REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

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Review Section:	**07.08 – Diverse Instrumentation and Control Systems**
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Question No. 07.08-10

Clarify that the ATWS mitigation logic and DAS is designed such that, once initiated, the mitigation function will go to completion.

10 CFR Part 50.62, “Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants,” require- ment (c)(1) states, “Each pressurized water reactor must have equipment from sensor output to final actuation device, that is diverse from the reactor trip system, to automatically initiate the auxiliary (or emergency) feedwater system and initiate a turbine trip under conditions indicative of an ATWS.

This equipment must be designed to perform its function in a reliable manner and be independent (from sensor output to the final actuation device) from the existing reactor trip system.” Item II.Q of the SRM to SECY-93-087, Position 3, states, “If a postulated common mode failure could disable a safety function, then a diverse means, with a documented basis that the diverse means is unlikely to be subject to the same common-mode failure, shall be required to perform either the same function or a different function. The diverse or different function may be performed by a non-safety system if the system is of sufficient quality to perform the necessary function under the associated event conditions.”

Clarify whether the ATWS mitigation logic and DAS is designed such that, once initiated, the mitigation functions will go to completion. Update the FSAR documents and/or technical reports accordingly.

Clarify whether the ATWS mitigation logic and DAS is designed such that, once initiated, the mitigation functions will go to completion. Update the FSAR documents and/or technical reports accordingly.

Response – (Rev. 1)

The diverse actuation system (DAS) consists of the diverse protection system (DPS), the diverse indication system (DIS), and the diverse manual engineered safety features (ESF) actuation system (DMA).

The DPS provides the anticipated transient without scram (ATWS) mitigation functions required by 10 CFR Part 50.62 for the reduction of risk from ATWS events. In addition, the DPS is designed to meet the requirements Item II.Q of the SRM on SECY-93-087 to assist in mitigation of the effects of a postulated software common cause failure (CCF) of the digital computer logic within the plant protective system (PPS) and ESF component control system (ESF-CCS).

Section 5.1 of APR1400-Z-J-NR-14002-P, "Diversity and Defense in Depth," will be revised to include the following explanations:

> "Once the diverse reactor trip signals are initiated automatically from the DPS cabinet, the diverse reactor trip function is completed by the actuation of shunt trip devices of reactor trip circuit breakers. The diverse reactor trip is completed when the reactor trip circuit breakers open. Deliberate operator action (i.e., reset of reactor trip circuit breakers) is required to clear the diverse reactor trip and close the reactor trip circuit breakers."

The cycling AFAS has been used to refer to the repeated open/close actuations of the AFWS valves initiated by the DPS-AFAS. The setting and resetting of the DPS-AFAS repeats according to the changes of SG water level during plant transients.

> "A DPS-AFAS occurs when the water level in a SG drops below the DPS-AFAS setpoint, and is reset when the SG water level is recovered to the reset setpoint. The setting and resetting of the DPS-AFAS repeats according to the changes of SG water level during plant transients."

> "Once the DPS-SIAS is automatically initiated from the DPS, it is maintained until operator resets it. The DPS-SIAS can be reset when the pressurizer pressure is increased above its setpoint."

The DMA switches are designed to permit the operator to actuate ESF systems in a timely manner from the MCR after a postulated CCF of the PPS and ESF-CCS. The DMA switches are normally disabled. The functions of the DMA switches could become enabled only by the actuation of the DMA enable switch.

The DMA switches provide ESF actuation as required by Item II.Q of the SRM on SECY-93-087, Position 4, and are listed in Appendix C of the D3 TeR.

Section 5.3 of the D3 TeR (APR1400-Z-J-NR-14002-P) will be revised to include the following explanations:

“The DMA switches send latch signals to the component interface module (CIM). Therefore, the ESF actuation initiated by the DMA switch continues until completion once initiated. These latch signals will be reset manually when the mitigation function is completed.”

Based on above descriptions, the DAS including the DPS and DMA switches is designed such that, once initiated, the mitigation function continues until completion.

Impact on DCD

There is no impact on the DCD.

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

Sections 5.1 and 5.3 of the D3 TeR, APR1400-Z-J-NR-14002, will be revised as indicated in the attachment associated with this response.

