RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification
Korea Electric Power Corporation / Korea Hydro & Nuclear Power
Docket No. 52-046

RAI No.: **481-8546**

SRP Section:

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. 16-145

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility. NUREG-1432, "Standard Technical Specifications-Combustion Engineering Plants," Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements. Staff needs to evaluate all technical differences from standard TS (STS) NUREG-1432, STS Combustion Engineering Plants, Rev. 4, which is referenced by the DC applicant in DCD Tier 2 Section 16.1, and the docketed rationale for each difference because conformance to STS provisions is used in the safety review as the initial point of guidance for evaluating the adequacy of the generic TS to ensure adequate protection of public health and safety, and the completeness and accuracy of the generic TS Bases.

This request stems from discussion at the February 2016 meeting with the applicant is request stems from discussion at the February 2016 meeting with the applicant.

The applicant is requested to correct the design certification application where the generic TS provision language quoted in the STS Deviation Report does not match the actual language in Revision 0 of the generic TS:

1. Generic TS SR 3.4.2.1 Frequency is missing the 12 hour Frequency, which is included in the Deviation Report. Also, the 12 hour Frequency should be second, not third, since only the last Frequency may have a Note, per TSTF-GG-05-01 Paragraph 4.1.7.e. But that conflicts with the convention to have Frequencies listed from smallest interval to largest interval. The applicant is requested to remove the Note and state the 30 minute Frequency as "30 minutes with the reactor critical and T_{cold} < 289.4 °C (553 °F)".

2. Generic TS 3.4.4, "RCS Loops - MODES 1 and 2," LCO 3.4.4 states, "Two RCS loops shall be OPERABLE and in operation with two reactor coolant pumps operating in each loop." The Deviation Report states it as "Two RCS loops shall be OPERABLE and two reactor coolant pumps

in each loop shall be in operation." The applicant is requested to correct the Deviation Report.

3. Generic TS 3.4.10, "POSRVs," the Applicability is missing the Note stated in the Deviation Report.

4. (See RAI-Question 16-23 Subquestion 18, RAI 119-7976, Question 27125) Generic TS 3.9.5, "Shutdown Cooling System (SCS) and Coolant Circulation – Low Water Level," does not contain Required Action B.4 which is included in the Deviation Report. Revise Required Action B.4 as indicated: "B.4 Initiate actions to place the containment building penetrations in the status specified in LCO 3.6.7, "Containment Penetrations - REDUCED RCS INVENTORY Operations." "Immediately". (Note that this provision may be affected by resolution of a concern about the definition of REDUCED RCS INVENTORY.)

Response

1. The 12 hour Frequency of SR 3.4.2.1 has been added per RAI 119-7976. The 12 hour Frequency of SR 3.4.2.1 will be revised as shown in Attachment 1 of this RAI response.

2. The Deviation Report will be revised as shown in Attachment 2.

3. The Note of the Applicability in TS 3.4.10 will be revised as shown in Attachment 3.

4. The revised markup has been provided in response to RAI 133-7978. For details refer to response to RAI 133-7978.

Impact on DCD

Same as changes described in the impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

SR 3.4.2.1 will be revised as shown in Attachment 1.

Note of the Applicability in TS 3.4.10 will be revised as shown in Attachment 3.

Impact on Technical/Topical/Environmental Reports

LCO 3.4.4 of the Deviation Report (APR1400-K-O-NR-14001-P/NP) will be revised as shown in Attachment 2.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.2 RCS Minimum Temperature for Criticality

LCO 3.4.2 Each RCS cold leg temperature (T_{cold}) shall be ≥ 286.7 °C (548 °F).

APPLICABILITY: MODE 1,
MODE 2 with k_{eff} ≥ 1.0.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. RCS T_{cold} in one or more RCS loops not within limit.	A.1 Be in MODE 3.	30 minutes

SURVEILLANCE REQUIREMENTS

SURVEILLANCE	FREQUENCY
SR 3.4.2.1 Verify RCS T_{cold} in each loop ≥ 286.7 °C (548 °F).	Once within 15 minutes prior to achieving criticality AND ---------- NOTE ---------- Required if reactor is critical and RCS T_{cold} < 289.4 °C (553 °F). ---------- 30 minutes

30 minutes with the reactor critical and T_{cold} < 289.4 °C (553 °F)

