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.: **43-7887**

SRP Section: Section **07.01 - Instrumentation and Controls - Introduction**

Application Section: **7.1**

Date of RAI Issue: **06/22/2015**

Question No. 07.01-21

Identify and describe auxiliary features in the APR1400 design in order to demonstrate compliance to IEEE Std. 603-1991, Clause 5.12. Specifically, describe how auxiliary features within the protection system will not adversely impact safety functions. In addition, provide a comprehensive list of all safety related auxiliary supporting features.

10 CFR 50.55a(h)(3) requires compliance to IEEE Std. 603-1991. IEEE Std. 603-1991, Clause 5.12, "Auxiliary Features," states that (1) auxiliary supporting features shall meet all requirements of this standard, and (2) other auxiliary features that perform a function that is not required for the safety systems to accomplish their safety functions, and are part of the safety system by association, shall be designed to meet those criteria necessary to ensure that these components, equipment, and systems do not degrade the safety systems below an acceptable level. APR1400 FSAR Tier 2, Section 7.1.1.10, "Auxiliary Support Features" states that auxiliary supporting features and other auxiliary features are safety systems or components of systems that provide the services that are required for the safety systems to accomplish their safety functions. HVAC and electrical power systems are examples of auxiliary supporting features. The I&C aspects of auxiliary supporting features are described primarily in Chapters 8 and 9. Examples of other auxiliary features are built-in test equipment and isolation devices. Section A.5.12, "Auxiliary Features," of Technical Report APR1400-Z-J-NR-14001-P, Rev. 0, "Safety I&C System" states that any features (components, equipment and systems) of the safety I&C system that perform safety functions satisfy the Clause 5.12 requirements of IEEE Std. 603-1991. All of these features are designated as safety-related and are part of the safety I&C system. The communication architecture provides the ability to transmit information to non-safety related devices and is classified as safety-related until the non-safety boundary. Auxiliary features (bypass, control element assembly withdrawal prohibit (CWP) signal, test, and calibration functions) are designed not to affect the protection system from accomplishing their safety functions.

The staff finds that additional information is required regarding the auxiliary features that are designed to not affect the protection system from accomplishing their safety function. Specifically, the staff requests the applicant to identify and describe how the auxiliary features (bypass, CWP signal, test, and calibration functions) within the protection system do not affect the protection system from accomplishing their safety functions. In addition, the application states that the HVAC and electrical power systems, built-in test equipment, and isolation devices are examples of safety-related auxiliary support systems. The staff requests the applicant to provide a comprehensive list of all safety-related auxiliary supporting features in the APR1400 design in order to meet the requirements of IEEE Std. 603-1991, Clause 5.12.

Response

Identify and describe how the auxiliary features (bypass, CWP signal, test, and calibration functions) within the protection system do not affect the protection system from accomplishing their safety functions

The other auxiliary features of the plant protection system (PPS) meet the requirements of IEEE Std. 603, IEEE Std. 384, NRC RG 1.75, and DI&C-ISG-04. Operation of other auxiliary features requires the use of a function enable (FE) key switch, which is controlled by administrative procedures to prevent loss of protection functions.

- **Setpoint Change**

As described in Section 7.2.1.2 of DCD Tier 2, the setpoint for bistable logic is adjustable from the maintenance and test panel (MTP). The setpoint change can be applied only if the FE key switch is enabled. Also, the setpoint change is restricted by a cabinet door open alarm, door keylock, and administrative procedure.

As described in Section 4.2.3.4 of the Safety I&C System Technical Report, both setpoint change and testing require the FE key switch on the MTP switch panel to be enabled. The safety-critical class software (for bistable logic and local coincidence logic) performs a logical block on incoming setpoint data and testing signals based on the FE key switch signal. The logical block is implemented as an AND gate for the incoming data and the FE key switch signal.

To perform a setpoint change, which is not required during normal operation, the safety division shall be placed in a bypass state. After applying the setpoint change, the functional test is performed to ensure that the intended setpoint change is applied. This ensures that the setpoint change does not affect the protection system from accomplishing the intended safety functions.

- **Testing**

As described in Section 7.2.1.7 of DCD Tier 2, administrative controls are placed on the testing function of the PPS to ensure only one of four safety divisions can be tested at a time. Before testing can occur, the FE key switch must be enabled and the channel to be tested must be placed in bypass. The FE key switch enables both the bypass and the testing functions. Likewise, initiation circuit testing is restricted to one safety division at a time by

administrative procedures to ensure that the testing function does not affect the protection system from accomplishing the intended safety functions.

■ **Bypass**

As described in Section 7.2.1.7 of DCD Tier 2, bypassing the same parameter in more than one division is restricted by administrative procedures to ensure that the bypass does not affect the protection system from accomplishing the intended safety functions.

■ **CWP**

As described in Section A.6.3 of the Safety I&C System Technical Report, low DNBR, high LPD, and high pressurizer pressure pre-trip provide a CWP, which is treated as an associated circuit. As an associated circuit, it meets the requirements of IEEE Std. 603-1991 so that it cannot affect the protection system from accomplishing the intended safety functions.

■ **Calibration**

As described in Section A.5.7 of the Safety I&C System Technical Report, the channel calibrations are performed during refueling outages when the PPS is not required to be operable. Calibration and testing is performed according to plant specific approved procedures that establish specific surveillance techniques and surveillance intervals intended to maintain high reliability.

■ **Electrical Isolation**

As described in Section 7.2.2.3 of DCD Tier 2, the PPS and non-safety systems are isolated using qualified isolation devices or fiber-optic cables so that any failure in a non-safety system does not cause loss of the safety system function.

■ **Independence**

The PPS includes other auxiliary features beside the reactor trip function and ESF initiation function. The other auxiliary features conform to the independence requirements described in Section A.5.6 of the Safety I&C System Technical Report.

