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.:	**175-8034**
SRP Section:	**05.04.12 – Reactor Coolant System High Point Vents**
Application Section:	**5.4.12**
Date of RAI Issue:	**08/28/2015**

Question No. 05.04.12-1

10 CFR 50.46a, “Acceptance Criteria for Reactor Coolant System Venting Systems,” describes the criteria for acceptable high point vent systems. 10 CFR 50.34(f)(2)(vi) requires, in part, that high point vent operation does not lead to an unacceptable increase in LOCA probability or an unacceptable challenge to containment integrity. Furthermore, in Standard Review Plan (SRP) Section 5.4.12, Acceptance Criterion 1 states that the reactor coolant vent design must ensure that use of these vents during and following an accident does not aggravate the challenge to containment or the course of the accident.

DCD Tier 2, Section 5.4.12 states that the reactor coolant gas vent system (RCGVS) is designed to provide a “safety-grade” means of remotely venting noncondensible gases and steam. It only discusses flow paths to the in-containment refueling water storage tank (IRWST) except for Subsection 5.4.12.2.3, “Design Features for Minimization of Contamination,” which mentions a vent path to the nonsafety-related reactor drain tank (RDT). The only other Tier 2 information the staff could locate regarding RCGVS discharge to the RDT is in Subsection 9.3.4.2.8.3, “Chemical and Volume Control System Tanks,” which states that the RDT is designed to receive discharge from the RCGVS for a limited period. No details are provided on that “limited period.”

However, Section 2.4.5 of DCD Tier 1 does state that the safety function vent path is to the IRWST, while for the non-safety function during plant startup and shutdown, the vent path can be to the RDT or IRWST. Because DCD Tier 2 does not provide such a description, please clarify in DCD Tier 2, Section 5.4.12 when the paths to the IRWST and RDT are used, and distinguish between the safety-related and non-safety-related functions. This is necessary to ensure that the Tier 2 material regarding the high point vent system satisfies 10 CFR 50.46a and 10 CFR 50.34(f)(2)(vi).

Response

In DCD Tier 2, Subsection 5.4.12 will be revised to clarify when the paths to the IRSWT and RDT are used and provide the non-safety function description.

Impact on DCD

In DCD Tier 2, Subsection 5.4.12 will be revised as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

5.4.12 Reactor Coolant System High Point Vents

The reactor coolant gas vent system (RCGVS) is used to discharge noncondensable gases and steam from the high point of the RCS for venting or pressure control during post-accident conditions.

5.4.12.1 Design Bases

the RCGVS effluent from the pressurizer or the reactor vessel closure head is transported to the reactor drain tank (RDT) or the in-containment refueling water storage tank (IRWST) for the non-safety gas vent operation during plant startup and shutdown.

The RCGVS is designed to provide a safety-grade means of remotely venting noncondensable gases from the reactor vessel closure head and the pressurizer steam space during post-accident conditions. The RCGVS is also 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. In addition, ~~the RCGVS is used for the noncondensable gases vent path during plant startup to fill the RCS.~~

The reactor vessel closure head vent portion of the RCGVS is designed to provide sufficient venting capacity to vent a steam bubble formed in the reactor vessel closure head during a natural circulation cooldown analysis, assuming a single failure. Reactor vessel closure head vent flow isolation is possible, assuming a single failure.

The pressurizer vent portion of the RCGVS is designed to provide sufficient venting capacity to reduce pressurizer pressure consistent with plant cooldown requirements, assuming a single failure. Pressurizer vent flow isolation is possible, assuming a single failure.

The RCGVS equipment and piping from the reactor vessel closure head vent up to and including the second vent valve, and from the pressurizer up to and including second vent valve are designed as seismic Category I, Class 1E and designed, fabricated, erected, tested and maintained to high quality standards in accordance with ASME Section III, Class 1 requirements.

Each active RCGV valve is designed to be powered from the normal or the emergency power source. Power connections are through two independent power divisions so that in

the event of an accident, in conjunction with a loss of normal power and a single failure of one emergency DC power division, a vent path from the pressurizer and the reactor vessel head can be established. The RCGV valves are remotely operated from the main control room and remote shutdown room.

