

## 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.:** 470-8552  
**SRP Section:** 16 – Technical Specifications  
**Application Section:** 16.3.3.1  
**Date of RAI Issue:** 04/26/2016

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### **Question No. 16-137**

The response to RAI-Question 16-89 was lacking sufficient detail to resolve the questions asked.

1. The applicant is requested to submit a table that shows the following for each component, segment, and portion of the instrument loop from the process sensor through bistable logic, coincidence logic, initiation logic, actuation logic, the component interface module, or reactor trip logic to the reactor trip circuit breakers, or the actuated end device in the ESFAS circuits:

- component name or description
- name of test as depicted on DCD Figure 7.2-11
- name of test as stated in DCD 7.2.2.5
- corresponding generic TS Section 3.3 surveillance requirement as defined in generic TS Section 1.1 (CHANNEL CHECK; CHANNEL FUNCTIONAL TEST, CHANNEL CALIBRATION)

The NRC staff included a draft of the requested table in the agenda notes for the meeting between the NRC staff and Applicant staff on February 24 and 25, 2016. That table was based on information in the DCD and in the response to RAI-Question 16-89. The applicant may use that draft table as a guide in preparing the requested table; however, the staff does not consider the table to be fully accurate because the DCD descriptions are unclear.

2. Notice that DCD Figure 7.2-11 does not depict "CPCS Test" and "Manual Trip Test", which are described in DCD Section 7.2.2.5. The applicant is requested to revise DCD Tier 2 Section 7.2 so that Section 7.2.2.5 and Figure 7.2-11 are correctly aligned. In addition, consider adding a discussion in DCD Tier 2 Section 7.3 that describes the testing for the ESFAS instrumentation loops with the same level of detail as the requested revised description in DCD Tier 2 Section 7.2.2.5, and also a figure equivalent to Figure 7.2-11. Notice that Figure 7.2-11 depicts no tests for ESFAS related components after the input to the actuation logic in the group controller.

3. The last two sentences of the response to RAI-Question 16-89 said,

... the "Bistable Logic Test" and the "CPCS Test" of the RPS CHANNEL FUNCTIONAL TEST are performed in accordance with the Setpoint Control program (SCP). The remaining tests specified in the SCP such as Nominal Trip Setpoint, Allowable Value, As-Found Tolerance, and As-Left Tolerance are not directly related to setpoints.

The applicant is requested to explain what is meant by these statements. For example, the NTSP, AV, AFT, and ALT are not tests. Also, the ESFAS CHANNEL FUNCTIONAL TEST and the CHANNEL CALIBRATION are not mentioned.

4. The applicant is requested to explain what meaning the "OR" logical gate symbols on Figure 7.2-11 are intended to convey; especially with respect to depicting testing overlap. The requested information is needed to enable the NRC staff to determine whether or not surveillances for RPS and ESFAS instrumentation functions satisfy 10 CFR 50.36 requirements.

## **Response**

1. Table 1 is prepared based on DCD Tier 2 Figure 7.2-11, which shows the testing overlap for the periodic manual tests required to verify the integrity of the RPS functions during power operation of the plant. The component names and descriptions in the figure are identified by relationship with the testing type provided in DCD Tier 2 Section 7.2.2.5, "System Testing and Inoperable Surveillance". Additionally, the "CPCS" and "CPCS test" will be included in DCD Tier 2 Figure 7.2-11.

Table 2 is prepared based on a new figure, DCD Tier 2 Figure 7.3-24, "ESF-CCS Actuation Test Logic Diagram". The component names and descriptions in the figure are identified by relationship with the testing type provided in DCD Tier 2 Section 7.3.2.5, "System Testing and Inoperable Surveillance".

DCD Tier 2 Figure 7.3-24 will be added and Section 7.3.2.5 will include items i) and j) for the component logic test and communication interface module (CIM) test.

