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## 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.: 281-8232  
SRP Section: 14.02 – Initial Plant Test Program - Design Certification and New License Applicants  
Application Section: 14.02  
Date of RAI Issue: 11/02/2015

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### **Question No. 14.02-49**

10 CFR Part 50, Appendix E, Section IV, indicates that the emergency response data system is required to include various parameters, some of which are associated with radiation monitoring including, reactor coolant radioactivity, containment radiation level, condenser air removal radiation level, effluent radiation monitor, and process radiation monitor levels.

Regulatory Guide 1.68, "Initial Test Programs for Water-Cooled Nuclear Power Plants," provides guidance on initial tests that are acceptable to staff as part of the initial test program. Appendix A to Regulatory Guide 1.68 provides guidance on the types of tests that should be included as part of the initial test program. Section A-1.k. "Radiation Protection Systems" indicates that the initial test program should include a test to test that radiation data is being transmitted to the emergency response data system.

1. Please update FSAR Chapters 11 and 12 to specify which radiation monitors are responsible for transmitting the emergency response data system parameters required in 10 CFR Part 50, Appendix E.
2. Include a test in the applicable initial test program section 14.2 to ensure that each of these radiation monitors are accurately transmitting data to the emergency response data system and that the emergency response data system is accurately providing the correct data.

### **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. 1)**

1. The following radiation monitors are to have the capability to transmit the associated data via the ERDS link:

- Containment air monitor (RE-039A)
- Condenser vacuum pump vent effluent monitor (RE-063)
- Main steam line effluent monitors (RE-217, RE-218)

Subsections 11.5.2.2.5.e, 11.5.2.2.5.g, and 11.5.2.2.5.m are revised to state that these monitors transmit the radiation signals to the emergency response data system. The markups for the Subsections 11.5.2.2.5.e and 11.5.2.2.5.g have been included in the revised response to the RAI 131-8087 Question 11.05-1 transmitted previously via KHNP letter MKD/NW-16-0480L, dated May 11, 2016; ML16132A380.

2. These RMS parameters stated above are monitored by the gaseous process effluent radiation monitoring and sampling system (PERMSS). The gaseous PERMSS communicates with the information processing system (IPS) to transmit these parameters to ERDS. The IPS receives these parameters via unidirectional communication and transmits these parameters to the ERDS. The communication test between the gaseous PERMSS and the IPS is performed at the manufacturer's facility during the factory acceptance test. The communication test between the IPS and the ERDS is performed at the site during the initial test period. Since the manufacturer for the gaseous PERMSS has not been determined for APR1400, the test method for the communication between the gaseous PERMSS and IPS cannot be determined at this time. Therefore, the communication test between the gaseous PERMSS and the ERDS will be performed by the COL applicant. COL Item 14.2(12) has been added to ensure that the COL applicant is to perform the appropriate interface testing of the monitors with ERDS.

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### **Impact on DCD**

DCD Tier 2, Subsection 11.5.2.2.5.m, 14.2.13, and Table 1.8-2 will be revised as shown in the Attachment.

### **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.

## APR1400 DCD TIER 2

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Table 1.8-2 (25 of 29)

Item No.	Description
COL 14.2(8)	The COL applicant that references the APR1400 design certification is to identify the specific operator training to be conducted as part of the low-power testing program related to the resolution of TMI Action Plan Item I.G.1, as described in (1) NUREG-0660, "NRC Action Plans Developed as a Result of the TMI-2 Accident," Revision 1, August 1980 and (2) NUREG-0737, "Clarification of TMI Action Plan Requirements."
COL 14.2(9)	The COL applicant is to prepare the pre-operational test of cooling tower and associated auxiliaries, and raw water and service water cooling systems.
COL 14.2(10)	The COL applicant is to develop the test program of personnel monitors and radiation survey instruments.
COL 14.2(11)	The COL applicant is to develop the test procedure of the communication system.
COL 14.3(1)	The COL applicant is to provide the ITAAC for the site-specific portion of the plant systems specified in Subsection 14.3.3.
COL 14.3(2)	The COL applicant is to provide the proposed ITAAC for the facility's emergency planning addressed in Subsection 14.3.2.10.
COL 14.3(3)	The COL applicant is to provide the proposed ITAAC for the facility's physical security hardware addressed in Subsection 14.3.2.12.
COL 14.3(4)	The COL applicant is to provide a DAC closure schedule for implementing the piping DAC.
COL 15.0(1)	The COL applicant is to perform the radiological consequence analysis using site-specific $\chi/Q$ values, unless the $\chi/Q$ values used in the DCD envelop the site-specific short-term or long-term $\chi/Q$ values of the DCD, and to show that the resultant doses are within the guideline values of 10 CFR 50.34 for EAB and LPZ and that of 10 CFR Part 50, Appendix A, GDC 19 for the MCR and TSC.
COL 17.4(1)	The COL applicant is to develop and implement Phases 2 and 3 of the design RAP, including QA requirements. In Phase 2, the plant's site-specific information is to be subjected to the design RAP process, and the site-specific risk-significant SSCs are combined with the APR1400 design risk-significant SSCs into one list for the plant. Phase 2 is to be performed during the COL application phase and updated/maintained during the COL license holder phase. In Phase 3, procurement, fabrication, construction, and test specifications for the SSCs within the scope of the RAP provide reasonable assurance that key assumptions, such as equipment reliability, are realistic and achievable. The QA requirements are implemented during the procurement, fabrication, construction, and pre-operational testing of the SSCs within the scope of the RAP. Phase 3 is to be performed during the COL license holder phase and prior to initial fuel loading. The COL applicant is to propose a method for incorporating the objectives of the reliability assurance program into other programs for design or operational errors that degrade non-safety-related, risk-significant SSCs.

