay heat curve for conservatism.

  However, specifying allowable and reasonable time in the Technical Specification for recovering from a maintenance activity (installation of nozzle dams or close the SG manway) and establishing an intermediate reactor vessel level following a loss of shutdown cooling may not be applicable. Because, orderly operator actions would be vary as follows.

  If a loss of shutdown cooling occurs during the installation of SG nozzle dams, operators may not be able to complete the installation of nozzle dam. At these conditions, operators need to close SG manways immediately to increase RCS level above the mid-loop conditions.

However, before closing the SG manways, operators should maintain the RCS level in the mid-loop condition to protect RCS overfill through the SG manway. If SCS operation is not re-established, core boiling can produce a rapid core uncovery. Therefore, operators need to initiate safety injection pump(s) to protect against the core uncovery.

- The Subsection 2.2, Time available for mitigation, in the enclosure 1 to Generic Letter, “Overview and background information pertinent to generic letter 88-17”, which states:

  > The time available for operators to respond to a loss of DHR can be far less than was previously believed. **Immediate actions are necessary** to reasonably assure an adequate operator response during such conditions.

  It is also specified in the Standard TS (NUREG-1432, Rev.04) that **immediately perform the required actions** upon each Condition.

  An additional concern could be that if the COMPLETION TIME is allowed to a period of time, an operator may not take an appropriate action immediately and think that there is enough time before taking the action. For example, if COMPLETION TIME is set as 1 hour and 20 minutes is required time to complete the required action; the operator could start initiating the action after 40 minutes upon occurrence of an event. This would not meet the guidance of the GL 88-17.

- Conclusion: Based on the discussions above, the changing of the COMPLETION TIME for Conditions A & B of Generic TS Subsection 3.4.8 is not considered appropriate and the COMPLETION TIME will be maintained as “Immediately”.

2.C-2 Response to the suggested Action A.2

- The NRC reviewer suggests adding Action A.2 for raising RCS level because of the concerns about the high risk when RCS is low level conditions in MODE 5. However, the APR1400 is designed such that the Containment Spray Pump (CSP) is interchangeable for the shutdown cooling function and one operating SC train assures adequate core cooling.

- Also, the suggested Action A.2 is not included in the Standard TS and it is not plant specific.

- Therefore, Action A.2 will not be included in the APR1400 TS.

2.C-3 Response to the suggested Action B.1, B.2 and B.3

- Action B.1: Mark-up has been provided through response of RAI 119-7976 Q16.23 as indicated in the Attachment 4.

- Action B.2 and its completion time: Refer to the response 2.C-1, Response to the changing completion time (Conditions A & B). The wording to “Initiate actions to” will be maintained to be consistent with the Standard TS for the Required Action with “Immediately”.

- Action B.3 and its completion time: The enclosure 3 to Generic Letter 88-17, “Abbreviations and Definitions”, states:

  > Reduced inventory or Reduced RCS inventory - An RCS inventory that results in a reactor vessel water level lower than three feet below the RV flange.

  GL 88-17 is focused on the Reduced RCS inventory and consistently uses the terms of Reduced RCS inventory. Based on those, RCS level of 38.72 m (127 ft 1/4 in) has been adopted in the General TS.

  Therefore, the RCS level of 38.72 m (127 ft 1/4 in) will be used in the APR1400 TS and this level definition is consistent with the purpose of the GL 88-17.

  For Completion Time for Action B.3, refer to the response 2.C-1, Response to the changing completion time (Condition A & B).

  The wording to “Initiate actions to” will be maintained to be consistent with the Standard TS for the Required Action with “Immediately”.

2.C-4 Response to the suggested Action C

- The suggested CONDITION C states:

  > Core exit temperature > 57.2 °C (135 °F) with RCS level ≤ 38.72 m (127 ft 1/4 in) OR RCS level ≤ 38.72 m (127 ft 1/4 in) with < 96 hours after reactor shutdown.

- The suggested CONDITION C is initial conditions for mid-loop operation assumed in the Safety Analysis. The mid-loop operation is initiated at RCS level = 119 ft 1 in. In order to incorporate the result of safety analysis, the suggested CONDITION C will be included in the APR1400 TS. However, the NRC’s suggested CONDITION C for ACTIONS table will be revised to be applicable during the mid-loop operation as indicated as CONDITION E for the ACTIONS table in the Attachment 4.

- Completion time for the suggested CONDITION C actions: The suggested Completion Time will be revised to **immediately**. Refer to the response 2.C-1, Response to the changing completion time.

2.C-5 Response to the suggested CONDITION D

- The suggested ACTION D: When the hot legs are drained, the U-tubes of the SGs will also be drained and the SGs will not be used as an effective heat sink. Once a plant is brought to the MODE 5 (RCS loops not filled condition), the plant is not able to be returned to the mode 5 (RCS loops filled condition) unless RCS vent operation (including U-tubes of the steam generators) is performed.

  Also, considering the required operator action time for removing the RV upper head and the time of onset of boiling in the core upon loss of shutdown cooling, changing from MODE 5 to MODE 6 would not be appropriate.

  Since the suggested ACTION D, Required Action and associated Completion Time not met in the MODE 5 (RCS loops not filled condition) means that there is no normal heat removal means, it is not able to comply with LCO 3.4.7, “RCS Loops – MODE 5 (Loops Filled)” or LCO 3.9.4, “SCS and Coolant Circulation – High Water Level” in MODE 6 which requires at least one SC train operable and in operation.

- Conclusion: The suggested ACTIONs for the CONDITION D will not be applied in the APR1400 Technical Specification.

2.D The APR1400 Technical Specification will be revised as indicated in the Attachment 4.

Please note that the limitation is applicable to the mid-loop operation (RCS level ≤ 36.30 m (119 ft 1 in)). Therefore, the note 4 will be revised from the NRC’s suggestion as follows;

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

4. MID-LOOP operation is allowed ≥ 96 hours after reactor shutdown and core exit temperature is ≤ 57.2 °C (135 °F).

And the bases for Note 4 will be included as indicated in the Attachment 4 as follows:

Note 4 limits MID-LOOP entry conditions (RCS level ≤ 36.30 m (119 ft 1 in)) which of the time after 96 hours after reactor shutdown and the core exit temperature less than 57.2 °C (135 °F). These limitations are the same as those of MID-LOOP operating conditions assumed in the Safety Analysis of Loss of Residual Heat Removal event and the limitations shall be maintained in order to operate the plant safely.

