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.:	**198-8208**
SRP Section:	**14.02 - Initial Test Program - Design Certification and New License Applicants**
Application Section:	**14.2.12.1.25**
Date of RAI Issue:	**09/04/2015**

Question No. 14.02-22

Demonstrate how the Ex-Core Neutron Flux Monitoring System (ENFMS) Test described in APR1400 FSAR Tier 2, Section 14.2.12.1.25 meets the requirements of Criterion XI of Appendix B to 10 CFR Part 50.

Criterion XI, “Test Control,” of Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” to 10 CFR Part 50 states, in part, that a test program shall be established to assure that all testing required to demonstrate that SSCs will perform satisfactorily in service is identified and performed in accordance with written test procedures, which incorporate the requirements and acceptance limits contained in applicable design requirements. RG 1.68, “Initial Test Programs for Nuclear Power Plants” provides guidance on the initial test program.

APR1400 FSAR Tier 2, Section 14.2.12.1.25 provides the initial test for the ENFMS. The staff reviewed this test and finds that additional information is required to determine whether this test meets the requirements of Criterion XI of Appendix B to 10 CFR Part 50. Specifically, the staff requests the applicant to address the following items described below.

1) Item 1.1 under “Objective” states that the objective is to “verify the proper functional performance of the [ENFMS].” Test Method Item 3.1 states, “Using appropriate test instrumentation, simulate and vary input signals to the startup, safety, and control channels of the ex-core neutron flux monitoring system.” In addition Acceptance Criteria Item 5.1 states, “The [ENFMS] performs as described in Subsection 7.7.1.1 h.” It is unclear to the staff whether this test will verify the functional performance of all channels of the ENFMS or only the non-safety related channels since Subsection 7.7.1.1 h only describes the non-safety related portion of the ENFMS. Clarify this discrepancy.

2) Item 2.0, “Prerequisites” does not specify whether the factory acceptance testing need to be complete prior to this test. Clarify this issue.

3) RG 1.68, Section A-1.j, “Instrumentation and Control Systems” specify that “tests should be conducted, as appropriate, to verify redundancy and electrical independence.” Since the ENFMS contains both safety and non-safety related channels, what tests are performed to verify sufficient electrical independence between the safety and non-safety related channels of the ENFMS?

Response – (Rev. 2)

1) This test will verify the functional performance of all channels of the ENFMS, so the sentence in 5.1 of the Acceptance Criteria will be revised to add Subsection 7.2.1.1.c to 7.7.1.1.h.

2) Performance of factory acceptance testing (FAT) by the vendor before the equipment is delivered to the site is generally a requirement of the procurement specification and would be applicable to the ENFMS as well. The completion of the ENFMS FAT will be added as a prerequisite in the test plan detailed in Section 14.2.12.1.25.

3) For redundancy, ENFMS consists of four redundant safety channels, two redundant startup channels, and two redundant control channels. For electrical independence, safety and non-safety channels are designed to meet RG 1.75 and IEEE Std. 384 by providing sufficient electrical isolation and physical separation. In detail, the circuits of safety and non-safety channels are physically separated in the safety channel drawer and the startup/control channel drawer respectively for physical separation, and the qualified isolation devices are applied to connections of Class 1E and non-Class 1E circuits for electrical isolation.

   For electrical independence between the safety and non-safety related channels of the ENFMS, testing, analysis or combination of testing and analysis will be performed as described in 3.b of Table 2.5.1-5 in Section 2.5.1.2 of the APR1400 FSAR Tier 1.

   In addition, an objective, test method, and acceptance criteria will be added to verify electrical independence between the safety and non-safety related channels of the ENFMS in the associated test plan specified in Section 14.2.12.1.25 of the DCD.

Impact on DCD

Section 14.2.12.1.25 of the APR1400 FSAR Tier 2 will be revised as indicated on the attached markup.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specification.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

4.2 Resistance for ground fault detector operation

4.3 Circuit breaker and indicator operation

4.4 Point of actuation of bistable comparators

4.5 Reset margin and rate of setpoint change of variable setpoints

4.6 Maximum and minimum values of variable setpoints

4.7 RPS and ESF trip and actuation path response times

4.8 LCL operation

5.0 ACCEPTANCE CRITERIA

5.1 The PPS performs as described in Sections 7.2 and 7.3.

5.2 The total response time of each RPS and ESFAS trip or actuation path is verified to be conservative with respect to the times used in the safety analysis.

14.2.12.1.25 Ex-Core Neutron Flux Monitoring System

1.0 OBJECTIVE

1.1 To verify the proper functional performance of the ex-core neutron flux monitoring system

1.2 To verify the proper performance of audio and visual indicators

1.3 To verify electrical independence of safety and non-safety portions of the ex-core neutron flux monitoring system.

2.0 PREREQUISITES

2.1 Construction activities on the ex-core neutron flux monitoring system have been completed.

2.2 Ex-core neutron flux monitoring system instrumentation has been calibrated.

2.3 External test equipment has been calibrated and is operational.

2.4 Support systems required for operation of the ex-core neutron flux monitoring system are operational.

2.5 Factory acceptance testing has been completed.

3.0 TEST METHOD

3.1 Using appropriate test instrumentation, simulate and vary input signals to the startup, safety, and control channels of the ex-core neutron flux monitoring system.

3.2 Monitor and record all output signals as a function of variable inputs provided by test instrumentation.

3.3 Record the performance of audio and visual indicators in response to changing input signals.

3.4 Verify that electrical independence is achieved for each channel, at interfaces between redundant channels, and at interfaces between safety and non-safety systems.

4.0 DATA REQUIRED

4.1 Values of input and output signals for correlation purposes, as required

4.2 Values of all output signals triggering audio and visual alarms

5.0 ACCEPTANCE CRITERIA

Subsections 7.2.1.1.c and 7.7.1.1.h

5.1 The ex-core neutron flux monitoring system performs as described in ~~Subsection 7.7.1.1.h~~.

5.2 Non-safety portions of the ENFMS channels are electrically independent of safety related portions.