COL 14.2(12)

The COL applicant is to perform the appropriate interface testing of the gaseous PERMSS monitors with ERDS.

## A(2/2)

Calculation software estimates concurrent releases of lower energy noble gases that cannot be detected or measured by the methods or techniques employed. The monitor is an on-line type without actually drawing steam samples but satisfies the volumetric measurement requirements specified in the NRC RG 1.97. The calculation accurately estimates the amount of effluent releases using the measurement of the monitor plus open/close status of MSADVs and MSSVs as well as AFWP running status. The calculation is performed based on the following:

- a) The time period that the safety relief valves are open and valve flow capacity. The valve flow capacity is provided as a constant value.
- b) The time period that the atmospheric dump valves are open and valve flow capacity. The valve flow capacity is provided as constant value.
- c) Fixed steam flow value for AFWP turbine for the duration of turbine operation.

The calculation is initiated upon detection of high radiation in the steam line and either:

- a) Any valve out of 1 ADV and 5 MSSVs is open and/or,
- b) AFWP turbine is running.

The monitors provide indication and alarm to the MCR, RSR, and local RMS skid.

The monitors are located in Auxiliary Building as shown in Figure 11.5-2L (RE-217), Figure 11.5-2K (RE-218), Figure 11.5-2BB (RE-219), and Figure 11.5-2M (RE-220).

The method of detecting the SG leak rate is described in Appendix 11B.

The monitors transmit the radiation signals to the licensing entity via emergency response data system (ERDS) link.

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- COL 14.2(4) The COL applicant is to perform review and evaluation of individual test results.
- COL 14.2(5) The COL applicant is to develop the detailed description of test and acceptance criteria for the Security System.
- COL 14.2(6) The COL applicant is to develop a schedule for the development of the plant operating and emergency procedures should allow sufficient time for trial use of these procedures during the Initial Test Program. The schedule for plant startup is to be developed by the COL applicant to allow sufficient time to systematically perform the required testing in each phase.
- COL 14.2(7) The COL applicant is to describe its program for reviewing available information on reactor operating and testing experiences and discusses how it used this information in developing the initial test program. The description is to include the sources and types of information reviewed, the conclusions or findings, and the effect of the review on the initial test program.
- COL 14.2(8) The COL applicant that references the APR1400 design certification is to identify the specific operator training to be conducted as part of the low-power testing program related to the resolution of TMI Action Plan Item I.G.1, as described in (1) NUREG-0660 – NRC Action Plans Developed as a Result of the TMI-2 Accident, Revision 1, August 1980 and (2) NUREG-0737 – Clarification of TMI Action Plan Requirements.
- COL 14.2(9) The COL applicant is to prepare the preoperational test of cooling tower and associated auxiliaries, and raw water and service water cooling systems.
- COL 14.2(10) The COL applicant is to develop the test program of personnel monitors and radiation survey instruments.
- COL 14.2(11) The COL applicant is to develop the test procedure of the communication system.



COL 14.2(12) The COL applicant is to perform the appropriate interface testing of the gaseous PERMSS monitors with ERDS.

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### **Question No. 14.02-52**

SRP 14.2 indicates that the staff will review the adequacy of testing proposed for specific SSCs.

In FSAR Section 14.2.12.4.9, “Biological shield survey test,” the acceptance criteria indicate that accessible areas and occupancy times during power operation have been defined as described in subsection 12.3.2. However, FSAR subsection 12.3.2 does not provide any information on occupancy times. Please update FSAR subsection 12.3.2 to provide this information or reference an appropriate FSAR section.