TS LCO 3.4.7 Note 1.a and LCO 3.4.8 Note 1.b will be revised with the NRC’s suggested Note as Mark-ups have been provided through response of RAI 119-7976 Q16.23 (Also indicated in the Attachments 3 and 4).

2.E The suggested Surveillance Requirement will be included in the APR1400 TS. However, please note that the limitation is applicable to the mid-loop operation. Therefore, the SR will be revised from the NRC’s suggestion as indicated in the Attachment 4 as follows;

SURVEILLANCE		FREQUENCY
SR 3.4.8.1	----------NOTE---------- Only required to be met when in MID-LOOP operation. ---------- Verify core exit temperature is ≤ 57.2°C (135°F).	15 minutes

And bases for the SURVEILLANCE will be included as indicated in the Attachment 4 as follows;

SR 3.4.8.1

This SR requires verification of the core exit temperature is within the limit. This verification ensures the plant conditions assumed in the safety analysis during MID-LOOP operation.

The Frequency of 15 minutes reflects the importance of maintaining the core exit temperature below the assumed value in the safety analysis during the MID-LOOP operation.

This SR is modified by a Note that states the SR is only required to be met when in MID-LOOP operation.

2.F Enclosure 3 to Generic Letter 88-17, “Abbreviations and Definitions”, which states:

> Reduced inventory or Reduced RCS inventory - An RCS inventory that results in a **reactor vessel water level lower than three feet below the RV flange**.

GL 88-17 is focused on the Reduced RCS inventory and uses the terms of Reduced RCS inventory. Based on the definition, RCS level of 38.72 m (127 ft 1/4 in) has been adopted in the General TS.

Therefore, the RCS level of 38.72 m (127 ft 1/4 in) will be used in the APR1400 TS and this level definition is consistent with the definition in GL 88-17.

2.G The APR1400 TS and Bases of 3.6.7 will be revised as indicated in Attachment 1.

2.H As defined in Technical Specification Bases 3.5.3, Actions B.1.1, an RCS level 39.7 m (130 ft 0 in) corresponds to the top of the vessel flange and is specified because it will provide the minimum required inventory in the event of a LOCA.

As specified, a requirement for an RCS water level 39.7 m (130 ft 0 in) ensures that the water in the RCS will be at least to the reactor vessel flange, if not the refueling pool.

Therefore, the MODE 6 with RCS level < 39.7 m (130 ft 0 in) is appropriate APPLICABILITY for LCO 3.5.3.

2.I As discussed in H, the required RCS level 39.7 m (130 ft 0 in) in MODE 6 is not changed to the suggested RCS water level.

The COMPLETION TIME of 6 hours for the suggested ACTION by NRC, One Required SIS train inoperable, is not appropriate. If either the one SIS train or two SIS trains are inoperable, the inoperable SIS trains are required to be restored to operable in 1 hour. Since at least two SIS trains, which are diagonally oriented with respect to reactor vessel, are required to be operable when the unit is in MODE 4, 5 and 6 with RCS level < 39.7 m (130 ft 0 in).

If the Required Action and associated Completion Time of Condition A are not met in MODE 4, the REQUIRED ACTION B.1.1 verifies that the RCS is filled immediately. The core exit temperature is reduced to < 57.2°C (135°F) in 24 hours by REQUIRED ACTION B.2. And the RCS cold leg temperature is lower than 99 °C (210 °F) the unit is in MODE 5.

If the Required Action and associated Completion Time of Condition A are not met in MODE 5 with RCS loops filled, the REQUIRED ACTION B.1.1 verifies that the RCS is filled to the vessel flange immediately. The core exit temperature is reduced to < 57.2 °C (135 °F) in 24 hours by REQUIRED ACTION B.2.

If the Required Action and associated Completion Time of Condition A are not met in MODE 5 with RCS loops not filled, the REQUIRED ACTION B.1.2 initiates to increase the RCS level to the vessel flange level (39.7 m (130 ft 0 in)) immediately. The core exit temperature is reduced to < 57.2 °C (135 °F) in 24 hours by REQUIRED ACTION B.2.

If the Required Action and associated Completion Time of Condition A are not met in MODE 6 with RCS level < 39.7 m (130 ft 0 in), the REQUIRED ACTION B.1.2 initiate an increase in the level of RCS to the vessel flange. The core exit temperature is reduced to < 57.2°C (135°F) in 24 hours by REQUIRED ACTION B.2.

As discussed above, the CONDITION and ACTION REQUIRED in the current TS 3.5.3 Bases are not different from the suggested ACTION by NRC.

2.J General TS LCO 3.3.6 requires the SIAS manual trip function to be OPERABLE in MODES 1, 2, 3, and 4. The APPLICABILITY of General TS B 3.3.6 states that the SIAS manual actuation is simplified by the use of the manual trip push buttons because of the large number of components actuated by this function. This means LCO 3.3.6 addresses only system level manual trip function. The APPLICABILITY also

states that the systems initiated by ESFAS are either reconfigured or disabled for shutdown cooling operation in MODES 5 and 6, and accidents in these MODES are slow to develop and would be mitigated by manual operation of individual components. This indicates that the component level manual SIS actuation is performed in MODES 5 and 6 if required. Regarding the SIAS manual trip, the General TS approach complies with STS LCO 3.3.6 and B 3.3.6.

The diverse manual actuation is required to be OPERABLE in the same MODE as the manual trip function since the purpose of the diverse manual actuation is to cope with the common cause failure of the ESF-CCS.

Therefore, the manual SIS actuation function in MODES 5 and 6 can be performed by the component level SIS actuation in accordance with the APPLICABILITY of General TS B 3.3.6, which is the same approach as Standard TS B 3.3.6 (Rev. 4.0).

2.K The conditions for TS 3.4.7 (RCS loops filled condition) and TS 3.4.8 (RCS loops not filled condition) are specified in the bases for the background of each TS Subsection.

The difference between the RCS loops filled and not filled conditions is the operability of the steam generators (SGs) as an effective heat sink. The RCS loops filled condition means that all the loops including SG U-tubes are filled with coolant and RCP can be operating with SGs as a heat sink if RCS is not yet open. Once RCS is drained below the hot legs elevation, the U-tubes of the steam generators will also be drained to the same level of the RCS. Then, the SGs will not be able to be used as an effective heat sink.