OR

12 hours

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OR

12 hours

Number (NUREG-1432 Contents)	Standard Technical Specifications (NUREG-1432, Rev. 4)	APR1400 NRC DC Technical Specifications (Rev. 0)	Justification	Remark
3.4.3 RCS Pressure and Temperature (P/T) Limits	APPLICABILITY At all times	APPLICABILITY At all times (except when reactor vessel closure head is fully de-tensioned such that the RCS cannot be pressurized)	The exception is allowed in MODE 6 with the reactor vessel closure head removed since there is no potential for pressurization and therefore no potential for a non-ductile failure.	
3.4.4 RCS Loops – MODES 1 and 2	LCO 3.4.4 Two RCS loops shall be OPERABLE and in operation.	LCO 3.4.4 Two RCS loops shall be OPERABLE and ~~two reactor coolant pumps in each loop shall be in operation.~~	More specific information is described for "in operation".	
3.4.5 RCS Loops – MODE 3	LCO 3.4.5 [Two] RCS loops shall be OPERABLE and one RCS loop shall be in operation.	LCO 3.4.5 Two RCS loops shall be OPERABLE with steam generators and at least one reactor coolant pump per loop and at least one RCS loop shall be in operation.	The meanings of the REQUIRED ACTIONs are practically the same.	
	REQUIRED ACTION C.1. Suspend operations that would cause introduction of coolant into the RCS with boron concentration less than required to meet SDM of LCO 3.1.1.	REQUIRED ACTION C.1. Suspend all operations involving a reduction of RCS boron concentration.	The meanings of the REQUIRED ACTION are practically the same.	

in operation with two reactor coolant pumps operating in each loop.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.10 Pressurizer Pilot Operated Safety Relief Valves (POSRVs)

LCO 3.4.10 Four pressurizer POSRVs shall be OPERABLE such that:

a. Two spring-loaded pilot valves shall be OPERABLE with lift settings ≥ 171.1 kg/cm^{2}A (2,433 psia) and ≤ 176.3 kg/cm^{2}A (2,507 psia).

b. The opening time of pressurizer POSRV shall be OPERABLE within 0.5 seconds, including dead time

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 with all RCS cold leg temperature greater than the LTOP enable temperature specified in the PTLR.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One pressurizer POSRV	A.1 Restore pressurizer POSRV to	15 minutes
Time of Condition A not met. OR Two or more pressurizer POSRVs inoperable.	AND B.2.1 Be in MODE 4 with all RCS cold leg temperatures less than or equal to LTOP enable temperature specified in PTLR. OR B.2.2 Be in MODE 4 on shutdown cooling with requirements of LCO 3.4.11 met.	12 hours 12 hours

NOTE
The opening time measurement and lift pressure setting of POSRV are not required to be within LCO limits during MODES 3 and 4 for the purpose of setting the POSRVs under ambient (hot) conditions. This exception is allowed for 72 hours following entry into MODE 3.

RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification
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Docket No. 52-046

RAI No.:	**481-8546**
SRP 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:	0**5/12/2016**

Question No. 16-148

Paragraph (a)(11) of 10 CFR 52.47 and paragraph (a)(30) of 10 CFR 52.79 state that a design certification (DC) applicant and a combined license (COL) applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 50.36a. 10 CFR 50.36 sets forth requirements for technical specifications to be included as part of the operating license for a nuclear power facility. NUREG-1432, “Standard Technical Specifications-Combustion Engineering Plants,” Rev. 4, provides NRC guidance on format and content of technical specifications as one acceptable means to meet 10 CFR 50.36 requirements. Staff needs to evaluate all technical differences from standard TS (STS) NUREG-1432, STS Combustion Engineering Plants, Rev. 4, which is referenced by the DC applicant in DCD Tier 2 Section 16.1, and the docketed rationale for each difference because conformance to STS provisions is used in the safety review as the initial point of guidance for evaluating the adequacy of the generic TS to ensure adequate protection of public health and safety, and the completeness and accuracy of the generic TS Bases.

This request stems from discussion at the February 2016 meeting with the applicant.

The applicant is requested to explain what the following statement in Deviation Report Section III.2.2.2 means: “In the APPLICABILITY section[of Specification 3.4.10], the 72 hours exception is based on 18 hours of outage time for each of the four valves (APR1400 adopts 4 POSRVs). The 18-hour period is determined based on operating experience.”
The “72 hours exception” is stated in the following 3.4.10 Applicability Note:

> The POSRV opening time measurement and lift pressure setting of POSRV are not required to be within LCO limits during MODES 3 and 4 for the purpose of setting the POSRVs under ambient (hot) conditions. This exception is allowed for 72 hours following entry into MODE 3 provided a preliminary cold setting was made prior to heatup.