### **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. 1)**

The original response resulted in a change to Acceptance Criteria 5.1 specified in DCD section 14.2.12.4.9 to refer to Table 12.3-2 rather than Subsection 12.3.2 for accessible areas and occupancy time during power operation. Additional changes to the Acceptance Criteria of ITP 14.2.12.4.9 were provided as a result of an upgrade initiative to DCD Section 14.2 (ref. KHNP submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003).

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Based on the staff's review and further clarification provided in a telephone conference call on April 7, 2016, KHNP is proposing additional revision to DCD Tier 2 Subsection 14.2.12.4.9, "Biological Shield Survey Test" and also a revision to Subsection 14.2.12.3.1 "Low-Power Biological Shield Survey Test." The proposed revision to Subsection 14.2.12.4.9, "Biological Shield (Primary Shield) Radiation Measurements Test" addresses radiation measurements at 5% or less, 50%, and 100% power levels to ensure that the radiation dose is acceptable and as designed. Subsection 14.2.12.3.1 "Baseline Biological Shield (Primary Shield) Radiation Measurements Test" is being revised to better describe the radiation survey that is performed prior to initial plant startup to establish radiation baseline levels for comparison of buildup resulting from normal power operation. Radiation zone designation and maximum stay time in each of the zones are well defined in DCD Subsection 12.3.2 Table 12.3-2 and on the radiation zone drawings. Therefore, DCD Subsection 14.2.12.4.9 does not need to contain this information. This approach is consistent with other license applications previously reviewed by the NRC.

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**Impact on DCD**

DCD Tier 2 Subsections 14.2.12.3.1 and 14.2.12.4.9 will be revised as indicated in Attachments 1 and 2.

**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 Environment Report.



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5.3 Interface between safety channel and startup and control channel should be satisfied

5.4 Boron Dilution Alarm System(BDAS) operate as designed

14.2.12.3 Low-Power Physics Test14.2.12.3.1 Low-Power Biological Shield Survey Test1.0 ~~OBJECTIVE~~ OBJECTIVES

1.1 To ~~measure~~ demonstrate the effectiveness of the radiation ~~in accessible locations of the plant outside the biological~~ shield

1.2 To obtain baseline levels for comparison with future measurements of radioactivity level buildup with operation

## 2.0 PREREQUISITES

2.1 Radiation survey instruments ~~are~~ have been calibrated.

2.2 Background radiation levels have been measured in designated locations prior to initial criticality.

## 3.0 TEST METHOD

3.1 Measure gamma and neutron dose rates during low-power (<5 percent rated thermal power ~~(RTP)~~) operation-

## 4.0 DATA REQUIRED

4.1 Power level

4.2 Gamma and neutron dose rates at each specified location

Replace this area with "A"

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## 5.0 ACCEPTANCE CRITERIA

Replace this area with  
"A"

- 5.1 ~~Baseline neutron and gamma surveys have been completed.~~
- ~~5.2 The biological shield survey test performs as described in Subsection 12.3.2.2.~~
- 5.2 Radiation levels shall be less than the maximum specified for the applicable zone.
- ~~5.3 Accessible areas and occupancy time during power operation shall be within the design values.~~

14.2.12.3.2 Isothermal Temperature Coefficient Test1.0 ~~OBJECTIVE~~OBJECTIVES

- 1.1 To measure the ~~isothermal temperature coefficients (ITCs)~~ITC for various ~~reactor coolant system (RCS) temperatures, pressures, and control element assembly (CEA) configurations~~
- 1.2 To determine the ~~moderator temperature coefficient (MTC)~~ from the measured ITC

## 2.0 PREREQUISITES

- 2.1 The reactor is critical with a stable boron concentration and the desired CEA configuration and RCS temperature and pressure.
- 2.2 The reactivity computer is operable.

## 3.0 TEST METHOD

- 3.1 Changes in RCS temperature are introduced and the resultant changes in reactivity measured.

"A"

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14.2.12.3.1 Baseline Biological Shield (Primary Shield) Radiation Measurements Test

1.0 OBJECTIVES

1.1 To demonstrate the effectiveness of the primary shield.

1.2 To obtain baseline radiation levels for comparison with future measurements of radioactivity level buildup with operation.

2.0 PREREQUISITES

2.1 The required preoperational tests have been completed and plant management has approved the initiation of radiation measurement testing.

