REVISED 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.:	**71-7906**
SRP Section:	**14.03.05 – Instrumentation and Controls - Inspections, Tests, Analyses, and Acceptance Criteria**
Application Section:	
Date of RAI Issue:	**07/15/2015**

Question No. 14.03.05-11

Modify the APR1400, Tier 1, to provide design descriptions and ITAAC that address communications independence between redundant divisions of the ESF-CCS and between the ESF-CCS and non-safety systems.

10 CFR 50.55a(h)(3) states, in part, that applications filed on or after May 13, 1999, for design certifications must meet the requirements for safety systems in IEEE Std. 603-1991 and the correction sheet dated January 30, 1995. IEEE Std. 603-1991, Clause 5.6, requires independence between redundant portions of safety systems and between safety and non-safety systems. Digital I&C Interim Staff Guidance (ISG) -04 provides guidance for achieving communications independence in order to meet the requirements of IEEE Std. 603-1991, Clause 5.6. 10 CFR 52.47(b)(1) requires an application to contain the proposed inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations.

Technical Report APR1400-Z-J-NR-14001, Rev. 0, "Safety I&C System," Section 4.2.4, "System Interfaces," states, “The PPS sends the ESFAS [engineered safety features actuation system] initiation signals to the ESF-CCS GCs [group controllers] in all ESF-CCS divisions through the fiber optic SDL [safety data link].” In addition, Section 4.4.2, "Design Features," of this TeR states “The ESCM [ESF-Soft Control Module] provides the operators with primary manual control means for other safety components as well as ESF components. There is one ESCM per division at each operator console in the MCR [main control room] and RSR [remote shutdown room] and SC [Safety Console] in the MCR. The divisionalized ESCM has access to all ESF safety components within its division. The ESCMs on the operator consoles work in conjunction with the IPFDs [Information Flat Panel and Display], but the ESCMs on the SC work independently of the IFPDs. DI&C-ISG-04 compliance for communication between the IFPD and

ESCM is described in Appendix C.5.1.5." These design descriptions indicate that data communications exist between redundant divisions of ESF-CCS and between the ESF-CCS and non-safety systems. However, the staff could not identify any Tier 1 descriptions or corresponding ITAACs committing to achieve communications independence between these interfaces. As such, the staff requests to modify Tier 1 of the FSAR, including the ITAAC to include this information to verify communication independence in the as-built design. The design commitment and associated ITAAC should include sufficient information regarding the types of data communications faults that the system will be protected from and software features to mitigate these faults.

Response – (Rev. 2)

A design description and ITAAC will be added as design description Item 23 and Item 24 of Section 2.5.4.1 and ITAAC Table 2.5.4.4 of DCD Tier 1 to provide the key features used to mitigate data communications faults and ensure that communications independence is achieved between redundant divisions of the ESF-CCS and between the ESF-CCS and non-safety systems as follows:

[DCD Tier 1, Section 2.5.4.1 Design description]

Design description (Item 23, Item 24)	
Before	After
No description	23. Communication independence between redundant divisions of ESF-CCS and between ESF-CCS soft control module (ESCM) and information flat panel display (IFPD) is achieved by use of dual-ported memory and separation of functional processor and communication processor.
No description	24. Communication from IFPD to ESCM is implemented by using a predefined message format, protocol, and error checking code.

[DCD Tier 1, Table 2.5.4-4 ESF-CCS ITAAC]

Design commitment (Item 23, Item 24)	
Before	After
No description	23. Communication independence between redundant divisions of ESF-CCS and between ESF-CCS soft control module (ESCM) and information flat panel display (IFPD) is achieved by use of dual-ported memory and separation of functional processor and communication processor.
No description	24. Communication from IFPD to ESCM is implemented by using a predefined message format, protocol, and error checking code.