It appears that since 4 times 18 is 72, the total time spent in MODE 3 to “set” the four POSRVs is 72 hours. In addition, does the phrase “provided a preliminary cold setting was made prior to heatup” imply that the cold setting must be completed in MODE 5 before entry into MODE 4? And how does the “cold setting” ensure RCS overpressure protection in MODES 3 and 4 before performance of SR

3.4.10.3? Should there be a “cold setting” SR with its own acceptance criteria for lift setting pressure and opening time?

The statement of SR 3.4.10.3 appears to be incorrect. The within ± 1.50% of lift pressure setpoint is the operability acceptance criterion of the as-found lift pressure setting. In all performances of this SR, the pilot valves must be adjusted so that the as-left lift pressure setting is within ± 0.75% of lift pressure setpoint. See markup of SR 3.4.10.3 below.

Does “within 0.5 seconds” mean “< 0.5 seconds” or “≤ 0.5 seconds”? Use the appropriate symbol instead of “within” to clarify the POSRV opening time acceptance criterion.

The applicant is requested to explain the phrase “including dead time” in the Bases for SR 3.4.10.1, where indicated in the below markup.

However, the above Note, SR 3.4.10.3, and the Bases for SR 3.4.10.3 need editorial improvements, as indicated in the above and below markups. The applicant should correct any inaccuracies that may have been introduced in the suggested edits.

SR 3.4.10.3	~~Verify~~ For each pressurizer POSRV ~~meets the following~~: a. Verify ~~The~~ lift pressure settings of each of the two spring-loaded pilot valves ~~are~~ is ≥ 171.1 kg/cm^{2}A (2,433 psia) and ≤ 176.3 kg/cm^{2}A (2,507 psia). b. Adjust each spring-loaded pilot valve, as necessary, so that the lift pressure settings ~~to within limits if lift setting pressure~~ is ≥ 172.4 kg/cm^{2}A (2,451.4 psia) and ≤ 175.0 kg/cm^{2}A (2,488.5 psia). ~~b~~c. Verify opening time of pressurizer POSRV is ~~shall be within~~ ≤ 0.5 seconds, including dead time.	18 months
SURVEILLANCE REQUIREMENTS	SR 3.4.10.3 Surveillance Requirements ~~is~~ are specified for verifying the pressurizer POSRV lift pressure settings and POSRV opening time ~~of pressurizer POSRVs~~. The allowable range of ~~LCO to meet~~ the as-found lift pressure setting~~s of POSRVs set~~ of each POSRV spring-loaded pilot valve is 1.5% of the valve setpoint ~~to~~ above the valve setpoint to 1.5% of the valve setpoint below the valve setpoint. ~~and then~~ The surveillance requires adjusting the as-left lift pressure setting to ~~valve setpoint is reset~~ within the allowable range of 0.75% of the valve setpoint above the valve setpoint and 0.75% of the valve setpoint below the valve setpoint. The specified POSRV opening time of 0.5 seconds or less is consistent with the safety analyses. {KHNP to insert statement to explain the phrase “including dead time.”} The POSRV lift pressure setpoint verification and adjustment, and opening time verification are normally performed in MODE 3 during plant heatup following each ~~after~~ refueling, which is once every 18 months. The ASME OM Code (Reference 2) ~~permits the~~ recommends performing the lift pressure setting	

	verification and adjustment every 5 years as the necessary Frequency ~~necessary~~ to satisfy the requirements for lift pressure settings of safety relief valves. However, the surveillance to verify ~~of~~ the POSRV lift pressure setting and opening time is performed every refueling cycle according to the special requirements of ~~valves~~ the POSRVs. If the two spring-loaded pilot valves of a POSRV ~~per valve~~ both satisfy the requirements of lift setting and opening time, then ~~it~~ the POSRV is OPERABLE ~~status~~.

Response

Q1) It appears that since 4 times 18 is 72, the total time spent in MODE 3 to "set" the four POSRVs is 72 hours. In addition, does the phrase "provided a preliminary cold setting was made prior to heatup" imply that the cold setting must be completed in MODE 5 before entry into MODE 4?

