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.:	**521-8696**
SRP Section:	**07.06 – Interlock Systems Important to safety**
Application Section:	**7.6.1.5**
Date of RAI Issue:	**09/22/2016**

Question No. 07.06-3

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

DCD descriptions disagree regarding the existence of Component Cooling Water (CCW) cross connections. NRC staff needs clarification in order to make a safety finding regarding system interlocks in the CCW system.

DCD Tier 2 Section 7.6.1.5, "Interlocks Required to Preclude Inadvertent Interties between Redundant or Diverse Safety Systems," states "...there is no connection between the CCW safety divisions, the APR1400 design does not include interlocks to prevent inadvertent interties between redundant or diverse safety systems." However, this statement conflicts with DCD Tier 2, Sections 9.2.2.2.2.4 (2nd paragraph) and 9.2.2.2.2.4.c, Figure 9.2.2-1, "Component Cooling Water System Flow Diagram," DCD Tier 1, Section 2.7.2.2.1, "Design Description," Table 2.7.2.2-2, "Component Cooling Water System Components List," and Figure 2.7.2.2-1, "Component Cooling Water System," which reflect cross connection supply and return values (CC-937, 938, 939, and 940) connecting the two CCW divisions and that these two valves in series automatically close on a Safety Injection Actuation Signal (SIAS) control signal from different divisions.

Clarify and update DCD Tier 1 and 2 to reflect whether there are cross-connections between the two divisions of CCW. If there are cross-connections, ensure that instrumentation and control system descriptions are appropriately corrected.

Response – (Rev. 1)

The statements in Section 7.6.1.5 that there is no connection between CCW safety divisions is not an accurate reflection of the current system design as specified in Tier 2 Section 9.2.2.2.2 and Tier 1 Section 2.7.2.2. There are two cross connections between the CCW divisions that are normally locked closed during operation through two in-series motor operated valves on each cross connection. If opened, the valves will close through interlocks with an SIAS or on a low-low surge tank level. These functions are tested in accordance with the pre-operational testing specified in Section 14.2.12.1.76.

The description of this CCW interlock function will be incorporated into DCD Tier 2 section 7.6.1.5, with appropriate references to Figure 7.6-3 and Table 7.6-2 (which will also be revised) to be consistent with the design and that which is described in other DCD sections. Except for CCW, there are no other systems that have automatic isolation controls between cross connected safety divisions.

Impact on DCD

DCD Tier 2, Subsections 7.6.1, 7.6.1.4, 7.6.1.5, Table 7.6-2, and Figure 7.6-3 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.

Non-essential

Component Cooling Water ~~Nonessential~~ Supply and Return Header Isolation Valves Interlocks

7.6.1.5 CCW Cross Connection Line Isolation Valve Interlocks

7.6 Interlock Systems Important to Safety

7.6.1 System Description

This section describes interlock systems important to safety that are credited in the safety analysis to:

a. Prevent overpressurization of low-pressure systems.

b. Prevent overpressurization of the reactor coolant system (RCS) during low-temperature operations of the reactor vessel.

c. Provide reasonable assurance of the availability of safety injection tank (SIT) isolation valves.

d. Provide reasonable assurance of the availability of component cooling water (CCW) supply and return header tie line isolation.

~~e. Preclude inadvertent interties between redundant or diverse safety systems.~~

Bypassed and inoperable status of all interlocks is provided via the bypassed and inoperable status indication (BISI), as described in Section 7.5.

7.6.1.1 Shutdown Cooling System Suction Line Isolation Valve Interlocks

The shutdown cooling system (SCS) is a low-temperature and low-pressure system used to remove decay heat from the RCS. The initial phase of a cooldown of the RCS is accomplished using the steam generator (SG) down to at least 176.7 °C (350 °F) and 31.6 kg/cm^{2}A (450 psia). Below these values, the SCS is used to cool the RCS to refueling temperature and to maintain these conditions for extended periods.

An interlock associated with the SCS suction line isolation valves prevents the isolation valves from being opened at RCS pressures above 31.6 kg/cm^{2}A (450 psia). The interlock setpoint is calculated considering tolerances necessary to provide reasonable assurance that the pressure at the valves does not exceed the low temperature overpressurization protection (LTOP) valve setpoint when the SCS is aligned to the RCS for normal shutdown cooling.

e. Provide reasonable assurance of the independence of each safety mechanical divisions of the CCW system.

The SIT permissive interlocks are used to allow isolation of the SITs below the pressure required for mitigation following a loss of coolant accident (LOCA). See Figure 7.6-2 for the interlock logic.

The isolation valves are manually closed when RCS pressure drops below the setpoint in Table 7.6-1 so that the SITs cannot cause overpressurization of the SCS while the SITs are maintained above atmospheric pressure.

As RCS pressure increases, the valves automatically reopen at the set pressure.

The opening of the SIT isolation valves provides reasonable assurance that the SITs are available for injection during plant startup.

