SUPPLEMENTAL 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.:	**25-7844**
SRP Section:	**06.02.02 - Containment Heat Removal Systems**
Application Section:	**6.2.2**
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Question No. 06.02.02-8

General Design Criterion (GDC) 38 requires, in part, that the containment heat removal system perform in a manner consistent with the function of other systems. It also requires that the system have suitable redundancy in components and features and suitable interconnections… [that] the system safety function can be accomplished in the event of a single failure.

The holdup volume tank (HVT) flooding valves are described as having the ability to be operated either separately or simultaneously. Explain, in the DCD, the impact of having these valves opened inadvertently at the same time (provide a failure mode and effects analysis for these components), or provide details on the interlocks in place to prevent such an occurrence from taking place. The staff requires this information to ensure that the in-containment refueling water storage tank (IRWST) will perform its safety function for all postulated accidents.

Response

As described in the third paragraph of DCD Section 6.8.2.1.2, the HVT flooding valves (IW-0001, IW-0002) and the reactor cavity flooding valves (IW-0003, IW-0004) are motor operated valves which are normally closed, de-energized, and remotely opened by operator action from the main control room (MCR). So these valves do not open inadvertently at the same without any operator actions.

Supplemental Response

As discussed during the August 26th teleconference between the NRC staff and KHNP, the HVT flooding valves and reactor cavity flooding valves are designated as cavity flooding system (CFS) valves. The valves are only used to flood the reactor cavity through the HVT for

severe accident mitigation in the event of a severe accident. The valves remain locked closed and the power connections for the valves are separated from the power source during all plant conditions, except during a severe accident condition. When the severe accident occurs and the CFS operation is required, operators restore the power for the valves and operate the valves for CFS operation by administrative controls. Therefore, a single signal failure will not result in inadvertent simultaneous operation of the CFS valves during any mode of plant operation. DCD Tier 2, Section 6.8.2.1.2 will be revised to provide clarity regarding operation of the valves.

Impact on DCD
DCD Tier 2, Section 6.8.2.1.2 will be revised as indicated in the attachment associated with this response.

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.

Following refueling, water is transferred from the refueling pool to the IRWST by diverting a portion of the SC pump discharge downstream of the SC heat exchanger to the IRWST. The refueling pool is drained in this manner down to the reactor vessel flange. Subsequent draining of the refueling pool is performed by the SFP cleanup pumps directly to the IRWST, followed by gravity draining directly to the IRWST (shown in Figure 9.1.3-1).

6.8.2.1.2 Accident conditions

The IRWST is cooled by the CS heat exchangers during a LOCA or secondary side pipe break. The CS pumps take suction from the IRWST and pump the water through the CS heat exchangers where it is cooled before being sprayed through the spray nozzles into the containment atmosphere. The containment atmosphere is cooled by heat transfer to the falling spray water. The spray water drains into the HVT and is ultimately returned to the IRWST through the IRWST spillways once the HVT water level reaches the IRWST spillways.

During the bleed phase of RCS rapid depressurization, the IRWST can be cooled by the SC or the CS heat exchangers.

The CFS is used to flood the reactor cavity in the event of a severe accident to cover core debris in the reactor cavity with water. The CFS takes water from the IRWST and directs it to the reactor cavity. The water flows first into the HVT through HVT flooding lines and then into the reactor cavity through reactor cavity flooding lines. Two 35.36 cm (14 inch) diameter HVT flooding lines, two 30.48 cm (12 inch) diameter reactor cavity flooding lines, and related motor operated valves and controls are used to deliver the water from the IRWST to the reactor cavity. The motor-operated valves (MOVs) are ~~normally closed, de-energized, and~~ remotely opened by operator action from the main control room (MCR). The motive force for the flooding is gravity and the static head of water between the IRWST water level and the HVT water level. Flooding of the HVT progresses until the water level in the HVT reaches the level of the reactor cavity flooding lines, at which time reactor cavity flooding commences. Flooding stops when an equal water level in the IRWST, HVT, and reactor cavity is attained.

, which remain locked closed and disconnected from the power source during all plant conditions except the severe accident condition,

after restoration of power to the valves

assurance that much of the higher density debris and debris that tends to sink slowly settles to the bottom of the HVT before spilling over into the IRWST. Debris that remains in suspension makes its way to the IRWST spillways. The spillways are shown in Figure 6.8-1.

The fine debris introduced into the IRWST is prevented from entering the pump suction by the IRWST strainers. The IRWST strainers can remove debris greater than 2.38 mm (3/32 in) in diameter. The strainer design includes redundancy, a large surface area to account for potential debris blockage and maintain safety performance, corrosion resistance, and a strainer hole size to minimize downstream effects. Additional design attributes are described in Reference 4.

6.8.2.2.2 Holdup Volume Tank

The HVT is located between the primary shield wall and the IRWST inner wall.

During accidents, water from breaks and CS are drained and collected in the HVT. The collected water reaches the IRWST spillways and then flows into the IRWST.

The HVT delays cavity flooding after the actuation of the CFS to allow MCR operators to abort the cavity flooding if desired.

6.8.2.2.3 Cavity Flooding System

The function of the CFS is to flood the reactor cavity in the event of a severe accident to cover core debris in the reactor cavity with water. Covering the core debris facilitates the cooling and stabilization of the debris.

6.8.2.2.4 Valves

The relative location, valve type, operator type, position during normal plant power operation, and failure position of IRWST and CFS valves are shown in Figure 6.8-3.

~~HVT flooding valves are normally closed, and these motor-operated gate valves are in the flow paths that connect the IRWST to the HVT. Reactor cavity flooding valves IW-0003~~

~~and -0004 are normally closed, and these motor-operated gate valves are in the flow paths that connect the HVT to the reactor cavity. These two groups of valves are designated as the CFS valves. These valves are opened by the operator from the MCR to flood the reactor cavity in the event of a severe accident. Controls are provided to allow the valves to be opened either individually or simultaneously for reactor cavity flooding.~~

Normally closed motor-operated gate valves are located in the IRWST suction line to the boric acid makeup pumps. These gate valves are opened from the MCR to allow adjustments of the IRWST boron concentration during normal operation or to supply the borated water to the reactor cavity for external reactor vessel cooling operation in a severe accident condition. These valves automatically close upon receiving a containment isolation actuation signal (CIAS).

Local-manual valves are normally locked open gate valves located upstream of the MOVs in each flow path connecting the IRWST to the HVT. These local manual valves are closed during stroke testing of the MOVs to prevent draining the IRWST.

6.8.2.2.5 IRWST Pressure Devices

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HVT flooding valves are motor-operated gate valves in the flow paths that connect the IRWST to the HVT. The reactor cavity flooding valves are motor-operated gate valves in the flow paths that connect the HVT to the reactor cavity. These two groups of valves are designated as CFS valves. The valves are only used to flood the reactor cavity through the HVT for severe accident mitigation in the event of a severe accident. The valves remain locked closed and the power connections for the valves are separated from the power source during all plant conditions, except during a severe accident condition. When a severe accident occurs, and the CFS operation is required, operators in the MCR restore power to the valves and operate the valves for CFS operation by administrative controls.

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accident (DBA) steam release and POSRV actuation, assuming that no cooling of the IRWST is available.

The swing panels provide 13.38 m^2 (144 ft^2) of free vent area for a severe accident with POSRV actuation. The swing panels work with the passive autocatalytic recombiners (PARs) to prevent detonable hydrogen concentrations in the IRWST during a severe accident. The PARs are located at the IRWST vent stack area to prevent an accumulation in the IRWST. The hydrogen mitigation system is addressed in Subsection 6.2.5.