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 Plant Test Program – Design Certification and New License Applicants**
Application Section:	**14.2.12.1.26**
Date of RAI Issue:	**09/04/2015**

Question No. 14.02-23

Demonstrate how the Fixed In-Core Nuclear Signal Channel Test described in APR1400 FSAR Tier 2, Section 14.2.12.1.26 meets the requirements of General Design Criterion (GDC) 1 of Appendix A to 10 CFR Part 50.

GDC 1, “Quality standards and records” of Appendix A, “General Design Criteria for Nuclear Power Plants” to 10 CFR Part 50 states, in part, that structures, systems, and components important to safety shall be tested to quality standards commensurate with the importance of the safety functions to be performed.

APR1400 FSAR Tier 2, Section 14.2.12.1.26 describes the initial test for the fixed in-core nuclear instrumentation system. The staff reviewed this test and finds that additional information is required to determine whether this test meets the requirements of GDC 1 of Appendix A to 10 CFR Part 50. Specifically, the staff requests the applicant to address the following items described below.

1) Item 1.0, “Objective” only provides two objectives for this test, Item 1.1, “To measure cable insulation resistance,” and Item 1.2, “To verify proper amplifier operation.” The incore instrumentation system consists of more than just the in-core instrumentation, but also the core exit thermocouples (CET) instrumentation. It is unclear whether Item 1.2 will verify the proper operation of both the in-core instrumentation and the CET instrumentation. Clarify this in FSAR Section 14.2.12.1.26. In addition, the proper amplifier operation is only one function performed by the in-core instrumentation system. Are other functions verified (e.g. sending amplified signals to the information processing system (IPS)?

2) The staff finds that the Item 2.0, “Prerequisites” does not specify that the proper location of each in-core detectors are verified, which is important to verify the accuracy of the instrument measurements in order to ensure the proper mapping of the core. Provide this

as a prerequisite or justify why it is not needed.

Response

KHNP has reviewed the subject question and understands the staff's request. KHNP is in the process of upgrading the test plans presented in Section 14.2 of the DCD. This effort is focused on adding additional SSCs that are important to safety and risk significant as well as increasing the level of detail described in the DCD for test prerequisites, test methods and acceptance criteria for the various tests. It has been determined that the actions to be taken as a result of this question is within the scope of the upgrade effort. Therefore, KHNP will address the noted items in the upgrade effort, which is scheduled to be completed by February 1, 2016. A revised response to this question that incorporates the results of the upgrade effort will be submitted to the NRC after completion.

Response – (Rev. 2)

The test described in FSAR Tier 2, Section 14.2.12.1.26 is the preoperational test for the verification of the FIDAS (Fixed In-core Detector Amplifier System) cabinet itself to process the incoming signals from fixed in-core detectors. The safety classification of FIDAS cabinet is classified as NNS (Non-Nuclear Safety) as specified in APR1400 FSAR Tier 2, Table 3.2-1, item 37. Therefore, it is considered that the Fixed In-Core Nuclear Signal Channel Test described in APR1400 FSAR Tier 2, Section 14.2.12.1.26 meets the requirements of General Design Criterion (GDC) 1 of Appendix A to 10 CFR Part 50.

1. As the title of FSAR Tier 2, Section 14.2.12.1.26 implies, item 1.2 is to verify the proper amplifier operation inside FIDAS cabinet itself, but does not include the verification of CET (Core Exit Thermocouple) itself, which are addressed in the post-core and power ascension test stages. Instead, as specified in items 1.3 and 1.4 of amended Section 14.2.12.1.26 that was submitted to the staff (ref. KHNP submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003), only the cable continuity and insulation resistance of the interface cables related with CET and in-core detectors are to be verified.

   In addition, the coverage of verification is clearly specified in item 1.1 and 1.2 of amended Section 14.2.12.1.26.