Table 1. Components List and Corresponding Test between Figure 7.2-11 and Section 7.2.2.5

Components (As depicted in DCD Tier 2 Figure 7.2-11)	DCD Tier 2 Figure 7.2-11, "RPS Testing Overlap"	DCD Tier 2 Section 7.2.2.5	Generic TS Surveillance * performed at power ** 18 month Frequency
Process Sensor	Manual Transmitter Test	a. Sensor check	CHANNEL CHECK **CHANNEL CALIBRATION
CPCS	CPCS Test	c. CPCS test	CPC SYSTEM EVENT LOG CHECK *CHANNEL FUNCTIONAL TEST **CHANNEL CALIBRATION
TU Switch	Manual Transmitter Test	a. Sensor check	CHANNEL CHECK **CHANNEL CALIBRATION(MANUAL TRANSMITTER TEST)
BP Rack AI Module A/D [Converter]	Manual Transmitter Test Analog Input Test	a. Sensor check	CHANNEL CHECK **CHANNEL CALIBRATION(MANUAL TRANSMITTER TEST)
Bistable Processor (BP) – partial trip signal	Bistable Logic Test	b. Bistable logic test	*CHANNEL FUNCTIONAL TEST
SDL Communication to Local Coincidence Logic (LCL) Rack	Bistable Logic Test	b. Bistable logic test	*CHANNEL FUNCTIONAL TEST
LCL Rack - SDL Signal Distribution (Communication)	Bistable Logic Test	b. Bistable logic test	*CHANNEL FUNCTIONAL TEST
Local Coincidence Logic (LCL) RPS 2/4 → RPS (coincidence) Initiation Signal	RT LCL Logic Test	d. LCL test	*CHANNEL FUNCTIONAL TEST
RPS Digital Output	RT LCL Logic Test RT Initiation Test	d. LCL test e. Initiation logic and circuit test	*CHANNEL FUNCTIONAL TEST
Hardwire to RT Initiation Logic (selective 2/4)	RT LCL Logic Test RT Initiation Test	e. Initiation logic and circuit test	*CHANNEL FUNCTIONAL TEST
Interposing Relay & Contacts	RT Initiation Test	e. Initiation logic and circuit test	*CHANNEL FUNCTIONAL TEST
RTSS-1 and RTSS-2	RT Initiation Test	e. Initiation logic and circuit test	*CHANNEL FUNCTIONAL TEST
RTCB Undervoltage Trip Device	RT Initiation Test	e. Initiation logic and circuit test	*CHANNEL FUNCTIONAL TEST
LCL Rack - SDL Signal Distribution	Bistable Logic Test	<u>Section 7.3.2.5</u> b) Bistable logic test	*CHANNEL FUNCTIONAL TEST
Local Coincidence Logic (LCL) ESFAS 2/4 → ESFAS (coincidence) Initiation Signal	ESF LCL Logic Test	<u>Section 7.3.2.5</u> c) LCL test	*CHANNEL FUNCTIONAL TEST
SDL to Group Controller (GC) Station (ESF-CCS)	ESF LCL Logic Test	<u>Section 7.3.2.5</u> d) Initiation logic test	*CHANNEL FUNCTIONAL TEST

Table 2. Components List and Corresponding Test between Figure 7.3-24 and Section 7.3.2.5

Components (As depicted in DCD Tier 2 Figure 7.3-24)	DCD Tier 2 Figure 7.3-24, "ESF-CCS Actuation Test Logic Diagram"	DCD Tier 2 Section 7.3.2.5	Generic TS Surveillance * performed at power ** 18 month Frequency
GC Station – Selective 2/4 Logic	Actuation Logic Test	e) Actuation logic test	*CHANNEL FUNCTIONAL TEST
SDL to Loop Controller (Component Control Logic)	Component Logic Test	i) Component logic test	*CHANNEL FUNCTIONAL TEST
Component Interface Module (CIM)	CIM Test	j) CIM test	*CHANNEL FUNCTIONAL TEST

2. The missing information of CPCS and CPCS Test in DCD Tier 2 Figure 7.2-11 will be added.

Section 7.2.2.5 of DCD Tier 2 states, "The manual trip test is performed by using one of the two pairs of manual trip pushbuttons on the safety console or one pair of manual trip pushbuttons on the RSC, observing an RTSG trip, and closing the RTSG prior to the next manual trip test." The manual trip test input is directly connected to the reactor trip switchgear system (RTSS) without going through any portion of the plant protection system (PPS) application program containing the bistable processing logic and local coincidence processing logic.

