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:	**16 – Technical Specifications**
Application Section:	**16.3.4, 16.3.5, 16.3.6, 16.3.7, 16.3.9**
Date of RAI Issue:	**5/12/2016**

Question No. 16-146

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.

1. STS Revision 4 provisions equivalent to generic TS Revision 0 provisions are not correctly identified in Deviation Report:

    a. STS 3.4.10, "Pressurizer Safety Valves," does not contain a SR equivalent to SR 3.4.10.1 of generic TS 3.4.10, "POSRVs." However generic TS SR 3.4.10.3 does correspond to STS SR 3.4.10.1. The applicant is requested to correct the Deviation report, which incorrectly depicts STS SR 3.4.10.1 as equivalent to generic TS SR 3.4.10.1.
    b. STS 3.4.11, "Pressurizer Power Operated Relief Valves (PORVs)," is equivalent to generic TS 3.4.16, "Reactor Coolant Gas Vent (RCGV) Function," for the purpose of mitigating a steam generator tube rupture event. The Deviation Report does not show this correspondence. The applicant is requested to correct the Deviation report. In addition, DCD Tier 2 Section 5.4.12 should also include a discussion of the RCGV Function in SGTR mitigation.

2. The applicant is requested to clarify justifications for generic TS differences from STS in the Deviation Report that are not clear, or are invalid, or remove such differences:

   a. Generic TS 3.4.3, “RCS P/T Limits,” Applicability contains an exception to “At all times” that is not justifiable and is not consistent with STS 3.4.3. The applicant is requested to remove the proposed exception
   b. STS 3.4.5, “RCS Loops – MODE 3,” LCO 3.4.5 states, “[Two] RCS loops shall be OPERABLE and one RCS loop shall be in operation.” The generic TS states LCO 3.4.5 as, “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 proposed LCO statement is confusing, and the justification in the Deviation Report is invalid (“The meaning of the LCO is practically the same.”). The applicant is requested to revert to the STS version. Also, ensure the Bases describes what constitutes an operable RCS loop, and the number of operating reactor coolant pumps needed to consider a loop “in operation.”
   c. Generic TS 3.4.6, “RCS Loops – MODE 4,” LCO 3.4.6 omits the pressurizer water level upper limit for starting a reactor coolant pump. In addition, the generic TS LCO 3.4.6 statement includes the phrase “at least” in “... at least one loop or train shall be in operation.” The Deviation Report does not address this difference. LCO 3.4.6 should be consistent with DCD Tier 2 Section 5.2.2.
   d. Generic TS 3.4.10, “POSRVs” alternate Required Action B.2.2 (“OR Be in MODE 4 on shutdown cooling with the requirements of LCO 3.4.11 met.”) is not included in STS 3.4.10 Action B; the justification for this difference in unclear. It states, “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.”

Response

1.a.

The applicant has intended to compare generic TS SRs 3.4.10.1~3.4.10.6 with STS SR 3.4.10.1 because Pressurizer POSRVs have some different characteristics compared to typical Pressurizer Safety Valves. Hence, the applicant will add the justification in the Deviation Report as shown in Attachment 1.

1.b.

Response to Deviation Report

The safety analyses for a steam generator tube rupture (SGTR) event do not take credit for RCGV function. However, as described in the BACKGROUND of the Bases to generic TS 3.4.16, the RCGV function is designed to be used during all design bases events for RCS pressure control purposes when main spray and auxiliary spray systems are unavailable. Accordingly the RCGV function can be used manually to reduce RCS pressure in the event of an SGTR. From this point of view, STS 3.4.11 may be considered equivalent to generic TS 3.4.16.

However, in a strict sense, STS 3.4.11 is not exactly equivalent to generic TS 3.4.16 since RCGV function is not credited in the SGTR analysis.

The Deviation Report and Bases of generic TS 3.4.16 will be revised as shown in Attachment 2 and 3, respectively.

Response to Discussion of the RCGV Function for SGTR mitigation in DCD Tier 2 Section 5.4.12

RCGVS is designed to provide a safety-grade means of remotely and selectively removing steam from the pressurizer steam space and/or the reactor vessel for RCS pressure control purposes in the event that pressurizer main spray and auxiliary spray are unavailable during non-LOCA design basis events as discussed in DCD Tier 2 Section 5.4.12.1, Design Bases and 5.4.12.2, System Design. Although the discussion described in the Section 5.4.12 does not specifically identify an RCGV function for SGTR mitigation, RCGVS can be used for an operator to mitigate the SGTR event since the SGTR event is one of the non-LOCA design basis events. Therefore, adding a description of an RCGV function for SGTR mitigation to DCD Tier 2 Section 5.4.12 is considered not necessary.

2.a.

The APR1400 general TS will be revised to state as same as those of NUREG-1432 Rev.4 as shown in Attachment 4.

2.b.

The LCO 3.4.5 of the APR1400 generic TS will be revised as shown in the Attachment 5.

2.c.

