

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.: 356-7881

SRP Section: 7.0 – Instrumentation and Controls

Application Section: 7.0

Date of RAI Issue: 01/04/2016

Question No. 07-7

Identify and explain the basis for the specific plant components that are contained within control groups as show on Tables 4.5-2, "Control Group," and 5.1-1, "Shared Signals," of Technical Report APR1400-ZJ-NR-14012-P, Rev. 0, "Control System CCF Analysis."

10 CFR 50.55a(h)(3) requires compliance to IEEE Std. 603-1991. IEEE Std. 603-1991, Clause 5.6.3, states, in part, the safety system design shall be such that credible failure in and consequential actions by other systems, as documented in Clause 4.8 of the design basis section of this standard, shall not prevent the safety systems from meeting the requirements of this standard. Technical Report APR1400-Z-J-NR-14012-P, Table 5.2-1, "Control Group Segmentation," documents the segmented control groups for the APR1400 non-safety control systems. The table also states whether these control groups have separate controllers. However, the table does not itemize the physical plant components that are controlled by, and part of, each control group. As a result, this requires further analysis of the material provided by the applicant later in the report, such as Tables 5.1-1 and 5.1-2 (thru 5.1-19), "Multiple Failure due to a Single Failure of Shared Signals." As a result, it is more difficult to understand and ascertain whether an entire control group is affected by a single failure or only a single component is affected. In addition, Tables 5.1-2 thru 5.1-19 documents the single failure of shared signals. In the column labeled "Evaluation Result", the applicant cites various Chapter 15 events as bounding analyses for a particular failure identified on the table. For example, the failure mode of "Reactor power signal fails low", the applicant states in the evaluation result column that "This failure is bounded by DCD Ch. 15.2.3 (Loss of condenser vacuum)". There does not appear to be any further explanation on the table as to why this particular failure is bounded by the loss of condenser vacuum event.

1. Identify the physical plant components (i.e. pumps, valves, etc.) controlled by each control group or identify where in the application this information is located.

2. Provide the basis for why the cited Chapter 15 analysis sections are adequate for each failure mode in Tables 5.1-2 thru 5.1-19.
3. Clarify whether the current approach adequately captures failure modes and effects on control groups beyond shared signals.

Response

1. Identify the physical plant components (i.e. pumps, valves, etc.) controlled by each control group or identify where in the application this information is located.

The physical plant components and control functions affected by a shared signal failure are identified in Table 5.1-1. The physical plant components controlled by each control group are identified in Table 5.2-1.

Clarification for the physical plant components has been made to Table 5.1-1 of technical report APR1400-Z-J-NR-14012-P, as indicated in the attachment associated with this response.

Refer to the response to Question No. 07-9 of RAI 356-7881 for the physical plant components controlled by each control group. Clarification will be made to Table 5.2-1 of technical report APR1400-Z-J-NR-14012-P in the response.

2. Provide the basis for why the cited Chapter 15 analysis sections are adequate for each failure mode in Tables 5.1-2 thru 5.1-19.

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The following table is the basis for why the cited Chapter 15 analysis sections bound each shared signal failure of Failure Type 1.

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Failure Mode	Basis

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Failure Mode	Basis

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[illegible]

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Failure Mode	Basis

3. Clarify whether the current approach adequately captures failure modes and effects on control groups beyond shared signals.

Refer to the Response to Request No.1. And refer to the response to Question No. 07-10 of RAI 356-7881 for failure modes and effects of all the failure types.

Supplemental Response

The physical plant components and control functions affected by a shared signal failure are identified in existing Tables 5.1-1 and 5.1-2 through 5.1-19. The physical plant components controlled by each control group are identified in Table 5.2-1.

Tables 5.1-2 through 5.1-19 provide the evaluation results of the failures of the shared signals provided in Table 5.1-1 and include the affected control function and plant component information pertaining to the shared signal failure.

Tables 5.1-2 through 5.1-19 of technical report APR1400-Z-J-NR-14012-P provide similar information and will be combined into a single table, Table 5.1-2, as indicated in the attachment associated with this response.

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

Technical Report APR1400-Z-J-NR-14012, Rev. 0, "Control System CCF Analysis" will be revised as indicated in Attachment.