Provide a comprehensive list of all safety-related auxiliary supporting features

The auxiliary supporting features and other auxiliary features are listed as follows:

■ **Auxiliary Supporting Features**

- Electric power supply system for the reactor protection system and engineered safety features systems
- I&C portions of the component cooling water system, essential service water system, and ultimate heat sink
- I&C portions of safety-related heating, ventilation, and air conditioning systems

■ **Other Auxiliary Features**

- Equipment protection devices (monitoring for door open and cabinet high temperature)
- Operating bypass, trip channel bypass
- Setpoint reset/change function

- Built-in test functions
- Diagnostic functions
- Trip, pre-trip, sequence of events, and status indications/alarms
- Qualified isolators to interface with non-safety systems
- Emergency diesel generator support systems
  - Emergency diesel engine fuel oil system
  - Emergency diesel engine cooling water system
  - Emergency diesel engine starting air system
  - Emergency diesel engine lubrication system
  - Emergency diesel engine combustion air intake and exhaust system

Supplemental Response

The plant protection system (PPS) receives the core protection calculator – CEA (control element assembly) withdrawal prohibit (CPC-CWP) signal as a contact signal from the core protection calculator system (CPCS) to generate the CWP initiation signal at the bistable processing stage. The bistable CWP initiation signal is then sent to the local coincidence logic (LCL) processors within the PPS in division D for 2-out-of-4 coincidence logic processing in order to generate and transmit the final CWP initiation output to the digital rod control system (DRCS) remote I/O cabinet in division D. Although the PPS generates the CWP output within equipment classified as Class 1E, the function of the CWP itself is non-safety and is transmitted to the DRCS remote I/O cabinet so that the final non-safety CWP action is accomplished through that cabinet. Also, the isolation for the CWP initiation output signal being transmitted from the PPS cabinet to the DRCS remote I/O cabinet is accomplished through an isolation device located in the DRCS remote I/O cabinet in division D.

DCD Tier 2 Table 3.11-2 specifies the DRCS remote I/O cabinets in divisions C and D to be associated circuits. Additionally, DCD Tier 2, Table 3.2-1 specifies that the equipment, components, or systems (including the DRCS remote I/O cabinet) defined as associated circuits (though they are functionally Non-Nuclear Safety) are subject to the qualification requirements placed on Class 1E equipment, components, or systems.

The safety-related auxiliary supporting features comprehensively listed in the original response to this RAI will be added in Section A.5.12 of the Safety I&C System technical report.

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

Section A.5.12 of the Safety I&C System technical report will be revised to include the safety-related auxiliary supporting features as indicated in the attachment associated with this response.

All equipment, including panels, modules, and cables associated with the RPS and ESF systems, are marked in order to facilitate identification. The safety I&C system is configured in accordance with specific identification requirements which provide a standardized method for identifying equipment, diagrams and signals for the purpose of consistency during the installation process. Interconnecting cabling is color-coded.

The physical identification is provided so that an operator can confirm if the safety I&C system cabinets and related cable are the safety class. The safety I&C system cabinets are distinguished by name plates. The safety I&C system components are uniquely identified by designations per project procedures and as defined in contract specifications. The physically isolated cable from sensor to actuation devices is identified by different colors between divisions.

The identification of software is assured by identification provisions as discussed in the SPM TeR.

A.5.12 Auxiliary Features

Clause 5.12:

"5.12.1 Auxiliary supporting features shall meet all requirements of this standard.

5.12.2 Other auxiliary features that (1) perform a function that is not required for the safety systems to accomplish their safety functions, and (2) are part of the safety systems by association (that is, not isolated from the safety system) shall be designed to meet those criteria necessary to ensure that these components, equipment, and systems do not degrade the safety systems below an acceptable level. Examples of these other auxiliary features are shown in Figure 3 and an illustration of the application of this criterion is contained in Appendix A."

Analysis:

Any features (components, equipment and systems) of the safety I&C system that perform safety functions satisfy the Clause 5.12 requirements of IEEE Std. 603-1991. All of these features are designated as safety-related and are part of the safety I&C system. The Communication architecture provides the ability to transmit information to non-safety related devices and is classified as safety-related until the non-safety boundary.

Auxiliary features (bypass, CWP signal, test, and calibration functions) are designed not to affect the protection system from accomplishing their safety functions.

A.5.13 Multi-Unit Stations

Insert the list shown on the next page.

Clause 5.13:

"The sharing of structures, systems, and components between units at multi-unit generating stations is permissible provided that the ability to simultaneously perform required safety functions in all units is not impaired. Guidance on the sharing of electrical power systems between units is contained in IEEE Std. 308-1980. Guidance on the application of the single failure criterion to shared systems is contained in IEEE Std. 379-1988."

Analysis:

This requirement is not applicable as there is no planned sharing between units.

The list of the auxiliary features is as follows:

Auxiliary Supporting Features

(1) Electric power supply system for the reactor protection system and engineered safety features systems
(2) I&C portions of the component cooling water system, essential service water system, and ultimate heat sink
(3) I&C portions of safety-related heating, ventilation, and air conditioning systems

Other Auxiliary Features

(1) Equipment protection devices (monitoring for door open and cabinet high temperature)
(2) Operating bypass, trip channel bypass
(3) Setpoint reset/change function
(4) Built-in test functions
(5) Diagnostic functions
(6) Trip, pre-trip, sequence of events, and status indications/alarms
(7) Qualified isolators to interface with non-safety systems
(8) Emergency diesel generator support systems
- Emergency diesel engine fuel oil system
- Emergency diesel engine cooling water system
- Emergency diesel engine starting air system
- Emergency diesel engine lubrication system
- Emergency diesel engine combustion air intake and exhaust system