Vent areas provide for mixing of the containment air. Swing panels at the top of the IRWST allow circulation of air for adequate mixing of any combustible gases with the containment atmosphere.

Venting does not adversely affect the performance of safety-related SSCs and does not aggravate the challenge to containment or the course of an accident.

The RCGVS is designed in accordance with the quality assurance acceptance criteria provided in Chapter 17.

The RCGVS satisfies applicable requirements and industry standards, including ASME Code classifications; 10 CFR 50.34(f)(2)(vi); 10 CFR 50.44; 10 CFR 50.46; 10 CFR 50.46a; 10 CFR 50.49; 10 CFR 50.55a; GDC 1, 14, 17, 19, 30, 34, and 36; and safety classifications and environmental qualifications.

5.4.12.2 System Design IRWST and the RDT.

RCGVS provides a means of venting noncondensable gases and steam from the pressurizer and the reactor vessel closure head to the ~~in-containment refueling water storage tank (IRWST)~~. The functions are as follows:

and the reactor vessel closure head

a. RCGVS provides a safety-grade means of venting noncondensable gases and steam from the pressurizer during post-accident conditions for non-LOCA design basis events.

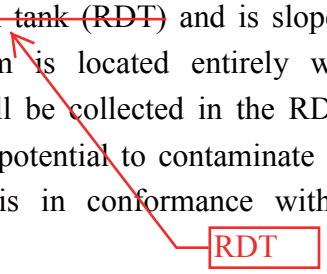
b. Safety-grade means to depressurize the RCS in the event that pressurizer main spray and auxiliary spray systems are unavailable.

c. RCGVS provides a non-safety gas vent operation from the pressurizer or the reactor vessel closure head during plant startup and shutdown.

5.4.12.2.3 Design Features for Minimization of Contamination

The RCGVS is designed with features that meet the requirements of 10 CFR 20.1406 and NRC RG 4.21. The basic principles of NRC RG 4.21, and the methods of control suggested in the regulations, are delineated in four design objectives and two operational objectives, as described in Subsection 12.4.2.

The reactor coolant gas vent system consists of piping and valves that are located inside the containment. The RCGVS vents noncondensable gases from the pressurizer and the reactor vessel upper head and depressurizes the RCS in the event that the pressurizer main spray or auxiliary spray systems are unavailable during plant cool down. The piping directs the vented gases to the IRWST or the ~~reactor drain tank (RDT)~~ and is sloped to facilitate the drainage of condensation. As the system is located entirely within containment, any leakage from the system components will be collected in the RDT or IRWST inside containment. Hence, the RCGVS has low potential to contaminate other areas of the plant or the environment. This design is in conformance with the requirements of NRC RG 4.21.



Prevention/Minimization of Unintended Contamination

The RCGVS is designed to vent non-condensable gases from the pressurizer and the reactor vessel upper head and depressurizes the reactor coolant system in the event that the pressurizer main spray or auxiliary spray systems are unavailable during plant cooldown. The piping directs the vented gases to the IRWST or the RDT and is sloped to facilitate the drainage of condensation, thus minimizing leakage and unintended contamination of the facility and the environment.

Adequate and Early Leak Detection

The RCGVS is designed not to be used during normal operation, and the piping is designed to slope downward to drain to the RDT and the IRWST. The potential for leakage is very low and a leak detection system is not required.

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Application Section:	**5.4.12**
Date of RAI Issue:	**08/28/2015**

Question No. 05.04.12-2

10 CFR 50.46a, “Acceptance Criteria for Reactor Coolant System Venting Systems,” criterion (c) requires that the high point vent system be designed to ensure that:

(1) The vents will perform their safety functions; and

(2) There would not be inadvertent or irreversible actuation of a vent.

DCD Tier 1, Section 2.4.5 explains that the safety function vent path for the RCGVS is to the IRWST, while the path is directed to the RDT for the non-safety plant startup and shutdown function. Because the safety-related and non-safety-related functions of the RCGVS use common piping up until the branch to the RDT, please discuss whether the non-safety-related function during startup and shutdown could adversely affect the ability of the RCGVS to operate during post-accident conditions. This information is needed so the staff can determine whether the RCGVS meets 10 CFR 50.46a.