Inspections, Tests, Analysis (Item 23, Item 24)	
Before	After
No description	23.a An inspection of the as-built ESF-CCS will be performed to verify dual-ported memory is installed. 23.b An inspection of the as-built ESF-CCS will be performed to verify that functional processor and communication processor are installed and separated. 23.c Analyses, tests or a combination of analyses and tests of the communication independence will be performed.
No description	24.a A test will be performed to verify that the signal from IFPD to ESCM has a predefined message format and protocol. 24.b A test will be performed to verify that ESCM uses an error checking code for

	communication from IFPD to ESCM. 24.c Analyses, tests or a combination of analyses and tests of the communication independence will be performed.

Acceptance Criteria (Item 23, Item 24)	
Before	After
No description	23.a Dual-ported memory exists in the as-built ESF-CCS for communication between redundant divisions of ESF-CCS and between ESCM and IFPD. 23.b Functional processor and communication processor exist and are separated in the as-built ESF-CCS for communication between redundant divisions of ESF-CCS and between ESCM and IFPD. 23.c A report exists and concludes that communication independence is achieved between redundant divisions of ESF-CCS and between ESCM and IFPD.
No description	24.a Signal from IFPD to ESCM has a predefined message format and protocol for communication from IFPD to ESCM. 24.b The Ethernet processor of ESCM checks the integrity of the received data set from IFPD using an error checking code, such as cyclic redundancy check, and discards erroneous data. 24.c A report exists and concludes that communication from IFPD to ESCM is implemented by using a predefined message format, protocol, and error checking code.

The MTP to IPS communication and ITP to QIAS-N communication was addressed in the response to RAI 71-7906, Question 14.03.05-2 (refer to KHNP submittal MKD/NW-16-0686L dated June 28, 2016; ML16180A280).

The further descriptions regarding the compliance analysis to Digital I&C-ISG-04 for the interdivisional communication between the ESF-CCS and between the IFPD and ESCM is provided in Section C.5 of technical report APR1400-Z-J-NR-14001-P, Rev. 0, “Safety I&C System.”

Impact on DCD

APR1400 DCD Tier 1, Section 2.5.4.1 and Table 2.5.4-4 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.

18. The Class 1E equipment and components listed in Table 2.5.4-1 are protected from accident related hazards such as missiles, pipe breaks and flooding.

19. The ESF-CCS cabinets listed in Table 2.5.4-1 have key locks and door position alarms, and are located in a vital area of the facility.

20. The ESF-CCS provides ESF actuation within required response time for ESF functions identified in Table 2.5.4-2.

Item 22 has been allocated in response to RAI 317-8271, Q 14.03.05-29.

21. The ESF-CCS has the testing functions.

2.5.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

The inspections, tests, analyses, and associated acceptance criteria for the ESF-CCS are specified in Table 2.5.4-4.

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~~22. Communication independence is achieved between redundant divisions of ESF-CCS and between Class 1E equipment listed in Table 2.5.4-1 and non-safety systems (information flat panel display (IFPD), information processing system (IPS), and qualified indication and alarm system-N (QIAS-N)).~~

Communication independence between redundant divisions of ESF-CCS and between ESF-CCS soft control module (ESCM) and information flat panel display (IFPD) is achieved by use of dual-ported memory and separation of functional processor and communication processor.

24. Communication from IFPD to ESCM is implemented by using a predefined message format, protocol, and error checking code.

