

KHNPDCDRAIsPEm Resource

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Sent: Monday, July 20, 2015 1:05 PM
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Cc: Talbot, Frank; Kavanagh, Kerri; Olson, Bruce; Lee, Samuel
Subject: APR1400 Design Certification Application RAI 91-7867 (14.02 - Initial Plant Test Program - Design Certification and New License Applicants)
Attachments: image001.jpg; APR1400 DC RAI 91 QVIB 7867.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. However, KHNP requests, and we grant, the following days to respond to the RAI's questions. We may adjust the schedule accordingly.

14.02-2: 60 days
14.02-3: 60 days
14.02-4: 30 days
14.02-5: 30 days
14.02-6: 60 days
14.02-7: 60 days
14.02-8: 60 days
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Please submit your RAI response to the NRC Document Control Desk.

Thank you,

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REQUEST FOR ADDITIONAL INFORMATION 91-7867

Issue Date: 07/20/2015

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: APR1400 DCD Sectio 14.2

QUESTIONS

14.02-2

APR-1400 Tier 2 DCD Section 14.2, Table 14.2-7, "Conformance Matrix of RG 1.68, Appendix A Versus Individual Test Systems," Page 14.2-317, matches RG 1.68, Appendix A, Test 1.a.2.h, "Reactor Vessel and Reactor Internal Vent Valves," with the following APR1400 Individual Tests:

RG 1.68, APP A	Subsection #	Individual Test
1.a.2.h	14.2.12.1.41	Internals vibration monitoring system test
	14.2.12.1.42	Loose parts monitoring system test
	14.2.12.1.43	Acoustic monitoring system test

The DC applicant does not reference APR1400 Subsections 14.2.12.1.2, "Reactor Coolant System Test," and 14.2.12.1.37, "Safety Depressurization and Vent System Test." in Table 14.2-7 which includes testing of the reactor coolant gas vent system using vent valves for a number of major reactor coolant system (RCS) components (e.g., reactor vessel upper head vent valves, pressurizer vent valves, etc.) in the reactor coolant system.

INFORMATION NEEDED

1. The DC applicant should add Subsections 14.2.12.1.2 and 14.2.12.1.37 as noted below to this part of Table 14.2-7.

RG 1.68, APP A	Subsection #	Individual Test
1.a.2.h	14.2.12.1.2	Reactor coolant system test
	14.2.12.1.37	Safety depressurization and vent system test
	14.2.12.1.41	Internals vibration monitoring system test
	14.2.12.1.42	Loose parts monitoring system test
	14.2.12.1.43	Acoustic monitoring system test

2. The DC applicant should verify if other APR1400 test abstract subsections are correctly referenced in Table 14.2-7 for conformance with RG 1.68, Appendix A.

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14.02-3

REQUIREMENT

In APR1400 DCD Chapter 1, Table 1.91, "APR1400 Conformance to NRC Regulatory Guides," Page 1.9-15, and DCD Subsection 14.2.7.3, NRC Regulatory Guide 1.79, "Preoperational Testing of Emergency Core Cooling Systems for Pressurized Water Reactors," the DC applicant commits to Regulatory Guidance in RG 1.79.

RG 1.79, Prerequisite Section, page 4, 1st paragraph, 1st through 6th sentences state:

"NRC Regulatory Issue Summary (RIS) 2013-09, NRC Endorsement of NEI 09-10, Revision 1a-A, Guidelines for Effective Prevention and Management of System Gas Accumulation (Ref. 6) endorses Nuclear Energy Institute (NEI) topical report No. 09-10, Guidelines for Effective Prevention and Management of System Gas Accumulation, Rev. 1a-A, (Ref. 7) as an acceptable and recommended approach to managing gas accumulation in power reactor piping systems. The NRC staff uses this guidance when evaluating the applicant or licensee's treatment of gas accumulation concerns. As a prerequisite to ECCS preoperational tests, the licensee or applicant should verify that all types of non-condensable gases (i.e., air, hydrogen, nitrogen, oxygen, etc.) in the ECCS systems are kept to an acceptable level. This verification should be accomplished by performing nondestructive examination techniques, opening vent valves to remove non-condensable gases, or by other methods justified through an engineering evaluation. The engineering evaluation should consider void volume, void transport to pumps and pump void acceptance criteria and include performance of void transport analysis. The evaluation should document the rationale and determination that gas intrusion into the ECCS system would not adversely affect the ability of the system to perform its function. If non-condensable gases are vented through high-point vent valves, verify closure of the valves before starting the ECCS pumps (active PWR plants designs only)."

