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## 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.: 256-8321  
SRP Section: 09.02.02 - Reactor Auxiliary Cooling Water Systems  
Application Section: 9.2.2  
Date of RAI Issue: 10/19/2015

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### **Question No. 09.02.02-7**

General Design Criterion (GDC) 4 requires safety systems be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents. These structures systems and components shall be appropriately protected against dynamic effects of flow instabilities and attendant loads (i.e. water hammer).

Water hammer prevention for the CCWS is addressed in DCD Tier 2, Section 9.2.2.2.4, "Pipe Valves, and Fittings." The Component Cooling Water System (CCWS) design includes features to minimize the potential for water hammer. To ensure that adequate precautions are taken to prevent water hammer once the system has been put into operation, the applicant specifies COL Item 9.2(9), indicating that a COL applicant is to develop procedures for water systems filling, venting, keeping the system full, and operation to minimize the potential for water hammer; to analyze the system for water hammer impacts; to design the piping system to withstand potential water hammer forces; and to analyze inadvertent water hammer events in accordance with NUREG-0927.

The staff has reviewed the information in the DCD, including COL item 9.2(9). While the staff agrees with the need for the COL applicant to develop appropriate operation and maintenance procedures addressing water hammer concerns, the staff does not understand the need for the requirements related to system design, since the system design is fully within the scope of the DCD. Therefore, the applicant is requested to clarify:

- a. As the CCWS designer, to what extent has the CCWS design been analyzed for water hammer impacts, and to what extent has the CCWS piping been designed to withstand potential water hammer.
- b. What portions of the CCWS system is the COL Item requesting the COL applicant to analyze for water hammer impacts.

**Response**

In COL item 9.2(9), it is the responsibility of the COL applicant to develop procedures for water systems filling, venting, keeping the system full, and operation to minimize the potential for water hammer. The analysis of water hammer impacts on the system, designing the piping system to withstand water hammer forces, and the analysis of inadvertent water hammer events is the responsibility of the CCWS designer.

Therefore, Table 1.8-2, Subsection 9.2.2.2.4, and Subsection 9.2.10 will be revised to clarify the scope of the COL applicant.

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**Impact on DCD**

DCD Tier 2 Table 1.8-2, Subsection 9.2.2.2.4, and Subsection 9.2.10 will be revised as shown 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.

**APR1400 DCD TIER 2**

Table 1.8-2 (13 of 29)

Item No.	Description
COL 9.2(9)	The COL applicant is to develop procedures for water systems filling, venting, keeping the system full, and operation to minimize the potential for water hammer; <del>to analyze the system for water hammer impacts; to design the piping system to withstand potential water hammer forces; and to analyze inadvertent water hammer events</del> in accordance with NUREG-0927 in the CCWS.
COL 9.2(10)	The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control in the CCWS.
COL 9.2(11)	The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations in the CCWS.
COL 9.2(12)	The COL applicant is to include a site-wide radiological environmental monitoring program to monitor environmental contamination in the CCWS.
COL 9.2(13)	The COL applicant is to determine all state and local departments of health and environmental protection standards to be applied and followed for the domestic water system.
COL 9.2(14)	The COL applicant is to determine the source of domestic water to the site and the necessary required treatment plant.
COL 9.2(15)	The COL applicant is to confirm the sizing of domestic water tanks and associated pumps, if used.
COL 9.2(16)	The COL applicant is to confirm whether the sanitary waste is sent to an onsite treatment facility or the city sewage system.
COL 9.2(17)	The COL applicant is to provide the UHS-related design information based on the site characteristics, including meteorological conditions.
COL 9.2(18)	The COL applicant is to provide the UHS-related systems such as blowdown, chemical injection, and makeup water system.
COL 9.2(19)	The COL applicant is to provide the location and design of the ESW building, and makeup water source.
COL 9.2(20)	The COL applicant is to provide isolation between the UHS and the non-safety-related systems.
COL 9.2(21)	The COL applicant is to provide the design of UHS cooling tower basin so the minimum water level will provide adequate NPSH to ESW pumps under accident conditions.
COL 9.2(22)	The COL applicant is to provide the non-safety-related makeup water source and capacity for normal operation loss and evaporation in the UHS.

**APR1400 DCD TIER 2**

The surge tank is pressurized by the nitrogen gas to minimize air ingress. The elevation of the surge tank and piping arrangement minimize the potential for nitrogen accumulation in places other than the surge tank.

9.2.2.2.2.4 Piping, Valves, and Fittings

The system is designed to minimize the potential for water hammer in accordance with the guidance in NUREG-0927 (Reference 10).

CCWS piping is carbon steel and is protected against corrosion by the addition of corrosion inhibitors. The safety-related piping, valves, and fittings are designed and fabricated in accordance with ASME Section III, Class 3 requirements.

There are two cross connection lines between the divisions at the pump suction header and at the downstream of the CCW heat exchangers. Each line is normally isolated with two motor operated valves (MOVs) in series.

Relief valves are provided, as required, for equipment protection. Vents are installed in high points, and drains are installed in low points in the CCWS.

Vents are located to provide reasonable assurance that the piping is filled with water to reduce the water hammer occurrences after pump startups. Also, valve opening/closing times are selected to minimize water hammer effects and to provide reasonable assurance of isolation of a leak before the CCW surge tank empties.

The COL applicant is to develop procedures for water systems filling, venting, keeping the system full, and operation to minimize the potential for water hammer; ~~to analyze the system for water hammer impacts; to design the piping system to withstand potential water hammer forces; and to analyze inadvertent water hammer events~~ in accordance with NUREG-0927 (Reference 10) in the CCWS (COL 9.2(9)).

The following valves are required to perform a specific function in shutting down the reactor or to mitigate the consequences of an accident. The active valves are listed in Table 9.2.2-5.

- a. Nonessential supply header isolation valves (CC-143, 144, 145, and 146)

These MOVs close to terminate CCW flow to the nonessential equipment in the event of an accident. These valves automatically close on the SIAS or CCW surge tank low-low-level signal. The valve closure times are selected to prevent

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pressure, and (3) evaluate potential for vortex formation based on the most limiting applicable conditions in the ESWS.

- COL 9.2(4) The COL applicant is to determine the design details of the backwashing line and vent line and their discharge locations in the ESWS.
- COL 9.2(5) The COL applicant is to provide the evaluation of the ESW pump at the high and low water levels of the UHS. In the event of approaching low UHS water level, the COL applicant is to develop a recovery procedure.
- COL 9.2(6) The COL applicant is to provide measures to prevent long-term corrosion and organic fouling that may degrade system performance in the ESWS.
- COL 9.2(7) The COL applicant is to evaluate the need and design and install freeze protection in the ESWS if required.
- COL 9.2(8) The COL applicant is to conduct periodic inspection, monitoring, maintenance, performance and functional testing, of the ESWS and UHS piping and components, including the heat transfer capability of the CCW heat exchangers based on GL 89-13 and GL 89-13 supplement 1.
- COL 9.2(9) The COL applicant is to develop procedures for water systems filling, venting, keeping the system full, and operation to minimize the potential for water hammer; ~~to analyze the system for water hammer impacts; to design the piping system to withstand potential water hammer forces; and to analyze inadvertent water hammer events~~ in accordance with NUREG-0927 in the CCWS.
- COL 9.2(10) The COL applicant is to provide operational procedures and maintenance programs as related to leak detection and contamination control in the CCWS.
- COL 9.2(11) The COL applicant is to maintain complete documentation of system design, construction, design modifications, field changes, and operations in the CCWS.