Response

The RCGVS is designed to provide the safety-related functions of remotely venting non-condensible gases from the reactor vessel closure head and the pressurizer steam space during post-accident conditions and natural circulation cooldown. And the RCGVS provides the non-safety-related functions to aid RCS venting during the heat-up and the pre-refueling shutdown of the RCS.

Therefore, the non-safety-related functions do not adversely affect the ability of the RCGVS to operate during post-accident conditions because the safety-related and non-safety-related functions of RCGVS do not operated at the same time.

Impact on DCD

There is no impact on the DCD.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

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Question No. 05.04.12-4

The quality assurance criteria in 10 CFR Part 50, Appendix B require measures to assure that applicable regulatory requirements and the design basis are correctly translated into specifications and drawings, including provisions to assure that appropriate quality standards are specified and included in design documents.

In DCD Tier 2, Table 5.4.12-1, “Reactor Coolant Gas Vent System - Active Valve List,” the Safety Class column appears to be inconsistent with the information in DCD Tier 2, Table 3.9-4, “Seismic Category I Active Valves,” and DCD Tier 2, Table 3.9-13, “Inservice Testing of Safety-Related Pumps and Valves." In particular, the safety class for each valve in Table 5.4.12-1 is listed as the Roman numeral “I”. Both Table 3.9-4 and Table 3.9-13 list RG-0410 through RG-0417 as Quality Group A and RG-0419 and RG-0420 as Quality Group B.

Staff identified an omission in DCD Tier 2, Figure 5.4.12-1, as well as a typographical error:

(1) Markings that should indicate a transition from Seismic Category I and Quality Group B to Seismic Category II and Quality Group D after isolation valves V419 and V420 are missing.

(2) The size of the line downstream of isolation valves V416 and V417 in the RCVH portion of the RCGVS appears to jump from 1” to 3” without passing through a flow enlarger.

Please address these inconsistencies and errors and make updates as appropriate in the DCD to ensure consistency and accuracy of the design information. This is necessary to demonstrate compliance with 10 CFR Part 50, Appendix B.

Response

The safety class of valves RG-419 and RG-420 in DCD Tier 2, Table 5.4.12-1 will be corrected from I to 2 as shown in Attachment 1. Table 5.4.12-1 will also change safety class Roman numeral I to the number 1 for consistency.

The downstream line size of isolation valves V416 and V417 will be changed from 3 inches to 1 inch, and Qualify Group and Seismic Category will be added after V419 and V420 in DCD Tier 2, Figure 5.4.12-1 as shown in Attachment 2.

Impact on DCD

In DCD Tier 2, Table 5.4.12-1 and Figure 5.4.12-1 will be corrected as indicated in the Attachments.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