A1) The 72 hour exception is based on 18 hour outage time for each of the four valves (4x18=72). The reply of the second question about a preliminary cold setting is "No". The applicant intended to incorporate STS TS 3.4.10. However, the phrase "provided a preliminary cold setting was made prior to heatup" is not necessary because we need to test, verify and adjust the lift set pressure and the opening time of the POSRVs in MODE 3. The applicant will delete this phrase as shown in Attachment 1 and 2.

Q2) And how does the "cold setting" ensure RCS overpressure protection in MODES 3 and 4 before performance of SR 3.4.10.3?

A2) See Answer A1 above.

Q3) Should there be a "cold setting" SR with its own acceptance criteria for lift setting pressure and opening time?

A3) No. See Answer A1 above.

Q4) The statement of SR 3.4.10.3 appears to be incorrect. The within ± 1.50% of lift pressure setpoint is the operability acceptance criterion of the as-found lift pressure setting. In all performances of this SR, the pilot valves must be adjusted so that the as-left lift pressure setting is within ± 0.75% of lift pressure setpoint. See markup of SR 3.4.10.3 below.

A4) Agreed. See the mark-up shown in Attachment 1.

Q5) Does "within 0.5 seconds" mean "< 0.5 seconds" or "$\leq$ 0.5 seconds"? Use the appropriate symbol instead of "within" to clarify the POSRV opening time acceptance criterion.

A5) Within (in this context) means $\leq$ 0.5 seconds. See the mark-ups shown in Attachment 1.

Q6) The applicant is requested to explain the phrase "including dead time" in the Bases for SR 3.4.10.1, where indicated in the below markup.

A6) Agreed. See the mark-ups in Attachment 1.

Q7) However, the above Note, SR 3.4.10.3, and the Bases for SR 3.4.10.3 need editorial improvements, as indicated in the above and below markups. The applicant should correct any inaccuracies that may have been introduced in the suggested edits.

A7) Agreed. See the mark-ups in Attachment 1..

Impact on DCD

Same as changes described in the Impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

TS 3.4.10 will be revised as shown in Attachment 1.

Impact on Technical/Topical/Environmental Reports

The Deviation Report will be revised as shown in Attachment 2.

---------- NOTE ----------
The opening time measurement and lift pressure setting of POSRV are not required to be within LCO limits during MODES 3 and 4 for the purpose of setting the POSRVs under ambient (hot) conditions. This exception is allowed for 72 hours following entry into MODE 3.

3.4 REAC

3.4.10 Pressurizer Pilot Operated Safety Relief Valves (POSRVs)

LCO 3.4.10 Four pressurizer POSRVs shall be OPERABLE such that:

a. Two spring-loaded pilot valves shall be OPERABLE with lift settings ≥ 171.1 kg/cm^{2}A (2,433 psia) and ≤ 176.3 kg/cm^{2}A (2,507 psia).

b. The opening time of pressurizer POSRV shall be ~~OPERABLE within~~ 0.5 seconds, including dead time

≤

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 with all RCS cold leg temperature greater than the LTOP enable temperature specified in the PTLR.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One pressurizer POSRV inoperable.	A.1 Restore pressurizer POSRV to OPERABLE status.	15 minutes
B. Required Action and associated Completion Time of Condition A not met. OR Two or more pressurizer POSRVs inoperable.	B.1 Be in MODE 3. AND B.2.1 Be in MODE 4 with all RCS cold leg temperatures less than or equal to LTOP enable temperature specified in PTLR. OR B.2.2 Be in MODE 4 on shutdown cooling with requirements of LCO 3.4.11 met.	6 hours 12 hours 12 hours

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.4.10.1	Verify open and close positions for the following valves in the main control room (MCR): a. Main valves – close b. Motor-operated isolation valves and manual isolation valves – open c. Spring-loaded pilot valves – close d. Motor-operated pilot valves – close	12 hours
SR 3.4.10.2	Verify electric power disconnections of the following motor-operated valves: a. Motor-operated isolation valves b. Upstream valve of double motor-operated pilot valves	7 days
SR 3.4.10.3	~~Verify~~ each pressurizer POSRV ~~meets the following~~: a. ~~The~~ lift settings of ~~two~~ spring-loaded pilot valves are set ~~within limit~~ [≥ 171.1 kg/cm^{2}A (2,433 psia) and ≤ 176.3 kg/cm^{2}A (2,507 psia)]. ~~Adjust lift settings within limit if lift setting pressure exceeds ≥ 172.4 kg/cm^{2}A (2,451.4 psia) and ≤ 175.0 kg/cm^{2}A (2,488.5 psia).~~ b. ~~Opening~~ time of pressurizer POSRV ~~shall be within~~ 0.5 seconds, including dead time.	18 months
SR 3.4.10.4	Verify alarm devices for valve positions and electric power connections of the following valves: a. Motor-operated isolation valves – power connection alarm b. Upstream valve of double motor-operated pilot valves – power connection alarm c. Manual isolation valves – not fully open alarm	18 months

For

pressure

each of the

Verify

c.