In the RCS loops filled condition, RCS can be open (e.g., a vent flow path) and still be in the RCS loops filled condition but SG U-tubes are filled with coolant. In the RCS loops not filled condition, RCS be also open (e.g., a vent flow path) but SG U-tubes are not filled with coolant.

Once a plant is brought to the mode 5 (loops not filled condition), the return to the mode 5 (loops filled condition) requires an RCS vent operation (including U-tubes of SGs). Therefore RCS can be open in the RCS loops not filled condition and the RCS loops filled condition can be achieved after an RCS vent operation.

2.L As described in the Applicability of TS Bases 3.5.4, the IRWST operability requirements in Mode 5 and Mode 6 with RCS level less than 39.7 m (130 ft) are dictated by the SIS operability requirements in TS 3.5.3. The Applicability and Action requirements for the SIS in TS 3.5.3 are discussed in the response to 2.H and 2.I above, respectively, and are determined to be appropriate. Therefore, the Applicability and Action requirements for IRWST in TS 3.5.4 are also appropriate.

2.M With no SCS train OPERABLE or in operation, Condition B must be entered. If the plant was in this condition with no SCS train OPERABLE, then the plant is also required to enter Condition A. The unit is in Conditions A and B concurrently. If the plant is operating below RCS level 38.72 m (127 ft 1/4 in) with no SCS train

OPERABLE or in operation, the Required Action is to immediately “initiate action to establish RCS water level above 38.72 m (127 ft 1/4 in)” and maintain this level. In this condition the heat removal function is lost. Therefore, the Required Actions in Condition B is to restore RCS level above 38.72 m (127 ft 1/4 in) (not optional) and to restore one SCS train to OPERABLE status and place it in operation. If the plant is operating above 38.72 m (127 ft 1/4 in), then this Required Action is already met. RCS level is required to be established above 38.72 m(127 ft-1/4 in) to ensure air is not ingested into the SCS with the possibility of affecting SCS performance after the SC pump is restored to OPERABLE status and placed in operation. With at least one SCS train operable, water level can be raised greater than or equal to 7.0 m (23 ft) above the reactor vessel flange and the applicability will change to that of LCO 3.9.4, “SCS and Coolant Circulation – High Water Level,” and only one SCS train is required. Therefore, it is not necessary to have an RCS level of “≥ 7.0 m (23 ft) of water above the top of reactor vessel flange to place the system in operation.”

Below the RCS level 38.72 m (127 ft 1/4 in), Condition C is only entered when there is no OPERABLE containment spray pump in the operating SC train. This Condition can be exited, by placing the SCS train not in operation, in operation, with an SC pump (Required Action C.1) and by restoring the containment spray pump (Required Action C.3) to OPERABLE status. If reactor water level is increased above 38.72 m (127 ft 1/4 in), Condition C can always be exited. This optional action is provided in Condition D. Therefore, it is not necessary to have an RCS level of “≥ 7.0 m (23 ft) of water above the top of reactor vessel flange to place the system in operation.”

Impact on DCD

Same as changes described in Impact on Technical Specification section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

TS 1.1 Definition and each section that the definition is used will be revised as indicated in the Attachments 1, 2 and 5.
The terms of “EL” used in the TS will be revised as indicated in the Attachments 1, 2, 4 and 5.
TS 3.4.7 will be revised as indicated in the Attachment 3.
TS 3.4.8 and their Bases will be revised as indicated in the Attachment 4.
TS 3.6.7 and their Bases will be revised as indicated in the Attachment 1.
TS 3.9.5 and their Bases will be revised as indicated in the Attachment 5.
B 3.6.1 and B 3.6.2 will be revised as indicated in the Attachment 1

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

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3.6 CONTAINMENT SYSTEMS

3.6.7 Containment Penetrations - ~~REDUCED RCS~~ ~~INVENTORY~~ Operations
Shutdown

LCO 3.6.7 The containment building penetrations shall be in the following status:

a. The equipment hatch closed and held in place by [a minimum of four bolts,]

b. One door in each airlock closed,

c. Each penetration providing direct access from the containment atmosphere to the outside atmosphere is either:

1. Closed by a manual or automatic isolation valve, blind flange, or equivalent; or

2. Exhausting through OPERABLE Containment Purge System ACUs, and is capable of being closed by an OPERABLE Containment Purge and Exhaust Isolation System.

APPLICABILITY: MODE 5 with ~~REDUCED RCS INVENTORY~~,
MODE 6 with ~~REDUCED RCS INVENTORY~~

Reactor Coolant System (RCS) loops not filled

the water level < 7.0 m (23 ft) above the top of reactor vessel flange

----------NOTE----------
The equipment hatch is closed before the manway of pressurizer (PZR) opens in MODE 5.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more containment penetrations not in required status.	A.1 Restore containment penetration to required status.	[6 hours]
B. Required Action and Completion Time not met.	B.1 Restore RCS level to > [~~EL 127' 0" (38.7 m)~~].	[6 hours]

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38.72 m (127 ft 1/4in)

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BASES

APPLICABLE SAFETY ANALYSES (continued)

The acceptance criteria applied to accidental releases of radioactive material to the environment are given in terms of total effective dose (TED) received by a member of the general public who remains at the exclusion area boundary for any two hours period following onset of the postulated fission product release. The limit established in Reference 1 is 0.25 Sv total effective dose.

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

LCO

Containment OPERABILITY is maintained by limiting leakage to less than or equal to 1.0 La, except prior to the first startup after performing a required Containment Leakage Rate Testing Program leakage test. At this time, the applicable leakage limits must be met. Compliance with this LCO will ensure a containment configuration, including equipment hatches, that is structurally sound and that will limit leakage to those leakage rates assumed in the safety analysis.

Individual leakage rates specified for the containment airlocks (LCO 3.6.2), and purge valves with resilient seals (LCO 3.6.3) are not specifically part of the acceptance criteria of 10 CFR Part 50, Appendix J. Therefore, leakage rates exceeding these individual limits only result in the containment being inoperable when the leakage results in exceeding the overall acceptance criteria of 1.0 La.

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material into containment. In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, containment is not required to be OPERABLE in MODE 5, to prevent leakage of radioactive material from containment. The requirements for containment during MODES 5 and 6 are addressed in LCOs 3.9.3, “Containment Penetrations” and 3.6.7, “Containment Penetrations - ~~REDUCED RCS INVENTORY~~ Operations.”