APR1400 DCD TIER 2

Table 5.4.12-1

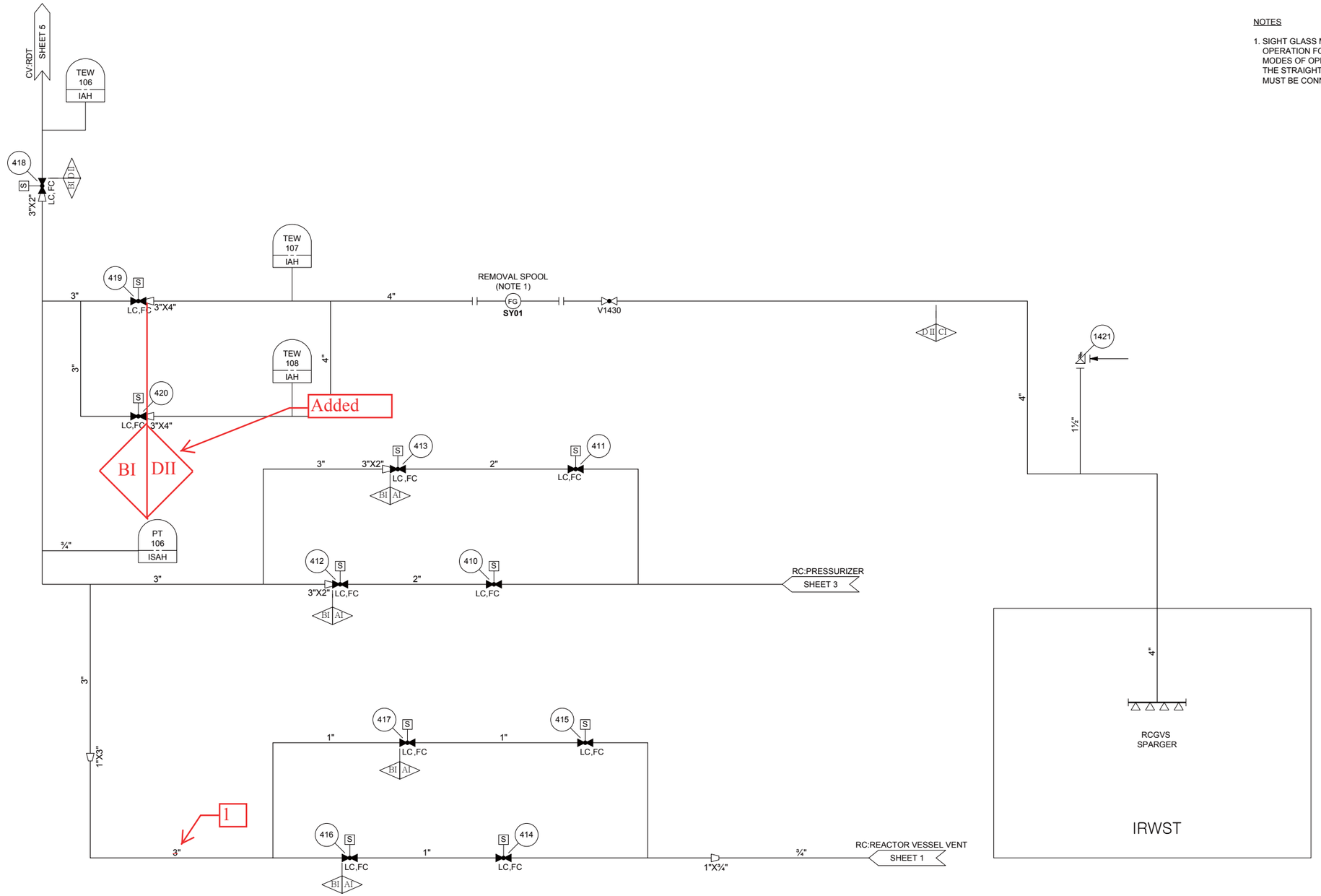
Reactor Coolant Gas Vent System – Active Valve List

Valve Number	Type	Line Size – Schedule	Power Source 125V DC Bus	Actuator	Safety Class
RG-410	Globe	50 mm (2 in) - 160	A	Solenoid	1
RG-411	Globe	50 mm (2 in) -160	B	Solenoid	~~1~~
RG-412	Globe	50 mm (2 in) - 160	C	Solenoid	~~1~~
RG-413	Globe	50 mm (2 in) - 160	D	Solenoid	~~1~~
RG-414	Globe	50 mm (2 in) - 160	A	Solenoid	~~1~~
RG-415	Globe	25 mm (1 in) - 160	B	Solenoid	~~1~~
RG-416	Globe	25 mm (1 in) - 160	C	Solenoid	~~1~~
RG-417	Globe	25 mm (1 in) - 160	D	Solenoid	~~1~~
RG-419	Globe	80 mm (3 in) - 160	B	Solenoid	~~1~~
RG-420	Globe	80 mm (3 in) - 160	A	Solenoid	~~1~~

1

2

APR1400 DCD TIER 2



NOTES

1. SIGHT GLASS MUST BE CONNECTED ONLY WHEN VENTING OPERATION FOR RCS FILLING IS REQUIRED. DURING ALL MODES OF OPERATION EXCEPT ABOVE OPERATION, THE STRAIGHT REMOVAL SPOOL WITHOUT SIGHT GLASS MUST BE CONNECTED.