ISSUE

To meet the prerequisite regulatory guidance in RG 1.79, the DC applicant should verify if adequate prerequisite test checks are performed on vent valves in safety related ECCS systems in APR1400 DCD Section 14.2. For example, APR1400 DCD Subsection 14.2.12.1.20, "Shutdown Cooling System Test," contains Prerequisite 2.5, "All lines in the shutdown cooling system have been filled and vented," but the prerequisite does not include any engineering evaluation for non-condensable gas intrusion into ECCS systems or prerequisite test checks to verify vent valves are closed before starting the shutdown cooling system pumps.

INFORMATION NEEDED

1. Please provide an engineering evaluation for gas intrusion into the ECCS systems and pre-requisite test checks to verify the vent valves are closed before starting the ECCS pumps.

14.02-4

Consistent with the Regulatory Guidance in RG 1.206, Section C.I.14, "Verification Programs," and RG 1.68, Revision 4 and NRC review and approval of other DC applications, the DC applicant for the APR1400 provided a list of COL responsibilities related to the Initial Test Program in DC Section 14.2.13, Combined Licensee Information. To meet the Regulatory Guidance in RG 1.206, Section C.I.14, SRP Section 14.2 and RG 1.68, the NRC staff also identified some additional administrative control changes to COL applicant responsibilities that should be added to DCD Subsection 14.2.13 in accordance with the following text corrections:

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- COL 14.2(1) The COL applicant is to develop the site-specific organization and staffing levels appropriate for its facility to implement the initial test program. The COL's plant operating and plant technical staff should participate, to the extent practical, in developing and conducting the Initial Test Program and evaluating the test results.
- COL 14.2(2) The COL applicant is to prepare the site specific preoperational and startup test specifications and test procedures and/or guidelines that is to be used for the conduct of the plant startup program Initial Test Program. The preoperational and startup test procedures should have controls in place to ensure that test procedures include appropriate prerequisites, objectives, safety precautions, initial test conditions, methods to direct and control test performance and test acceptance criteria by which the test is evaluated. Testing performed at other than design operating conditions for systems is to be reconciled either through the test acceptance criteria or post-test data analysis. These procedures are to be submitted at least 60 days prior to their intended use to the NRC staff for review as described in Subsection 14.2.11.
- COL 14.2(3) The COL applicant is to prepare a startup administrative manual and also provide preoperational and startup test summaries that contain testing objectives and acceptance criteria applicable for its scope of the plant design. Testing performed at other than design operating conditions for systems is to be reconciled either through the test acceptance criteria or post test data analysis (SAM) which contains administrative controls that govern the conduct of each major phase of the ITP. This description should include the administrative controls used to ensure that necessary prerequisites are satisfied for each major phase and for individual tests. The COL applicant should also describe the methods to be followed in initiating plant modifications or maintenance tasks that are deemed to be necessary to conduct the ITP. This description should include methods used to ensure retesting following such modifications or maintenance. In addition, the description should discuss the involvement of design organizations with the COL applicant in reviewing and approving proposed plant modifications. The COL applicant should also describe in the SAM adherence to approved test procedures during the conduct of the ITP as well as the methods for effecting changes to approved test procedures.
- COL 14.2(4) The COL applicant is to perform a review and evaluation of individual test results in a test report made available to NRC personnel after preoperational and startup tests are completed. The specific test acceptance criteria for determining success or failure of a test shall be included in the test report approval of the test results. The test report should also include test results associated with any license conditions in the plant specific Initial Test Program.
- COL 14.2.(6) The COL applicant is to develop a sequence and schedule for the development of the plant operating and emergency procedures should allow sufficient time for trial use of the procedure during the Initial Test Program. The sequence and 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 responsible for establishing hold points at selected milestones throughout the power ascension test phase to ensure that designated personnel or groups evaluate and approve relevant test results before proceeding to the next power-ascension test phase. At a minimum, the COL applicant should establish hold points at approximately 25-percent, 50-percent, and 75-percent power-level test conditions for pressurized-water reactors.

The DC applicant should make the following number sequence changes to COL 14.2(78) through COL 14.2(112) but no text changes are needed.

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COL 14.2(13) The COL applicant is responsible for retaining preoperational and startup test procedures and test results as part of the plant's historical records in accordance with 10 CFR 50.36, "Technical Specification," 10 CFR 50.71, "Maintenance of Records, Making of Reports," 10 CFR 50, Appendix B, Criterion XVII, "Test Records," and RG 1.28, "Quality Assurance Program Criteria (Design and Construction)."