Shutdown

BASES

RCS level < 38.72 m (127 ft 1/4 in)

APPLICABILITY

In MODES 1, 2, 3, and 4, a DBA could cause a release of radioactive material to containment. In MODES 5 and 6, the probability and consequences of these events are reduced due to the pressure and temperature limitations of these MODES. Therefore, the containment airlocks are not required in MODE 5 to prevent leakage of radioactive material from containment. The requirements for the containment airlocks during MODE 6 are addressed in LCO 3.9.3, "Containment Penetrations." In MODES 5 and 6 with ~~REDUCED RCS INVENTORY conditions~~, the requirements of the containment air locks are addressed in LCO 3.6.7, "Containment Penetrations - ~~REDUCED RCS INVENTORY~~".

Shutdown Operations

ACTIONS

The ACTIONS are modified by a Note that allows entry and exit to perform repairs on the affected airlock component. If the outer door is inoperable, then it can be easily accessed for most repairs. It is preferred that the airlock be accessed from inside containment by entering through the other OPERABLE airlock. However, if this is not practicable, or if repairs on either door must be performed from the barrel side of the door then it is permissible to enter the airlock through the OPERABLE door, which means there is a short time during which the containment boundary is not intact(during access through the outer door). The ability to open the OPERABLE door, even if it means the containment boundary is temporarily not intact, is acceptable because of the low probability of an event that could pressurize the containment during the short time in which the OPERABLE door is expected to be open. After each entry and exit, the OPERABLE door must be immediately closed. If ALARA conditions permit, entry and exit should be via an OPERABLE airlock.

A second Note has been added to provide clarification that, for this LCO, separate Condition entry is allowed for each airlock. This is acceptable, since the Required Actions for each Condition provide appropriate compensatory action for each inoperable airlock. Complying with the Required Actions may allow for continued operation, and a subsequent inoperable airlock is governed by subsequent condition entry and application of associated Required Actions. A third Note has been included that requires entry into the applicable Conditions and Required Actions of LCO 3.6.1, "Containment," when leakage results in exceeding the overall containment leakage limit.

Shutdown

Shutdown

B 3.6 CONTAINMENT SYSTEMS

B 3.6.7 Containment Penetrations - ~~REDUCED RCS INVENTORY~~ Operations

BASES

Replace with the attachment "A" on next page.

BACKGROUND During REDUCED RCS INVENTORY operations, a release of fission product radioactivity within containment will be restricted from leakage to the environment when the LCO requirements are met.

APPLICABLE SAFETY ANALYSES Release of fission products to the environment from containment is limited by 10 CFR 50.34. If the LCO requirements are adhered to, then no release exceeding the 10 CFR 50.34 limits can occur (Ref. 1).

~~REDUCED RCS INVENTORY~~ operations satisfy LCO Selection Criterion 3.

Shutdown

LCO This LCO minimizes the release of radioactivity from containment. The LCO requires the equipment [ ] in place by [four bolts], one door in each airlock be closed, and each penetration providing direct access to the outside environment to be closed with the exception of the containment purge.

RCS loops not filled

APPLICABILITY The LCO is applicable during MODE 5 with ~~REDUCED RCS INVENTORY~~ or MODE 6 with ~~REDUCED RCS INVENTORY~~.

the water level <7.0 m (23 ft) above the top of reactor vessel flange

ACTIONS A.1

If one or more containment penetrations are not in the required status, restoration must be accomplished within [6] hours. This will ensure that the plant will be within the assumptions of the safety analysis.

B.1

Deleted

If Action A.1 has not been completed within the [6] hours, then the RCS level must be restored to > ~~[EL 127' 0" (38.7 m)]~~ within [6] hours of Action A.1 not being met.

38.72 m (127 ft 1/4 in)

The equipment hatch keeps closed during these applicability MODEs, because the equipment hatch is administratively closed before the manway of the pressurizer opens.

BACKGROUND Containment closure capability is required during shutdown operations, such as in MODE 5 with the Reactor Coolant System (RCS) loops not filled or in MODE 6 with the water level < 7.0 m (23 ft) above the top of reactor vessel flange. RCS heatup and direct venting could result in steaming into the containment if heat removal function is no longer available in MODES 5 and 6 during shutdown operations. In response to such an event, the equipment hatch, air locks and penetrations must be closed prior to steaming into containment. The Limiting Condition for Operation (LCO) requires "containment closure" in MODES 5 and 6 during shutdown operations. Containment closure means that all potential leak paths are closed or capable of being closed.

The containment equipment hatch, which is part of the containment pressure boundary, provides a means for moving large equipment and components into and out of the containment. The equipment hatch can be closed within an hour with or without alternating current (AC) power. The hatch moves vertically; the hatch is pulled down to the operation floor for closure.

However, the equipment hatch keeps closed during shutdown operations because administratively the hatch is closed prior to entering MODES 5 and 6 when the containment is OPERABLE. In MODES 5 and 6 during shutdown operations, the equipment hatch must be held in place by at least four bolts. Good engineering practice dictates that the bolts required by this LCO be approximately equally spaced.

The containment airlocks, which are also part of the containment pressure boundary, provide a means for personnel access during shutdown operations in accordance with LCO 3.6.2, “Containment Airlocks." Each airlock has a door at both ends. The doors are normally interlocked to prevent simultaneous opening when containment OPERABILITY is required. During shutdown operations when containment closure is not required, the door interlock mechanism may be disabled, allowing both doors of an airlock to remain open for extended periods when frequent containment entry is necessary. In MODES 5 and 6 during shutdown operations, only containment closure is required; therefore the door interlock mechanism may remain disabled, but one airlock door must remain capable of being closed.

In MODE 6 during shutdown operations, large air exchanges may be required to conduct refueling operations. The high volume purge system is used for this purpose and all valves are closed by the ESFAS such as containment purge isolation actuation signal (CPIAS) and containment isolation actuation signal (CIAS) in accordance with LCO 3.3.5, “Engineered Safety Feature Actuation System (ESFAS) Instrumentation."