Figure 5.4.12-1 Reactor Coolant Gas Vent System Flow Diagram

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Question No. 05.04.12-8

10 CFR 52.47(b)(1) requires that a DC application contain “the proposed inspections, tests, and analyses, and acceptance criteria (ITAAC) necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and should operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations.” Standard Review Plan (SRP) Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria,” provides ways to comply with 10 CFR 52.47(b)(1) and states that the Tier 1 design description or figure should identify the electrical power source/division for the equipment included in the system. This information is provided in DCD Tier 2, Table 5.4.12-1 but is not provided in DCD Tier 1, Section 2.4.5, “Reactor Coolant Gas Vent System.” As such, please update DCD Tier 1, Section 2.4.5 to provide this information as requested by SRP Section 14.3.

Response

The electrical power source in DCD Tier 1, Table 2.4.5-2 will be added as indicated in the attachment.

Impact on DCD

The electrical power source in DCD Tier 1, Table 2.4.5-2 will be added as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

Table 2.4.5-2

Reactor Coolant Gas Vent System Component List (2)

Component Name	Item No. (1)	ASME Section III Class	seismic Category	Class 1E/Harsh Envir. Qual.	Control/ Display at MCR	Control/ Display at RSR	Control Signal	Active Safety Function	Loss of Motive Power Position
Pressurizer Gas Vent Isolation Valves (SOV)	RG-V410, 411, 412, 413	1	I	Yes/Yes	Yes/Yes	Yes/Yes	-	Open/ Closed	Closed
Reactor Vessel Upper Head Gas Vent Isolation Valves (SOV)	RG-V414, 415 416, 417	1	I	Yes/Yes	Yes/Yes	Yes/Yes	-	Open/ Closed	Closed
Gas Vent to RDT Valves (SOV)	RG-V418	2	I	No/No	Yes/Yes	Yes/Yes	-	-	Closed
Gas Vent to IRWST Valves (SOV)	RG-V419, 420	2	I	Yes/Yes	Yes/Yes	Yes/Yes	-	Open	Closed
RCGVS Vacuum Breaker Valve	RG-V1421	3	I	No/No	-	-	-	-	-

(1) The column “Item No.” is information only (not part of certified design).

(2) The power source of the reactor coolant gas vent system is described in DCD Tier 2, Table 5.4.12-1.

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SRP Section:	**05.04.12 – Reactor Coolant System High Point Vents**
Application Section:	**5.4.12**
Date of RAI Issue:	**08/28/2015**

Question No. 05.04.12-10

10 CFR 52.47(b)(1) requires that a DC application contain the proposed ITAAC necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and should operate in accordance with the design certification, the provisions of the Atomic Energy Act, and the NRC's regulations. Standard Review Plan (SRP) Section 14.3, “Inspections, Tests, Analyses, and Acceptance Criteria,” provides ways to comply with 10 CFR 52.47(b)(1) and states that Tier 1 information should be clear and consistent with Tier 2 information.

DCD Tier 1, Section 2.4.5 lacks clarity and consistency with DCD Tier 2, Section 5.4.12 in a few areas, namely:

a. Tier 1 refers to the “reactor vessel closure head” in the design description, consistent with Tier 2, Section 5.4.12, but refers to the “reactor vessel upper head” in Tables 2.4.5-1 and 2 and Figure 2.4.5-1.

b. Tier 1, Figure 2.4.5-1 shows the inlet to the pressurizer portion of the RCGVS coming from the “POSRV Inlet Lines,” whereas Tier 2, Section 5.4.12 says the inlet is at the “steam sample/vent line off the pressurizer upper head.”

c. A label for the RCGVS pressure instrument downstream of the parallel RCGVS flow paths is visible in Tier 1, Figure 2.4.5-1, but the actual instrument is not shown in the figure, nor are any of the other RCGVS instruments listed in Tier 1, Table 2.4.5-3.

Please update DCD Tier 1, Section 2.4.5 and/or DCD Tier 2, Section 5.4.12 to ensure consistency of terminology. In addition, for clarity in DCD Tier 1, Figure 2.4.5-1, either (1) properly indicate the RCGVS instrumentation or (2) remove the text label for the pressure instrument.

Response

The terms “reactor vessel upper head” in Table 2.4.5-1, Table 2.4.5-2, and Figure 2.4.5-1 in DCD Tier 1 and Subsection 5.4.12.2.3 in DCD Tier 2, and “POSRV Inlet Lines” in Figure 2.4.5-1 in DCD Tier 2 will be changed to “reactor vessel closure head” and “Steam/Vent Line Off the Pressurizer Upper Head”, respectively. Also, the text label for the pressure instrument in Figure 2.4.5-1 in DCD Tier 1 will be deleted.