The justification of deleting the pressurizer water level upper limit for starting a reactor coolant pump in the general TS is follows and it is written in the Deviation Report Rev.1:

> *The LTOP analyses in FSAR Section 5.2.2.10 are performed with the pressurizer in a water solid condition with a temperature difference of ≥ 139 °C (250 °F) between RCS cold leg and secondary side in each steam generator. There are no analyses performed with the pressurizer at a lower water level. Therefore, the option in NUREG-1432 is not utilized and this is conservative and consistent with the analyses.*

In addition, the phase “at least” in “... at least one loop or train shall be in operation.” will be deleted to state as same as those of NUREG-1432 Rev. 4 as shown in Attachment 6.

2.d.

The applicant has incorporated the APR1400 plant specific design for LTOP operable conditions. The Required Action B.2.1 in the generic TS 3.4.10 requires only the LTOP temperature. However, when the POSRVs are inoperable and the RCS decreases to LTOP conditions, additional actions like LCO 3.4.11 are needed. Especially, generic TS 3.4.11 is different from STS 3.4.11. As a result, the applicant will add the justification in the Deviation as shown in Attachment 1.

Impact on DCD

Same as changes described in Impact on Technical Specifications section.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

TS 3.4.3, TS 3.4.5, TS 3.4.6, and TS B 3.4.16 will be revised as shown in the Attachments 4, 5, 6 and 3, respectively.

Impact on Technical/Topical/Environmental Reports

TeR APR1400-K-O-NR-14001-NP will be revised as indicated in the Attachments 1 & 2.

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.	The deviations reflect the APR1400 plant specific design for LTOP operable conditions.
	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.	inoperable and the RCS decreases to LTOP conditions, LCO 3.4.11 conditions
	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.	The deviations reflect the APR1400 plant specific Pressurizer Safety Valve that is the Pressurizer POSRV.

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:		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.
	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.

Number (NUREG-1432 Contents)	Standard Technical Specifications (NUREG-1432, Rev. 4)	APR1400 NRC DC Technical Specifications (Rev. 0)	Justification	Remark
	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.

, and STS 3.4.11 is considered not exactly equivalent to generic TS 3.4.16, “Reactor Coolant Gas Vent (RCGV) Function,” for the purpose of mitigating a steam generator tube rupture (SGTR) event since the SGTR safety analysis does not take credit for the RCGV function in APR1400.

B 3.4 REACTOR COOLANT SYSTEM (RCS)

B 3.4.16 Reactor Coolant Gas Vent (RCGV) Function

BASES

BACKGROUND

The reactor coolant gas vent (RCGV) function is to provide a safety grade means of venting non-condensible gases and steam from the pressurizer and the reactor vessel closure head. The RCGV function is designed to be used during all design bases events for RCS pressure control purposes when main spray and auxiliary spray systems are unavailable. The OPERABILITY of at least one RCGV path from the pressurizer and at least one RCGV path from the reactor vessel closure head to the IRWST ensures that this function can be performed.

The RCGV function is a manually operated safety grade system. It removes non-condensible gases or steam from the pressurizer and the reactor vessel closure head through vent lines to the IRWST. Each vent line has two pairs of parallel isolation valves which are closed during normal operation. During shutdown or transient conditions, if the operator judges that non-condensible gases are collected in the pressurizer or in the reactor vessel closure head, the operator vents the gases by manually opening the RCGV valves from the MCR according to operating procedures. The RCGV function will have the capability to be manually actuated, monitored, and controlled from the MCR as required by GDC 19.

The two isolation valves in each parallel path are normally powered from the 125Vdc buses and emergency power is provided to the valves by batteries. A failure modes and effect analysis (FMEA) (Reference 1) demonstrates that the RCGV function will maintain a vent path after a single failure of any single valve or its power source. This demonstration satisfies the requirements of GDC 17 and GDC 34.

APPLICABLE SAFETY ANALYSES

The RCGV function provides a safety grade method of RCS depressurization that is credited during natural circulation ~~and during steam generator tube rupture events.~~ The operator uses the SI system, the pressurizer backup heaters, and the RCGV function to control RCS inventory and subcooling. The pressurizer vent line is 5.0 cm (2.0 in) nominal diameter to meet the requirement to vent one-half the RCS volume in one hour.

BASES

APPLICABLE SAFETY ANALYSES (continued)

The reactor vessel vent line is a 1.9 cm (3/4 in) line which expands to 2.54 cm (1 in) through the valving. This provides adequate venting to remove steam and non-condensible gases from the reactor vessel closure head.

The RCGV function satisfies LCO SELECTION CRITERION 3.

LCO

The purpose of the LCO is to ensure the core cooldown and RCS depressurization can be established using natural circulation venting non-condensible gases from the reactor vessel upper closure head and the pressurizer steam space at post-accident conditions. The RCGV function is OPERABLE when a vent path can be established from the pressurizer steam space and from the reactor vessel closure head to the IRWST. The valves are designed to be closed when the solenoid valves are de-energized to minimize the possibility of the common failure, and powered from the divisions A and B with different power sources, respectively.

This LCO is to ensure the capability of core cooldown and RCS depressurization, therefore, establishes the OPERABLE vent paths from the reactor vessel closure head and the pressurizer steam space to the IRWST, and ensure the independent power for valves in vent paths.