5 DIVERSE ACTUATION SYSTEM

The DAS consists of the DPS, DIS, and the DMA switches. Each subsystem is described in the following subsections. The DAS is implemented on a platform that is diverse from the common safety PLC platform. The DAS is designed to meet the quality assurance guidance of Generic Letter 85-06. Any software associated with the DAS is qualified as ITS.

5.1 Diverse Protection System

The DPS is designed to mitigate the effects of an ATWS event characterized by an AOO concurrent

Once the diverse reactor trip signals are initiated automatically from the DPS cabinet, the diverse reactor trip function is completed by the actuation of shunt trip devices of reactor trip circuit breakers. The diverse reactor trip is completed when the reactor trip circuit breakers open. Deliberate operator action (i.e., reset of reactor trip circuit breakers) is required to clear the diverse reactor trip and close the reactor trip circuit breakers.

RPCS is out of service.

The DPS is designed to transmit reactor trip signals to total eight shunt trip devices of the RTSS-1 and RTSS-2 reactor trip breakers. The PPS transmits reactor trip signals to total eight undervoltage trip devices of the RTSS-1 and RTSS-2 reactor trip circuit breakers. Four trip circuit breakers of RTSS-1 are diverse from four trip circuit breakers of RTSS-2. This arrangement ensures the capability of the DPS to interrupt power to the control element drive mechanisms (CEDMs) regardless of the PPS failure to trip the reactor.

The DPS is implemented with a 2-out-of-4 voting logic to ensure a single failure within the DPS does not (a) cause a spurious actuation, and (b) preclude an actuation. The BP provides a channel trip signal to the LCL processor located in t
the local coincidence logic trip state an
the state of the four trip signals.

A DPS-AFAS occurs when the water level in a SG drops below the DPS-AFAS setpoint, and is reset when the SG water level is recovered to the reset setpoint. The setting and resetting of the DPS-AFAS repeats according to the changes of SG water level during plant transients.

The DPS actuates the auxiliary feedwa
steam generator when the level decrea
actuation signals (AFAS) generated ind
CIM, so that either system actuates the AFWS. Isolation is provided at the ESF-CCS loop controller (LC) cabinet to maintain electrical isolation between the DPS and the CIM.

The DPS also actuates the safety injection system (SIS) on low pressurizer pressure when the pressure decreases below a predetermined value. The safety injection actuation signals (SIAS) generated independently by the DPS and the ESF-CCS are prioritized in the CIM, so that either system actuates the safety injection of reactor coolant. Isolation is provided at the ESF-CCS LC cabinet to maintain electrical isolation between the DPS and the CIM.

The DPS also automatically initiates a turbine trip whenever the DPS reactor trip conditions have been met. The DPS turbine trip signal is generated with three seconds of time delay after the initiation of DPS reactor trip signal.

The AFWS actuation initiated by DPS-AFAS has a cycling mechanism (or simply 'cycling AFAS' hereafter). The cycling AFAS is designed to cycle based on the steam generator (SG) level signals. The actuation of AFWS valves are cycled (i.e., not locked) by the cycling AFAS from the DPS. However, the actuation of AFWS pumps are not cycled (i.e., actuated continuously) once initiated by the DPS-AFAS. When the low SG level trip signals clear, the cycling AFAS is cleared until the SG level drops to the AFAS trip setpoint again.

Once the DPS-SIAS is initiated automatically, it is maintained until operator resets it. The DPS-SIAS can be reset when the pressurizer pressure is increased above its setpoint.

- DMA auxiliary feedwater actuation signal-1 (AFAS-1) switch - Division A
- DMA auxiliary feedwater actuation signal-2 (AFAS-2) switch - Division B

The DMA signals are hardwired directly to the CIM through the isolators. The CIMs interface directly with plant components through the component control circuitry. The CIMs receive component control signals from the ESF-CCS, DPS, and DMA switches.

The DMA switches also provide component-level manual stations to modulate control systems as follows:

- DMA auxiliary feedwater flow/steam generator 1 level manual station - Division A
- DMA auxiliary feedwater flow/steam generator 2 level manual station - Division B

The component-level manual stations of the DMA switches are only enabled when each DMA AFAS is activated in the same division. The component-level manual stations provide manual analog control and indication of auxiliary feedwater flow and steam generator level. The component-level manual stations are directly hardwired to the designated components.

The DMA switches send latch signals to the component interface module (CIM). Therefore, the ESF actuation initiated by the DMA switch continues until completion once initiated. These latch signals will be reset manually when the mitigation function is completed.