If the isolation valves are closed and an SIAS is initiated, the isolation valves automatically open. The SIAS overrides the interlock or any manual signal.

The alarm associated with the SITs is activated if the RCS pressure is increased to the determined values and the SITs have not been repressurized.

Physically separate and independent signals are provided for SIT isolation valve interlocks. Refer to Section 6.3 for SIS and Subsections 3.9.6.3.1 and 6.3.4 for valve tests.

7.6.1.4 Component Cooling Water ~~Supply and Return Header Tie Line Isolation Interlocks~~ ~~Nonessential~~ Supply and Return Header Isolation Valves Interlocks

Non-essential

The CCW system removes heat from all safety components required for normal power plant operation, and normal and emergency shutdown of the plant, and transfers the heat to the essential service water through the CCW heat exchangers. The CCW system also provides cooling water for some non-safety components required for plant operation.

Non-essential supply and return header isolation valves are provided to isolate the non-essential supply and return headers from the essential supply and return headers in the event of an accident. These valves are two series electric motor operated valves and can be remotely operated.

These valves are automatically closed on an SIAS or low-low CCW surge tank level signal. The valve closure times are set to prevent complete loss of surge tank volume due to a

break in the non-safety piping. These valves can be manually opened and closed from the main control room.

Cooling water may be supplied to the post-accident primary sample cooler rack by the function of the ESFAS overriding to open non-essential supply and return header isolation valves of the other division under the discretion of the operator during post-accident condition.

The design of the CCW system is described in Subsection 9.2.2, and a flow diagram of the isolation valves (CC-V-143, 144, 145, 146, 147, 148, 149, and 150) is provided in Figure 9.2.2-1. The setpoint and function of CCW isolation valves are described in Table 7.6-2.

A single interlock failure may result in valve malfunction within a single division, but this does not adversely affect the other division. These interlocks provide reasonable assurance of the independence between essential supply and return headers, and non-essential supply and return headers.

The interlocks for these valves are shown in Figure 7.6-3. The signal path for the surge tank interlock is from local level transmitters to the ESF-CCS loop controller for control of these valves.

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~~7.6.1.5 Interlocks Required to Preclude Inadvertent Interties between Redundant or Diverse Safety Systems~~

~~Because there is no connection between the CCW safety divisions, the APR1400 design does not include interlocks to prevent inadvertent interties between redundant or diverse safety systems. Therefore, this is not applicable.~~

7.6.2 Design Basis Information

This subsection describes the criteria for the interlock systems that are important to safety and that operate to reduce the probability of events such as a LOCA or LTOP and to maintain safety systems in a state that provide reasonable assurance of their availability in an accident. Conformance with applicable GDC is described in Subsection 7.6.2.1, and conformance with IEEE Std. 603 (Reference 1) is described in Subsection 7.6.2.2.

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7.6.1.5 CCW Cross Connection Line Isolation Valve Interlocks

The CCW system consists of two independent and redundant closed loop safety divisions. There are two cross connection lines between the two separate divisions, and each cross connection line has two in series motor-operated isolation valves ~~(CC-937 and CC-938 downstream of the CCW heat exchangers and CC-939 and CC-940 on the pump suction header).~~

If one division fails, the isolation valves can be manually opened to supply CCW flow to the other division during normal operation. The valves are normally locked closed and automatically close on a SIAS or low-low CCW surge tank level signal in the event of an accident or transient.

The interlocks provide reasonable assurance of the independence of each safety mechanical division of the CCW system, thereby providing cooling water to safety components required for mitigating an event.

The two series valves powered from different divisions provide reasonable assurance of isolation in the presence of a single failure. The interlocks provide reasonable assurance of the independence of each CCW safety division.

~~The signal path for low-low level interlock of surge tank is from the local tank level transmitters to the ESF-CCS loop controller for closure of these valves.~~

(CC-V-937 and CC-V-938 downstream of the CCW heat exchangers and CC-V-939 and CC-V-940 on the pump suction header).

The design of the CCW system is described in Subsection 9.2.2, and a flow diagram of the isolation valves (CC-V-937, 938, 939, and 940) is provided in Figure 9.2.2-1. The setpoint and function of CCW isolation valves are described in Table 7.6-2.

The interlocks for these valves are shown in Figure 7.6-3. The signal path for surge tank interlock is from local level transmitters to the ESF-CCS loop controller for control of these valves.

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Table 7.6-2 CCW non-essential supply and return header isolation valves and cross connection line isolation valves.

~~CCW Supply and Return Header Tie Line Isolation Interlocks~~

System	Setpoint	Function
Component Cooling Water System		
Non-essential supply header isolation valves (CC-V-143, CC-V-144, CC-V-145, CC-V-146) (1)	SIAS CCW surge tank low-low level signal (2)	Closes to terminate CCW flow to the nonessential equipment in the event of an accident
Non-essential return header isolation valves (CC-V-147, CC-V-148, CC-V-149, CC-V-150) (1)	SIAS CCW surge tank low-low level signal (2)	Isolates the nonessential return headers in the event of an accident
CCW Cross Connection Line Isolation Valves (CC-V-937, CC-V-938, CC-V-939, CC-V-940)(3)	SIAS CCW Surge tank low-low level signal(2)	Closes to terminate CCW flow to the other safety division in the event of an accident.

