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.:	**522-8633**
SRP Section:	**07.07 – Control Systems**
Application Section:	**7.7**
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Question No. 07.07-19

10 CFR 50.55a(h)(3) requires compliance to IEEE Std. 603-1991. IEEE Std. 603-1991, Clause 5.6, in part, requires independence: (1) between redundant portions of a safety system; (2) between safety systems and the effects of design basis events; and, (3) between safety systems and other systems. The design function of the remote control console (RCC) is to provide the necessary controls and displays for the operator to achieve hot shutdown if an aircraft impact causes control failures in both the main control room (MCR) and the remote shutdown room (RSR). The RCC will need access to the control of various safety and non-safety related components to achieve this design function. The RCC will have direct interconnections to safety-related I&C functions and components in order to achieve hot shutdown functionality. The applicant's response to RAI 356-7881, Question 07-05 did not provide sufficient detail on how controls and displays in the RCC meet relevant safety I&C criteria.

1. For the newly added Figure 7.7-14, I&C System Architecture for the RCC Panel," identify the safety class of each component or panel. It is not clear what portions of the network configuration and component shown are safety class and which parts are not (specifically the safety class of the ESCMs on the RCC panel). The applicant used color coding on other network drawings such as Figure 7.1-1, "APR1400 I&C System Overview Architecture," in DCD FSAR Tier 2, Section 7.1 to denote safety class.

2. Demonstrate how the RCC meets Independence requirements (IEEE Std. 603-1991 Clause 5.6) for both redundant portions of the safety systems and between safety and non-safety systems.

3. In its response, the applicant only refers to a single panel within the RCC. The exact physical configuration of the controls and displays remains unclear to the staff. Clarify whether the RCC provides all controls and displays on a single panel or on multiple panels.

4. Are there any dedicated I&C equipment cabinets for the RCC? If so, describe how these cabinets are designed to meet applicable safety requirements such as environmental protections (e.g. cooling fans, temperature monitoring)?

5. Verify that the I&C equipment cabinets dedicated to the RCC are located in an area such that they will not be affected by an aircraft event that would affect the MCR and the RSR.

6. For Figure 7.7-14, Independence requirements are not clearly addressed for the RCC safety and non-safety systems. Describe on Figure 7.7-14 how isolation and separation for redundant portions of the safety systems and between safety and non-safety systems are implemented to address IEEE Std. 603-1991 Clause 5.6.

7. Provide an ITAAC for the RCC that verifies design information provided within the applicant's previous response to RAI 356-7881, Question 07-05 as well as all other subsequent RAI responses.

Response

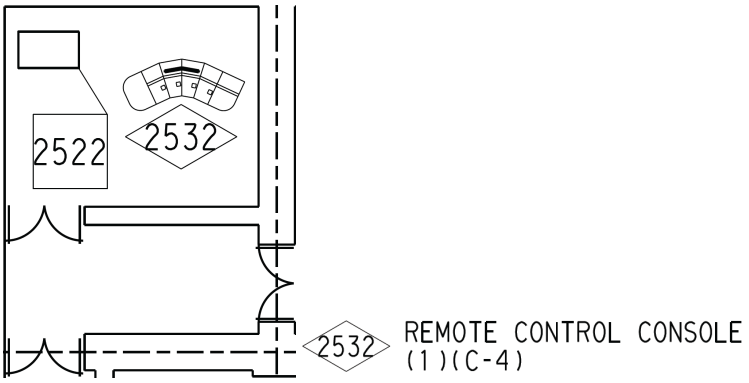
1. The response to RAI 356-7881 Question 07-5 was subsequently revised to Rev. 2 and revised Figure 7.7-14 to identify the class of each component or panel, safety or non-safety, including the ESCMs on the RCC panel. (refer to KHNP submittal MKD/NW-16-0651L Attachment (10/13) dated October 24, 2016; ML16298A377)

2. The RCC consists of four channelized ESCMs and a dedicated control channel gateway (CCG) for safety systems. The RCC contains non-safety manual switches and a dedicated P-CCS loop controller (LC) to control and monitor non-safety components. As described in the revised Figure 7.7-14 provided previously, a communication interface does not exist between the safety system and the non-safety system. The non-safety manual switches on the RCC and P-CCS LC are physically separated and electrically isolated from the ESCMs and the CCGs on the RCC.

   The MCR/RCC transfer switches consist of four safety division switches (A, B, C, and D) and one non-safety switch. These switches are physically separated and electrically isolated from each other.

   Therefore, the redundant portions of the safety system are also physically and electrically isolated to meet the independence requirements of IEEE Std. 603-1991, Clause 5.6.

3. The RCC accommodates MCR evacuation due to damage in the MCR. The RCC provides controls and displays needed for achieving hot shutdown of the plant, located on a single panel. The design of the ESCM in the RCC has the same shape as the ESCM in the MCR. The RCC is a sit-down console which includes four ESCMs, hardwired type P-CCS components switches, hardwired type indicators, voice communications and laydown space. The RCC arrangement is shown as follows:



4. There are no dedicated ESF-CCS LC cabinets for the RCC in the APR1400. The ESF-CCS cabinets which contain the component control logics for hot shutdown are connected with the ESCM for the RCC via the CCG, as well as the ESCM for the MCR/RSR, via a dedicated CCG. The control command signals from both the ESCM for the MCR/RSR and the ESCM for the RCC are inputs into the voting logic in the ESF-CCS LC.