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

1.1 Definitions

PHYSICS TESTS	PHYSICS TESTS shall be those tests performed to measure the fundamental nuclear characteristics of the reactor core and related instrumentation. These tests are: a. Described in Chapter 14, Initial Test Program, of the DCD Tier 2 b. Authorized under the provisions of 10 CFR 50.59 c. Otherwise approved by the NRC
PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR)	The PTLR is the unit specific document that provides the reactor vessel pressure and temperature limits, including heatup and cooldown rates, for the current reactor vessel fluence period. These pressure and temperature limits shall be determined for each fluence period in accordance with Specification 5.6.4.
RATED THERMAL POWER (RTP)	RTP shall be a total reactor core heat transfer rate to the reactor coolant of 3,983 MWt.
REACTOR PROTECTION SYSTEM (RPS) RESPONSE TIME	The RPS RESPONSE TIME shall be that time interval from when the monitored parameter exceeds its RPS trip setpoint at the input to the input to the channel sensor until electrical power to the control element assemblies (CEAs) drive mechanism is interrupted. The response time may be measured by means of any series of sequential, overlapping, or total steps so the entire response time is measured. In lieu of measurement, response time may be verified for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC.
~~REDUCED RCS INVENTORY~~	~~REDUCED RCS INVENTORY is the plant condition when the RCS level is below the 38.72 m (127 ft 1/4 in) elevation and fuel is in the reactor vessel. The 38.72 m (127 ft 1/4 in) elevation corresponds to 91.44 cm (3 ft) below the reactor vessel flange.~~

Deleted

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.7 RCS Loops – MODE 5 (Loops Filled)

LCO 3.4.7 One shutdown cooling (SC) train shall be OPERABLE and in operation, and either:

a. One additional SC train shall be OPERABLE, or

b. The secondary side water level of each steam generator (SG) shall be ≥ 25 % wide range indication.

may be removed from operation

NOTES → ~~NOTE~~

1. The SC pump of the train in operation may ~~be de-energized~~ for ≤ 1 hour per 8-hour period provided:
   a. No operations are permitted that would cause ~~reduction of the RCS boron concentration~~ required to meet the SDM of LCO ~~3.1.1~~; and
   b. Core outlet temperature is maintained at least 5.6 °C (10 °F) below saturation temperature.
2. One required SC train may be inoperable for up to 2 hours for surveillance testing provided that the other SC train is OPERABLE and in operation.
3. No RCP shall be started with one or more of the RCS cold leg temperatures less than or equal to the LTOP enable temperature specified in the PTLR, unless secondary water temperature of each SG is < 55.6 °C (100 °F) above each of the RCS cold leg temperatures.
4. All SC trains may be removed from operation during planned heatup to MODE 4 when at least one RCS loop is in operation.
5. A containment spray pump can be manually realigned to meet the requirement of a SC pump.

introduction of coolant into the RCS with boron concentration less than

3.1.2

APPLICABILITY: MODE 5 with RCS loops filled.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.8 RCS Loops – MODE 5 (Loops Not Filled)

be removed from operation
(RAI 119-7976 - Question 16-23)

LCO 3.4.8 ~~Two shutdown cooling (SC) trains shall be OPERABLE and one SC train shall be in operation.~~

NOTES

~~NOTE~~

1. All SC pumps may ~~be de-energized~~ for ≤ 15 minutes when switching from one train to another provided:
   a. Core outlet temperature is maintained at least 5.6 °C (10 °F) below saturation temperature.
   b. No operations are permitted that would cause ~~a reduction of RCS boron concentration required to meet the SDM of LCO 3.1.1~~; and
   c. No draining operations to further reduce RCS water volume are permitted.
2. One SC train may be inoperable for ≤ 2 hours for surveillance testing provided the other SC train is OPERABLE and in operation.
3. ~~A containment spray pump can be manually realigned to meet the requirement of a SC pump.~~

introduction of coolant into the RCS with boron concentration less than required to meet the SDM of LCO 3.1.2
(RAI 119-7976 - Question 16.23)

The containment spray pump associated with the SC train not in operation may be manually aligned to meet the requirement of its associated SC pump.

APPLICABILITY: MODE 5 with RCS loops not filled.

4. MID-LOOP operation is allowed ≥ 96 hours after reactor shutdown and core exit temperature is maintained ≤ 57.2 °C (135 °F).
(RAI 481-8546 - Question 16-149)

The heat removal system shall be in the following status:

a. Two shutdown cooling (SC) trains shall be OPERABLE and one SC train shall be in operation; and

b. The containment spray pump in the operating SC train shall be OPERABLE.
(RAI 119-7976 - Question 16.23)

Replace with the attachment "B" on next page. (RAI 119-7976 - Question 16.23)

RAI 481-8549 - Question 16-149

RAI 119-7976 - Question 16-23

	REQUIRED ACTION	COMPLETION TIME
A. One SC train inoperable.	A.1 Initiate action to restore SC train to OPERABLE status.	Immediately
B. Required SC trains inoperable. OR No SC train in operation.	B.1 Suspend all operations involving reduction of RCS boron concentration. AND B.2 Initiate action to restore one SC train to OPERABLE status and operation. AND B.3 Initiate action to raise RCS level to > EL. 38.72 m (127 ft-1/4 in).	Immediately Immediately Immediately

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.4.8.1	Verify one SC train is in operation.	12 hours
SR 3.4.8.2	---------- NOTE ---------- Not required to be performed until 24 hours after a required pump is not in operation. ---------- Verify correct breaker alignment and indicated power available to required SC pump.	7 days
~~SR 3.4.8.3~~	Verify required SCS train locations susceptible to gas accumulation are sufficiently filled with water.	31 days
SR 3.4.8.3	Verify correct breaker alignment and indicated power available to the required containment spray pump that is not in operation.	24 hours

RAI 119-7976 - Question 16.23

RAI 119-7976 - Question 16.23

RAI 119-7976 - Question 16.23

Replace with the attachment "C" on next page.
(RAI 481-8546 - Question 16-149) on the next pages.

