REVISED 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.:	**235-8275**
SRP Section:	**12.03 – 12.04 Radiation Protection Design Features**
Application Section:	**12.3 – 12.4**
Date of RAI Issue:	**10/07/2015**

Question No. 12.03-43

10 CFR 20.1101(b) requires that the licensee use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

10 CFR 20.1406(b) requires that applicants for standard design certifications describe in the application how facility design will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

FSAR Section 11.3.2 discusses the use of the gas stripper to remove dissolved gases from the reactor coolant. However, the application does not appear to discuss the process for removing gasses from the pressurizer to facilitate reactor shutdown. Some nuclear power plants have been known to degas the pressurizer directly using the primary sampling system, which could potentially cause equipment degradation issues, which could potentially result in the unexpected release of radioactive material or unnecessary worker dose due to the event or system repair.

Please indicate if the processes of degassing the pressurizer directly will be used in the APR 1400 design and update the FSAR to specify if this process will be used. If this process will be used please provide justification ensuring that the primary sampling line heat exchangers, valves, and other components are designed to handle this process.

Response – (Rev. 3)

The APR1400 does not use the sampling system directly to degas the pressurizer. Instead, the APR1400 design provides gas removal capability from the pressurizer to facilitate reactor shutdown using the connections before the pressurizer pilot-operated safety relief valves (POSRVs) (Please refer to DCD Figure 5.1.2-3). The connections are joined together to form a header, which is routed to the reactor coolant gas vent system (RCGVS) (Please refer to DCD

Figure 5.4.12-1). The RCGVS vent is routed to the reactor drain tank (RDT) for moisture separation in the CVCS. Venting operations of the pressurizer to the RDT for normal shutdown is performed during Mode 5, when reactor coolant temperature is less than 210 °F and the RCS pressure is fairly low, so that the integrity of the RDT is not challenged. The RDT vent is then sent to the gaseous radwaste system (GRS) for processing. The GRS provides further moisture separation, gas drying, and charcoal adsorber to delay release of halogens and noble gases. The gas is then mixed with the compound building vent and is released to the plant vent for discharge. And the vent gas from the PZR and the RVCH may go the RDT or the IRWST. When the RCS pressure is low for RCS filling, the vent gas is aligned to the RDT with the IRWST line (RC-419, 420) closed. While the RCS pressure is high (NOP/NOT), the vent gas is aligned to the IRWST with the RDT line (RC-418) closed.

This design approach minimizes contamination of the facility and the environment, and unnecessary radiation exposure to the worker.

As indicated in Attachment 1, the paragraphs will be inserted to the end of DCD Subsection 5.4.12.2.2 Pressurizer Vent, and since the reactor vessel closure head is provides the same gas removal capability, similar clarifications will be added to DCD Subsection 5.4.12.2.1.

Based on NRC feedback from a public conference call held on February 23, 2017, the information described in DCD Tier 2, Subsection 5.4.12.2.1 will be revised as indicated in Attachment 2.

Impact on DCD

DCD Tier 2 Section Subsection 5.4.12.2.1 and 5.4.12.2.2 will be updated as indicated in Attachments 1 and 2.

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.

the desired steam pressure in the pressurizer. The remaining heaters are connected to on-off controllers. These heaters are normally de-energized but are automatically turned on by a low pressurizer pressure signal or a high level error signal. This latter feature is provided because load increases result in an in-surge of relatively cold coolant into the pressurizer, thereby decreasing the bulk water temperature. The CVCS acts to restore level, resulting in a transient pressure below normal operating pressure. To minimize the extent of this transient, the on-off controlled backup heaters are energized, contributing more heat to the water. A low-low pressurizer water level signal de-energizes all heaters to prevent heater damage before they are uncovered. The pressure control program is shown in Figure 5.4.10-5. ~~The pressurizer is provided with gas removal for shutdown operation as discussed in DCD Subsection 5.4.12.2.2.~~

5.4.10.3 Design Evaluation

It is demonstrated by analysis in accordance with requirements for ASME Section III, Class 1 vessels that the pressurizer is adequate for all normal operating and transient conditions expected during the life of the facility. Following completion of fabrication, the pressurizer is subjected to the required ASME Section III hydrostatic test and post-hydrostatic test nondestructive testing.

During hot functional testing, the transient performance of the pressurizer is checked by determining its normal heat losses and maximum depressurization rate. This information is used in setting the pressure controllers. Reasonable assurance of the structural integrity of the pressurizer is further obtained from the inservice inspections performed in accordance with ASME Section XI and described in Section 5.2.

Overpressure protection of the RCS is provided by four pilot-operated safety-relief valves. See Subsection 5.4.14.