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5.1. Failure Type 1: Multiple Failure due to a Single Failure of Shared Signal

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5.1.1. Assumptions Used in the Evaluation

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Table 5.1-1 Shared Signals

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Table 5.1-1 Shared Signals (Continued)

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Table 5.1-2 Multiple Failure due to a Single Failure of Shared Signals ~~(1 of 18)~~

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Table 5.1-2

(Sh. 2 of 18)

~~Table 5.1-3 Multiple Failure due to a Single Failure of Shared Signals (2 of 18)~~

TS

Table 5.1-2

(Sh. 3 of 18)

~~Table 5.1-4 Multiple Failure due to a Single Failure of Shared Signals (3 of 18)~~

TS

Table 5.1-2

(Sh. 4 of 18)

~~Table 5.1-5 Multiple Failure due to a Single Failure of Shared Signals (4 of 18)~~

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Table 5.1-2

(Sh. 5 of 18)

~~Table 5.1-6 Multiple Failure due to a Single Failure of Shared Signals (5 of 18)~~

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Table 5.1-2

(Sh. 6 of 18)

~~Table 5.1-7 Multiple Failure due to a Single Failure of Shared Signals (6 of 18)~~

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Table 5.1-2

(Sh. 7 of 18)

~~Table 5.1-8 Multiple Failure due to a Single Failure of Shared Signals (7 of 18)~~

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Table 5.1-2

(Sh. 8 of 18)

~~Table 5.1-9 Multiple Failure due to a Single Failure of Shared Signals (8 of 18)~~

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Table 5.1-2

(Sh. 9 of 18)

Table 5.1-10 Multiple Failure due to a Single Failure of Shared Signals (9 of 18)

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Table 5.1-2

(Sh. 10 of 18)

Table 5.1-11 Multiple Failure due to a Single Failure of Shared Signals (10 of 18)

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Table 5.1-2

(Sh. 11 of 18)

Table 5.1-12 Multiple Failure due to a Single Failure of Shared Signals (11 of 18)

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Table 5.1-2

(Sh. 12 of 18)

Table 5.1-13 Multiple Failure due to a Single Failure of Shared Signals (12 of 18)

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Table 5.1-2

(Sh. 13 of 18)

Table 5.1-14 Multiple Failure due to a Single Failure of Shared Signals (13 of 18)

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Table 5.1-2

(Sh. 14 of 18)

Table 5.1-15 Multiple Failure due to a Single Failure of Shared Signals (14 of 18)

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Table 5.1-2

(Sh. 15 of 18)

Table 5.1-16 Multiple Failure due to a Single Failure of Shared Signals (15 of 18)

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Table 5.1-2

(Sh. 16 of 18)

Table 5.1-17 Multiple Failure due to a Single Failure of Shared Signals (16 of 18)

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Table 5.1-2

(Sh. 17 of 18)

Table 5.1-18 Multiple Failure due to a Single Failure of Shared Signals (17 of 18)

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Table 5.1-2

(Sh. 18 of 18)

Table 5.1-19 Multiple Failure due to a Single Failure of Shared Signals (18 of 18)

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Docket No. 52-046

RAI No.: 356-7881

SRP Section: 7.0 – Instrumentation and Controls

Application Section: 7.0

Date of RAI Issue: 01/04/2016

Question No. 07-10

Discuss whether shared signals are the only failure mechanisms considered when determining the four failure categories listed in Section 4.3, "Credible Failure Types of Control System CCF," of Technical Report APR1400-Z-J-NR-14012-P, Rev. 0.

10 CFR 50.55a(h)(3) requires compliance to IEEE Std 603-1991. IEEE Std. 603-1991, Clause 5.6.3, states, in part, the safety system design shall be such that credible failure in and consequential actions by other systems, as documented in Clause 4.8 of the design basis section of this standard, shall not prevent the safety systems from meeting the requirements of this standard. Table 5.1-1, "Shared Signals" of Technical Report APR1400-Z-J-NR-14012-P presents a list of common signals from specific primary/secondary controls systems and interfacing systems that receive the common shared signal. The analysis in Section 5, "Evaluation Method and Results," appears to limit initiators of CCF to that of shared signals. The applicant does not necessarily provide a basis as to why this failure mode is the sole means to cause a CCF, even if it is the more likely vector. For example, upon reviewing the technical report, the applicant does not appear to consider other potential failure modes such as EMI/RFI, seismic movement, etc. It is possible that the four failure categories, supporting design constraints, and analysis bound all failure modes beyond that of shared signals, but the applicant does not make this claim or arguments to support this premise within the technical report. Explain why failures of shared signals is the only failure mode that was used to develop all the failure types in Technical Report APR1400-Z-J-NR-14012-P, Rev.0.

Response

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Supplemental Response

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The assumptions for failure type due to a seismic event or EMI/RFI will be included into technical report APR1400-Z-J-NR-14012-P as shown in the attachment associated with this response.

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

Technical Report APR1400-Z-J-NR-14012-NP, Rev. 0, "Control System CCF Analysis" will be revised as indicated in Attachment.

5.2. Failure Type 2: Multiple Failure due to Single Control group

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5.2.1. Selection of Initiating Events**5.2.2. Assumptions Used in the Evaluation****5.2.3. Acceptance Criteria**

5.3. Failure Type 3: Multiple Failures of more than One Control Group

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5.3.1. Selection of Initiating Events**5.3.2. Assumptions Used in the Evaluation**