≤

Verify opening

is

b. Adjust each spring−loaded pilot valve, as necessary, so that the lift pressure settings are ≥ 172.4 kg/cm^{2}A (2,451.4 psia) and ≤ 175.0 kg/cm^{2}A (2,488.5 psia).

BASES

ACTIONS (continued)

With RCS cold leg temperature less than or equal to the LTOP enable temperature specified in the PTLR, overpressure protection is provided by LTOP.

The change from MODE 1, 2, or 3 to MODE 4 reduces the RCS energy (core power and pressure), lowers the potential for large pressurizer insurges, and thereby removes the need for overpressure protection by four POSRVs.

SURVEILLANCE REQUIREMENTS

SR 3.4.10.1

Periodic verification of the correct valve position indication in the MCR for all pressurizer POSRVs, spring-loaded pilot valves, motor operated isolation valves, manual isolation valves, and double motor operated pilot

Surveillance Requirements are specified for verifying the lift pressure settings and opening time of pressurizer POSRVs. The allowable range of the as-found lift pressure setting of each pressurizer POSRV spring-loaded pilot valve is 1.5% of the valve setpoint above the valve setpoint to 1.5% of the valve setpoint below the valve setpoint. The surveillance requires adjusting the as-left lift pressure setting within the allowable range of 0.75% of the valve setpoint above the valve setpoint and 0.75% of the valve setpoint below the valve setpoint. The specified pressurizer POSRV opening time including dead time of 0.5 seconds or less is consistent with the safety analyses. The dead time is from when the pressure reaches the spring-loaded pilot valves' opening setpoint until the main valve begins to move (open).
The pressurizer POSRV lift pressure setpoint verification and adjustment, and opening time verification are normally performed in MODE 3 during plant heatup following each refueling, which is once every 18 months. The ASME OM Code (Reference 2) recommends performing the lift pressure setting verification and adjustment every 5 years as the necessary Frequency to satisfy the requirements for lift pressure settings of safety relief valves. However, the surveillance to verify the pressurizer POSRV lift pressure setting and opening time are performed every refueling cycle according to the special requirements of the pressurizer POSRVs. If the two spring-loaded pilot valves of a pressurizer POSRV both satisfy the requirements of lift setting and opening time, then the pressurizer POSRV is OPERABLE.

by industry practice and has been shown to be acceptable by operating experience.

SR 3.4.10.3

~~Surveillance Requirements is specified for the lift settings and opening time of pressurizer POSRVs. The allowable range of LCO to meet lift settings of POSRVs set 1.5 % of the valve setpoint and then the valve setpoint is reset within 0.75 % after refueling. ASME OM Code (Reference 2) permits the 5 years Frequency necessary to satisfy the requirements for lift settings of safety valves. However, the surveillance of the lift setting and opening time is performed every refueling cycle according to the special requirements of valves. If the two spring-loaded pilot valves per valve satisfy the requirements of lift setting and opening time, then it is OPERABLE status.~~