5. As specified above, the APR1400 does not have dedicated ESF-CCS LC cabinets for the RCC; some ESF-CCS LC cabinets are shared by the ESCM for the MCR/RSR and the RCC through the SDN. These ESF-CCS LC cabinets are distributed in the remote multiplexer rooms in the plant which have component control logic to achieve plant hot shutdown. The cabinets will be installed in opposite locations or different elevations from the MCR and RSR, so that the loss of functionality of the MCR/RSR by an aircraft event cannot adversely affect the operability of the RCC.

6. Like the response to 1 above, the revised Figure 7.7-14 provided in RAI 356-7881 Question 07-5 Rev. 2 shows how isolation and separation for redundant portions of the safety systems and between safety and non-safety systems are implemented to address IEEE Std. 603-1991 Clause 5.6.

7. The MCR/RCC transfer switches and transfer control function of the ESF-CCS are verified as described in DCD Tier 1, Table 2.5.4-4, Item 8. (Refer to the response to RAI 356-7881, Question 07-5, Rev. 2, Attachment (3/13))

   The test for the MCR/RCC transfer switches and transfer control function of the P-CCS will be added to DCD Tier 1, Table 2.5.5-2, Item 3, as indicated in the attachment associated with this response.

   The ESCMs in the RCC are verified to meet independence, physical separation, and EMI/RFI requirements as described in DCD Tier 1, Table 2.5.4-1, Items 2 and 16.

Impact on DCD

DCD Tier 1 Section 2.5.5.1, and Table 2.5.5-2 will be revised as indicated 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.

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2.5.5 Control System Not Required for Safety

2.5.5.1 Design Description

Control system which is not required for safety consists of power control system (PCS) and process-component control system (P-CCS).

The PCS includes the reactor regulating system (RRS), the digital rod control system (DRCS), and the reactor power cutback system (RPCS). The P-CCS includes nuclear steam sypply system (NSSS) process control system (NPCS) and balance of plant (BOP) control systems. The NPCS consists of the feedwater control system (FWCS), the steam bypass control system (SBCS), the pressurizer pressure control system (PPCS), the pressurizer level control system (PLCS), and other miscellaneous NSSS control systems which include reactor makeup control function of the chemical and volume control system (CVCS).

The PCS and P-CCS provide control of functions to maintain the plant within its normal operating range for all normal modes of plant operation.

Control and display interface devices for the PCS and P-CCS are provided in the main control room (MCR) and in the remote shutdown room (RSR) for control and monitoring of the PCS and P-CCS.

1. The major controllers of the PCS and NPCS are arranged in separate controller groups as identified in Table 2.5.5-1.

2. The digital equipment and software used in the PCS and P-CCS are independent from those of the plant protection system (PPS) and the engineered safety features-component control system (ESF-CCS).

3. The PCS and P-CCS are controlled from either the MCR or RSR, as selected from master transfer switches.

   or either the MCR or RCC

   MCR/RSR or MCR/RCC

2.5.5.2 Inspection, Test, Analyses, and Acceptance Criteria

The inspections, tests, analyses, and associated acceptance criteria for the PCS and P-CCS are specified in Table 2.5.5-2..

Table 2.5.5-2

Control System Not Required for Safety ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The major controllers of PCS and NPCS are arranged in separate controller groups as identified in Table 2.5.5-1.	1. Inspection of the as-built PCS and NPCS will be performed.	1. The as-built PCS and NPCS are arranged in separate controller groups as identified in Table 2.5.5-1.
2. The digital equipment and software used in the PCS and P-CCS are independent from those of the plant protection system (PPS) and the engineered safety features-component control system (ESF-CCS).	2. Inspection of the as-built PCS and P-CCS equipment will be performed. Inspection of the design documentation will be performed to confirm that the software is developed by independent design groups.	2. The as-built digital equipment and software used in the PCS and P-CCS are independent from those of the PPS and ESF-CCS based on: • PCS and P-CCS use a platform which is independent from the platform used in the PPS and ESF-CCS and • The design group(s) which developed the PCS and P-CCS software is independent from the design group(s) which developed the PPS and ESF-CCS software.
3. The PCS and P-CCS are controlled from either the MCR or RSR, as selected from MCR/RSR master transfer switches.	3. A test of the as-built ~~system~~ PCS and P-CCS will be performed to demonstrate the transfer ~~of~~ function control ~~capability~~ and between the MCR and ~~RSR~~ and between the MCR and RCC.	3. The as-built ~~MCR/RSR~~ and between the MCR and RCC master transfer switches transfer controls between the MCR and ~~the~~ or MCR/RCC RSR or either the MCR or RCC for as-built PCS and P-CCS, as follows: • Controls at the RSR are disabled when controls are active in the MCR ~~for the as-built PCS and P-CCS.~~ and the MCR controls the PCS and P-CCS. • Controls at the MCR are disabled when controls are active in the RSR ~~for the as-built PCS and P-CCS.~~ and the RSR controls the PCS and P-CCS. • Controls at the RCC are disabled when controls are active in the MCR and the MCR controls the PCS and P-CCS. • Controls at the MCR are disabled when controls are active in the RCC and the RCC controls the PCS and P-CCS.