REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

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Question No. 14.02-41

Preoperational Test 14.2.12.1.2 “Reactor Coolant System Test”

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 structures, systems, and components (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. NRC Regulatory Guide (RG) 1.68, “Initial Test Programs for Nuclear Power Plants,” provides guidance on the initial test program.

General Design Criterion (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 (SSCs) important to safety shall be tested to quality standards commensurate with the importance of the safety functions to be performed.

For consistency with RG 1.68, Regulatory Guide C.3, the NRC staff considers that the RCP preoperational tests should be performed because they can detect early burn-in failures where SSCs exhibit high failure rates when first introduced or operated due to defects, design errors, and other early sources of potential failures, such as handling and installation errors. Preoperational testing as part of the initial test program (ITP) can significantly reduce the possibility of SSCs failing early in plant operation by identifying and correcting these early sources of failures. In particular, failures of the RCPs can result in unexpected plant transients that challenge plant safety systems.

The APR1400 design certification (DC) applicant identified the following test methods, data required and acceptance criteria in APR1400 DCD Tier 2, Section 14.2.12.1.2:

3.0 TEST METHODS

3.1 Simulate temperature, pressure, and flow signals from each RCP [reactor coolant pumps] and verify alarm setpoints.
3.2 Simulate temperature signals from each RCS [reactor coolant system] resistance temperature detector (RTD) that has an alarm function and verify alarm setpoints.
3.3 Perform initial venting of RCPs, pressurizer, and reactor vessel.
3.4 Perform initial run of RCPs. Vent the RCS after each run is complete.
4.0 DATA REQUIRED
4.1 Setpoints at which alarms occur
4.2 RCP Performance Data
5.0 ACCEPTANCE CRITERIA
5.1 RCS and RCP Performance and alarms are as described in Subsections 5.4.1 and 5.4.3.

The NRC staff review of APR1400 DCD Tier 2, Sections 5.4.1 through 5.4.3 indicated that the DC applicant should provide additional information related to preoperational test methods in DCD Sections 14.2.12.1.2 and/or 14.2.12.1.7 to address defense in depth and important to safety functions related to the RCPs, such as:

3.4 Perform calibration and operational check of instruments used to monitor RCP seals performance, including seal filters and differential pressure alarms.
3.5 Perform operational check of the auxiliary charging pump and discharge check valves open to provide adequate flow for a diverse means of seal water injection if normal RCP seal cooling is lost.
3.6 Perform operational check of the acoustic leak sensor for leakage past the RCP vapor seal.
3.7 Perform calibration and operational check of RCP bearing metal temperature detectors, oil flow and pressure, oil levels, cooling water flow and temperature alarms from the control room.
3.8 Perform operational check of the RCP Vibration Monitoring System (VMS) to respond to bearing degradation.
3.9 Verify proper RCS flow rates from the RCPs meet the flow rate range in Technical Specification 3.4.1 (DCD Chapter 16).

It is noted that test method 3.4 should be moved to test methods 3.10 as noted below

3.10 Perform initial run of RCPs. Vent the RCS after each run is complete.

The DC applicant should also provide the test acceptance criteria for each of the test methods described above.

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)

As part of the specified upgrade effort, KHNP provided revised testing plans for RCP systems related to RCP operation, (ref. KHNP submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003). The information to address defense in depth and important to safety functions related to the RCPs are provided as follows.

The calibration of the RCP seal pressure and temperature instrumentation is included in prerequisite 2.2 for the Reactor Coolant System Test (14.2.12.1.2). The acceptance criteria for performing the initial run of the RCPs (test method 3.4) with RCP seal pressures and temperatures within design limits and normal operating ranges are included in 5.11 of the Reactor Coolant System Test (14.2.12.1.2).

The operational check of instruments used to monitor RCP seal injection performance, including seal filters and differential pressure alarms are performed in the testing described in DCD Subsection 14.2.12.1.7 Chemical and Volume Control System Charging Subsystem Test. The acceptance criteria 5.11 and 5.15 will be revised and 5.16 through 5.18 will be added to clearly include all of the objectives.

The operational check of the auxiliary charging pump and discharge check valves to open to provide adequate flow for a diverse means of seal water injection, if normal RCP seal cooling is lost, is also performed in the testing described in DCD Subsection 14.2.12.1.7 Chemical and Volume Control System Charging Subsystem Test, (refer to test method 3.8 and acceptance criteria 5.5). The Chemical and Volume Control System Charging Subsystem Test is one of the prerequisite pre-operational tests for the RCS test.

The operational check of the acoustic leak sensor for leakage past the RCP vapor seal using simulated signals is performed with the testing described in DCD Subsection 14.2.12.1.43, Acoustic Leak Monitoring System Test. Collecting baseline RCP seal leakage data for ALMS is performed during pre/post-core HFT and at the applicable power levels in the testing described in DCD Subsections 14.2.12.1.137, NSSS Integrity Monitoring System (Pre-core), 14.2.12.2.2, NSSS Integrity Monitoring System (Post-core), and 14.2.12.4.18, NSSS Integrity Monitoring System.

The instrumentation calibration for RCP bearing metal temperature, oil flow and pressure, oil levels, cooling water flow and temperatures are included in prerequisites 2.2 and 2.3 for the Reactor Coolant System Test (14.2.12.1.2). The acceptance criteria for performing the initial run of the RCPs (test method 3.4) with RCP bearing metal temperature detectors, oil flow and pressure, oil levels within design limits and normal operating ranges are included in 5.11 of the Reactor Coolant System Test (14.2.12.1.2).