APPLICABILITY

In MODES 1, 2, 3, and in MODE 4 with RCS pressure greater than or equal to 31.6 kg/cm^{2}A (450 psia), the two vent paths of the reactor vessel closure head and the pressurizer are required to be OPERABLE. The RCGV function is primarily used for natural circulation ~~and for steam generator tube rupture events~~ considering loss of offsite power and single failure events. It assumes the pressurizer auxiliary spray system is inoperable when these events occur. Vent paths of the reactor vessel closure head and the pressurizer steam space are used as the means of RCS depressurization. In MODES 1, 2, 3, and in MODE 4 with RCS pressure greater than or equal to 31.6 kg/cm^{2}A (450 psia), the steam generators are primarily used for RCS heat removal up to a point of the time before starting shutdown cooling system.

In MODES 1, 2, 3, and in MODE 4 with RCS pressure greater than or equal to 31.6 kg/cm^{2}A (450 psia), vent valves of the reactor vessel closure head and the pressurizer are used for RCS depressurization up to a point of the time before entering shutdown cooling when the pressurizer auxiliary spray system is inoperable.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.3 RCS Pressure and Temperature (P/T) Limits

LCO 3.4.3 RCS pressure, RCS temperature, and RCS heatup and cooldown rates shall be maintained within the limits specified in PTLR.

APPLICABILITY: ~~At all times (except when reactor vessel closure head is fully de-tensioned such that the RCS cannot be pressurized).~~ At all times.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. ---------- NOTE ---------- Required Action A.2 shall be completed whenever Condition A is entered. ---------- Requirements of LCO not met in MODE 1, 2, 3, or 4.	A.1 Restore parameter(s) to within limits. AND A.2 Determine RCS is acceptable for continued operation.	30 minutes 72 hours
B. Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 3. AND B.2 Be in MODE 5 with RCS pressure < 33.7 kg/cm^{2}A (479 psia).	6 hours 36 hours

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.6 RCS Loops – MODE 4

LCO 3.4.6 Two loops or trains consisting of any combination of ~~RCS loops~~ and shutdown cooling (SC) trains shall be OPERABLE and ~~at least~~ one loop or train shall be in operation.

Deleted

NOTE

1. All reactor coolant pumps (RCPs) and SC pumps may be de-energized ≤ 1 hour per 8-hour period, provided:
   a. No operations are permitted that would cause reduction of the RCS boron concentration required to meet the SDM of LCO 3.1.1; and
   b. Core outlet temperature is maintained at least 5.6 °C (10 °F) below saturation temperature.
2. No RCP shall be started with any RCS cold leg temperatures less than or equal to the LTOP enable temperature specified in the PTLR, unless secondary side water temperature in each steam generator (SG) is < 55.6 °C (100 °F) above each of the RCS cold leg temperatures.

APPLICABILITY: MODE 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required RCS loop inoperable. AND Two SC trains inoperable.	A.1 Initiate action to restore a second loop or train to OPERABLE status.	Immediately
B. One required SC train inoperable. AND Two required RCS loops inoperable.	B.1 Be in MODE 5.	24 hours

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.5 RCS Loops – MODE 3

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.

---------- NOTE ----------

All reactor coolant pumps may be de-energized for up to ≤ 1 hour per 8-hour period, provided:

a. No operations are permitted that would cause reduction of the RCS boron concentration required to meet the SDM of LCO 3.1.1; and

b. Core outlet temperature is maintained at least 5.6 °C (10 °F) below saturation temperature.

APPLICABILITY: MODE 3.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One RCS loop inoperable.	A.1 Restore RCS loop to OPERABLE status.	72 hours
B. Required Action and associated Completion Time of Condition A not met.	B.1 Be in MODE 4.	12 hours
C. No RCS loop OPERABLE. OR Required RCS loop not in operation.	C.1 Suspend all operations involving a reduction of RCS boron concentration. AND C.2 Initiate action to restore one RCS loop to OPERABLE status and operation.	Immediately Immediately

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.6 RCS Loops – MODE 4

LCO 3.4.6 Two loops or trains consisting of any combination of ~~RCS loops~~ and shutdown cooling (SC) trains shall be OPERABLE and ~~at least~~ one loop or train shall be in operation.

Deleted

NOTE

1. All reactor coolant pumps (RCPs) and SC pumps may be de-energized ≤ 1 hour per 8-hour period, provided:
   a. No operations are permitted that would cause reduction of the RCS boron concentration required to meet the SDM of LCO 3.1.1; and
   b. Core outlet temperature is maintained at least 5.6 °C (10 °F) below saturation temperature.
2. No RCP shall be started with any RCS cold leg temperatures less than or equal to the LTOP enable temperature specified in the PTLR, unless secondary side water temperature in each steam generator (SG) is < 55.6 °C (100 °F) above each of the RCS cold leg temperatures.

APPLICABILITY: MODE 4.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required RCS loop inoperable. AND Two SC trains inoperable.	A.1 Initiate action to restore a second loop or train to OPERABLE status.	Immediately
B. One required SC train inoperable. AND Two required RCS loops inoperable.	B.1 Be in MODE 5.	24 hours