Impact on DCD

Table 2.4.5-1, Table 2.4.5-2, and Figure 2.4.5-1 in DCD Tier 1 and Subsection 5.4.12.2.3 in DCD Tier 2 will be corrected as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

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

Table 2.4.5-1

closure

Reactor Coolant Gas Vent System Equipment and Piping Location/Characteristics

Equipment and Piping Name	Location	ASME Section III Class	Seismic Category
Pressurizer gas vent piping upstream of and including the vent isolation valves RG-V412 and 413	Containment	1	I
Reactor vessel ~~upper~~ head gas vent piping upstream of and including the vent isolation valves RG-V416 and 417	Containment	1	I
RCGVS gas vent piping from downstream of the vent isolation valves RG-V412, 413, 416, 417 (excluding) to the vent isolation valves RG-V418, 419, 420 (including)	Containment	2	I
RCGVS gas vent piping from downstream of the vent isolation valves RG-V418 to RDT	Containment	-	II
RCGVS gas vent piping from downstream of the vent isolation valves RG-V419, 420 to the IRWST anchor wall	Containment	-	II
RCGVS gas vent piping from downstream of the IRWST anchor wall to the end point of RCGVS sparger	Containment	3	I

Table 2.4.5-2

Reactor Coolant Gas Vent System Component List

Closure

Component Name	Item No. (1)	ASME Section III Class	seismic Category	Class 1E/Harsh Envir. Qual.	Control/ Display at MCR	Control/ Display at RSR	Control Signal	Active Safety Function	Loss of Motive Power Position
Pressurizer Gas Vent Isolation Valves (SOV)	RG-V410, 411, 412, 413	1	I	Yes/Yes	Yes/Yes	Yes/Yes	-	Open/ Closed	Closed
Reactor Vessel ~~Upper~~ Head Gas Vent Isolation Valves (SOV)	RG-V414, 415 416, 417	1	I	Yes/Yes	Yes/Yes	Yes/Yes	-	Open/ Closed	Closed
Gas Vent to RDT Valves (SOV)	RG-V418	2	I	No/No	Yes/Yes	Yes/Yes	-	-	Closed
Gas Vent to IRWST Valves (SOV)	RG-V419, 420	2	I	Yes/Yes	Yes/Yes	Yes/Yes	-	Open	Closed
RCGVS Vacuum Breaker Valve	RG-V1421	3	I	No/No	-	-	-	-	-

(1) The column “Item No.” is information only (not part of certified design).