Figure 7.2-16 "Manual Reactor Trip Initiation Diagram" shows that the manual reactor trip input either from the main control room (MCR) or remote shutdown room (RSR) is directly transmitted to the RTSS. The following will be added in item f) of DCD Tier 2 Section 7.2.2.5: "Figure 7.2-16 shows the signal path for the manual trip test."

Figure 7.3-22, "ESF-CCS Simplified Test Logic Diagram" shows the actuation logic test of the group controller (GC) portion of the engineered safety features – component control system (ESF-CCS).

Also, Figure 7.3-24, "ESF-CCS Actuation Test Logic Diagram" will be added to DCD Tier 2 to show the tests that cannot be performed by the PPS. Accordingly, items i) and j) will be added to Section 7.3.2.5 for the component logic test and CIM test.

3. Except for DNBR and LPD trip setpoints, which are programmed in the CPCS to perform the RPS function, all trip setpoints for the RPS and ESFAS functions are set into the PPS bistable logics. For the RPS CHANNEL FUNCTIONAL TEST, the "Bistable Logic Test" and the "CPCS Test" are performed to verify RPS trip setpoints to be within the corresponding Allowable Values. In addition, for the ESFAS CHANNEL FUNCTIONAL TEST, the "Bistable Logic Test" is performed to verify ESFAS trip setpoints to be within the corresponding Allowable Values. The NTSP, AV, AFT, and ALT stated in the Setpoint Control program (SCP) are used for performing the CHANNEL FUNCTIONAL TEST and CHANNEL CALIBRATION for RPS and ESFAS functions. Therefore, it was intended to specify that the "Bistable Logic Test" and the "CPCS Test" are performed in accordance with the SCP since the purpose of the SCP is to establish the requirements for ensuring that setpoint for automatic protective devices are initially within and remain within the assumptions of the applicable safety analyses.

4. The logical OR in the receiving stage of bistable processor (BP) indicates that BP logic is processed either by the actual signal or by the test signal. The logical OR in the receiving stage of LCL indicates that local coincidence logic (LCL) logic is processed either by the actual signal or by the test signal.

The logical OR in the transmitting stage of LCL or the receiving stage of the digital output module indicates that the digital output module generates the output either by the actual signal or by the test signal.

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#### **Impact on DCD**

DCD Tier 2 Section 7.2.2.5, Section 7.3.2.5, and Figure 7.2-11 will be revised as indicated in the attachment associated with this response.

DCD Tier 2 Figure 7.3-24 will be added 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.

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Input signals are injected from the MTP, and the results are verified with the expected contact status of the initiation circuit.

## f. Manual trip test

Figure 7.2-16 shows the signal path for the manual trip test.

The manual trip test is performed by using one of the two pairs of manual trip pushbuttons on the safety console or one pair of manual trip pushbuttons on the RSC, observing an RTSG trip, and closing the RTSG prior to the next manual trip test.

The RTSG can be closed from the MTP.

## g. Response time test

Response time from sensor to the RTSG is tested during shutdown to verify that the measured system response time is less than or equal to the response time assumed in the Chapter 15 safety analysis.

**7.2.2.6 Use of Digital Systems**

All RPS functions are implemented by digital systems. Manual reactor trip pushbuttons from the MCR and RSR are hardwired directly to the RTSGs.