Table 2.5.4-4 (7 of 7)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
18. The Class 1E equipment and components listed in Table 2.5.4-1 are protected from accident related hazards such as missiles, pipe breaks and flooding.	18. An inspection and analysis will be performed on the locations of the as-built Class 1E equipment and components listed in Table 2.5.4-1.	18. A report exists and concludes that the as-built equipment and components listed in Table 2.5.4-1 are protected from accident related hazards such as missiles, pipe breaks and flooding.
19. The ESF-CCS cabinets listed in Table 2.5.4-1 have key locks and door position alarms, and are located in a vital area of the facility.	19.a A test of the as-built cabinets listed in Table 2.5.4-1 for key lock capability, and a test of door position alarms, will be performed.	19.a Each as-built cabinet listed in Table 2.5.4-1 has key lock capability, and door position alarms are received in the as-built MCR when cabinet doors are opened.
	19.b An inspection of the cabinets listed in Table 2.5.4-1 will be performed.	19.b The cabinets listed in Table 2.5.4-1 are located in a vital area of the facility.
20. The ESF-CCS provides ESF actuation within required response time for ESF functions identified in Table 2.5.4-2.	20.a A type test and analysis will be performed on the ESF-CCS to verify that the ESF-CCS actuates the ESF functions identified in Table 2.5.4-2.	20.a A report exists and concludes that the ESF-CCS actuates the ESF functions identified in Table 2.5.4-2 within response time requirements.
	20.b An inspection will be performed on the as-built ESF-CCS to determine if the response time of ESF actuation functions identified in Table 2.5.4-2.	20.b The as-built ESF actuation functions identified in Table 2.5.4-2 with response time requirements are bounded by type tests or a combination of a type test and analysis.
21. The ESF-CCS has the testing functions.	21. A type tests and analysis of the ESF-CCS will be performed using simulated failure condition.	21. A report exists and concludes that the ESF-CCS has the testing functions to detect malfunctioning components or modules and have them replaced, repaired, or adjusted.
~~22. Communication independence is achieved between redundant divisions of ESF-CCS and between Class 1E equipment listed in Table 2.5.4-1 and non-safety systems (information flat panel display (IFPD), information processing system (IPS), and qualified indication and alarm system-N (QIAS-N)).~~	~~22. Analyses, tests or a combination of analyses and tests of the as-built Class 1E equipment listed in Table 2.5.4-1 will be performed to verify its communication independence.~~	~~22. A report exists and concludes that data communication between redundant divisions of the Class 1E equipment listed in Table 2.5.4-1 and between the Class 1E equipment listed in Table 2.5.4-1 and non-safety systems (IFPD, IPS, and QIAS-N) does not inhibit the performance of any safety function.~~

Replace with "A" on the next page.

23 and 24

ITACC for Item ~~22~~ is added.

"A"

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
23. Communication independence between redundant divisions of ESF-CCS and between ESF-CCS soft control module (ESCM) and information flat panel display (IFPD) is achieved by use of dual-ported memory and separation of functional processor and communication processor.	23.a An inspection of the as-built ESF-CCS will be performed to verify dual-ported memory is installed.	23.a Dual-ported memory exists in the as-built ESF-CCS for communication between redundant divisions of ESF-CCS and between ESCM and IFPD.
	23.b An inspection of the as-built ESF-CCS will be performed to verify that functional processor and communication processor are installed and separated.	23.b Functional processor and communication processor exist and are separated in the as-built ESF-CCS for communication between redundant divisions of ESF-CCS and between ESCM and IFPD.
	23.c Analyses, tests or a combination of analyses and tests of the communication independence will be performed.	23.c A report exists and concludes that communication independence is achieved between redundant divisions of ESF-CCS and between ESCM and IFPD.
24. Communication from IFPD to ESCM is implemented by using a predefined message format, protocol, and error checking code.	24.a A test will be performed to verify that the signal from IFPD to ESCM has a predefined message format and protocol.	24.a Signal from IFPD to ESCM has a predefined message format and protocol for communication from IFPD to ESCM.
	24.b A test will be performed to verify that ESCM uses an error checking code for communication from IFPD to ESCM.	24.b The Ethernet processor of ESCM checks the integrity of the received data set from IFPD using an error checking code such as cyclic redundancy check, and discards erroneous data.
	24.c Analyses, tests or a combination of analyses and tests of the communication independence will be performed.	24.c A report exists and concludes that communication from IFPD to ESCM is implemented by using a predefined message format, protocol, and error checking code.