

## REVISED 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: 09/04/2015

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

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

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).

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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  $\leq 57.2^{\circ}\text{C}$  ( $135^{\circ}\text{F}$ ) is a condition for reducing reactor vessel level to  $\leq 119$  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	<p>-----NOTE-----</p> <p>Only required to be met when RCS level is <math>\leq</math> EL 38.72 m (127 ft 1/4 in).</p> <p>-----</p> <p>Verify core outlet temperature is <math>\leq 57.2^{\circ}\text{C}</math> (<math>135^{\circ}\text{F}</math>).</p>	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. <del>One R</del> required SIS train inoperable.	A.1 Restore required SIS train to OPERABLE status.	<del>6 hours</del> <del>4-hour</del>
B. <del>Required Action and associated Completion Time of Condition A not met.</del>	<del>B.1.1 Verify RCS level <math>\geq</math> 39.7 m (130 ft 0 in).</del>	<del>Immediately</del>
	<u>OR</u>	
	<del>B.1.2 Initiate actions to restore RCS level to <math>\geq</math> 39.7 m (130 ft 0 in).</del>	<del>Immediately</del>
	<u>AND</u>	
	<del>B.2 Reduce RCS cold leg temperature to <math>&lt;</math> 57.2°C (135°F).</del>	<del>24 hours</del>
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.	24 hours
	<u>AND</u>	
	C.2 Reduce RCS cold leg temperature to $<$ 57.2°C (135°F).	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.	Immediately
	<u>AND</u>	
	E.2 Reduce RCS cold leg temperature to $<$ 57.2°C (135°F).	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.	<p>restore water level to <math>\geq</math> 7 m (23 ft) above the top of reactor vessel flange.</p> <p><u>AND</u></p> <p>F.2 Reduce RCS cold leg temperature to <math>&lt; 57.2^{\circ}\text{C}</math> (<math>135^{\circ}\text{F}</math>).</p>	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 flow 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  $\geq 7.0$  m (23 ft) of water above the top of reactor vessel flange.

**Response – (Rev. 3)**

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 1 and 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 °C (135 °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 overflow through the SG manway. If SCS operation is not re-established, core boiling can produce a rapid core uncover. Therefore, operators need to initiate safety injection pump(s) to protect against the core uncover.

- 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  $\leq$  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  $\geq$  96 hours after reactor shutdown and core exit temperature is  $\leq$  57.2 °C (135 °F).**

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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  $\leq$  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	<p>-----NOTE-----  Only required to be met when in MID-LOOP operation.  -----</p> <p>Verify core exit temperature is <math>\leq 57.2^{\circ}\text{C}</math> (<math>135^{\circ}\text{F}</math>).</p>	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 A description on an entry condition into the loops filled or the loops not filled will be added in Applicability sections of B3.4.7 and B3.4.8 as follows;

#### B3.4.7

The MODE 5 with RCS loops filled condition is when the steam generators (SGs) can be used for the core decay heat removal. This loops filled condition can be maintained while draining the RCS provided the reactor coolant level is maintained above 134 ft, since below this level, containment atmospheric pressure can no longer completely support the column of water remaining in the SG tubes above the reactor coolant level. At reactor coolant level below 134 ft, water vapor voids begin forming in the horizontal portions of SG tubes, beginning with the highest tubes. The number of affected tubes increases as RCS level decreases until all tubes contain water vapor voids. SG tubes containing voids of water vapor, at the saturation temperature corresponding to vapor pressure of the coolant in the tubes, block coolant flow and secondary heat transfer. When reactor coolant level has decreased to 119 ft 1 in (just above the highest point of the hot leg), air can begin entering the hot leg through the surge line connection and displace the coolant remaining in the SG tubes. This results in the SG tubes being filled with non-condensable gases. The condition in MODE 5 with RCS water level within the top half of the hot legs is called mid-loop operation.

Restoring the unit to the MODE 5 with RCS loops filled condition requires raising RCS level above 134 ft during a draining operation, provided no air was introduced into the



SG tubes. Restoring the unit to the MODE 5 with RCS loops filled condition following mid-loop operation requires closing the pressurizer manway, filling the pressurizer, and dynamically venting non-condensable gases from the SG tubes and reactor vessel closure head using the RCGVS and the reactor coolant pumps.