The operational check of the RCP Vibration Monitoring System (VMS) using simulated signals is performed in the testing described in DCD Subsection 14.2.12.1.136, RCP Vibration Monitoring System. Collecting baseline RCP vibration data is performed during pre/post-core HFT and at the applicable power levels in the testing described in DCD Subsections 14.2.12.1.137, NSSS Integrity Monitoring System (Pre-core), 14.2.12.2.2, NSSS Integrity Monitoring System (Post-core), and 14.2.12.4.18, NSSS Integrity Monitoring System.

Verification that the proper RCS flow rates from the RCPs meet the flow rate range in Technical Specification 3.4.1 is performed in the testing described in DCD Subsection 14.2.12.2.3, Post-Core Reactor Coolant System Flow Measurements.

The test acceptance criteria for each of the test methods are included in DCD Subsections 14.2.12.1.2, 14.2.12.1.7, 14.2.12.1.43, 14.2.12.1.136, 14.2.12.1.137, 14.2.12.2.2, 14.2.12.2.3, and 14.2.12.4.18.

The objective to verify the automated calibration feature is being deleted in subsection 14.2.12.1.43, Acoustic Leak Monitoring System Test, since it does not pertain to this test. Also the prerequisite for the data analysis, trending, and storage software to be operable is not necessary for this test and will also be deleted. The terminology IVMS is corrected to RCPVMS in subsection 14.2.12.1.136.

Impact on DCD

DCD subsections 14.2.12.1.7, 14.2.12.1.43 and 14.2.12.1.136 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 Specifications.

Impact on Technical/Topical/Environmental Reports

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

4.10 Charging pump head vs. flow

4.11 Auxiliary charging pump running data

5.0 ACCEPTANCE CRITERIA

5.1 The CVCS charging subsystem performs as described in Subsection 9.3.4.2.1.

5.2 At rated flow condition, charging pumps miniflow is within the design value

5.3 Shut-off head of charging pumps is less than design limit

5.4 Rated head of charging pumps is within design range

5.5 Auxiliary charging pump is capable of providing a flow of minimum design value through auxiliary charging pump discharge check valve.

5.6 Suction trip pressure of charging pumps and auxiliary charging pump is verified as specified

5.7 Maximum charging flow in each flow paths is within design range

5.8 The charging pump and auxiliary charging pump stops on the load shed signal

5.9 The suction pressure shall be greater than design value while the following suction flow paths allow the operation of a charging pump

5.10 The suction pressure shall be greater than design value while the following suction flow paths allow the operation of the auxiliary charging pump

Pressure and flow alarms

, seal injection and RCP controlled bleedoff lines

5.11 ~~Alarms~~ and setpoint in the charging ~~line~~ should meet the required value

5.12 Low, high and high-high flow in the seal injection is within design values

5.13 CVCS charging and seal injection subsystem valves can be opened and closed by their respective hand switches as specified

5.14 CVCS charging and seal injection subsystem valve stroke time (open and close) should meet the required time

and seal injection subsystem valve interlocks and control function are

5.15 CVCS charging ~~subsystem valve interlock is~~ verified as specified

14.2.12.1.8 Chemical Addition Subsystem Test

1.0 OBJECTIVES

1.1 To verify proper op

1.2 To verify the flow CAT

5.16 The flow is verified to be established through the charging and seal injection flow paths.
5.17 CVCS charging, seal injection, and RCP controlled bleedoff lines instrumentation channels are operated properly as specified.
5.18 The RCP controlled bleedoff containment isolation valves are closed on CSAS.

1.3 To verify the flow path from the CAT to LWMS

2.0 PREREQUISITES

2.1 Support systems required for operation of the chemical addition subsystem are complete and operational.

2.2 The chemical addition tank has been filled from the makeup system with a predetermined amount of RMW.

2.3 The charging subsystem is in operation.

2.4 Associated instrumentation has been calibrated.

1.2 To adjust the alarm setpoints under operational conditions.

Delete

~~1.3 To verify automated calibration features~~

2.0 PREREQUISITES

2.1 Construction activities on the NIMS applicable to the ALMS are complete.

2.2 Sensors, cables, and signal conditioning electronics are installed and operable.

2.3 Power cabinets, test circuits, and amplifiers are ready to support testing.

2.4 Required test equipment is operable.

Delete

~~2.5 Data analysis, storage, and trending software is operable.~~

3.0 TEST METHOD

3.1 Verify the calibration and alarm setpoints using simulated signals to the acoustic monitoring channels.

3.2 Verify all alarm functions.

3.3 Establish the alarm level. This alarm level applies to the preoperational test phase, to startup, and to power operations.

4.0 DATA REQUIRED

4.1 Baseline acoustic data

4.2 Alarm levels applicable to detection of coolant leaks

3.3 Perform a walkdown and visual inspection of all the piping.

3.3 If any leakage is found, perform corrective maintenance for all practically repairable leakage.

3.4 If the system must be shutdown for corrective maintenance, complete the system walkdown and record all the leakage information.

4.0 DATA REQUIRED

4.1 Alarms, indications, and control logic for safety injection system, shutdown cooling system, containment spray system and primary sampling system instrumentation

5.0 ACCEPTANCE CRITERIA

5.1 The leakage control and detection of outside containment system operates as described in section 9.3.3.

5.2 Leakages identified, all practical corrective maintenances performed, and all remaining leakages quantified.

14.2.12.1.136 RCP Vibration Monitoring System

1.0 OBJECTIVES

1.1 To verify the proper operation of the RCPVMS of the NIMS

2.0 PREREQUISITES

RCPVMS

2.1 Construction activities on the NIMS applicable to the ~~IVMS~~ are completed.

2.2 Sensors, cables, and signal conditioning electronics are installed and operable.