5.4.10.4 Test and Inspection

Prior to and during fabrication of the pressurizer, nondestructive testing is performed in accordance with the requirements of ASME Section III. Table 5.4.10-2 summarizes the pressurizer inspection program, which also includes tests not required by the Code. See Subsection 5.2.4 for inservice inspections of the pressurizer.

RCGV connections to the RCS are located at the reactor vessel closure head vent pipe and at the steam sample/vent line off the pressurizer upper head. The RCGVS flow diagram is shown in Figure 5.4.12-1.

5.4.12.2.1 Reactor Vessel Closure Head Vent

Piping from the reactor vessel is routed directly to the RCGV piping. This piping allows the operator to direct the RCGV discharge, through parallel valve divisions, to the IRWST, which is designed as seismic Category I.

The solenoid-operated valves of the parallel valve divisions are controlled from the MCR or RSR. Open and closed indications of the valves are provided and monitored from the MCR or RSR. Each valve is powered by the independent Class 1E power supply, and the valves are supplied with power by alternate alternating current power during an SBO. The valves are qualified using the ANSI/IEEE Std. 344 (Reference 23) as endorsed by NRC RG.1.100 (Reference 24).

The following information is available to the operator for initiating and terminating the reactor vessel closure head venting operation during post-accident conditions:

a. For initiating system operation: reactor vessel water level

b. For terminating system operation: reactor vessel water level

If voids form in the reactor vessel closure head, the operator may open the RCGV valves on the top of the reactor vessel (RG-415, RG-414, RG-417, and RG-416) to vent steam from the reactor vessel closure head, allowing the reactor vessel to be refilled. The reactor vessel closure head vent has a capacity of 4,797 kg/hr (10,576 lb/hr) at 175.8 kg/cm^{2}A (2,500 psia).

The noncondensable gases accumulating in the U-tubes of the steam generators are transferred to the reactor vessel closure head by using a procedure in which one or more RCPs per loop operate for short periods to force noncondensable gases out of the U-tubes.

The reactor vessel closure head is provided with gas removal capability for the shutdown operation using the connection from the reactor vessel closure head to the reactor coolant gas vent system (DCD Figure 5.1.1-1). The vent piping is connected to the pressurizer vent and then is routed to the reactor coolant gas vent system (RCGVS) (DCD Figure 5.4.12-1 and 5.4.12-1). The RCGVS vent is routed to the reactor drain tank (RDT) for moisture separation in the CVCS while the isolation valves to the IRWST are closed. Venting operations of the reactor vessel closure head to the RDT for normal shutdown is to be performed during Mode 5, when reactor coolant temperature is less than 210 °F and the RCS pressure is fairly low, so that integrity of the RDT is not challenged. The RDT vent is then routed to the gaseous radwaste system (GRS) for processing.

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5.4.12.2.2 Pressurizer Vent

The RCGV piping allows the operator to direct the RCGV discharge, through parallel valve divisions, to the IRWST, which is designed as seismic Category I.

The solenoid-operated valves of the parallel valve divisions are controlled from the MCR or RSR. Open and closed indications of the valves are provided and monitored from the MCR or RSR. Each valve is powered by the independent Class 1E power supply, and the valves are supplied power by alternate alternating current power during an SBO. The valves are qualified using the ANSI/IEEE Std. 344 as endorsed by NRC RG.1.100.

The following information is available to the operator for initiating and terminating the pressurizer venting operation during post-accident conditions:

a. For initiating system operation: pressurizer pressure and cold leg temperatures

b. For terminating system operation: pressurizer pressure and cold leg temperatures

while the isolation valve (RG-418) to the RDT is closed.

The operator may use the RCGV function to cool down and depressurize the plant in the event the pressurizer main spray and auxiliary spray systems are not operable. The operator manually opens the RCGV valves (RG-410, RG-411, RG-412, and RG-413) on the top of the pressurizer, releasing steam to the IRWST through valve RG-0419/RG-0420. This pressurizer vent has the capacity of 14,023 kg/hr (30,915 lb/hr) at the pressurizer condition of 175.8 kg/cm^{2}A (2,500 psia). The RCGV flow and the depressurization rate are controlled by valves RG-410, RG-411, RG-412, and RG-413 in the vent lines from the top of the pressurizer, and by opening and closing the RCGV valves (RG-414, RG-415, RG-416, and RG-417) from the top of the reactor vessel closure head.

The noncondensable gases accumulating in the U-tubes of the steam generators are transferred to the pressurizer by using a procedure in which one or more RCPs per loop operate for short periods to force noncondensable gases out of the U-tubes.

