

## 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.: 348-8279  
SRP Section: 07.09 - Data Communication Systems  
Application Section: 07.09  
Date of RAI Issue: 12/24/2015

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### **Question No. 07.09-18**

Discuss how the CPP and CEAC/ CPP interdivisional communications support or enhance the performance of the safety functions.

10 CFR 50.55a(h) requires compliance to IEEE Std 603-1991. IEEE Std 603-1991, Clause 5.6.1, states, in part, "Redundant portions of a safety system provided for a safety function shall be independent of and physically separated from each other to the degree necessary to retain the capability to accomplish the safety function during and following any design basis event requiring that safety function," and Clause 5.6.3, states, in part, "The safety system design shall be such that credible failures in and consequential actions by other systems, as documented in 4.8 of the design basis, shall not prevent the safety systems from meeting the requirements of this standard." DI&C-ISG-04 provides guidance for meeting the communications independence requirements of IEEE Std. 603-1991, Clause 5.6.

DI&C ISG-04, Section 1, Position 3, states, in part, "A safety channel should not receive any communication from outside its own safety division unless that communication supports or enhances the performance of the safety function." It is not clear to the staff how the CPP and CEAC/ CPP interdivisional communication as described in Section C.5.1.3 of Technical Report, APR1400-Z-J-NR-14001-P, meets DI&C ISG-04, Section 1, Position 3. Specifically, how do the described CPCS interdivisional communications support or enhance the performance of the safety functions? The staff requests the applicant to address this portion of DI&C ISG-04 and update the FSAR and/or technical reports accordingly.

### **Response**

To meet the requirements of IEEE Std. 603, Clause 5.6.1, ideally there would be four reed switch position transmitters (RSPTs) measuring each control element assembly (CEA)

position independently for each core protection calculator system (CPCS) channel. This would allow each CPCS channel to independently calculate penalty factors (PFs) based on its own unique sensor data. However, due to physical space limitations on the CEA itself and in the reactor head area, including the necessary space for channel physical independence, there are only two RSPTs for each CEA. These are designated as RSPT1 and RSPT2.

Nevertheless, as described in Section C.5.1.3 of technical report, APR1400-Z-J-NR-14001-P, the departure from nucleate boiling ratio (DNBR) and local power density (LPD) calculations are compensated to account for any deviations between the positions of the four CEAs within each subgroup. To detect CEA position deviations within each subgroup, and thereby generate PFs, it is essential that each CPCS channel monitor the positions of all CEAs through interdivisional communication.

#### CPCS Design to meet Single Failure Criteria (SFC)

To comply with the SFC, the two RSPTs on a CEA are assigned to separate safety channels, and both signals are interfaced to their respective CPCS channels prior to distribution to all CPCS channels via cross-channel serial data link (SDL). Although there are only two RSPT channels per CEA, the 186 RSPTs (two each per 93 CEAs) are distributed among all four CPCS channels.

Within each CPCS channel there are two separate PF calculations, one based on CEA positions only from RSPT1, and the other based on CEA positions only from RSPT2. These PF calculations are performed by CEA Calculator 1 (CEAC1) and CEA Calculator 2 (CEAC2), respectively, within each CPCS channel. The PFs from each of the two CEACs are transmitted to the CPC within the same channel. Each CPC then uses the more conservative of the two PFs in its final DNBR and LPD calculations.

#### Enhancement of the safety functions

The DNBR and LPD reactor trip functions are credited for anticipated operational occurrences (AOO) and postulated accidents (PA) in the APR1400 safety analysis.

Because of their location around the periphery of the core, excore neutron detectors are most sensitive to the fuel assemblies at the periphery of the core which are typically not the limiting locations relative to protecting fuel safety limits. Radial flux distribution is a function of CEA position. Each CPCS channel corrects the output of its excore detectors for changes in power distribution due to CEA insertion. For example, deeply inserted CEAs in the center of the core force power to the peripheral fuel assemblies, while CEAs inserted at the core periphery have the opposite effect. Without direct CEA position monitoring, uncertainties and assumptions must be factored into the excore detector measurements to relate the indirect measurements to the calculated real conditions in fuel assemblies closer to the center of the core.

The CPCS has 23 CEA subgroups, each consisting of four CEAs symmetrically distributed to the four quadrants of the reactor core (A, B, C or D). The twenty-third subgroup consists of 4 CEAs distributed to the four quadrants of the reactor core and CEA number 1 which is located at the center of the core. All CEAs in each subgroup normally move concurrently to maintain an even radial power distribution. However, in reality CEAs occasionally experience stepping

malfunctions that result in deviations between the positions of the CEAs within the same subgroup. These deviations are an important component of the DNBR and LPD calculations because differences in CEA positions within the same subgroup can skew the normally symmetrical power distribution within the core.