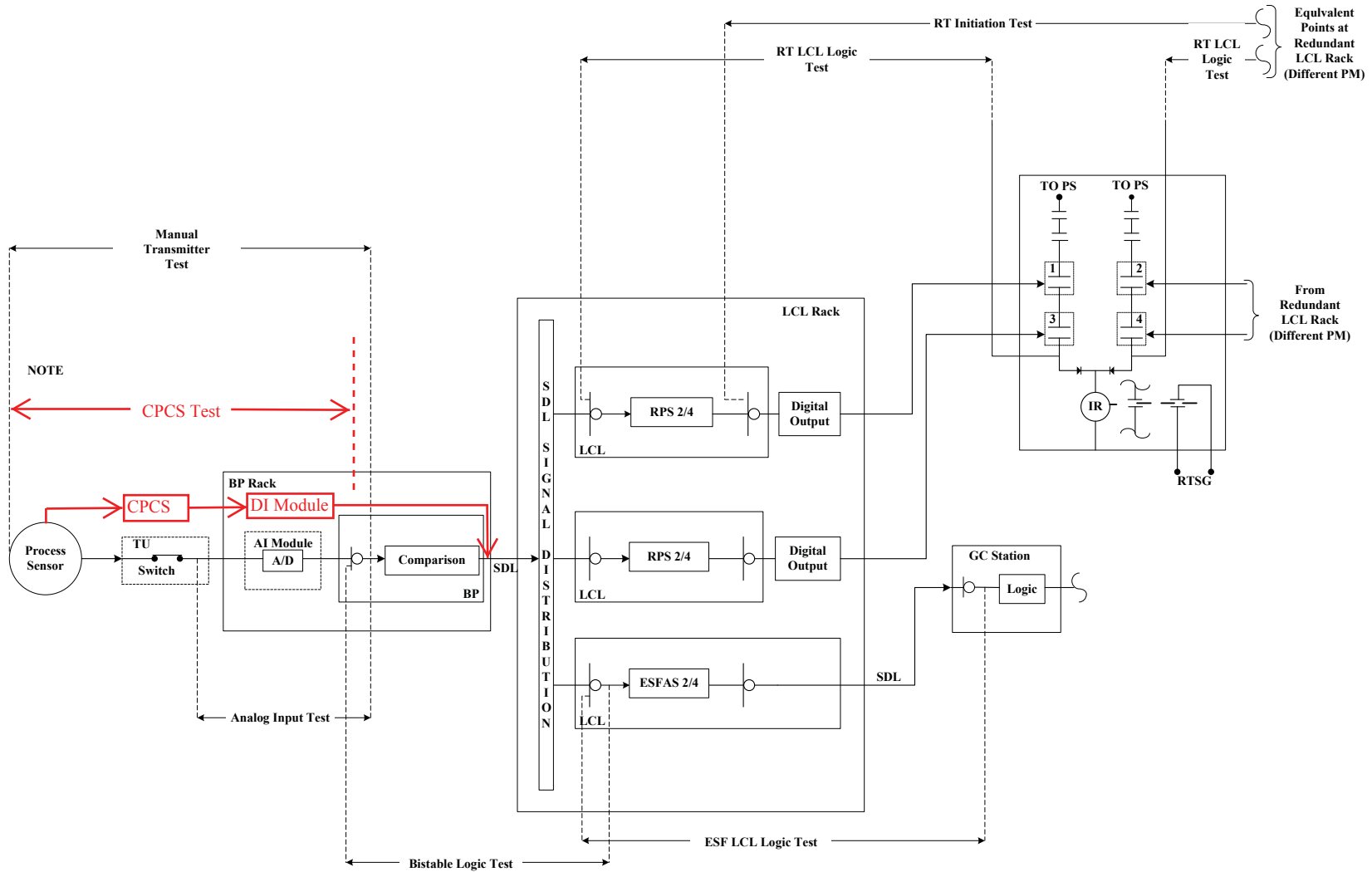
**7.2.2.7 Setpoint Determination**

The RPS nominal trip setpoints are determined based on the analysis setpoints in the Chapter 15 safety analysis, in which analysis setpoints exist for the parameters.

When determining uncertainties, the worst environment considering a reactor trip or ESF actuation is assumed based on the bounding initiating event. The methodology for calculating uncertainty is provided in the Uncertainty Methodology and Application for Instrumentation Technical Report (Reference 13).

The methodology for combining uncertainty in a channel and determining the final trip setpoint is provided in the Setpoint Methodology for Plant Protection System Technical Report (Reference 14).

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NOTE:  
EACH DASHED LINE INDICATES EITHER THE STARTING OR ENDING POINT OF TESTING.

Figure 7.2-11 **PPS** Testing Overlap

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The selective group test of the ESF-CCS is performed manually in the MTP. The testing is conducted one group at a time to prevent the complete undesired actuation of an ESF system during testing.

## g. Response time test

Response time from the sensor to the actuation device is tested during shutdown to verify that the response times assumed in Chapter 15 safety analysis are less than or equal to the actual time response.