A forced circulation by the reactor coolant pumps (RCPs) in the MODE 5 with loops not filled condition is possible when the static head of the water from pressurizer water level establishes an RCS pressure high enough to run an RCP.

#### B3.4.8

In the MODE 5 with RCS loops not filled condition, the steam generators (SGs) cannot be used for the core decay heat removal because the SG tubes contain water vapor voids or non-condensable gases that restrict the flow of reactor coolant through the SG tubes to less than the flow needed for adequate secondary heat transfer. The loops not filled condition is entered during draining of the RCS when the reactor coolant level is below 134 ft, which is about 28 ft below the highest SG tubes. Below this level, containment atmospheric pressure can no longer completely support the column of water remaining in the SG tubes above the reactor coolant level. At reactor coolant levels below 134 ft, water vapor voids begin forming in the horizontal portions of SG tubes, beginning with the highest tubes. The number of affected tubes increases as RCS level decreases until all tubes contain water vapor voids. SG tubes containing voids of water vapor, at the saturation temperature corresponding to vapor pressure of the coolant in the tubes, block coolant flow and secondary heat transfer. When reactor coolant level has decreased to 119 ft 1 in (just above the highest point of the hot leg), air can begin entering the hot leg through the surge line connection and displace the coolant remaining in the SG tubes. This results in the SG tubes being filled with non-condensable gases. The condition in MODE 5 with RCS water level within the top half of the hot legs is called mid-loop operation.

Restoring the unit to the MODE 5 with RCS loops filled condition requires raising RCS level above 134 ft during a draining operation, provided no air was introduced into the SG tubes. Restoring the unit to the MODE 5 with RCS loops filled condition following

mid-loop operation requires closing the pressurizer manway, filling the pressurizer, and dynamically venting non-condensable gases from the SG tubes and reactor vessel closure head using the RCGVS and the-reactor coolant pumps.

A forced circulation by the reactor coolant pumps (RCPs) in the MODE 5 with loops not filled condition is possible when the static head of the water from pressurizer water level establishes an RCS pressure high enough to run an RCP.