2.2 Radiation survey instruments have been calibrated.

3.0 TEST METHOD

3.1 Measure baseline gamma and neutron dose rates before initial power operation.

3.2 The radiation levels outside the biological (primary) shield are determined via a radiation survey. The radiation tests include gamma dose rates as well as neutron dose rates. Radiation surveying is conducted in all accessible areas including potentially high and very high radiation areas where intermittent activities have the potential to produce transient high exposure conditions.

4.0 DATA REQUIRED

4.1 Gamma dose rate in accessible locations

4.2 Neutron dose rate in accessible locations

5.0 ACCEPTANCE CRITERIA

5.1 Radiation levels are acceptable and meet design requirements.

5.2 Administrative control procedures are in place to ensure that the occupancy times in the radiation zones during power operation are consistent with the design and the guidance of 10 CFR 20, "Standards for Protection Against Radiation."

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## 5.0 ACCEPTANCE CRITERIA

5.1 ~~The reactor is shut down and~~ NSSS shall be maintained in hot standby ~~on emergency power~~ for at least thirty (30) minutes ~~during on emergency power following~~ a simulated loss of main generator and offsite power ~~as described in Subsection 15.~~

~~5.2.1~~ The AFWS automatically shall initiate auxiliary feedwater flow to both steam generators and maintain the desired steam generator levels within the design value.

14.2.12.4.9 Biological Shield Survey Test1.0 ~~OBJECTIVE~~ OBJECTIVES

- 1.1 To measure the radiation levels in accessible locations of the plant outside the biological shield
- 1.2 To determine occupancy times for these areas during power operation

## 2.0 PREREQUISITES

- 2.1 Radiation survey instruments have been calibrated.
- 2.2 ~~Results of the radiation surveys performed at zero power conditions are available.~~

Replace this area with "B"

## 3.0 TEST METHOD

- 3.1 Measure gamma and neutron dose rates at 50 and 100 percent power levels.

## 4.0 DATA REQUIRED

- 4.1 Power level

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4.2 Gamma dose rates in the accessible locations

4.3 Neutron dose rates in the accessible locations

5.0 ACCEPTANCE CRITERIA

~~5.1 Accessible areas and occupancy times during power operation have been defined as described in Subsection 12.3.2.~~

~~5.2 5.1 The biological shield survey test performs as described in Subsection 12.3.2.2.~~

~~5.2 Radiation levels shall be less than the maximum specified for the applicable zone.~~

~~5.3 Accessible areas and occupancy times during power operation shall agree with the design values.~~

14.2.12.4.10 Steady-State Core Performance Test1.0 ~~OBJECTIVE~~OBJECTIVES~~1.1 To determine core power distributions using in-core instrumentation~~~~1.2 To demonstrate that the core has been assembled as designed~~

1.1 To compare measured values with predicted parameters at the selected power plateaus for the radial power distribution, axial power distribution, and peaking factors

## 2.0 PREREQUISITES

2.1 The reactor is operating at the desired power level and ~~control element assembly (CEA)~~ configuration with equilibrium xenon.

Replace this area with "B"

"B"

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## 14.2.12.4.9 Biological Shield (Primary Shield) Radiation Measurements Test

## 1.0 OBJECTIVES

- 1.1 To obtain radiation levels for comparison with measurements of radioactivity level buildup with operation.
- 1.2 To measure the radiation levels at selected power levels in accessible locations of the plant to assure the protection of personnel during plant operation.

## 2.0 PREREQUISITES

- 2.1 The required preoperational tests have been completed and plant management has approved the initiation of radiation measurement testing.
- 2.2 Results of background radiation and surveys performed at less than 5% power conditions are available.
- 2.3 Radiation survey instruments have been calibrated.
- 2.4 For each testing iteration, the plant has been set-up to the appropriate operational configuration.

## 3.0 TEST METHOD

- 3.1 Measure gamma and neutron dose rates at 5, 50, and 100 percent power levels.
- 3.2 The radiation levels outside the biological (primary) shield are determined via a radiation survey at various power levels. The radiation tests include gamma dose rates as well as neutron dose rates. Radiation surveying is conducted in all accessible areas including potentially high and very high radiation areas where intermittent activities have the potential to produce transient high exposure conditions.

## 4.0 DATA REQUIRED

- 4.1 Power Level
- 4.2 Gamma dose rate in accessible locations at each power level
- 4.3 Neutron dose rate in accessible locations at each power level

## 5.0 ACCEPTANCE CRITERIA

- 5.1 Radiation levels are acceptable and meet design requirements.

"B"

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- 5.2 The occupancy times in the radiation zones during power operation shall be controlled to be within the radiation zone designated stay times to ensure that the radiation doses to plant personnel are consistent with the guidance of 10 CFR 20, "Standards for Protection Against Radiation."