## h. EDG loading sequencer test

The EDG loading sequencer incorporates design features, shown in Figure 7.3-21, which allow complete online testing. During normal operation, all output control signals are disabled, allowing all logic functions to be tested without disturbing plant equipment. The outputs are enabled automatically when a valid actuation input signal is received. In this manner, testing can be conducted without impeding required sequencer operation.

7.3.2.6 Use of Digital Systems

All ESFAS functions rely on digital systems.

7.3.2.7 Setpoint Determination

The ESFAS nominal trip setpoints are determined based on the analysis setpoints in Chapter 15 safety analysis.

When determining uncertainties, the worst environment considering ESF actuation is assumed for each different event. The methodology for calculating uncertainty is provided in the Uncertainty Methodology and Application for Instrumentation Technical Report (Reference 15).

The methodology for combining uncertainty in a division and determining the final actuation setpoint is provided in the Setpoint Methodology for Plant Protection System Technical Report (Reference 16).

## i. Component logic test

The component logic test is individually performed using manual control switches on the ESCM and minimum inventory switches on the safety console according to predetermined maintenance procedure as shown in Figure 7.3-24.

## j. CIM test

The CIM is tested for interface test by inputting the signals to each connector or selecting Front Panel Control (FPC) switch at the CIM according to predetermined maintenance procedure as shown in Figure 7.3-24 .



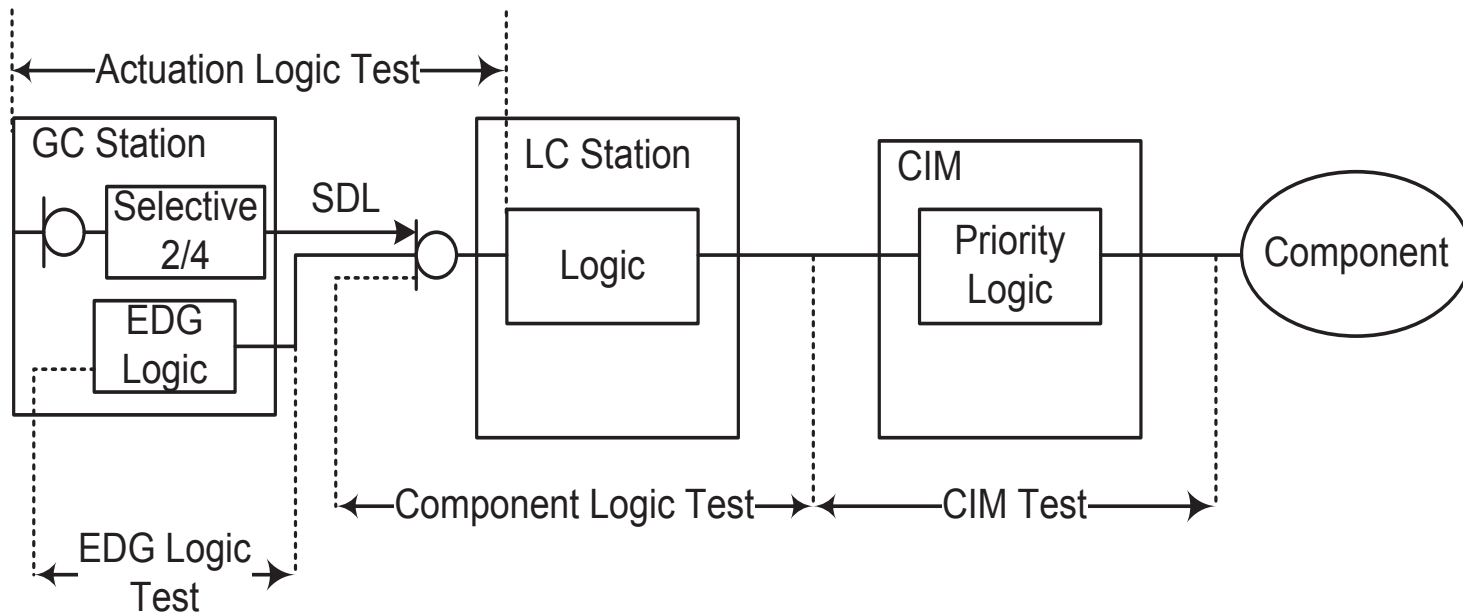


Figure 7.3-24 ESF-CCS Actuation Test Logic Diagram