Number (NUREG-1432 Contents)	Standard Technical Specifications (NUREG-1432, Rev. 4)	APR1400 NRC DC Technical Specifications (Rev. 0)	Justification	Remark
	be within LCO limits during MODES 3 and 4 for the purpose of setting the pressurizer safety valves under ambient (hot) conditions. This exception is allowed for [36] hours following entry into MODE 3 provided a preliminary cold setting was made prior to heatup	and lift pressure setting of POSRV are not required to be within LCO limits during MODES 3 and 4 for the purpose of setting the POSRVs under ambient (hot) conditions. This exception is allowed for 72 hours following entry into MODE 3 ~~provided a preliminary cold setting was made prior to heatup.~~	exception is based on 18 hours outage time for each of the four valves (APR1400 adopts 4 POSRVs). The 18 hours period is determined based on operating experience.	
	REQUIRED ACTION B.2 Be in MODE 4 with any RCS cold leg temperature less than or equal to the LTOP enable temperature specified in the PTLR	REQUIRED ACTION B.2.1 Be in MODE 4 with all RCS cold leg temperatures less than or equal to LTOP enable temperature specified in PTLR. OR B.2.2 Be in MODE 4 on shutdown cooling with the requirements of LCO 3.4.11 met.	The REQUIRED ACTIONs reflect the APR1400 design. When the POSRV(s) are inoperable, LTOP relief valves shall be aligned for OPP. Alignment of LTOP relief valves can be allowed by meeting conditions by reducing the cold leg temperature down to the LTOP enable temperature and by opening SCS isolation valves.	
	SURVEILLANCE SR 3.4.10.1 Verify each pressurizer safety valve is OPERABLE in accordance with the inservice Testing Program. Following testing, lift settings shall be within ±1%.	SURVEILLANCE SR 3.4.10.1 Verify the open and close positions for the following valves in the main control room (MCR); a. main valves – close, b. motor operated isolation valves and manual isolation valves – open, c. spring-loaded pilot valves – close, and d. motor operated pilot valves – close.	The SRs reflect POSRV characteristics. The testing and inspection for POSRVs are given in DCD Section 5.2.2.10.	

Delete

The deviations for a preliminary cold setting reflect the APR1400 plant specific design.

Number (NUREG-1432 Contents)	Standard Technical Specifications (NUREG-1432, Rev. 4)	APR1400 NRC DC Technical Specifications (Rev. 0)	Justification	
	None	SR 3.4.10.2 Verify electric power disconnections of the following motor-operated valves:		
	None	SR 3.4.10.3 Verify each pressurizer POSRV meets the following:		
	None	SR 3.4.10.4 Verify alarm devices for valve positions and electric power connections of the following valves:		
	None	SR 3.4.10.5 Verify position indicators of the following valves are operated normally:		
	None	SR 3.4.10.6 Verify downstream manual valves of spring-loaded pilot valves are locked in open position.		
3.4.11 Pressurizer Power Operated Relief Valves (PORVs)	The LCO is for PORV.	None	There is no PORV in the APR1400 (plant specific).	
3.4.12 Low Temperature Overpressure Protection (LTOP) System	LCO 3.4.12 An LTOP System shall be OPERABLE with a maximum of one high pressure safety injection (HPSI) pump and one charging pump capable of injecting into the RCS and the safety injection tanks (SITs) isolated, and: ----------NOTES----------	LCO 3.4.11 LTOP System shall be OPERABLE as follows:	SCS suction isolation valves are sized to accommodate mass addition for 4 SIPs and one charging pump. The flow rates from two charging pumps during pump switchover are limited by flow restrictor. Therefore, there is no need to limit the charging pump operation.	APR 1400 specific design is reflected.

The deviations reflect the APR1400 plant specific Pressurizer Safety Valve that is the Pressurizer POSRV.
The SRs reflect Pressurizer POSRV characteristics.
The testing and inspection for Pressurizer POSRVs are given in DCD Section 5.2.2.10.

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**

SRP 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. 16-151

Follow-up to the response dated 2/5/2016, to RAI 133-7978, Question 16-31 (26973), Subquestion 12.

The staff found the response to Subquestion 12 unacceptable for the following reason.

In the original RAI, the staff raised the Subquestion 12 issue as follows:

> SR 3.9.5.1 does not state the minimum reactor coolant circulating flow of 4150 gpm as in SR 3.9.4.1. The applicant is requested to add this acceptance criterion to SR 3.9.5.1.

In the response, the applicant stated

> [A]ccording to STS NUREG-1432 Rev.4, SR 3.9.5.1 does not state the minimum reactor coolant circulating flow. The minimum reactor coolant circulating flow in low water level operation including REDUCED RCS INVENTORY operation can be provided in operational procedures rather than the TS.

It should be noted that requirements for an explicit numerical value for SC pump flow in the STS SRs 3.4.7.1, 3.4.8.1, 3.9.5.1 and 3.9.6.1 are dependent on specific safety/accident analyses described in FSAR Chapter 5/Chapter 15 to ensure adequate decay heat removal and/or boron mixing, during shutdown modes where no RCP is running, and the SC pump is used to provide coolant circulation through the reactor core. In addition, based on operating experiences during Mid-Loop operations as documented in generic letter (GL) 88-17, “Loss of Decay Heat Removal - 10 CFR 50.54(f),” a flow requirement should also be established to address the air ingestion condition in the hot leg when the RCS water inventory is maintained at the lowest permitted level for SC operation.

