

KHNPDCDRAIsPEm Resource

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Sent: Friday, October 30, 2015 5:08 PM
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Subject: APR1400 Design Certification Application RAI 279-8175 (14.2 - Initial Test Program)
Attachments: APR1400 DC RAI 279 QVIB 8175.pdf

KHNP,

The attachment contains the subject request for additional information (RAI). This RAI was sent to you in draft form. Your licensing review schedule assumes technically correct and complete responses within 30 days of receipt of RAIs.

Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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Mail Envelope Properties (d1f16376e8584534b8fd125b2d104566)

Subject: APR1400 Design Certification Application RAI 279-8175 (14.2 - Initial Test Program)
Sent Date: 10/30/2015 5:07:50 PM
Received Date: 10/30/2015 5:07:51 PM
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Files	Size	Date & Time
MESSAGE	666	10/30/2015 5:07:51 PM
APR1400 DC RAI 279 QVIB 8175.pdf		117737

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Issue Date: 10/30/2015

Application Title: APR1400 Design Certification Review – 52-046

Operating Company: Korea Hydro & Nuclear Power Co. Ltd.

Docket No. 52-046

Review Section: 14.02 - Initial Plant Test Program - Design Certification and New License Applicants

Application Section: SRP Section 14.2 and RG 1.68

QUESTIONS

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

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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.

14.02-42

Preoperational Test 14.2.12.1.1, Reactor Coolant Pump Motor Initial Operation Test

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.

NRC Regulatory Guide (RG) 1.68, "Initial Test Programs for Nuclear Power Plants," Appendix A, "Initial Test Program," Section A-1.a, Reactor Coolant System, states, in Subsection A-1.a.2, *Component Tests*, that the following reactor coolant system (RCS) components should undergo appropriate tests and measurements:

- b. pumps, motors, and associated power sources.

For consistency with RG 1.68, Regulatory Guide C.3, the NRC staff considers the RCP motor preoperational tests noted above should be included in DCD Section 14.2.12.1.1 because they

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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 operational service by identifying and correcting these early sources of failures. In particular, failures of the RCP motors can result in unexpected plant transients that challenge plant safety systems.

In accordance with RG 1.26, Quality Group Classification and Standards For Water-, Steam, and Radioactive-Waste-Containing Components of Nuclear Power Plants, Revision 4, the NRC staff found that the RCP motors are typically classified as non-safety related Class D components for other nuclear power plants. However, the APR1400 design control document (DCD) does not identify the RCP motors as Class D components. Since the APR1400 design certification (DC) applicant is committed to RG 1.26 and RG 1.68, Revision 4, the NRC staff requests that the DC applicant discuss the performance of the following pump motor preoperational tests (or similar tests) and their acceptance criteria as part of the ITP for the APR1400 RCPs:

- Motor Current
- Motor Power
- Pump Motor Vibration
- Motor Stator temperature
- Proper transfer from variable speed startup operation

This may also include verification that the motor over-speed trip function operates to protect the RCP motor and impeller.

14.02-43

NRC Regulatory Guide (RG) 1.68, "Initial Test Program for Nuclear Power Plants," Appendix A, "Initial Test Program," Section A-1, "Preoperational Testing," Subsection A-1.a. "Reactor Coolant System," states, in part, that:

The reactor coolant system (RCS) includes all pressure containing components (such as pressure vessels, piping, pumps, and valves) within the reactor coolant pressure boundary, as defined in 10 CFR 50.2, "Definitions." For the reactor coolant system the following tests should be performed:

1. *Integrated Systems Tests.* Perform expansion and restraint tests to confirm the acceptability of clearances and displacements of vessels; piping; piping hangers; and seismic and other hold down, support, or restraining devices in the as built system during normal hot functional testing plant conditions. The system should be subjected to hot and/or cold testing with simultaneous operation of auxiliary systems.
2. *Component Tests.* The following RCS components should undergo appropriate tests and measurements:
 - a. pressurizer, including pressurizer heaters and pressurizer spray and throttle valves (PWR);
 - b. pumps, motors, and associated power sources;

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- c. steam generators;
 - d. pressure relief valves, block valves, and associated dump tanks, as well as supports and restraints for discharge piping;
 - e. other valves;
 - f. instrumentation used to monitor system performance or perform permissive and prohibit interlock functions;
 - g. reactor vessel and reactor internal vent valves;
 - h. safety and relief valves including testing of acoustic monitors used to detect leakage downstream from safety and relief valves;
 - i. heat exchangers;
3. Vibration Tests. The Reactor internal and other components, such as piping systems, heat exchangers and rotating machinery undergo vibration testing (i.e., to meet RG.120)
4. Pressure Boundary Integrity Tests. All pressure boundaries should be subject to hydrostatic tests to obtain baseline data for subsequent inservice inspection and testing.

