RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

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

Docket No. 52-046

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

Question No. 16-152

1. Follow-up to the responses dated 1/27/2016, to RAI 289-8215, Question 16-108 (27866), Subquestion 2.

   a. The staff found the response to Subquestion 2 acceptable, however, the applicant is requested to revise the LCO 3.4.11 statement as follows (with deleted text lined-out) to reflect the staff's recommendations in generic letter (GL) 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protections System Limits," regarding use of a reference to the PTLR in place of the specified lift setpoint for the SCS suction line relief valves:

      Two OPERABLE shutdown cooling system (SCS) suction line relief valves with lift settings ≤ 37.3 kg/cm2G (530 psig) specified in the PTLR, or

   b. The applicant is requested to include in the Bases an explanation of the following statement at end of replacement for Bases Background section, third paragraph, (Attachment 1 (2/5) of response to Subquestion 2.

      For an RCS vent to meet the specified flow capacity, it requires removing a pressurizer manway that located above the level of reactor coolant, so as not to drain the RCS when open.

2. Discuss whether generic TS 3.4.11 should include a SR to verify that the charging pump flow restrictor limits the flow rate from both charging pumps to the flow of one charging pump. (DR page 73)

   Discuss omission of requirement for SIT isolation in LCO 3.4.11; DR page 73 states:

      SIT operating pressure is 610 psig and SIT discharge cannot pressurize over

LTOP limit pressure, 625 psia. It is because RCS pressure can be assumed to be less than 450 psia (SCS cut in pressure), and RCS volume is larger than SIT. Therefore, there is no need to include SIT isolation in the APR1400 Technical Specification.

This discussion seems inconsistent with LCO 3.4.11.a, which requires SCS suction line relief valves with lift settings ≤ 37.3 kg/cm2 (530 psig). Explain.

3. Follow-up to the responses dated 1/27/2016, to RAI 289-8215, Question 16-108 (27866), Subquestions 7 and 8. Also related to RAI 119-7976, Question 16-23 (27125), Subquestion 22.

The generic TS 3.4.16 Actions and associated Bases are unclear regarding the basis for separate Condition entry. Staff believes that the basis is the **location** of each pair of vent flow paths (two solenoid operated valves per flow path, two flow paths per location).

And so, the Actions table note would state: “Separate condition entry is allowed for each RCGV flow path location.”

In addition, clarify the first paragraph of the Actions section of the Bases by making the suggested changes indicated in the following markup:

> The ACTIONS are modified by a Note which is added to provide clarification **to clarify** that **separate condition entry is allowed for** each **of the two** RCS **reactor coolant** gas vent **flow** path **locations**, of the reactor vessel closure head and the pressurizer steam space allows a separate entry into a Condition.

Since the above interpretation is correct, Subsection 3.4.16 needs to be revised to reflect STS Condition phrasing conventions for an Actions table with separate Condition entry allowed.

Since Condition B corresponds to a loss of RCGV function, a Completion Time of 2 hours is more appropriate than 6 hours. Staff suggest clarifying Required Action B.1 to emphasize that each location is treated independently.

Staff also suggests changing “RCGV path” to “RCGV flow path” for consistency with other Specifications’ phrasing. This includes SR 3.4.16.2; change “vent paths” to “vent flow paths.”

The applicant is requested to revise the LCO and Actions as indicated in the following markup; the applicant is also requested to make conforming changes to the Bases.

LCO 3.4.16 The following RCGV **flow** paths shall be OPERABLE:

a. Two **flow** paths from the reactor vessel closure head to **the** in-containment refueling water storage tank (IRWST), and

b. Two **flow** paths from the pressurizer steam space to the IRWST.

APPLICABILITY: MODES 1, 2, 3,
MODE 4 with RCS pressure ≥ 31.6 kg/cm2A (450 psia).

ACTIONS

----------NOTE----------
Separate condition entry is allowed for each RCGV flow path location.