   The terminology "Fixed in-core nuclear signal channel instrumentation" in Prerequisite 2.2 will be revised to "Fixed in-core nuclear instrumentation signal channel" to be consistent with the terminology in DCD section 7.7.1.1.g.

2. Each in-core instrumentation (ICI) assembly is assembled such that five in-core detectors are located by equal distance from ICI bullet nose with the allowance of +/- 1 inch, which is ensured by the quality control program required by the procurement specification and administered by the vendor at the time of manufacturing. Verifying that the detectors are positioned correctly within the ICI bullet nose assembly is not an attribute that would be performed by the licensee after receipt of the equipment. Unlike in-core detector testing and core performance testing where it is important to assure that the ICI bullet nose is in the proper location within the fuel assembly, the Fixed In-Core Nuclear Signal Channel Test is performed by injecting test signals to ensure proper circuit processing.

If a mis-positioning of a detector exists, it can be found during the In-core Detector Test which is described in DCD Tier 2, Section 14.2.12.4.16.

The fixed in-core detectors are used for generating the power distribution. Before they are used, the operability of the each detector is determined. Operability is based on a wedge test and consistency test using the CECOR code system. The wedge test is a simple check to determine whether the detector signal is within the acceptable range. The consistency test is more complex. The power distributions are generated with and without each in-core detector and the generated power distributions are compared. If the difference is too large, then the detector is declared inoperable. If the determination finds that a detector is improperly positioned, then the detector is discounted and not used in the power distribution.

An operability check is not the sole process to find a mis-positioned detector. A detector can perform its intended function and defined as operable if the mis-positioning is not large. In this case, an acceptable power distribution can be generated with the mis-positioned detector signal. The measured distribution is compared to the expected power distribution. When the power distribution acceptance criteria are met, a mis-positioned detector may not be found because it has a small effect on the power distribution and the small mis-positioning of the detector is considered acceptable. When the acceptance criteria are not met, a cause investigation is conducted. The process may not be a simple task; test conditions, fuel mis-loading, design inaccuracies, adequacy of detector signals, and other possible reasons may all need to be investigated depending on the results. If mis-positioning of the detector is the reason for the discrepancy, it will be found in the subsequent systematic cause investigation process.

After the in-core detectors are installed, there is no credible means to check the mis-positioning of the detector before the Power Ascension Test (PAT) stage. During the PAT, mis-positioning of the detector can be found by the In-core Detector Test using the neutron flux signals from the in-core detectors. The tests using the power distribution from in-core detector signals (e.g., the Steady State Core Performance Test in DCD Tier 2, Section 14.2.12.4.10) have a prerequisite for operation of the in-core instrumentation system. This test prerequisite is an overall operability assessment of the in-core detector system including the proper location of the in-core detectors.

Based on the above justification, it is not necessary to add a prerequisite to 14.2.12.1. 26 to specify that the proper location of each in-core detector be verified.

Impact on DCD

DCD Tier 2 Subsection 14.2.12.1.26 will be revised as indicated in the attachment.

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.

1.2 To verify the measured output is provided to the IPS through the data link server and DCS network.

1.3 Verify Cable Continuity.

1.4 Verify Cable Insulation Resistance.

2.0 PREREQUISITES

Fixed in-core nuclear instrumentation signal channel

2.1 Construction activities on the in-core nuclear instrumentation system are complete~~.~~ and system software is installed (Detectors do not need to be installed~~.)~~).

2.2 ~~Fixed in-core nuclear signal channel instrumentation~~ has been calibrated.

2.3 External test equipment has been checked and calibrated.

2.4 Support systems required for operation of the in-core nuclear instrumentation system are operational.

3.0 TEST METHOD

3.1 Measure and record cabling insulation resistance.

3.2 Using external test instrumentation, simulate in-core detector signals into the signal conditioning circuits.

3.3 Using internal test circuits, test each amplifier for proper operation in accordance with manufacturer's instruction manual.

3.4 Vary the simulated inputs to the amplifier and record its values displayed by the information processing system.