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.: **323-8281**

SRP Section: **07.03 - Engineered Safety Features Systems**

Application Section:

Date of RAI Issue: **11/30/2015**

Question No. 07.03-21

Describe the preferred safe states of ESF components to be controlled by both the diverse protection system (DPS) and ESF-CCS.

10 CFR 50.55a(h), “Protection and Safety Systems,” requires compliance with IEEE Std. 603-1991, “IEEE Standard Criteria for Safety Systems for Nuclear Power Generating Stations,” and the correction sheet dated January 30, 1995. Clause 5.5 of IEEE Std. 603-1991 requires safety systems be designed to accomplish their safety functions under the full range of applicable conditions enumerated in the design basis.

Section 4.4.3.4, "Component Interface Module," of Technical Report APR1400-Z-J-NR-14001-P, Rev. 0, “Safety I&C System,” and Section 5.2, "Priority Logic," of Technical Report APR1400-E-J-NR-14001-P, Rev. 0, “Component Interface Module” identify state-based priority as applicable to the ESF-CCS and DPS signals that are input to the component interface module. However, the staff was not able to identify the preferred safe states for each ESF component that is controlled by both DPS and ESF-CCS. Provide the preferred safe state of individual ESF components controlled by both the DPS and ESF-CCS.

Response

The diverse protection system (DPS) only provides an “energize” signal to the component interface module (CIM) to actuate engineered safety features (ESF) components into the preferred safe state, as shown in Figure 5.3-1 of technical report APR1400-E-J-NR-14001-P, Rev. 0, “Component Interface Module.”

The engineered safety features-component control system (ESF-CCS) loop controller (LC) can provide an “energize” signal or a “de-energize” signal to the CIM. The “energize” signal for the preferred safe state has priority over the de-energize signal for the opposite state.

A list of preferred safe states of individual ESF components controlled by both the DPS and ESF-CCS will be added into DCD Tier 2, Section 7.8 as Table 7.8-5 “Preferred Safe State of ESF Components Controlled by DPS and ESF-CCS”, as indicated in the attachment associated with this response.

Impact on DCD

DCD Tier 2, Section 7.8 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.

Reactor Trip Signal

The DPS initiates an automatic reactor trip when either pressurizer pressure or containment pressure exceeds a predetermined value (see Table 7.8-1). The DPS also initiates a reactor trip on turbine trip (RTOTT) if the RPCS is out of service. The DPS RTOTT can be manually enabled from the DPS operator module (DPS-OM) in the MCR.

The DPS design uses a 2-out-of-4 logic to open the trip circuit breakers (TCBs) of the reactor trip switchgear system (RTSS), thus removing motive power to the control element drive mechanisms (CEDMs), as shown in Figures 7.8-1 and 7.8-2. For reactor trip, the DPS energizes the shunt trip coil of the RTSS TCBs while the PPS de-energizes the undervoltage trip coil to cause the RTSS TCBs to open.

The DPS manual reactor trip is provided to permit the operator to trip the reactor from the DPS-OM in the MCR.

Turbine Trip Signal

The DPS turbine trip is automatically initiated whenever the DPS reactor trip conditions are met. The DPS turbine trip signal is automatically generated with a 3-second time delay after initiation of the DPS reactor trip signal. A block diagram of the reactor trip/turbine trip circuitry is shown in Figure 7.8-2. See Figure 7.8-3 for the DPS turbine trip signal.

Auxiliary Feedwater System Actuation Signal

The DPS initiates an AFWS actuation when the level in either of the two SGs decreases below a predetermined value (see Table 7.8-l). Each auxiliary feedwater actuation signal (AFAS) generated independently by the DPS and ESF-CCS is prioritized in the component interface module (CIM) using state-based priority logic, so that either system can actuate the auxiliary feedwater. Isolation is provided at the ESF-CCS loop controller cabinet to maintain electrical isolation between the DPS and CIM. See Figure 7.8-4 for the DPS-AFAS.

The safe state for sate-based priority logic is shown in Table 7.8-5.

Safety Injection System Actuation Signal

The DPS also initiates an SIS actuation when the pressure decreases below a predetermined value (see Table 7.8-l). Each safety injection actuation signal (SIAS) generated

independently by the DPS and ESF-CCS is prioritized in the CIM using state-based priority logic, so that either system can actuate the SIS. Isolation is provided at the ESF-CCS loop controller cabinet to maintain electrical isolation between the DPS and CIM. See Figure 7.8-5 for the DPS-SIAS.

The safe state for sate-based priority logic is shown in Table 7.8-5.

7.8.1.2 Diverse Manual Engineered Safety Features Actuation Switches

The DMA switches permit the operator to manually actuate ESF systems from the MCR after a postulated CCF of the PPS and ESF-CCS.