Reactor Coolant System Component Elevation for APR1400 Nuclear Power Plants

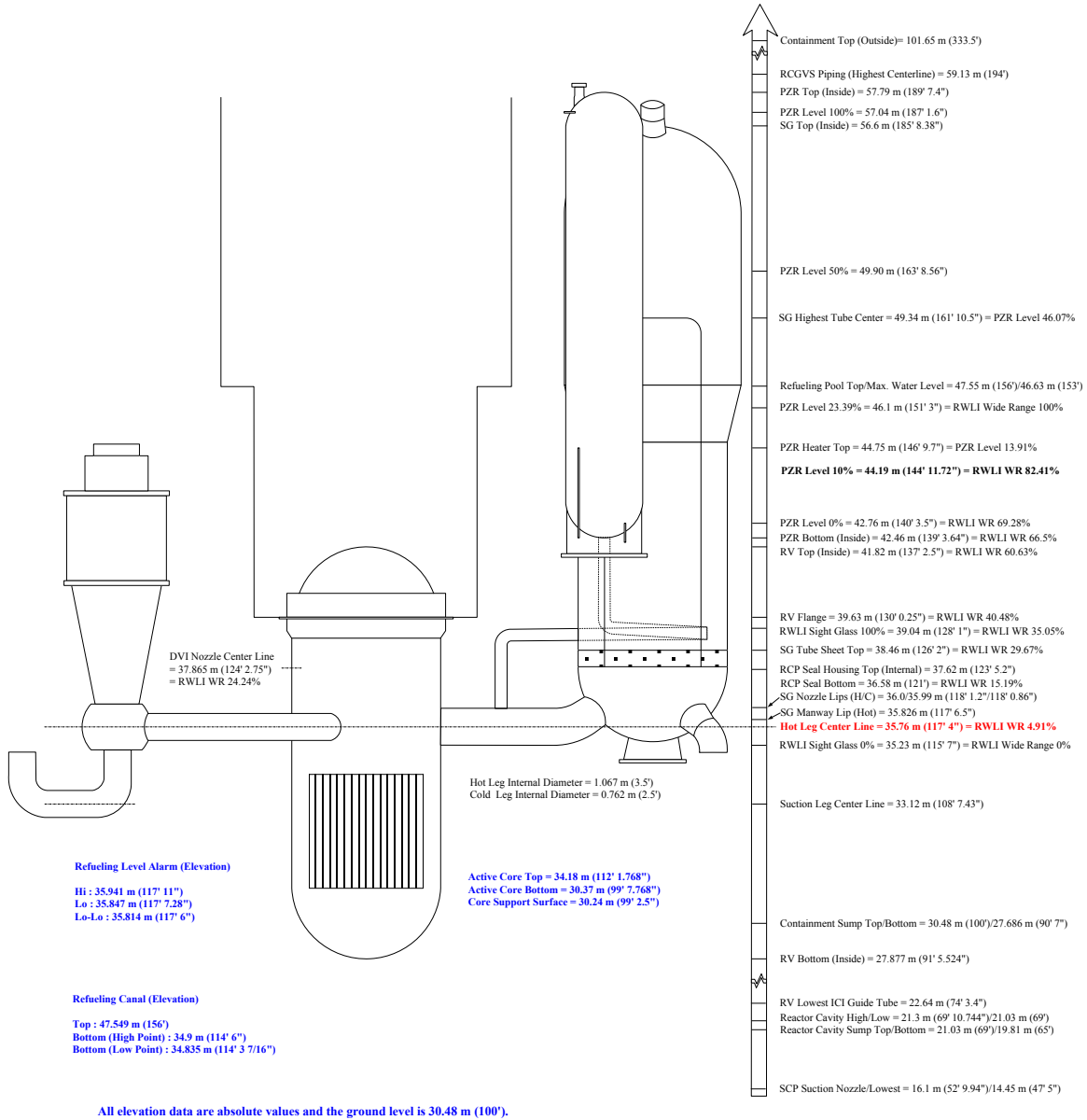


Figure 1 RCS Elevation View

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 LCO 3.9.5 is divided in two applicability as follows;

HEAT REMOVAL SYSTEM STATUS	APPLICABLE MODES or OTHER SPECIFIED CONDITION
a. Two SCS trains shall be OPERABLE, and one SCS train shall be in operation.	MODE 6 with the water level < 7.0 m (23 ft) above the top of reactor vessel flange and greater than 38.72 m (127 ft 1/4 in).
a. Two SCS trains shall be OPERABLE, and one SCS train shall be in operation, and  b. The containment spray pump in the operating SCS train shall be OPERABLE.	MODE 6 with the water level below 38.72 m (127 ft 1/4 in).

With no SCS train OPERABLE or in operation, if the plant is below 38.72 m (127 ft 1/4 in) action B.3 is applied. RCS level is required to be established above 38.72 m (127 ft 1/4 in) to increase the time to core uncover.

Operable safety injection pumps by LCO 3.5.3 can be used to raise RCS water level. Action B.3 is just an addition to NUREG-1432 of standard TS to enhance plant safety during shutdown mode. Because the Action B.3 is added with "AND" logic, overall Action B is more severe than Action A. In other words, while plant is paced above 38.72 m (127 ft 1/4 in) and the action is continued to restore one SCS train to operable and operation, operator shall prepare to shut the containment even with Action B.3 is completed. Addition of B.3 does not compromise NUREG-1432 requirements.

Also, please note that Action B.3 is only applicable when RCS level is lower than 38.72 m (127 ft 1/4 in). Operator may not need to stop the SIP at 38.72 m (127 ft 1/4 in) water level. However, it is just a minimum level requirement for the TS. The plant condition may not be prepared to fill the Refueling Pool over the reactor during RCS Reduced Inventory Operation.

Reduced inventory level is concern of GL 88-17. 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.

If at least one SCS train is operable, Condition A is entered. Required action A.2 to "Initiate actions to establish greater than or equal to 7.0 m (23 ft) above the reactor vessel flange" is applicable.

In the other case with no SCS train OPERABLE or in operation, if the plant is above 38.72 m (127 ft 1/4 in) action B.2 is applied. Because the plant is not operating below 38.72 m (127 ft 1/4 in) required action B.3 is already met. Because no SCS train is OPERABLE or in operation RCS water level cannot be raised greater than or equal to 7.0 m (23 ft) above the reactor vessel flange. Restoring one SCS train is initiated immediately. If at least one SCS train is operable, Condition A is entered. Required action A.2 to "Initiate actions to establish greater than or equal to 7.0 m(23 ft) above the reactor vessel flange" is applicable.