Attachment "B" (1 of 2) (RAI 119-7976 - Question 16.23), Part of 3.4.8

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One SC train inoperable.	A.1 Initiate action to restore SC train to OPERABLE status.	Immediately
B. ~~Required~~ Two (RAI 481-8546 - Question 16-149) SC trains inoperable. OR No SC train in operation	B.1 Suspend operations that would cause introduction of coolant into the RCS with boron concentration less than required to meet SDM of LCO 3.1.2. AND B.2 Initiate action to restore one SC train to OPERABLE status and operation. AND B.3 Initiate action to raise RCS level to > ~~EL~~ 38.72 m (~~127 ft 1/4 in~~).	Immediately Immediately Deleted; (RAI 481-8546 - Question 16-149) Immediately

127 ft 1/4 in (RAI 481-8546 - Question 16-149)

RAI 119-7976 - Question 16-23

Attachment "B" (2 of 2) (RAI 119-7976 - Question 16.23), Part of 3.4.8

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Containment Spray pump in operating SC train inoperable.	C.1 If the containment spray pump in the alternate train is OPERABLE, initiate action to place that train in operation. AND C.2 Monitor SC System performance. AND C.3 Restore containment spray pump to OPERABLE status.	Immediately Every 30 minutes 48 hours
D. Required Action and associated Completion Time of C.3 not met.	D.1 Raise RCS level > ~~EL~~ 38.72 m (~~127 ft 1/4 in~~).	6 hours

Deleted; (RAI 481-8546 - Question 16-149)

127 ft 1/4 in (RAI 481-8546 - Question 16-149)

E. Core exit temperature > 57.2 °C (135 °F) during MID-LOOP operation. **OR** **RCS level in MID-LOOP condition (≤ 36.30 m (119 ft 1 in)) with < 96 hours after reactor shutdown.**	**E.1 Initiate action to restore core exit temperature to ≤ 57.2 °C (135 °F).** **AND** **E.2 Initiate action to raise RCS level above MID-LOOP condition (> 36.30 m (119 ft 1 in)).**	**Immediately** **Immediately**

(RAI 481-8546 - Question 16-149)

Attachment "C" (1 of 1) (RAI 481-8546 - Question 16-149)

SURVEILLANCE		FREQUENCY
SR 3.4.8.1	----------NOTE---------- Only required to be met when in MID-LOOP operation. ---------- Verify core exit temperature is ≤ 57.2°C (135°F).	15 minutes
SR 3.4.8.2	Verify one SC train is in operation.	12 hours
SR 3.4.8.3	----------NOTE---------- Not required to be performed until 24 hours after a required pump is not in operation. ---------- Verify correct breaker alignment and indicated power available to required SC pump.	7 days
SR 3.4.8.4	Verify correct breaker alignment and indicated power available to the required containment spray pump that is not in operation.	24 hours
SR 3.4.8.5	Verify required SCS train locations susceptible to gas accumulation are sufficiently filled with water.	31 days

RAI 119-7976 - Question 16-23

BASES

BACKGROUND (continued)

In some cases, this can occur in 15 to 20 minutes. During "Loops Not Filled" operations, the SC system is the primary means of decay heat removal.

APPLICABLE SAFETY ANALYSES

In MODE 5, RCS circulation is considered in determining the time available for mitigation of the accidental boron dilution event. The SC trains provide this circulation. The flow provided by one SC train is adequate for decay heat removal and for boron mixing.

RCS loops – MODE 5 (loops not filled) has been included in specification as important contributors to risk reduction according to LCO SELECTION CRITERION 4.

LCO

The purpose of this LCO is to require a minimum of two SC trains be OPERABLE and one of these trains be in operation. An OPERABLE train is one that has the capability of transferring heat from the reactor coolant at a controlled rate.

Heat removal cannot occur via the SC system unless forced flow is used. A minimum of one running SC pump meets the LCO requirement for one train in operation. An additional SC train is required to be OPERABLE to meet the single failure criterion.

to be removed from operation (RAI 119-7976 - Question 16.23)

During Loops Not Filled operations, the containment spray pump in the OPERABLE SC train shall be OPERABLE.

Note 1 permits the SC pumps ~~to be de-energized~~ for less than or equal to 15 minutes when switching from one train to another. The circumstances for stopping both SC pumps are to be limited to situations when the outage time is short and the core outlet temperature is maintained at least 5.6 °C (10 °F) below saturation temperature. ~~The Note prohibits boron dilution and~~ draining operations when SC forced flow is stopped.

Note 2 allows one SC train to be inoperable for a period of 2 hours provided that the other train is OPERABLE and in operation. This permits periodic surveillance tests to be performed on the inoperable train during the only time when these tests are safe and possible.

The Note prohibits boron dilution with coolant at boron concentrations less than required to assure the SDM of LCO 3.1.2 is maintained or(RAI 119-7976 - Question 16.23)

BASES

LCO (continued)

Note 4 limits the mid-loop entry conditions (RCS level ≤ 36.30 m (119 ft 1 in)) which of the time after 96 hours after reactor shutdown and the core exit temperature less than 57.2 °C (135 °F). These limitations are the same as those of MID-LOOP operating conditions assumed in the Safety Analysis of Loss of Residual Heat Removal event and the limitations shall be maintained in order to operate the plant safely. (RAI 481-8546 - Question 16-149)

capable of providing forced flow to an OPERABLE SC heat exchanger, along with the appropriate flow and temperature instrumentation for control, protection, and indication. SC pumps are OPERABLE if they are capable of being powered and are able to provide flow if required. Management of gas voids is important to SCS OPERABILITY.

~~Note 3 permits the alignment of a containment spray pump if an SC pump is not available or becomes inoperable. These pumps are designed to be interchangeable for operational flexibility.~~

APPLICABILITY

In MODE 5 with loops not filled, this LCO requires core heat removal and coolant circulation by the SCS.

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 3.4.6, "RCS Loops – MODE 4"

LCO 3.4.7, "RCS Loops – MODE 5 (Loops Filled)"

LCO 3.9.4, "Shutdown Cooling System (SCS) and Coolant Circulation – High Water Level", and

LCO 3.9.5, "Shutdown Cooling System (SCS) and Coolant Circulation – Low Water Level"

ACTIONS

A.1

If one required SC train is inoperable, redundancy for heat removal is lost. Action must be initiated immediately to restore a second train to OPERABLE status. The immediate Completion Time reflects the importance of maintaining the availability of two paths for heat removal.

Note 3 permits the containment spray pump associated with the SC train not in operation to be manually aligned to meet the requirement of its associated SC pump. These pumps are designed to be interchangeable with the associated SC pump for operational flexibility. In MODE 5, the containment spray pumps are not required to meet the requirements of LCO 3.6.6, therefore they are available to support the SC function. If the containment spray pump is aligned to meet the requirements of the associated SC pump, then the Surveillance Requirements of this LCO must be applied to the containment spray pump instead of the SC pump, as necessary.(RAI 119-7976 - Question 16.23)

BASES

Replace with the attachment "D" on next page. (RAI 119-7976 - Question 16.23) on the next page.