The pressurizer is provided with gas removal capability for the shutdown operation using the connections before the pressurizer pilot operated safety relief valves (POSRVs) (DCD Figure 5.1.2-3). The connections are joined together to form a header, which is routed to the reactor coolant gas vent system (RCGVS) (DCD Figure 5.4.12-1). The RCGVS vent is routed to the reactor drain tank (RDT) for moisture separation in the CVCS. Venting operations of the pressurizer to the RDT for normal shutdown is to be performed during Mode 5, when reactor coolant temperature is less than 210 °F and the RCS pressure is fairly low, so that integrity of the RDT is not challenged. The RDT vent is then routed to the gaseous radwaste system (GRS) for processing.

The vent gas from the PZR and the RVCH may go the RDT or the IRWST (DCD Figure 5.1.12-1). When the RCS pressure is low for RCS filling, the vent gas is aligned to the RDT with the IRWST line (RC-419, 420) closed. While the RCS pressure is high, the vent gas is aligned to the IRWST with the RDT line (RC-418) closed.

RCGV connections to the RCS are located at the reactor vessel closure head vent pipe and at the steam sample/vent line off the pressurizer upper head. The RCGVS flow diagram is shown in Figure 5.4.12-1.

The RCGVS piping is designed to prevent any undrainable loops in the system piping from the vent entrance to the discharge locations. The RCGVS piping downstream of the gas vent isolation valves are maintained unclogged by the following physical aspect of the design:

a. Where possible, the RCGVS piping is pitched at least 10° from horizontal to facilitate drainage.

b. As a minimum, the piping is pitched at least 2° from horizontal and is routed to prevent buildup of drain water that may prevent venting.

In addition, the RCGVS includes a vacuum relief valve to ensure gravity drainage of the vent line.

5.4.12.2.1 Reactor Vessel Closure Head Vent

Delete

~~Piping from the reactor vessel is routed directly to the RCGV piping.~~ This piping allows the operator to direct the RCGV discharge, through parallel valve divisions, to the IRWST, which is designed as seismic Category I.

The solenoid-operated valves of the parallel valve divisions are controlled from the MCR or RSR. Open and closed indications of the valves are provided and monitored from the MCR or RSR. Each valve is powered by the independent Class 1E power supply, and the valves are supplied with power by alternate alternating current power during an SBO. The valves are qualified using the ANSI/IEEE Std. 344 (Reference 24) as endorsed by NRC RG.1.100 (Reference 25).

The following information is available to the operator for initiating and terminating the reactor vessel closure head venting operation during post-accident conditions:

a. For initiating system operation: reactor vessel water level

b. For terminating system operation: reactor vessel water level

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If voids form in the reactor vessel closure head, the operator may open the RCGV valves on the top of the reactor vessel (RG-415, RG-414, RG-417, and RG-416) to vent steam from the reactor vessel closure head, allowing the reactor vessel to be refilled. The reactor vessel closure head vent has a capacity of 4,797 kg/hr (10,576 lb/hr) at 175.8 kg/cm^{2}A (2,500 psia).

The noncondensable gases accumulating in the U-tubes of the steam generators are transferred to the reactor vessel closure head by using a procedure in which one or more RCPs per loop operate for short periods to force noncondensable gases out of the U-tubes.

and 5.4.12-1

The reactor vessel closure head is provided with gas removal capability for the shutdown operation using the connection from the reactor vessel closure head to the reactor coolant gas vent system (Figure 5.1.1-1). The vent piping is connected to the pressurizer vent and then is routed to the reactor coolant gas vent system (RCGVS) (Figure 5.4.12-1). The RCGVS vent is routed to the reactor drain tank (RDT) for moisture separation in the CVCS while the isolation valves to the IRWST are closed. Venting operations of the reactor vessel closure head to the RDT for normal shutdown is to be performed during Mode 5, when reactor coolant temperature is less than 210 °F and the RCS pressure is fairly low, so that integrity of the RDT is not challenged. The RDT vent is then routed to the gaseous radwaste system (GRS) for processing.

The vent gas from the PZR and the RVCH may go the RDT or the IRWST (Figure 5.1.12-1). When the RCS pressure is low for RCS filling, the vent gas is aligned to the RDT with the IRWST line (RC-419, 420) closed. While the RCS pressure is high, the vent gas is aligned to the IRWST with the RDT line (RC-418) closed.

5.4.12.2.2 <u>Pressurizer Vent</u>

The RCGV piping allows the operator to direct the RCGV discharge, through parallel valve divisions, to the IRWST, which is designed as seismic Category I.

The solenoid-operated valves of the parallel valve divisions are controlled from the MCR or RSR. Open and closed indications of the valves are provided and monitored from the MCR or RSR. Each valve is powered by the independent Class 1E power supply, and the valves are supplied power by alternate alternating current power during an SBO. The valves are qualified using the ANSI/IEEE Std. 344 as endorsed by NRC RG.1.100.