---

### **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 3.6.7 and its Bases will be revised as indicated in the Attachment.1.

B 3.4.7 and B 3.4.8 will be revised as indicated in the Attachment 2.

TS 3.3.8 and its Bases will be revised as indicated in the Attachment.3.

[Note: the numbered attachments from Rev. 0 of this response are not included. The prior revision of the RAI response was incorporated into Rev. 1 of the DCD and TS; therefore this revision starts with and only contains mark-ups to Revision 1 of the DCD and TS.]

### **Impact on Technical/Topical/Environmental Reports**

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

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 RAI 481-8546, 16-149 Rev.2  
 RAI 481-8546, 16-149 Rev.3

3.6 CONTAINMENT SYSTEMS

3.6.7 Containment Penetrations - Shutdown Operations

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,] Delete.
- 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
  2. Exhausting through OPERABLE Containment Purge System air cleaning units (ACUs), and is capable of being closed by an OPERABLE Containment Purge and Exhaust Isolation System.

APPLICABILITY: MODE 5 with <sup>any</sup> Reactor Coolant System (RCS) loops not filled, Delete.  
 MODE 6 with the water level < 7.0 m (23 ft) above the top of reactor vessel flange the

-----NOTE-----  
 The equipment hatch is closed before the manway of pressurizer (PZR) opens in MODE 5.  
 -----  
 shall be opening the pressurizer manway  
and held in place by a minimum of [four bolts]

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One or more containment penetrations not in required status.	A.1 Restore containment penetration to required status.	[4 hours] <span style="float: right;">Delete.</span> Delete.
B. Required Action and Completion Time not met.	B.1 Restore RCS level to > [38.72 m (127 ft 1/4 in)]. <span style="float: right;">Delete.</span>	[6 hours] <span style="float: right;">Delete.</span> Delete.

BASES

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BACKGROUND (continued)

BACKGROUND (Cont.)

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.

or

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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).

Containment penetration status during shutdown operations satisfies Shutdown operations satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

LCO

This LCO minimizes the release of radioactivity from containment. The LCO requires the equipment hatch be closed and held 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.

a minimum of

in

penetrations

any

and in

APPLICABILITY

The LCO is applicable during MODE 5 with RCS loops not filled or MODE 6 with the water level < 7.0 m (23 ft) above the top of reactor vessel flange.

refueling pool

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

is administratively required to be closed before opening the pressurizer manway in MODE 5, and is kept closed during MODE 5 in the RCS loops not filled condition and during MODE 6 with water level below the level required by LCO 3.9.6 "Refueling Water Level." This ensures that all containment penetrations will be in the status required by LCO 3.6.7 before the onset of reactor coolant boiling and steaming into containment in the event of a loss of shutdown cooling during reduced RCS inventory conditions.

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**BASES**

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**LCO (continued)**

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

Note 3 requires that before an RCP may be started with any RCS cold leg temperature less than or equal to the LTOP enable temperature specified in the PTLR, that secondary side water temperature in each SG is < 55.6°C (100°F) above each of the RCS cold leg temperatures.

Satisfying the above conditions will preclude a low temperature overpressure event due to a thermal transient when the RCP is started.

Note 4 provides for an orderly transition from MODE 5 to MODE 4 during a planned heatup by permitting removal of SC trains from operation when at least one RCP is in operation. This Note provides for the transition to MODE 4 where an RCP is permitted to be in operation and replaces the RCS circulation function provided by the SC trains.

An OPERABLE SC train is composed of an OPERABLE SC pump and an OPERABLE SC heat exchanger. Management of gas voids is important to SCS OPERABILITY.

SC pumps are OPERABLE if they are capable of being powered and are able to provide flow if required. An OPERABLE SG can perform as a heat sink when it has an adequate secondary water level and is OPERABLE in accordance with the In-service Inspection Program.

Note 5 permits the alignment of a containment spray pump if a SC pump is not available or becomes inoperable. These pumps are designed to be interchangeable for operational flexibility.

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**APPLICABILITY**

In MODE 5 with RCS loops filled, this LCO requires forced circulation to remove decay heat from the core and to provide proper boron mixing. One SC train provides sufficient circulation for these purposes.