The NRC staff noted that many of the RCS test descriptions in APR1400 DCD Section 14.2.12.1, "Preoperational Tests," start out at the RCS component or subsystem level, instead of RCS integrated system test level followed by component tests, vibration tests, and the pressure boundary integrity tests.

The NRC staff identified the following RCS related preoperational tests at the component and sub-system level in DCD Section 14.2.12.1 include:

- 14.2.12.1.1, Reactor Coolant Pump Motor Initial Operation Test
- 14.2.12.1.2, Reactor Coolant System Test
- 14.2.12.1.3, Pressurizer Pilot-Operated Safety Relief Valve (POSRVs) Test
- 14.2.12.1.4, Pressurizer Pressure and Level Control Systems Test
- 14.2.12.1.9, Reactor Coolant Drain Tank Subsystem Test
- 14.2.12.1.22, Safety Injection Tank Subsystem Test
- 14.2.12.1.35, Reactor Cooling System Hydrostatic Test
- 14.2.12.1.37, Safety Depressurization and Vent System Test
- 14.2.12.1.41, Internal Vibration Monitoring System Test
- 14.2.12.1.43, Acoustic Leak Monitoring System Test
- 14.2.12.1.46, Pre-Core Hot Functional Test Controlling Document
- 14.2.12.1.47, Pre-Core Instrument Correlation
- 14.2.12.1.51, Pre-Core Reactor Coolant System Expansion Measurements
- 14.2.12.1.52, Pre-Core Reactor Coolant and Secondary Water Chemistry Data
- 14.2.12.1.53, Pre-Core Pressurizer Performance Test
- 14.2.12.1.55, Pre-Core Reactor Coolant System Flow Measurements
- 14.2.12.1.56, Pre-Core Reactor Coolant System Heat Loss Measurement
- 14.2.12.1.57, Pre-Core Reactor Coolant System Leak Rate Measurement

However, the list noted above may not be all inclusive for identifying all the RCS preoperational tests. The NRC staff determined that APR1400 DCD Section 14.2.12.1.35 should address the vibration tests needed to meet RG 1.20 and that DCD Subsection 14.2.12.1.41 should cover the pressure boundary integrity tests needed to meet RG 1.68.

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The NRC staff could not verify that the DC applicant adequately addressed all of the RCS component preoperational tests listed in RG 1.68, Appendix A, Subsection A-1.a, Reactor Coolant System, Item 2, Component Tests. For example, the NRC staff could not identify preoperational tests under the RCS preoperational test program for some components and subsystem preoperational tests listed above for block valves, other valves, instrumentation used to monitor system performance or perform permissive and prohibit interlock functions, and heat exchangers listed in RG 1.68, Appendix A, Subsection A-1.a, Reactor Coolant System, Item 2, Component Tests.

Please justify the use of several different RCS component and subsystem preoperational tests noted above to meet the intent of RG 1.68, Appendix A, Subsection A-1, or expand DCD Subsection 14.2.12.1.2, "Reactor Coolant System Preoperational Tests," to include the preoperational tests listed in the DCD Subsections above, including any other RCS components listed in RG 1.68, Appendix A, Subsection A-1.a, Item 2, Component Tests. Please provide additional information in the appropriate preoperational tests noted above or add the information to DCD Subsection 14.2.12.1.2. The information should capture adequate test objectives, test prerequisites, test methods, data required and test acceptance criteria to verify that the preoperational tests for the RCS will demonstrate that the RCS can perform its intended functions to safely operate the plant before plant fuel load and initial operations.

Please update all 178 tests within the scope of the APR 1400 DC Section 14.2, "Initial Plant Test Program" to capture adequate test objectives, test prerequisites, test methods, data required and test acceptance criteria from the APR1400 DCD design chapters to meet the guidance in RG 1.68, Appendix A, Initial Test Program.