The DC applicant should also revise APR1400 DCD Sections 14.2.2, "Organization and Staffing," 14.2.3, "Test Procedures," and 14.2.6, "Test Records," to note these changes in COL applicant responsibilities for implementing the Initial Test Program in DCD Section 14.2.13, "COL Information Items."

14.02-5

The NRC staff determined that DCD Section 14.2.6 does not meet the guidance in RG 1.68, Staff Regulatory Guidance C.9, "Test Reports." DCD Section 14.2.6 states: "A single copy of each test procedure is designated as the official copy to be used for testing. The official copy and information specifically called for in the test procedure, such as completed data sheets, instrumentation calibration data and chart recordings, are to be retained for the life of the plant by the COL applicant in accordance with NRC RG 1.28 (Reference 2) for record retention."

The NRC staff determined that RG 1.28 only covers preoperational tests under the ITP **but does not cover startup tests.** NRC RG 1.68, Staff Regulatory Guidance Section C.9, "Test Reports," states:

"The preoperational and startup testing procedures and test results should be retained as part of the plant's historical record in accordance with 10 CFR 50.36, "Technical Specification," 10 CFR 50.71, "Maintenance of Records, Making of Reports," and 10 CFR 50, Appendix B, Criterion XVII, "Test Records." The test reports should also include test results associated with license conditions in the plant specific ITP. In addition, a summary of the startup testing should be included in a startup report. This summary should include the following information:

1. a description of the method and objectives for each test;
2. a comparison of applicable test data with the related acceptance criteria, including the systems' responses to major plant transients (such as reactor scram and turbine trip);
3. design- and construction-related deficiencies discovered during testing, system modifications and corrective actions required to correct those deficiencies, and the schedule for implementing these modifications and corrective actions unless previously reported to the NRC;
4. justification for acceptance of systems or components that are not in conformance with design predictions or performance requirements; and
5. conclusions about system or component adequacy."

The NRC staff determined that DCD Section 14.2.6 should be revised to address retention of startup testing procedures and startup test results as part of the plant's historical records in accordance with RG 1.68, Staff Regulatory Guidance C.9, "Test Reports."

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14.02-6

DCD Section 14.2.7, "Conformance with Test Programs with NRC Regulatory Guides," states

"Subsection 1.9.1 and Table 1.9-1 address the conformance of test programs with the applicable NRC RGs. Table 14.2-7 is a matrix of the applicable guidance in NRC RG 1.68 (Reference 3) Appendix A (Initial Test Program) and the test descriptions listed in Subsection 14.2.12 to conform the key test parameters systematically.

The intent of the NRC RGs listed below is followed with the noted differences."

In DCD Section 14.2.7.1.13, Reference Section C, Regulatory Position 4, the DC applicant states: "This section requires inclusion of acceptance criteria that account for uncertainties. The test summaries in Subsection 14.2.12.2.1 and 14.2.12.1.46 are essential to the demonstration of conformance to the requirement of structures, components and features importance to safety."

The NRC staff determined that RG 1.68, Staff Regulatory Guide C.4, does state that "each test procedure should include acceptance criteria that account for the uncertainties used in transient and accident analysis." However, the NRC staff could not determine if any uncertainties were included in the acceptance criteria for DCD Subsections 14.2.12.1.46, "Pre-Core Hot Functional Test Controlling Document," and 14.2.12.2.1, "Post-Core Hot Functional Test Controlling Document."

Please provide additional information on what uncertainties, if any, will be included in the test acceptance criteria related to DCD Subsections 14.2.12.1.46 and 14.2.12.2.1. In addition, please describe the differences that the DC applicant is taking in these test abstracts from the guidance in RG 1.68, Staff Regulatory Guide C.4, "Procedures."

14.02-7

In DCD Section 14.2.8.1, the DC applicant states:

14.2.8.1 First-of-a-Kind Test

"First-of-a-kind (FOAK) tests are defined as new, unique, or special tests for new design features in plants. The functional testing requirements necessary to verify FOAK test performance should be identified if these design features are used in the APR1400 in the United States. These tests are performed only for the first plant.

The APR1400 is not a first-of-a-kind plant since it is preceded by Shin-Kori Units 3&4 (SKN3&4) in Korea, which are scheduled to begin commercial operation. Therefore, FOAK testing and operational data will be available prior to the APR1400 in the United States.

Examples of FOAK tests are listed below, and detailed information is identified in each subsection.

<u>FOAK Test</u>	<u>Subsection</u>
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Natural circulation test	14.2.12.4.22"
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The NRC staff has determined that the first APR1400 plant built in the USA will be a FOAK plant per the regulations in 10 CFR 50.2, "Prototype Plant," and 10 CFR 50.43(e). The NRC staff does not accept the DC applicant's position that the first APR1400 plant built in South Korea is a FOAK plant. As such, the DC applicant cannot take credit for FOAK testing on the natural circulation test that occurred at SKN3&4 in South Korea.