 Insert the content "A" in the next sheet.



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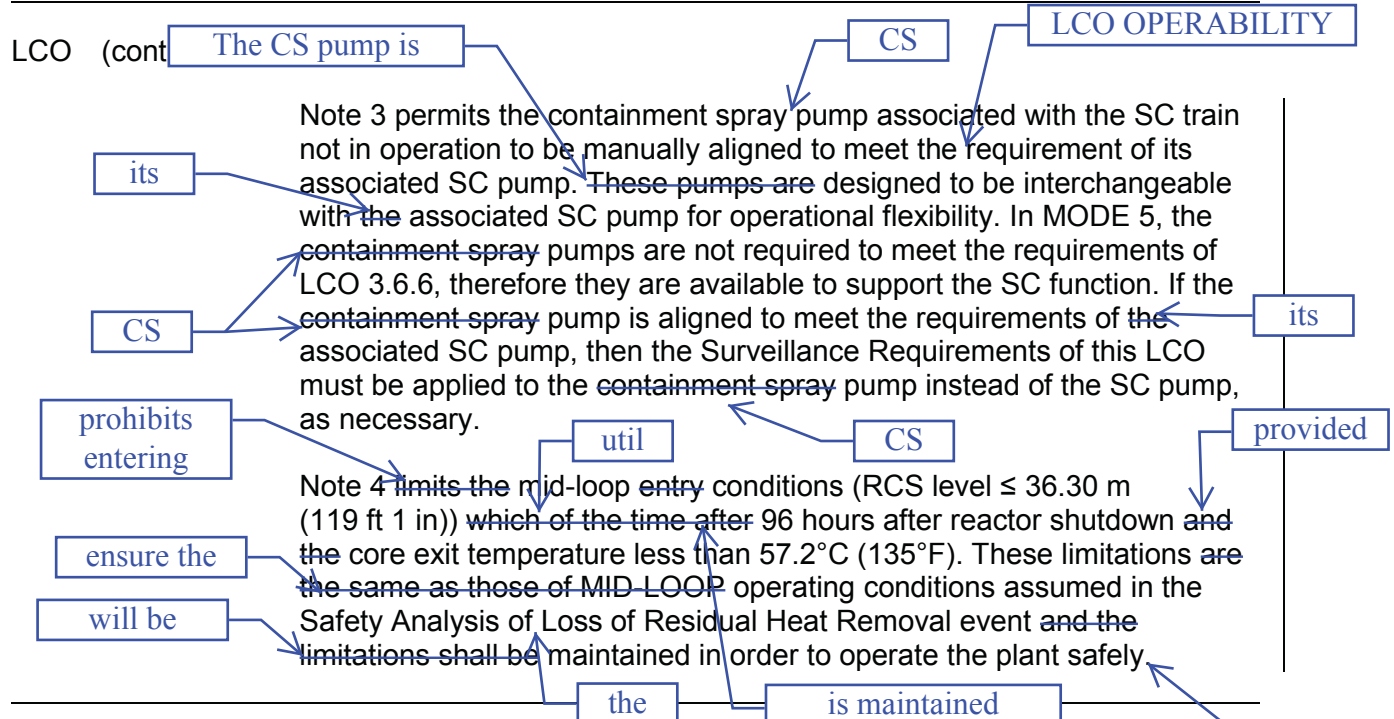
"A"

The MODE 5 with RCS loops filled condition is when the steam generators (SGs) can be used for the core decay heat removal. This loops filled condition can be maintained while draining the RCS provided the reactor coolant level is maintained above 134 ft, since below this level, containment atmospheric pressure can no longer completely support the column of water remaining in the SG tubes above the reactor coolant level. At reactor coolant level below 134 ft, water vapor voids begin forming in the horizontal portions of SG tubes, beginning with the highest tubes. The number of affected tubes increases as RCS level decreases until all tubes contain water vapor voids. SG tubes containing voids of water vapor, at the saturation temperature vapor pressure of the coolant in the tubes, block coolant flow and secondary heat transfer. When reactor coolant level has decreased to 119 ft 1 in (just above the high point of the hot leg), air can begin entering the hot leg through the surge line connection and displace the coolant remaining in the SG tubes. This results in the SG tubes being filled with non-condensable gases. The condition in MODE 5 with RCS water level within the top half of the hot legs is called mid-loop operation.