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One ~~required~~ **or both locations with one** RCGV **flow** path inoperable.	A.1 Restore RCGV **flow** path to OPERABLE status.	72 hours
B. ~~Two required~~ **One or both locations with two** RCGV **flow** paths ~~from the same location~~ inoperable.	B.1 Restore one RCGV **flow** path **in each location** to OPERABLE status.	~~6~~ **2** hours
C. Required Action and associated Completion Time of Condition A or B not met.	C.1 Be in MODE 3. AND C.2 Be in MODE 4 with RCS pressure < 31.6 kg/cm^{2}A (450 psia).	6 hours 12 hours

4. As shown in DCD Figure 5.4.12-1, the vent flow paths to the IRWST from the reactor vessel closure head and the pressurizer steam space also include a common flow path with two solenoid-operated valves RG-V419 and RG-V420 in parallel. These valves are not clearly identified as within the scope of SR 3.4.16.1 (“Cycle each RCGV valve to the fully closed and fully open position.”) and SR 3.4.16.4 (“Verify correct breaker alignment and position indication power available.”). The applicant is requested to revise the Bases to clarify that the scope of SR 3.4.16.1 and SR 3.4.16.4 includes these two solenoid-operated valves, as well as RG-V410, RG-V411, RG-V412, and RG-V413 (the solenoid-operated valves in the two flow paths from the pressurizer steam space), and RG-V414, RG-V415, RG-V416, and RG-V417 (the solenoid-operated valves in the two flow paths from the reactor vessel closure head). Also consider including RG-V418, the solenoid-operated valve in the common vent flow path to the reactor drain tank, within the scope of these SRs.

5. DCD Figure 5.4.12-1 also depicts one locally operated manual valve, RG-V1430, in the common vent flow path, which is downstream of the above two solenoid-operated valves, that also needs to be within the scope of SR 3.4.16.3 (“Verify the locally operated manual isolation valve from the reactor vessel closure head and the locally operated manual isolation valve from the pressurizer are locked in the open position.”). The two locally operated manual isolation valves described in SR 3.4.16.3 are apparently not depicted on DCD Figure 5.4.12-1. The applicant is requested to revise SR 3.4.16.3 and associated Bases to clarify that the scope of SR 3.4.16.3 includes all three of these locally operated manual isolation valves. Also consider revising DCD Tier 2 Figure 5.4.12-1 to depict the two locally operated manual isolation valves already described in SR 3.4.16.3.

6. Further, the applicant is requested to revise the third paragraph in the Background section of the Bases B 3.4.16 to reflect the RCGV system information described in DCD Subsection 5.4.12, which is listed as Reference 1 in the Reference section of the Bases B 3.4.16. The cited failure modes and effect analysis (FMEA) was not provided in DCD Subsection 5.4.12.

Response

1.a. The APR1400 Technical Specification will be revised as indicated in Attachment 1.

1.b. The APR1400 Technical Specification will be revised as indicated in Attachment 2.

2. Only one charging pump is assumed to be in operation (Refer to DCD Tier 2 Subsection 5.2.2.2.2.1). There are two centrifugal charging pumps in CVCS. Only one CCP runs during the plant operational modes and the other CCP is in standby mode. The standby CCP is not running during any modes of operation except for pump switching operation. Thus, only one CCP is considered to operate in calculating the mass addition during LTOP condition. Additionally CVCS charging line has charging flow restricting orifices which limit the charging flow when the RCS pressure is low. The charging flow is restricted to 150 gpm by the flow restricting orifices when the RCS pressure is low. However in the calculation of the mass addition a charging flow of 200 gpm is considered for additional conservatism. A SR to verify that the charging pump flow restrictor limits the flow rate from both charging pumps to the flow of one charging pump is not required.

   Normal operating pressure of SIT is 610 psig. When RCS pressure is decreased below 640 psia, the SIT pressure is lowered to 400 psig. When RCS pressure reaches 475 psia, the SIT discharge line is isolated. During heatup, the SIT isolation valves automatically open when RCS pressure reaches 600 psia. The operator repressurizes the SIT to 610 psig once RCS pressure reaches 640 psia. The SCS is put into operation for normal shutdown cooling below the RCS pressure of 450 psia. The lowered SIT pressure(400 psig) cannot pressurize the RCS during a low temperature condition. Therefore, the requirement for SIT isolation in LCO 3.4.11 is not necessary.

3. The first paragraph of the Actions section of the Bases 3.4.16 will be revised as shown in the Attachment 3. But conditions A and B will be maintained because entry condition should be applied for each location according to “NOTE”. Therefore a Completion Time of 6 hours is more appropriate than 2 hours because the RCGV function of the other location

is still available. Also the phrase “RCGV path” will be changed to “RCGV flow path” as shown in the Attachment 3.

4. The “each RCGV valve” statement means all valves on the line to the IRWST not Reactor Drain Tank (RDT). The vent flow path to the RDT does not affect the RCGV function. So, the Bases of SR 3.4.16.1 and SR 3.4.16.4 do not require revision.