Therefore, CEA position monitoring is necessary to achieve accurate DNBR and LPD calculations.

### **Supplemental Response**

Additional information discussed in the response regarding the enhanced safety functions using interdivisional communication to share RSPT 1 and 2 is incorporated into the Safety I&C System technical report.

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#### **Impact on DCD**

There is no impact on the DCD.

#### **Impact on PRA**

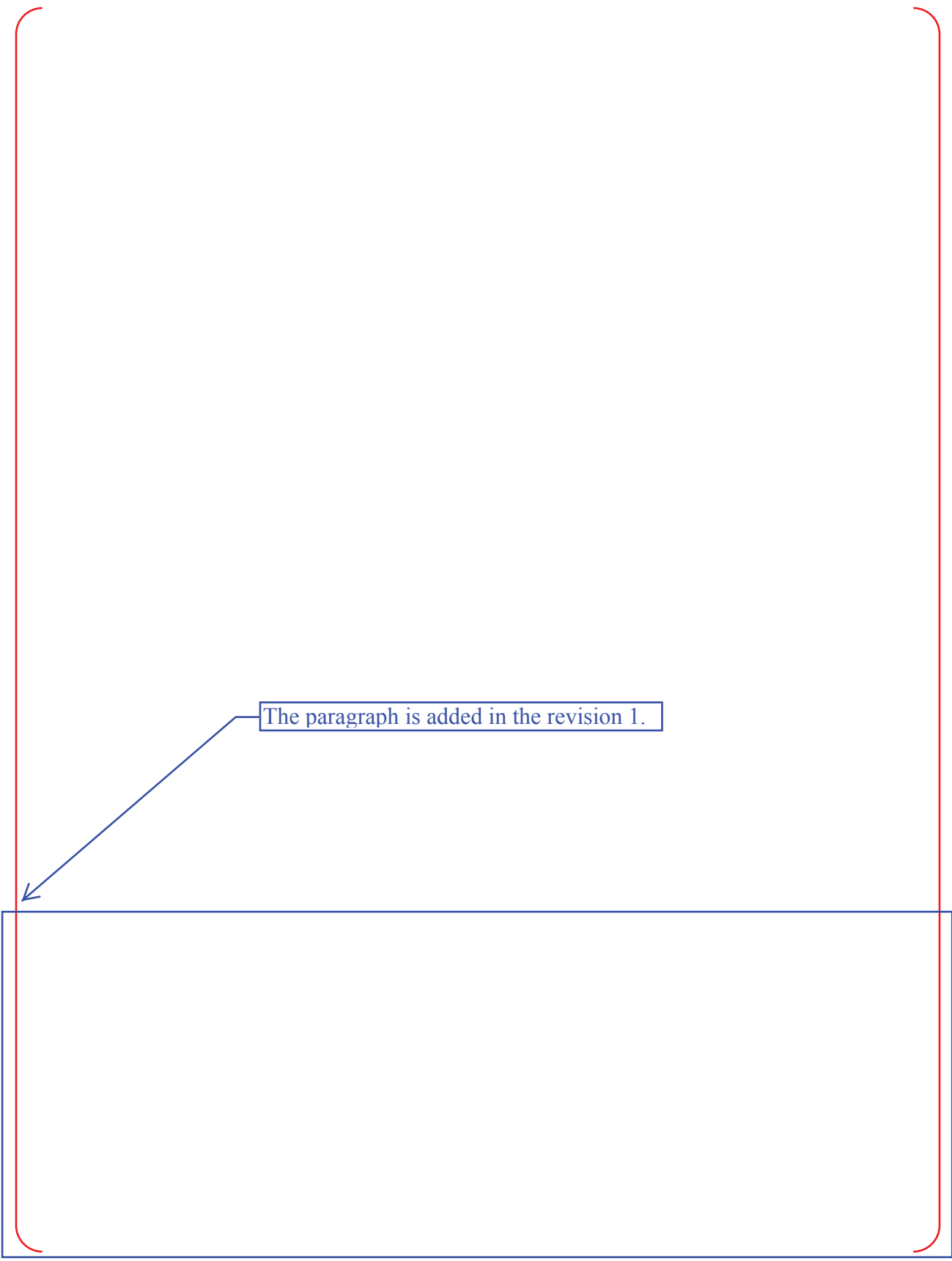
There is no impact on the PRA.

#### **Impact on Technical Specifications**

There is no impact on the Technical Specifications.

#### **Impact on Technical/Topical/Environmental Reports**

The Safety I&C System technical report, APR1400-Z-J-NR-14001, Rev.1, is revised as indicated in the attachment associated with this response.



The paragraph is added in the revision 1.