Restoring the unit to the MODE 5 with RCS loops filled condition requires raising RCS level above 134 ft during a draining operation, provided no air was introduced into the SG tubes. Restoring the unit to the MODE 5 with RCS loops filled condition following mid-loop operation requires closing the pressurizer manway, filling the pressurizer, and dynamically venting non-condensable gases from the SG tubes and RPV closure head using the RCGVS and the reactor coolant pumps.

A forced circulation by the reactor coolant pumps (RCPs) in the MODE 5 with loops not filled condition is possible when the static head of the water from pressurizer water level establishes an RCS pressure high enough to run an RCP.

BASES



APPLICABILITY In MODE 5 with loops not filled, this LCO requires core heat removal and coolant circulation by the SCS. **during mid-loop operation**

Insert the content "B" in the next sheet.

The typical initial conditions of loss of residual heat removal (LORHR) are the reduced inventory or the MID-LOOP operation. The pressurizer manway opening configuration is selected as a representative case because the pressurizer manway will be always open during the reduced inventory operation. Several calculations are performed for the LORHR events with various RCS openings in addition to the pressurizer manway opening.

The time of 4 days after shutdown and the hot leg temperature of 57.2°C (135°F) are used for the analyses. The initial steady state calculation is performed considering one train of the Shutdown Cooling System (SCS) operation based on the normal SCS operation. The coolant injection of SCS to the RCS is performed through the DVI nozzle and the SCS suction is considered from the hot leg. The SCS flow rate is assumed as approximate average value of 1 train SCS flow.

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",

"B"

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In the MODE 5 with RCS loops not filled condition, the steam generators (SGs) cannot be used for the core decay heat removal because the SG tubes contain water vapor voids or non\_condensable gases that restrict the flow of reactor coolant through the SG tubes to less than the flow needed for adequate secondary heat transfer. The loops not filled condition is entered during draining of the RCS when the reactor coolant level is below 134 ft, which is about 28 ft below the highest SG tubes. Below this level, containment atmospheric pressure can no longer completely support the column of water remaining in the SG tubes above the reactor coolant level. At reactor coolant levels below 134 ft, water vapor voids begin forming in the horizontal portions of SG tubes, beginning with the highest tubes. The number of affected tubes increases as RCS level decreases until all tubes contain water vapor voids. SG tubes containing voids of water vapor, at the saturation temperature vapor pressure of the coolant in the tubes, block coolant flow and secondary heat transfer. When reactor coolant level has decreased to 119 ft 1 in (just above the high point of the hot leg), air can begin entering the hot leg through the surge line connection and displace the coolant remaining in the SG tubes. This results in the SG tubes being filled with non-condensable gases. The condition in MODE 5 with RCS water level within the top half of the hot legs is called mid-loop operation.

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Restoring the unit to the MODE 5 with RCS loops filled condition requires raising RCS level above 134 ft during a draining operation, provided no air was introduced into the SG tubes. Restoring the unit to the MODE 5 with RCS loops filled condition following mid-loop operation requires closing the pressurizer manway, filling the pressurizer, and dynamically venting non\_condensable gases from the SG tubes and RPV closure head using the RCGVS and the reactor coolant pumps.

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A forced circulation by the reactor coolant pumps (RCPs) in the MODE 5 with loops not filled condition is possible when the static head of the water from pressurizer water level establishes an RCS pressure high enough to run an RCP.

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3.3 INSTRUMENTATION

3.3.8 Containment Purge Isolation Actuation Signal (CPIAS)

LCO 3.3.8 One CPIAS instrument division with two area radiation monitor channels, one Manual Actuation division, and one Actuation Logic division shall be OPERABLE.

MODE 5 with RCS loops not filled when relying on LCO 3.6.7.c.2, MODE 6 when relying on LCO 3.6.7.c.2 or LCO 3.9.3.c.2.