5. The SR 3.4.16.3 of the Bases will be revised as shown in the Attachment 3. The two locally operated manual isolation valves described in the SR 3.4.16.3 are the valves of V212 and V2300 in reactor coolant system (RCS). Since V212 and V2300 are shown in DCD Tier 2 Figure 5.1.2-1 and Figure 5.1.2-3 respectively, it is not necessary to depict the two valves to the DCD Tier 2 Figure 5.4.12-1.

6. The third paragraph in the Background section of the Bases B 3.4.16 will be revised as shown in the Attachment 3.

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 3.4.11, TS 3.4.16 and their Bases will be revised as indicated in Attachments 1, 2 and 3.

Impact on Technical/Topical/Environmental Reports

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

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.11 Low Temperature Overpressure Protection (LTOP) System

LCO 3.4.11 LTOP System shall be OPERABLE as follows:

a. Two OPERABLE ~~shutdown cooling system (SCS)~~ suction line relief valves with lift settings ~~≤ 37.3 kg/cm^{2}G (530 psig)~~ specified in the PTLR, or

b. RCS depressurized and an RCS vent of ≥ 180.6 cm^2 (28 in^2) established.

APPLICABILITY: MODE 4 when any RCS cold leg temperature is less than or equal to the LTOP enable temperature specified in the PTLR,
MODE 5,
MODE 6 when the reactor vessel closure head is on.

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One required SCS suction line relief valve inoperable in MODE 4.	A.1 Restore required SCS suction line relief valve to OPERABLE status.	7 days
B. One required SCS suction line relief valve inoperable in MODE 5 or 6.	B.1 Restore required SCS suction line relief valves to OPERABLE status.	24 hours
C. Required Action and associated Completion Time not met.	C.1 Depressurize RCS and establish an RCS vent of ≥ 180.6 cm^2 (28 in^2).	8 hours
D. Two required SCS suction line relief valves inoperable.	D.1 Initiate action to establish an RCS vent of ≥ 180.6 cm^2 (28 in^2).	Immediately

Revised for the BACKGROUND

The potential for vessel overpressurization is most acute when the RCS is water solid, occurring only while shutdown; a pressure fluctuation can occur more quickly than an operator can react to relieve the condition. Exceeding the RCS P/T limits by a significant amount could cause brittle cracking of the reactor vessel. LCO 3.4.3 requires administrative control of RCS pressure and temperature during heatup and cooldown to prevent exceeding the P/T limits.

This LCO provides RCS overpressure protection by having adequate pressure relief capacity. The pressure relief capacity requires either two OPERABLE SCS suction line relief valves or the RCS depressurized and an RCS vent of sufficient size. One SCS suction line relief valve or the RCS vent is sufficient to provide the overpressure protection necessary to terminate an increasing pressure event.

The LTOP System for pressure relief consists of two OPERABLE SCS suction line relief valves with their opening setpoints or an RCS vent of sufficient size. Two relief valves are required for redundancy. One SCS suction line relief valve has adequate relieving capability to prevent overpressurization for the limiting low temperature overpressurization transients.

SCS suction line relief valve Requirements

As designed for the LTOP System, the SCS suction line relief valves automatically open if the RCS pressure approaches their opening setpoints. When the SCS suction line relief valves are opened in an increasing pressure transient, the release of coolant causes the pressure increase to slow and maintain RCS pressure below the P/T limits.

RCS Vent Requiremen The required vent capacity may be provided by opening one or more vent paths.

Once the RCS is depressurized, a vent exposed to the containment atmosphere will maintain the RCS at containment ambient pressure in an RCS overpressure transient, if the relieving requirements of the transient do not exceed the capabilities of the vent. Thus, the vent path must be capable of relieving the flow resulting from an RCS overpressure transient and maintaining pressure below the P/T limits.

~~For an RCS vent to meet the specified flow capacity, it requires removing a pressurizer manway that located above the level of reactor coolant, so as not to drain the RCS when open.~~

For an RCS vent to meet the specified flow capacity, it requires removing a pressurizer manway that its flow area is more than the area of one of the SCS suction line relief valve discharge paths. Thus, opening the pressurizer manway ensures that the capabilities of the vent exceeds the relieving requirements of the transient. The pressurizer manway is located above the level of reactor coolant, so as not to drain the RCS when open.

