
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: 14.2
Date of RAI Issue: 11/02/2015

Question No. 14.02-51

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

In FSAR Sections 14.2.12.3.1, "Low-power biological shield survey test" and 14.2.12.4.9, "Biological shield survey test," the acceptance criteria indicate that the biological shield performs as described in Subsection 12.3.2.2, however, subsection 12.3.2.2 provides no information on how the biological shield is expected to perform. Please clarify what is meant by this statement, update FSAR subsection 12.3.2.2 to provide information on the shielding criteria for the biological shield, or update 14.2.12.3.1 and 14.2.12.4.9 to reference an accurate section.

Response – (Rev. 1)

As a result of related comments that resulted from review of KHNP's response to RAI 281-8232 Question 14.02-52, changes to DCD Tier 2 Subsection 14.2.12.3.1, "Low-Power Biological Shield Survey Test" and Subsection 14.2.12.4.9 "Biological Shield Survey Test" are being proposed. Subsection 14.2.12.3.1 is being revised to "Baseline Biological Shield (Primary Shield) Radiation Measurements Test" to describe the radiation survey to be performed around the primary shield structure areas prior to initial power operation to establish radiation baseline levels for comparison of buildup resulting from normal power operation (Please refer to Attachment 1 of this response). Subsection 14.2.12.4.9 is being revised to "Biological Shield (Primary Shield) Radiation Measurements Test" and addresses radiation measurements at 5% or less, 50%, and 100% power levels to ensure that the radiation dose is acceptable and as designed (Please refer to Attachment 2 of this response). The Biological Shield (Primary Shield) Radiation Measurements Test includes, which may include areas adjacent to the reactor, steam generators, reactor coolant pumps, and the pressurizer (RCS components), [high and very high radiation areas inside the Auxiliary Building and the Compound Building. These designated areas are identified in DCD Subsections 14.2.12.3.1 and 14.2.12.4.9 for clarity.](#) The reference to DCD Tier 2 Subsection 12.3.2.2 has been removed, since the acceptance criteria for "Baseline Radiation Measurements Test" and the "Radiation Measurements Test" are provided in Sub-item

5 “Acceptance Criteria” of Subsections 14.2.12.3.1 and 14.2.12.4.9, respectively in DCD Tier 2 Chapter 14.

The term ‘primary shield’ refers to the heavily reinforced concrete structure that houses the reactor vessel, provides the primary radiation shielding, and provides protection for the reactor vessel from internal missiles (DCD Tier 2 Subsection 3.8.3.1.5). The term, ‘secondary shield’ refers to the reinforced concrete structure surrounding the steam generators, the reactor coolant pumps, and the pressurizer (DCD Tier 2 Subsection 3.8.3.1.6). The term, ‘biological shield’ is a general term used for the provision of shielding against radiation around the primary and the secondary shielding structures. Since the baseline and the regular radiation measurement tests not only include areas of the RCS components, but also include high and very high radiation areas adjacent to these components, DCD Subsections 14.2.12.3.1 and 14.2.12.4.9 are revised accordingly.

The revised DCD Tier 2 Subsection 14.2.12.3.1, “Baseline Biological Shield (Primary Shield) Radiation Measurements Test” and Subsection 14.2.12.4.9 “Biological Shield (Primary Shield) Radiation Measurements Test” are the same as that proposed in the response to RAI 281-8232 Question 14.02-52 Rev. 1.

Impact on DCD

DCD Tier 2 Subsection 14.2.12.3.1 and Subsection 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

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 Test

Replace this area with "A"

1.0 ~~OBJECTIVE~~ OBJECTIVES1.1 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."

in areas adjacent to the reactor, the steam generators, the reactor coolant pumps, and the pressurizer; and high and very high radiation areas inside the Auxiliary Building and the Compound Building

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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.~~

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

Replace this area with
"B"

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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 Test

1.0 ~~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.

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"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.

in areas adjacent to the reactor, the steam generators, the reactor coolant pumps, and the pressurizer; and high and very high radiation areas inside the Auxiliary Building and the Compound Building

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."