ACTIONS (continued)

B.1, B.2 and B.3

If required SC trains are inoperable or no train is in operation, the action requires immediate suspension of any operation for boron concentration reduction, initiating action to raise RCS level to greater than EL 38.72 m (127 ft 1/4 in) and requires action to immediately start restoration of one SC train to OPERABLE status. Boron dilution requires forced circulation for proper mixing and margin to criticality must not be reduced in this type of operation. The immediate Completion Time reflects the importance of maintaining operation for decay heat removal.

SURVEILLANCE REQUIREMENTS

~~SR 3.4.8.1~~

SR 3.4.8.2 (RAI 481-8546 - Question 16-149)

This SR requires verification of the required SC train is in operation every 12 hours.

SR 3.4.8.2 (RAI 481-8546 - Question 16-149)

Verification includes flow rate, temperature, or pump status monitoring, which help ensure forced flow is providing decay heat removal.

The 12-hour Frequency has been shown by operating practice to be sufficient to regularly assess degradation and verify operation within safety analyses assumptions.

~~SR 3.4.8.2~~

SR 3.4.8.3 (RAI 481-8546 - Question 16-149)

Verification that the required number of trains are OPERABLE ensures that redundant paths for heat removal are available and additional trains 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 indicated power available to the required ~~pumps~~ pump that is not in operation. (RAI 119-7976 - Question 16.23)

This verification is not needed for the operating pump since it is verified to be in operation in accordance with ~~SR 3.4.8.1~~. If the containment spray pump is aligned to meet the requirements of the SC pump that is not in operation, then this SR must be applied to the containment spray pump instead of the SC pump. (RAI 119-7976 - Question 16.23)

The 7-day Frequency is considered reasonable in view of other administrative controls available and has been shown to be acceptable by operating experience.

This SR is modified by a Note that states the SR is not required to be performed until 24 hours after a required pump is not in operation.

SR 3.4.8.1

This SR requires verification of the core exit temperature is within the limit. This verification ensures the plant conditions assumed in the safety analysis during MID-LOOP operation.
The Frequency of 15 minutes reflects the importance of maintaining the core exit temperature below the assumed value in the safety analysis during the MID-LOOP operation.
This SR is modified by a Note that states the SR is only required to be met when in MID-LOOP operation.
(RAI 481-8546 - Question 16-149)

RAI 481-8549 - Question 16-149

RAI 119-7976 - Question 16-23

Attachment "D" (1 of 1)(RAI 119-7976 - Question 16.23), Part of B 3.4.8

B.1, B.2 and B.3

SC (RAI 481-8546 - Question 16-149)

If no required ~~SDC~~ train is OPERABLE or the required train is not in operation, except as provided in Note 1, all operations involving introduction of coolant into the RCS with boron concentration less than required to meet the minimum SDM of LCO 3.1.2 must be suspended., initiating action to raise RCS level to greater than ~~EL~~ 38.72 m (127 ft 1/4 in) and requires action to immediately start restoration of one SC train to OPERABLE status. The required margin to criticality must not be reduced in this type of operation. Suspending the introduction of coolant into the RCS of coolant with boron concentration less than required to meet the minimum SDM of LCO 3.1.2 is required to assure continued safe operation. With coolant added without forced circulation, unmixed coolant could be introduced to the core, however coolant added with boron concentration meeting the minimum SDM maintains acceptable margin to subcritical operations. The immediate Completion Time reflects the importance of maintaining operation for decay heat removal.

Deleted; (RAI 481-8546 - Question 16-149)

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

If the containment spray pump in the operating SC train is inoperable, action must be initiated immediately to place the alternate SC train in operation if the containment spray pump in the alternate train is OPERABLE. Also, SC System performance must be monitored every 30 minutes and the inoperable containment spray pump must be restored to OPERABLE status within 48 hours.

D.1

127' 1/4" (RAI 481-8546 - Question 16-149)

If the containment spray pump cannot be restored within 48 hours, RCS level must be raised to > ~~EL~~ 38.72 m (~~127' 1/4"~~) within 6 hours. This will place the plant in a conservative position with respect to providing decay heat removal.

(RAI 119-7976 - Question 16.23)

E.1 and E.2

If the core exit temperature > 57.2 °C (135 °F) during MID-LOOP operation or RCS level in MID-LOOP condition (≤ 36.30 m (119 ft 1 in)) with < 96 hours after reactor shutdown, action must be initiated immediately to decrease the RCS temperature and raise the RCS level higher than the hot leg top. These actions assure the plant conditions assumed in the safety analysis. (RAI 481-8546 - Question 16-149)

BASES

SURVEILLANCE REQUIREMENTS (continued)

SR 3.4.8.5 (RAI 481-8546 - Question 16-159)

~~SR 3.4.8.3~~ SR 3.4.8.4 (RAI 119-7976 - Question 16.23)

SCS piping and components have the potential to develop voids and pockets of entrained gases. Preventing and managing gas intrusion and accumulation is necessary for proper operation of the SC trains and may also prevent water hammer, pump cavitation, and pumping of noncondensible gas into the reactor vessel.

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

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

~~SR 3.4.8.3~~ SR 3.4.8.4 (RAI 481-8546 - Question 16-159)

Verification of the correct breaker alignment and indicated power available to the required containment spray pump ensures that the redundant containment spray pump will be able to remove heat from the RCS in the event of a power failure to the operating SC train. The Frequency of 24 hours is based on operating experience.
(RAI 119-7976 - Question 16.23)

3.9 REFUELING OPERATIONS

3.9.5 Shutdown Cooling System (SCS) and Coolant Circulation – Low Water Level

LCO 3.9.5 The heat removal system shall be in the following status:

a. Two SCS trains shall be OPERABLE and one SCS train shall be in operation.

b. With REDUCED RCS INVENTORY, the containment spray pump in the same train as an operating SCS train shall be OPERABLE.