DCD Subsection 5.4.7.2, “System Design,” states, in part, “[R]educed inventory including midloop operation is necessary for increasing the plant availability. During this operation, the RCS water level is lowered to below the reactor vessel flange. When the RCS water level

abnormally decreases, air may be ingested into the shutdown cooling system with the possibility of affecting the SCS. The RCS level is maintained higher than the RCS low water level of 8.3 cm (3.28 inch) above the loop center, and a SCS flow rate of 14,385 to 15,710 L/min (3,800 to 4,150 gpm) is maintained for decay heat removal and prevention of an air ingestion.“

In Appendix A, “Procedural Guidance to Support Reduced Reactor Coolant System Inventory Operations,” of Technical Report (TeR) APR1400-E-N-NR-14005-P, “Shutdown Evaluation Report,” a minimum SCS cooling flow of "3000 gpm" is specified to ensure adequate decay heat removal during Mid-Loop operations.

The applicant is requested to include in the above listed SRs a minimum flow of “3000 gpm” for the SC pump to ensure adequate decay heat removal and/or boron mixing, and a maximum flow of “4150 gpm” to ensure no occurrence of vortexing in the hot leg or provide justification for not doing so.

In addition, correct the DCD and TeR to reconcile the difference between the above minimum SC flow values of 3800 gpm and 3000 gpm.

Response

An explicit numerical value for SC pump flow is added in the TS SR 3.4.7.1, 3.9.5.1. This value is to ensure adequate decay heat removal and to prevent boron mixing based on safety/accident analyses. An explicit numerical value for SC pump flow is added in the TS SRs 3.4.8.1 and 3.9.5.1 as documented in generic letter (GL) 88-17. This value is established to ensure adequate decay heat removal and to prevent boron mixing and also to address the air ingestion in the hot leg when the RCS water inventory is maintained at the lowest permitted level on safety/accident analyses. However, because TS 3.9.6 is about refueling water level during movement of irradiated fuel assemblies within containment the flow requirement of SC pump is not required. TeR is corrected to reconcile the difference between the minimum SC flow values of 3800 gpm and 3000 gpm as indicated in the Attachment 1. TS 3.4.7, 3.4.8, 3.9.5, Bases 3.4.7, 3.4.8 and 3.9.5 will be revised as indicated in the Attachment 2. In addition, Instead of using “REDUCED RCS INVENTORY,” the associated elevation threshold value of 127' ¼" is used and “EL” is deleted in response to 16-149(RAI 481-8546).

Impact on DCD

Same as changes described in the Impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

TS 3.4.7, 3.4.8, 3.9.5, Bases 3.4.7, 3.4.8 and 3.9.5 will be revised as indicated in the Attachment 2.

Impact on Technical/Topical/Environmental Reports

TeR(APR1400-E-N-NR-14005-P/NP, Rev.0), Appendix A will be revised as indicated in the Attachment 1.

A.4.3 Perform the RCS drain procedure to lower the RCS level to the desired reduced inventory elevation identified below:

Scheduled Maintenance Activity RCS	Elevation
S/G cold leg nozzle dams	[ ]
S/G hot leg nozzle dams	[ ]
RCP seal housing removal	[ ]
DVI nozzle 2A or 2B valve maintenance	[ ]

A.4.4 Monitor the following RCS/SCS system parameters during reduced inventory operations.

RCS core exit temperature	[List instruments]
SCS system flow rate	[ ]
RCS boron concentration	[ ]
SCS system temperature	[ ]
RCS pressure	[ ]
RCS level	[ ]

NOTE

Decay heat production decreases steadily with time after shutdown. SCS flow rate should be throttled to match heat removal requirements to reduce the possibility of vortexing.

A.4.5 Adjust SCS flow rate to match DHR requirements. Minimum flow must be maintained at greater than (11.4 m^3/min (3,000 gpm)).

A.4.6 Perform the scheduled maintenance activities while in the reduced inventory mode.

If reduced inventory maintenance requires the installation of SG nozzle dams, the cold leg dams shall be installed first, prior to the hot leg dams and removed last, after hot leg nozzle dam removal.

A.4.7 After the completion of the desired maintenance activities, restore RCS level to greater than elevation [119 ft 1in] per the applicable RCS makeup procedure.