3.4 REACTOR COOLANT SYSTEM (RCS)

3.4.16 Reactor Coolant Gas Vent (RCGV) Function

LCO 3.4.16 The following RCGV paths shall be OPERABLE:

a. Two paths from the reactor vessel closure head to in-containment refueling water storage tank (IRWST), and

b. Two paths from the pressurizer steam space to the IRWST

APPLICABILITY: MODES 1, 2, and 3,
MODE 4 with RCS pressure ≥ 31.6 kg/cm^{2}A (450 psia).

ACTIONS

CONDITION	REQUIRED ACTION	COMPLETION TIME
A. One ~~required~~ RCGV path inoperable.	A.1 Restore RCGV path to OPERABLE status.	72 hours
B. Two ~~required~~ RCGV paths from the same location inoperable.	B.1 Restore one RCGV path to OPERABLE status.	6 hours
C. Required Action and associated Completion Time of Condition A or B not met.	C.1 Be in MODE 3. AND C.2 Be in MODE 4 with RCS pressure < 31.6 kg/cm^{2}A (450 psia).	6 hours 12 hours

----------NOTE----------
Separate condition entry is allowed for each RCGV flow path location.

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.

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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.

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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.

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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.

BASES

APPLICABILITY (continued)

The OPERABLE RCS vent paths are not required for operating shutdown cooling system because the overpressure protection of the RCS is performed by the LTOP system.

In MODES 5 and 6, there is no need for OPERABLE RCS vent paths since the RCS temperature is low and depressurized enough.

ACTIONS

~~The ACTIONS are modified by a Note which is added to provide clarification that each RCS gas vent path of the reactor vessel closure head and the pressurizer steam space allows a separate entry into a Condition.~~

The ACTIONS are modified by a Note to clarify that separate condition entry is allowed for each of the two RCS reactor coolant gas vent flow path locations, the reactor vessel closure head and the pressurizer steam space.

A.1

With inoperab
inoperable, the required vent path must be returned to OPERABLE status within 72 hours. The Completion Time of 72 hours is a reasonable considering OPERABLE status of the other vent path.

B.1

With components inoperable, such that two required vent paths from either location are inoperable, at least one of the vent paths must be returned to OPERABLE status within 6 hours.

The Completion Time of 6 hours is reasonable to allow time to correct the situation, considering the importance of restoring at least one vent path. If at least one vent path is not restored to OPERABLE within 6 hours, then Required Action C is entered.

C.1 and C.2

If the Required Action and associated Completion Time of Condition A or B cannot be met, the plant must be brought to a MODE in which the LCO does not apply. To achieve this status, the plant must be in MODE 3 within 6 hours, and then in MODE 4 with RCS pressure less than 31.6 kg/cm^2A (450 psia) within 12 hours. The Completion Times are reasonable, based on operating experience, to reach the required plant conditions from full power conditions in an orderly manner and without challenging plant systems.

BASES

SURVEILLANCE REQUIREMENTS

SR 3.4.16.1

At least one complete cycling for all remote control valves in each vent path from the MCR verifies the RCGV function valves will function when necessary. The Surveillance test must be performed in MODE 5 or 6. The 18-month Frequency is based on a typical refueling cycle and industry accepted practice.

SR 3.4.16.2

This SR requires verification of flow through each vent path and the Surveillance test must be performed in MODE 5 or 6. The Surveillance is performed during venting. The 18-month Frequency is based on a typical refueling cycle and is an industry accepted practice.

SR 3.4.16.3

There is also one locally operated manual valve for the RCGV function in the common vent flow path.

There is one locally operated manual valve for the RCGV function in the vent path from the reactor vessel closure head. ~~It is necessary to verify that this valve is locked open to ensure that a vent path can be established from the reactor vessel closure head to the IRWST~~. these valves are There is also one locally operated manual valve for the RCGV function in the vent path from the pressurizer. It is necessary to verify that ~~this valve is~~ locked open to ensure that a vent path can be established from the pressurizer to the IRWST. The Surveillance test must be performed in MODE 5 or 6. The 18-month Frequency is based on accessibility during the refueling cycle and industry accepted practice.

the reactor vessel closure head and

SR 3.4.16.4

Verification of the correct breaker alignment and valve position indication ensures that the valves are able to actuate and the valve positions are able to be monitored when necessary. The 7-day Frequency has been shown to be acceptable by operating experience.

REFERENCES

1. DCD Tier 2, Subsection 5.4.12.