APPLICABILITY: ~~MODES 1, 2, 3, and 4, During CORE ALTERATIONS, During movement of irradiated fuel assemblies within containment.~~

----- NOTE -----  
 Only required when the associated containment purge or exhaust line penetration flow path is not isolated by at least one closed and deactivated automatic valve, closed manual valve, or blind flange.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. CPIAS required Manual Actuation division, required Actuation Logic division, or required instrument division with one or more required area radiation monitor channels inoperable in MODES 1, 2, 3, and 4.	A.1 Enter applicable Conditions and Required Actions of LCO 3.6.3, "Containment Isolation Valves," for containment purge isolation valves made inoperable by CPIAS instrumentation.	Immediately
B. Required Action and associated Completion Time not met in MODE 1, 2, 3, or 4.	B.1 Be in MODE 3.	6 hours
	<u>AND</u> B.2 Be in MODE 5.	36 hours

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ACTIONS (continued)

CONDITION	REQUIRED ACTION	COMPLETION TIME
C. CPIAS required Manual Actuation division, required Actuation Logic division, or required instrument division with one or more required area radiation monitor channels inoperable during CORE ALTERATIONS or movement of irradiated fuel assemblies within <del>containment.</del>	C.1 Place and maintain containment purge and exhaust valves in closed position.	Immediately
	<u>OR</u>	
	C.2.1 Suspend CORE ALTERATIONS.	Immediately
	<u>AND</u>	
	C.2.2 Suspend movement of irradiated fuel assemblies in containment.	Immediately

SURVEILLANCE REQUIREMENTS

SURVEILLANCE		FREQUENCY
SR 3.3.8.1	Perform CHANNEL CHECK on required containment upper operating area radiation monitor channel and operating area radiation monitor channel.	12 hours
SR 3.3.8.2	----- NOTE ----- Only required to be met in MODES 1, 2, 3, and 4.  Perform CHANNEL FUNCTIONAL TEST on each required upper operating area radiation monitor channel and each required operating area radiation monitor channel in accordance with Setpoint Control Program.	92 days

containment, or in MODE 5 with LCO 3.6.7.c.2 not met or in MODE 6 with LCO 3.6.7.c.2. or LCO 3.9.3.c.2 not met.

## BASES

## LCO (continued)

The Bases for the LCO on CPIAS are discussed below for each Function:

a. Manual Actuation

The LCO on the CPIAS Manual Actuation Function division backs up the CPIAS Automatic Actuation Function division and ensures operators have the capability to rapidly initiate the CPIAS Function if any parameter is trending toward its NTSP. Only one Manual Actuation division of CPIAS is required in MODES 1, 2, 3, and 4, since the CPIAS is redundant to the CIAS and SIAS for isolating the purge supply and exhaust line containment penetrations. ~~Only one Manual Actuation division of CPIAS is required during CORE ALTERATIONS and movement of irradiated fuel assemblies, since there are additional means of closing the containment purge isolation valves in the event of a Manual Actuation division failure.~~

Add following page

In the event shutdown cooling is lost in MODE 5 with RCS loops not filled, or in MODE 6 with low RCS water level, and if LCO 3.6.7.c.2 is relied upon to mitigate a loss of decay heat removal capability, which could lead to reactor core fuel damage, LCO 3.3.8 requires only one CPIAS instrument division with two area radiation monitor channels for sending a bistable logic trip signal to the one required CPIAS Actuation Logic division. Acceptable mitigation of a core damage accident is assured in the event of a CPIAS instrument division failure, since there are additional means of closing the containment purge isolation valves.

b. Containment Area Radiation Monitors and Bistable Logic

The LCO on the CPIAS instrument Function division requires that each of the two area radiation monitor channels be OPERABLE for sending a bistable logic trip signal to the Actuation Logic division. The two area radiation monitor channels are not totally redundant to each other, since the indication overlap only ranges from 10 mSv/hour to 100 mSv/hour (1 rem/hr to 10 rem/hr); however both NTSPs are within this range.

The CPIAS NTSP is selected to allow detection of small deviations from the normal background radiation level. The absolute value of the NTSP in MODES 5 and 6 differs from the NTSP in MODES 1, 2, 3, and 4 so that a fuel handling accident can be detected in the lower levels of radiation expected in MODES 5 and 6. The containment upper operating area radiation monitor channel supports the CPIAS during MODES 1, 2, 3, and 4, and has a higher NTSP. The containment operating area radiation monitor channel supports the CPIAS during MODES 5 and 6, and has a lower NTSP. In any MODE, just one area radiation monitor channel is relied upon for initiating an automatic containment purge line isolation.

c. Actuation Logic

One Actuation Logic division is required, since the containment purge isolation valves can be shut independently of the CPIAS signal either manually from the main control room (MCR) or using either the SIAS or CIAS push button.

