KHNPDCDRAIsPEm Resource

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Sent: Friday, August 28, 2015 5:35 PM
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Cc: Ciocco, Jeff; Lee, Samuel; Ward, William; McKirgan, John; Burja, Alexandra
Subject: APR1400 Design Certification Application RAI 175-8034 (5.4.12 - Reactor Coolant System High Point Vents)
Attachments: APR1400 DC RAI 175 SRSB 8034.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs. However, KHNP requests, and we grant, the time shown below to respond to the RAI questions. We may adjust the schedule accordingly.

Question	Time to respond
05.04.12-1	30 days
05.04.12-2	45 days
05.04.12-3	45 days
05.04.12-4	30 days
05.04.12-5	45 days
05.04.12-6	45 days
05.04.12-7	30 days
05.04.12-8	30 days
05.04.12-9	45 days
05.04.12-10	30 days

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 175-8034

Issue Date: 08/28/2015
Application Title: APR1400 Design Certification Review – 52-046
Operating Company: Korea Hydro & Nuclear Power Co. Ltd.
Docket No. 52-046
Review Section: 05.04.12 - Reactor Coolant System High Point Vents
Application Section:

QUESTIONS

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).

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.

05.04.12-3

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. Section 10 CFR 50.46, subpart (b)(5) requires the ECCS to be capable of decay heat removal. In addition, SRP Section 5.4.12, SRP Acceptance Criterion 6 states: “The size of the vent should be smaller than the size corresponding to the definition of a LOCA (Appendix A to 10 CFR Part 50, 10 CFR 52.47(a)(1)(ii), and 10 CFR 52.79(b)) to avoid unnecessary challenges to the ECCS, unless the applicant provides justification for a larger size.”

DCD Tier 2, Section 5.4.12 does not discuss a break in the pressurizer vent line or present supporting LOCA analyses that would demonstrate compliance with the ECCS acceptance criteria in 10 CFR 50.46. In addition, Subsection 5.4.12.3, “Performance Evaluation,” states that a break in the vent line on the RVCH is categorized as a small break loss-of-coolant accident (SBLOCA) and that RVCH vent break phenomena are similar to those in DCD Tier 2, Section 15.6.5; therefore, the results in Section 15.6.5 conservatively bound the RVCH vent line break. However, it is unclear how the breaks analyzed are applicable to a potential break in the RVCH vent and how their results could envelop the RVCH vent line break case. For example, the SBLOCA analyses performed in DCD Tier 2, Section 15.6.5 are for cold leg breaks (pump discharge leg and DVI line) or a break in the top of the pressurizer. In addition, a break in the RVCH line would have an area of 5.07 cm^2 (0.005 ft^2), which is considerably smaller than even the smallest break analyzed, an 18.6 cm^2 (0.02 ft^2) break in the DVI line.

Therefore, please:

a. Address a break in the pressurizer vent line, providing supporting LOCA analyses if necessary, and update the DCD as appropriate.

b. Provide justification for why the results in Section 15.6.5 conservatively envelop the RVCH vent line break scenario.

This information is needed to evaluate whether the RCGVS meets the requirements of 10 CFR 50.34(f)(2)(vi) and 10 CFR 50.46.

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.

a. 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.

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.

05.04.12-5

10 CFR 50.49, “Environmental Qualification of Electric Equipment Important to Safety for Nuclear Power Plants,” requires that safety-related electric equipment is environmentally qualified. DCD Tier 2, Section 5.4.12.1 states that the RCGVS is environmentally qualified. However, the staff is unable to find discussion of the environmental qualification of the RCGVS in Tier 2, including Section 3.11, “Environmental Qualification of Mechanical and Electrical Equipment,” and Table 3.11-3, “Equipment Qualification Equipment List.” Although DCD Tier 1, Table 2.4.5-2, “Reactor Coolant Gas Vent System Component List,” shows that the safety-related gas vent valves are qualified for a harsh environment, no equivalent information is provided in DCD Tier 2. Therefore, please provide discussion on the environmental qualification of the RCGVS and update DCD Tier 2 as appropriate. This is required to allow the staff to evaluate whether the Tier 2 information for the RCGVS meets 10 CFR 50.49.