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The DC applicant should revise DCD Section 14.2.8.1 to be consistent with 10 CFR 50.2, 10 CFR 50.43(e), Revision 4 to RG 1.68, Regulatory Guidance C.7, "Trial Testing of Plant Emergency, Operating and Surveillance Test Procedures," RG 1.68, Appendix A, Section A-6, "First-of-a-Kind (FOAK) Testing," and Section A-7, "Design Qualification Tests for Advanced Reactors."

14.02-8

RG 1.68, Section A, "Introduction," page 3, states:

"While regulations require all SSCs important to safety be tested, all of them need not be tested to the same stringent requirements. Specifically, GDC 1, "Quality Standards and Records," of Appendix A to 10 CFR Part 50 requires, in part, that SSCs important to safety shall be tested to quality standards commensurate with the importance of the safety functions to be performed. Criterion XI of Appendix B to 10 CFR Part 50 also includes a graded approach for important to safety SSCs in the quality assurance (QA) program. Accordingly, the administrative requirements that govern the conduct of the test program (e.g., test program objectives, organizational elements, personnel qualifications, evaluation and approval of test results, and test records retention) contain provisions for the application of such administrative controls in a manner commensurate with the safety significance of the SSCs within its scope. This provides a systematic approach to the "defense-in-depth" concept. This concept dictates that the plant must be designed, constructed, and tested to (1) provide for safe normal operation, (2) ensure that, in the event of errors, malfunctions, and off-normal conditions, the reactor protection systems and other design features will mitigate the event or limit its consequences to defined and acceptable levels, and (3) ensure that adequate safety margin exists for events of extremely low probability or arbitrarily postulated hypothetical events without substantial reduction in the safety margin for the protection of public health and safety."

RG 1.68, Section B, "Discussion," pages 7 and 8, also states, in part:

"To provide for the development and safe execution of the ITP, the applicant should formulate advance plans for the entire testing program before the NRC staff completes its review of the COL application. Because of the complexity of these tests and the significant amount of resources needed to develop and execute the complete program, it is important for the applicant to give early consideration to the following:

4. Formulate administrative controls to govern the development and conduct of the ITP, including controls that will (a) provide for orderly turnover of plant systems and components from construction personnel or other preliminary checkout groups to the preoperational testing group and (b) ensure that general prerequisites (such as completion of construction, construction or preliminary tests, and inspections) will be satisfied before preoperational and/or startup tests of individual systems or components.

RG 1.68, Section C, Staff Regulatory Guidance C.2, "Prerequisites for Testing," also states, in part, that: "administrative controls should be established to ensure adequate retesting of systems or design features that are returned to construction custody, maintained, or modified during or after preoperational testing."

The NRC staff determined that the DC applicant should reference an Initial Test Program administrative manual in APR1400 DCD 14.2.3 and place the ITP administrative manual on the docket. The ITP administrative manual covers the DC applicant's responsibilities for ITP administrative controls that govern the development and conduct of the APR1400 Design Certification ITP. The COL applicant will then complete the ITP administrative manual or Startup Administrative Manual (SAM) for the COL applicant's portion of responsibilities for conducting and implementing the APR1400 ITP.

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14.02-9

In DCD Table 1.9.1, "APR1400 Conformance with NRC Regulatory Guides," the table contains the following information related to NRC RG 1.20:

NRC Regulatory Guides	Revision/ Issue Date	Conformance or Summary Description of Deviation	DCD Tier 2 Section
1.20 Comprehensive Vibration Assessment Program for Reactor Internals During Preoperational and Initial Startup Testing	Rev. 3 03/2007	The APR1400 conforms with this NRC RG.	11.5, 12.3.4, TS Part 3, 5.0

The NRC staff noted that this reference to RG 1.20 does not contain any references to APR1400 DCD Subsections 14.2.12.1.41, "Internal Vibration Monitoring System Test," 14.2.12.1.42, "Loose Parts Monitoring System Test," 14.2.12.1.43, "Acoustic Leak Monitoring System Test," and 14.2.14.4.18, "Baseline Nuclear Steam Supply System Integrity Test." These three preoperational tests and the power ascension test contain test objectives, prerequisites, methods, and acceptance criteria related to compliance with RG 1.20. Please add references to these test abstracts in DCD Table 1.9.1 and/or Subsection 14.2.7 related to APR1400 compliance with RG 1.20.