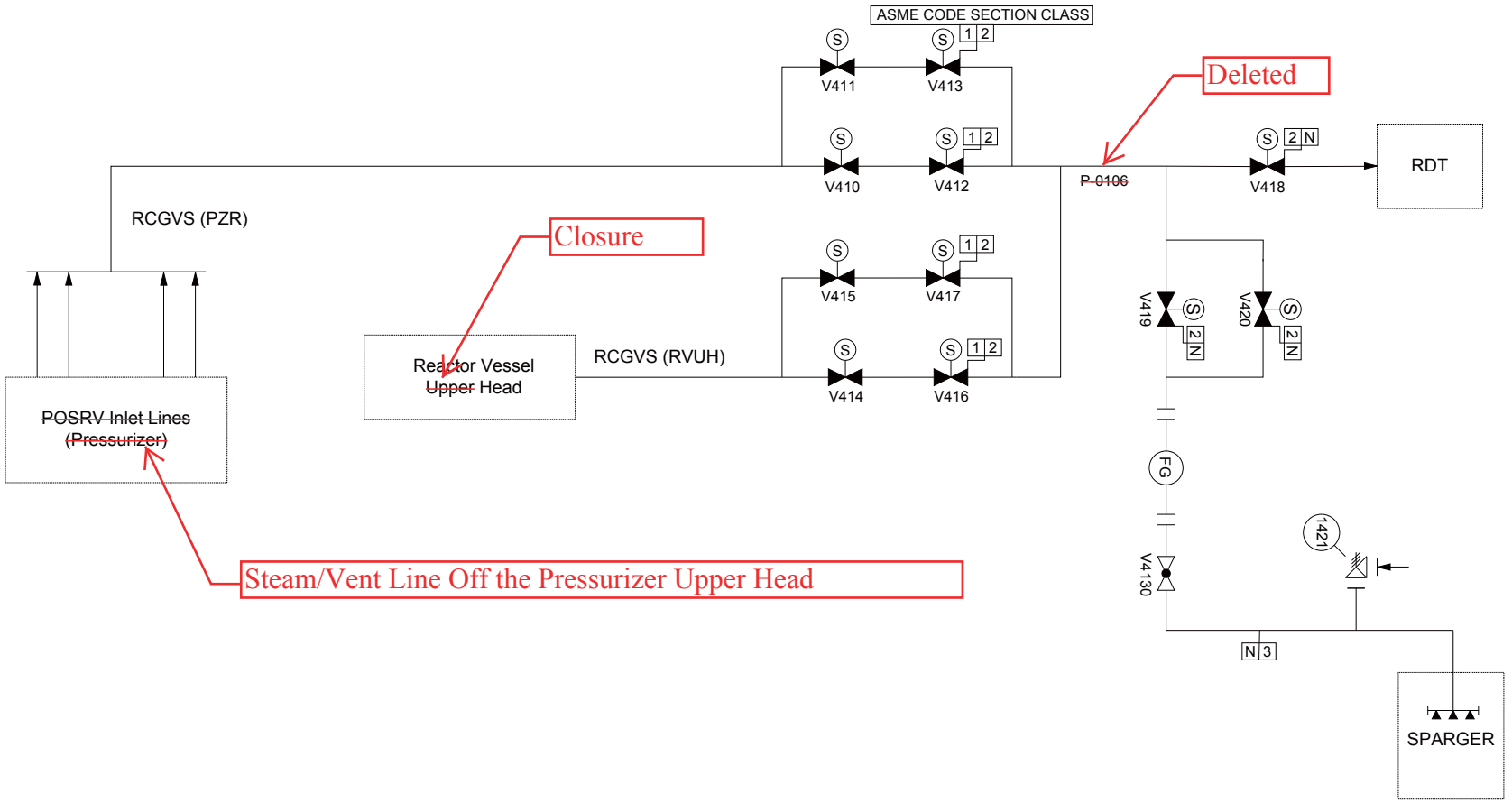

Figure 2.4.5-1 Reactor Coolant Gas Vent System

5.4.12.2.3 Design Features for Minimization of Contamination

The RCGVS is designed with features that meet the requirements of 10 CFR 20.1406 and NRC RG 4.21. The basic principles of NRC RG 4.21, and the methods of control suggested in the regulations, are delineated in four design objectives and two operational objectives, as described in Subsection 12.4.2.

closure

The reactor coolant gas vent system consists of piping and valves that are located inside the containment. The RCGVS vents noncondensable gases from the pressurizer and the reactor vessel ~~upper~~ head and depressurizes the RCS in the event that the pressurizer main spray or auxiliary spray systems are unavailable during plant cool down. The piping directs the vented gases to the IRWST or the reactor drain tank (RDT) and is sloped to facilitate the drainage of condensation. As the system is located entirely within containment, any leakage from the system components will be collected in the RDT or IRWST inside containment. Hence, the RCGVS has low potential to contaminate other areas of the plant or the environment. This design is in conformance with the requirements of NRC RG 4.21.

Prevention/Minimization of Unintended Contamination

closure

The RCGVS is designed to vent non-condensable gases from the pressurizer and the reactor vessel ~~upper~~ head and depressurizes the reactor coolant system in the event that the pressurizer main spray or auxiliary spray systems are unavailable during plant cooldown. The piping directs the vented gases to the IRWST or the RDT and is sloped to facilitate the drainage of condensation, thus minimizing leakage and unintended contamination of the facility and the environment.

Adequate and Early Leak Detection

The RCGVS is designed not to be used during normal operation, and the piping is designed to slope downward to drain to the RDT and the IRWST. The potential for leakage is very low and a leak detection system is not required.