A.5.0 ABNORMAL OPERATING CONDITIONS

A.5.1 Loss of shutdown cooling flow.

with circulating reactor coolant at a flow rate of ≥ 15,710 L/min (4,150 gpm)

SURVEILLANCE REQUIREMENTS

	SURVEILLANCE	FREQUENCY
SR 3.4.7.1	Verify one SC train is in operation.	12 hours
SR 3.4.7.2	Verify required SG secondary side water level is ≥ 25 % wide range indication.	12 hours
SR 3.4.7.3	---------- 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 3.4.7.4	Verify required SCS train locations susceptible to gas accumulation are sufficiently filled with water.	31 days

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 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

DELETED

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

with circulating reactor coolant at a flow rate ≥ 14,385 L/min (3,800 gpm)

with circulating reactor coolant at a flow rate of ≥ 15,709 L/min (4,150 gpm) at RCS level ≥ 38.72 m (127 ft-1/4 in) or ≥ 14,385 L/min (3,800 gpm) at RCS level < 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

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

and circulating reactor coolant.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.4.7.1

This SR requires verification every 12 hours that one SC train is in operation. Verification includes flow rate, temperature, or pump status monitoring, which help ensure that 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 is within safety analyses assumptions. In addition, MCR indication and alarms will normally indicate loop status.

The flow rate is determined by the flow rate necessary to provide sufficient decay heat removal capability and to prevent thermal and boron stratification.

The SC flow is established to ensure that core outlet temperature is maintained sufficiently below saturation to allow time for swap over to the standby SC train should the operating train be lost.

SR 3.4.7.2

Verifying the SGs are OPERABLE by ensuring their secondary side water levels are greater than or equal to 25 % wide range ensures that redundant heat removal paths are available if the second SC train is inoperable.

The Surveillance is required to be performed when the LCO requirement is being met by use of the SGs. If both SC trains are OPERABLE, this SR is not needed. 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 3.4.7.3

Verification that the second SC train is OPERABLE ensures that redundant paths for decay heat removal are available. The requirement also ensures that the additional train can be placed in operation, if needed, to maintain decay heat removal and reactor coolant circulation. Verification is performed by verifying proper breaker alignment and power available to the required pump. The Surveillance is required to be performed when the LCO requirement is being met by one of two SC trains (e.g., SGs have less than 25 % wide range water level). 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.

BASES

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.

and circulating reactor coolant.

SURVEILLANCE REQUIREMENTS

SR 3.4.8.1

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

The flow rate is determined to provide sufficient decay heat removal capability and to prevent thermal and boron stratification and also to address air ingestion in the hot leg when the RCS water inventory is maintained at the lowest permitted level.

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

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.

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.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.9.5.1

This Surveillance verifies that the SCS train is operating and circulating reactor coolant. The flow rate is determined by the flow rate necessary to provide sufficient decay heat removal and to prevent thermal and boron stratification in the core. In addition, this surveillance demonstrates that the other SCS train is OPERABLE.

The flow rate at RCS level < 38.72 m (127 ft-1/4 in) is determined to provide sufficient decay heat removal capability and to prevent thermal and boron stratification and also to address air ingestion in the hot leg when the RCS water inventory is maintained at the lowest permitted level.

In addition, during operation of the SCS train with the water level in the vicinity of the reactor vessel nozzles, the SCS train flow rate determination must also consider the SCS pump suction requirements. The 12-hour Frequency is sufficient considering the flow, temperature, pump control, and alarm indications available to the operator to monitor the SCS system in the MCR. This Frequency ensures that flow is checked and temperature monitored at adequate intervals.

Verification that the required trains are OPERABLE and in operation ensures that trains can be placed in operation as needed, to maintain decay heat and retain forced circulation. The 12-hour Frequency is considered reasonable, since other administrative controls are available and have proven to be acceptable by operating experience.

SR 3.9.5.2

Verification that the required pump is OPERABLE ensures that an additional SCS pump can be placed in operation, if needed, to maintain decay heat removal and reactor coolant circulation.

Verification is performed by ensuring correct breaker alignment and indicated power available to the required pumps. The 7-day Frequency is considered reasonable in view of other administrative controls available and has been shown to be acceptable by operating experience.

SR 3.9.5.3

Verification of the correct breaker alignment and indicated power available to the operable CS pump ensures that the CS pump will be able to remove heat from the RCS in the event of a power failure to the operating SCS train. The 24-hour Frequency is based on operating experience.