The DMA switches provide the SIAS, main steam isolation signal (MSIS), containment isolation actuation signal (CIAS), containment spray actuation signal (CSAS), AFAS-1, AFAS-2 and signal for auxiliary feedwater flow/steam generator (SG) level. Table 7.8-3 identifies diverse automatic and manual actuation signals. The DMA switches are hardwired to the CIM through the isolation devices and are independent and diverse from the safety system. The auxiliary feedwater flow/SG1 level and auxiliary feedwater flow/SG2 level are manual stations required to control auxiliary feedwater flow/SG level after the activation of diverse AFAS-1 and AFAS-2.

Each signal of the DMA switches actuates necessary ESF systems to perform the ESF functions. The functions of the DMA switches are enabled by the DMA enable switch on the safety console. The DMA switches block diagram is shown in Figure 7.8-6.

7.8.1.3 Diverse Indication System

The DIS provides functions to monitor critical variables following a postulated software CCF of safety I&C systems. Because the DIS receives its hardwired signal inputs from isolation devices in the auxiliary process cabinet-safety (APC-S) as well as in qualified indication and alarm system – P (QIAS-P), the DIS is independent from the APC-S and QIAS-P. The DIS is diverse from the QIAS-P.

The DIS provides control functions of heater power for the proper heated junction thermocouple (HJTC) output signal level to assist the mitigation of the effects of a postulated software CCF of the QIAS-P. The control function is manually transferred from the QIAS-P to the DIS by the DIS manual transfer switch.

Table 7.8-4 (2 of 2)

No	Parameter Description
27	SI Flow to DVI 1A
28	SI Flow to DVI 2B
29	CS Pump 1 Flow
30	Charging Line Flow
31	AFW Flow Rate to S/G 1
32	AFW Flow Rate to S/G 2
33	AFWST A Level
34	AFWST B Level
35	Auxiliary Building Sump Level
36	SIT 1 Pressure (WR)
37	Containment Air Radiation (Iodine)
38	HJTC Heater Power

New Table is added on the next page of DCD Tier 2.

"New Table"

Table 7.8-5 (1 of 2)

Safe State of ESF Components for State-Based Priority

Train (Division)	Component	Related Signal	State
A (A1)	SIP 1 Isolation Valve	SIAS	Open
	SIT 1 Isolation Valve	SIAS	Open
	SIT Fill and Drain Line Isolation Valve	SIAS	Close
	Check Valve Leakage Line Isolation Valve	SIAS	Close
	Letdown Isolation Valve	SIAS	Close
	SI Pump #1	SIAS	Start Run
C (A2)	SIP 3 Isolation Valve	SIAS	Open
	SIT 3 Isolation Valve	SIAS	Open
	SIT Fill and Drain Line Isolation Valve	SIAS	Close
	Check Valve Leakage Line Isolation Valve	SIAS	Close
	SI Pump #3	SIAS	Start Run
B (B1)	SIP 2 Isolation Valve	SIAS	Open
	SIT 2 Isolation Valve	SIAS	Open
	SIT Fill and Drain Line Isolation Valve	SIAS	Close
	Check Valve Leakage Line Isolation Valve	SIAS	Close
	SIT Fill Line Isolation Valve	SIAS	Close
	Letdown Isolation Valve	SIAS	Close
	SI Pump #2	SIAS	Start Run
D (B2)	SIP 4 Isolation Valve	SIAS	Open
	SIT 4 Isolation Valve	SIAS	Open
	SIT Fill and Drain Line Isolation Valve	SIAS	Close
	Check Valve Leakage Line Isolation Valve	SIAS	Close
	SI Pump #4	SIAS	Start Run

"New Table"

Table 7.8-5 (2 of 2)

Train (Division)	Component	Related Signal	State
A (A1)	SG Blowdown Containment Isolation Valve	AFAS	Close
	AFW Pump Turbine Steam Supply Valve	AFAS	Open
	AFW Pump (Motor Driven) #1	AFAS	Start Run
	AFW Modulating Valve	AFAS	Permit Modulation
	AFW Isolation Valve	AFAS	Open
C (A2)	Steam Supply Isolation Valve	AFAS	Open
	AFW Isolation Valve	AFAS	Open
B (B1)	SG Blowdown Containment Isolation Valve	AFAS	Close
	AFW Pump Turbine Steam Supply Valve	AFAS	Open
	AFW Pump (Motor Driven) #2	AFAS	Start Run
	AFW Modulating Valve	AFAS	Permit Modulation
	AFW Isolation Valve	AFAS	Open
D (Be)	Steam Supply Isolation Valve	AFAS	Open
	AFW Isolation Valve	AFAS	Open