(1) The valve closure times are selected to prevent the CCW surge tank from being emptied in the event of a break in the non-safety piping. The automatic close signal can be overridden by a manual operation from the MCR to cool the post-accident primary sample cooler rack in the other division, if necessary. The interlock valves are listed in Table 9.2.2-5. Refer to Figure 9.2.2-1 for a flow diagram of the valves.

(2) Refer to Subsection 9.2.2.5.4.

(3) The valve closure times are selected to prevent the CCW surge tank from being emptied in the event of a break in the non-safety piping. The automatic close signal cannot be overridden by a manual operation from the MCR. The interlock valves are listed in Table 9.2.2-5. Refer to Figure 9.2.2-1 for a flow diagram of the valves.

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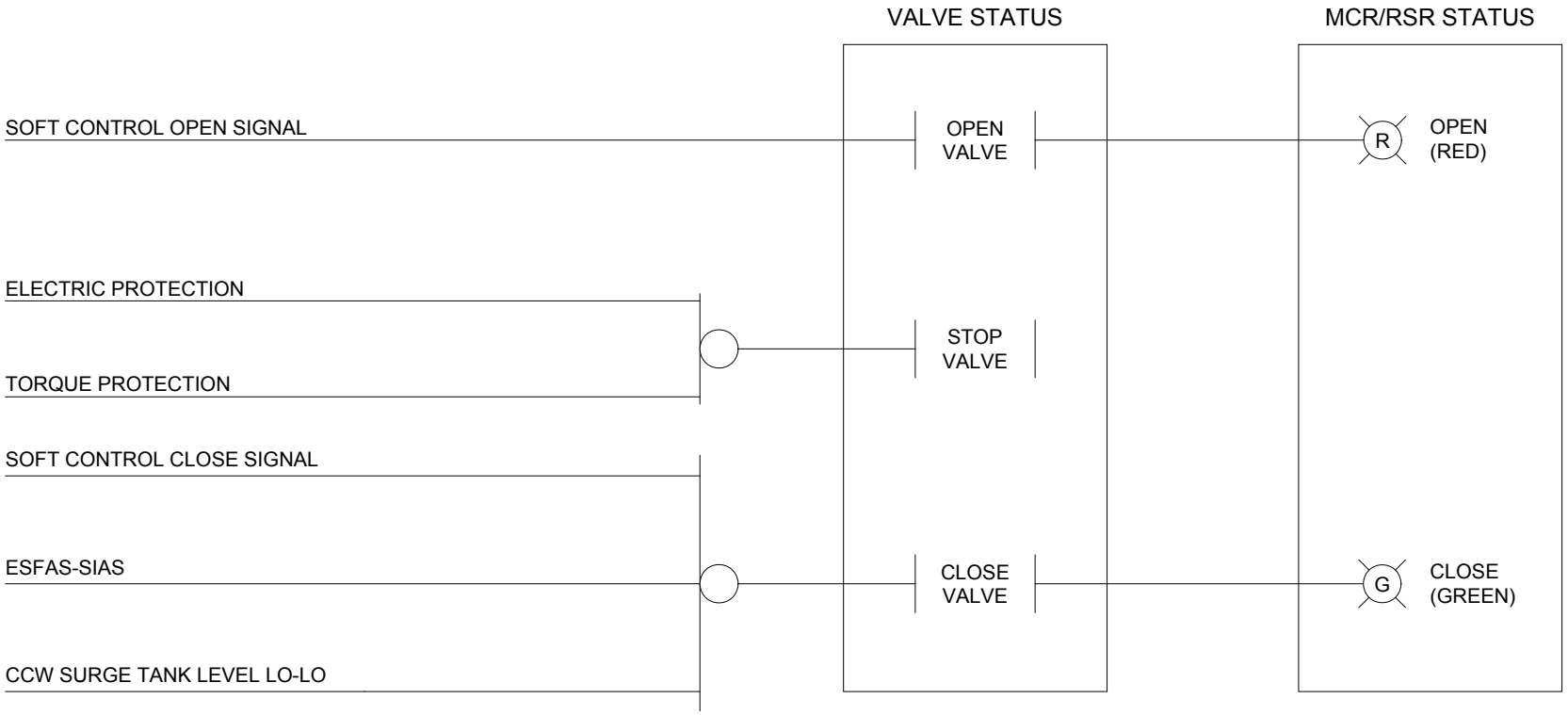

Interlocks for CCW non-essential supply and return header isolation valves and cross connection line isolation valves.

Figure 7.6-3 ~~Interlocks for CCW Supply and Return Header Isolation Valve~~