05.04.12-6

Standard Review Plan (SRP) Section 5.4.12, SRP Acceptance Criterion 13 states: “Procedures to effectively operate the vent system must consider when venting is needed and when it is not needed. A variety of initial conditions for which venting may be required should be considered. Operator actions and necessary instrumentation should be identified.” Additional guidance is provided in Regulatory Guide (RG) 1.206, Subsection C.I.5.4.12.3, “Performance Evaluation”: “The evaluation should cover vent system operation, including procedures that address, (1) when venting is/is not needed, (2) the method to determine the size of a non-condensable bubble, (3) initial conditions for venting, (4) requisite instrumentation, and (5) operator actions."

While DCD Tier 2, Subsection 5.4.12.3 provides some of the information requested by the SRP, it does not fully explain operation of the vent system. The procedures provided for the RVCH portion of the RCGVS are not entirely clear. Specifically, on page 5.4-84 of the DCD:

1. Regarding point a., what transients or other initial conditions would necessitate system operation, i.e., what conditions would make venting the noncondensible gases in the upper reactor vessel necessary?

2. Regarding point c., insufficient information has been provided as to how the operator would know when to initiate and terminate system operation. What conditions would an operator identify to know when to start and stop gas venting?

3. Regarding point e., it seems an operator would also need to close the RCGVS valve to terminate system operation. Is this accurate?

In addition, information has only been provided for the RVCH portion of the vent system; no procedures for the pressurizer vents are provided. Therefore, please address the aforementioned questions, provide procedures for the pressurizer portion of the RCGVS, and make updates in the DCD as appropriate. This is needed to fulfill SRP Acceptance Criterion 13, which is a way to satisfy, in part, the requirements of 10 CFR 50.46a and 10 CFR 50.34(f)(2)(vi).

05.04.12-7

Final Interim Staff Guidance DC/COL-ISG-019, “Review of Evaluation to Address Gas Accumulation Issues in Safety Related Systems and Systems Important to Safety,” identifies issues related to gas accumulation in nuclear systems. Although the RCGVS provides a means to alleviate gas accumulation in the RVCH and pressurizer, the potential exists for gas accumulation in the RCGVS piping. This could lead to water hammer, challenging piping integrity.

Therefore, please describe how it is ensured that the design of the piping from the vent entrance points to the discharge locations would not contribute to accumulation of the gases being vented. Identify whether this is the COL applicant’s responsibility and, if so, please appropriately identify this in the DCD.

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.

05.04.12-9

10 CFR 50.34(b)(6)(iii) requires an applicant to provide plans for preoperational testing, and SRP Section 14.2, “Initial Test Program – Design Certification and New License Applicants,” provides guidance for this area of review. SRP Section 14.2 states that the applicant should provide test abstracts of SSCs and unique design features, including tests and acceptance criteria.

The acceptance criteria for DCD Tier 2, Subsection 14.2.12.1.37, “Safety Depressurization and Vent System Test,” seem to reference incorrect sections of the DCD. In particular, Acceptance Criterion 5.2 says that the RCGVS depressurization rates are presented in Table 5.4.14-1. However, the rates in the referenced table are for the POSRVs, and those for the RCGVS are found in DCD Tier 2, Section 5.4.12. Also, Acceptance Criterion 5.3 states that the safety depressurization and vent system flow paths are described in Section 5.4.12, but Section 5.4.12 only discusses the RCGVS.

For compliance with 10 CFR 50.34(b)(6)(iii) and conformance to SRP Section 14.2, please address inconsistencies in DCD Tier 2, Subsection 14.2.12.1.37 and update the DCD accordingly.

In addition, the references to Chapter 5 for Acceptance Criteria 5.1 and 5.3 do not point to specific criteria for test acceptance. Therefore, either (1) provide in DCD Sections 5.4.12 and 5.4.14 the testing requirements and associated acceptance criteria or (2) provide in Subsection 14.2.12.1.37 the specific test acceptance criteria for each test method.

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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.