Only one Manual Actuation division of CPIAS is required in MODE 6 during CORE ALTERATIONS or movement of irradiated fuel assemblies, when reactor vessel water level is required by LCO 3.9.6, "Refueling Water Level," to be at least 23 ft above the top of the reactor vessel flange (high water level). One Manual Actuation division of CPIAS is also required in MODE 6 (high water level) when an OPERABLE Containment Purge System is being relied upon to close the containment purge isolation valves in accordance with LCO 3.9.3.c.2, by using the required CPIAS Manual Actuation division. Acceptable mitigation of a fuel handling accident is assured in the event of a Manual Actuation division failure, since there are additional means of closing the containment purge isolation valves.

In MODE 5 with RCS loops not filled, and in MODE 6 with reactor vessel water level less than 23 ft above the top of the reactor vessel flange (low water level) the unit is in a reduced water inventory condition and LCO 3.6.7, "Containment Penetrations - Shutdown Operations," is applicable. With the containment purge system unisolated, LCO 3.6.7.c.2 requires that each penetration providing direct access from the containment atmosphere to the outside atmosphere is exhausting through OPERABLE Containment Purge System air cleaning units (ACUs), and is capable of being closed by an OPERABLE Containment Purge and Exhaust Isolation System. In the event shutdown cooling is lost in MODE 6, Required Action A.4 of LCO 3.9.4, "Shutdown Cooling System (SCS) and Coolant Circulation - High Water Level," and Required Action B.4 of LCO 3.9.5, "SCS and Coolant Circulation - Low Water Level," require within 4 hours placing the containment building penetrations in the required status as specified in LCO 3.6.7. When LCO 3.6.7.c.2 is relied upon to mitigate a loss of decay heat removal capability, which could lead to reactor core fuel damage, LCO 3.3.8 requires only one Manual Actuation division of CPIAS. Acceptable mitigation of a core damage accident is assured in the event of a Manual Actuation division failure, since there are additional means of closing the containment purge isolation valves.

## BASES

## APPLICABILITY

In MODES 1, 2, 3, and 4, the low volume purge line isolation valves may be open. In these MODES, it is necessary to ensure the valves will shut in the event of a primary coolant leak in containment whenever any of the containment purge valves are open.

With the purge line isolation valves open during CORE ALTERATIONS or movement of irradiated fuel assemblies within containment, there is the possibility of a fuel handling accident requiring CPIAS on high radiation in containment.

The APPLICABILITY is modified by a Note, which states that the CPIAS Specification is only required when the associated containment purge or exhaust line penetration flow path is not isolated by at least one closed and deactivated automatic valve, closed manual valve, or blind flange.

With the purge line isolation valves open during RCS low water level conditions in MODES 5 and 6, there is a possibility of a loss of shutdown cooling, which could lead to a reactor core fuel damage event requiring CPIAS on high radiation in containment.

## ACTIONS

A CPIAS division is inoperable when it does not satisfy the OPERABILITY criteria for the division's function. The most common cause of process instrument channel inoperability is outright failure or drift of the sensor, transmitter, or analog signal processing equipment sufficient to exceed the tolerance allowed by the Nuclear Regulatory Commission (NRC) approved setpoint methodology specified in the Setpoint Control Program, Specification 5.5.19. Typically, the drift is not large and would result in a delay of actuation rather than a total loss of function. This determination is generally made during the performance of a CHANNEL FUNCTIONAL TEST when the process instrument is set up for adjustment to bring it within specification. If the as-found actuation setting is not consistent with the Allowable Value, the division must be declared inoperable immediately, and the appropriate Conditions must be entered.

In the event a division's actuation setting is found nonconservative with respect to the Allowable Value, or the sensor, instrument loop, signal processing electronics, or bistable logic processor is found inoperable, then all affected Functions provided by that division are required to be declared inoperable and the LCO Condition entered for the particular protective function affected.

When the number of inoperable channels or divisions of an ESF actuation Function exceeds that specified in any related Condition associated with the same ESF actuation Function, then the unit is outside the safety analyses. Therefore, LCO 3.0.3 is immediately entered if applicable in the current MODE of operation.