When RCS level < 38.72 m (127 ft 1/4 in)

APPLICABILITY: MODE 6 with the water level <7.0 m (23 ft) above the top of reactor vessel flange.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One SCS train inoperable.	A.1 Initiate action to restore SCS train to OPERABLE status. AND A.2 Initiate actions to establish ≥ 7.0 m (23 ft) of water above the top of reactor vessel flange.	Immediately Immediately
B. No SCS train OPERABLE or in operation.	B.1 Suspend operations involving a reduction in reactor coolant boron concentration. AND B.2 Initiate action to restore one SCS train to OPERABLE status and to operation AND B.3 Initiate action to raise RCS level to > EL 38.72 m (127'-1/4") when in REDUCED RCS INVENTORY.	Immediately Immediately Immediately

38.72 m (127 ft 1/4 in)

ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. Containment spray pump in the same train as an operating SCS train inoperable.	C.1 If the containment spray pump in the alternate SCS train is OPERABLE, initiate action to place that SCS train in operation. AND C.2 Monitor SCS performance. AND C.3 Restore containment spray pump to OPERABLE status.	Immediately Every 30 minutes 48 hours
D. Required Action and Completion time of Item C.3 not met.	D.1 Raise RCS level > EL 38.72 m (127'-1/4").	6 hours
E. Required Actions and associated Completion Tmes of Conditions A, B, and C not met.	E.1 Close equipment hatch and secure with [four] bolts. AND E.2 Close one door in each air lock. AND E.3.1 Close each penetration providing direct access from the containment atmosphere to the outside atmosphere with a manual or automatic isolation valve, blind flange, or equivalent. OR E.3.2 Verify each penetration is capable of being closed by an OPERABLE containment purge system.	4 hours 4 hours 4 hours 4 hours

38.72 m (127 ft 1/4 in)

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.9.5.1	Verify required SCS trains are OPERABLE and one SCS train is in operation.	12 hours
SR 3.9.5.2	Verify correct breaker alignment and indicated power available to the required SCS pump that is not in operation.	7 days
SR 3.9.5.3	Verify correct breaker alignment and indicated power available to the required CS pump.	24 hours when in REDUCED RCS INVENTORY
SR 3.9.5.4	Verify required SCS train piping locations susceptible to gas accumulation are sufficiently filled with water.	31 days

RCS level < 38.72 m (127 ft 1/4 in)

BASES

LCO

Only one SCS train is needed for decay heat removal in MODE 6 with water level less than 7.0 m (23 ft) above the top of the reactor vessel flange. To increase reliability, both SCS trains must be OPERABLE. Additionally, one train of SCS must be in operation in order to:

a. Provide for decay heat removal,

b. Provide mixing of borated coolant to minimize the possibility of a criticality, and

c. Provide indication of average reactor coolant temperature.

when RCS level < 38.72 m (127 ft 1/4 in),

An OPERABLE SCS train consists of an SCS pump, a heat exchanger, valves, piping, instruments, and controls to ensure an OPERABLE flow path and to determine the low end temperature. The flow path starts in one of the RCS hot legs and is returned to the DVI nozzle(s). Managing gas or voids in the piping is important to SCS OPERABILITY.

In addition, during REDUCED RCS INVENTORY conditions a containment spray pump in the same train as the operating SCS pump is required to be OPERABLE. The containment spray pump is interchangeable with the SCS pump and provides a backup to the operating SCS pump. This requirement ensures forced circulation is available for decay heat removal if the operating SCS pump becomes inoperable for any reason.

The requirements of this LCO are derived primarily from experience with decay heat removal in shutdown modes of operation. The principal purpose of this specification is to assure the capability to remove decay heat and to control RCS temperature, and chemistry with low water level.

Both SCS pumps may be aligned to the IRWST to support filling or draining the refueling pool or for performance of required testing.

APPLICABILITY

Two SCS trains are required to be OPERABLE and one SCS train must be in operation in MODE 6 with the water less than 7.0 m (23 ft) above the top of the reactor vessel flange to provide decay heat removal. Requirements for the SCS in other MODES are covered by LCOs in Section 3.4, Reactor Coolant System. MODE 6 requirements with water level greater than or equal to 7.0 m (23 ft) above the reactor vessel flange are covered in LCO 3.9.4, “SCS and Coolant Circulation – High Water Level.”

BASES

ACTIONS

A.1 and A.2

With one SCS train inoperable and the other SCS train operating, actions shall be taken and continued until the SCS train is restored to OPERABLE status or to establish water level of greater than 7.0 m (23 ft) above the reactor vessel flange. At that point, the Applicability will change to that of LCO 3.9.4, “SCS and Coolant Circulation – High Water Level,” and only one SCS train is required to be OPERABLE and in operation. With the unit in MODE 6, immediate corrective actions must be taken.

B.1

If no SCS train is in operation or no SCS trains are OPERABLE, there will be no forced circulation to provide mixing to establish uniform boron concentrations. Reduced boron concentrations can occur by the addition of water with lower boron concentration than that contained in the RCS. Therefore, actions which reduce boron concentration shall be suspended immediately.

B.2

With no SCS train in operation or with both SCS trains inoperable, actions shall be initiated immediately and continued without interruption to restore one SCS train to OPERABLE status and operation. As the unit is in Conditions A and B concurrently, the restoration of two OPERABLE SCS trains and one operating SCS train should be accomplished as quickly as possible. With at least one SCS train operable, water level can be raised greater than or equal to 7.0 m (23 ft) above the reactor vessel flange and the applicability will change to that of LCO 3.9.4, “SCS and Coolant Circulation – High Water Level,” and only one SCS train is required.

B.3

If no SCS train is in operation or no SCS trains are OPERABLE and the plant is in REDUCED RCS INVENTORY conditions the action requires to immediately initiate action to raise RCS level to greater than EL 38.72 m(127'-1/4"). The immediate Completion Time reflects the importance of maintaining operation for decay heat removal and prevents a boron dilution event.

(127 ft 1/4 in)

RCS level < 38.72 m (127 ft 1/4 in),

DELETED

BASES

ACTIONS (continued)

C.1, C.2 and C.3

If the containment spray pump in the same train as an operating SCS train is inoperable, action must be initiated to place the alternate SCS train in operation (if the containment spray pump in the alternate SCS train is OPERABLE) immediately. Also, SCS performance must be monitored every 30 minutes and the inoperable containment spray pump must be restored to OPERABLE condition within 48 hours.

D.1

If the containment spray pump cannot be restored within 48 hours, RCS level must be raised to greater than 38.72 m (EL 127'-1/4") within 6 hours. This will place the plant in a conservative position with respect to providing decay heat removal.

(127 ft 1/4 in)

E.1, E.2, E.3.1 and E.3.2

If no SCS train or CSP is OPERABLE and in operation, the following actions must be taken:

a. The equipment hatch must be closed and secured with [four] bolts,

b. One door in each airlock 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 system.

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

The 4-hour Completion Time allows fixing of most SCS problems and is reasonable, based on the low probability of the coolant boiling in that time.