

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.: 198-8208
SRP Section: 14 – Verification Test Program
Application Section: 14.2
Date of RAI Issue: 09/04/2015

Question No. 14.02-26

Demonstrate that the feedwater control system (FWCS) test described in APR1400 FSAR Tier 2, Section 14.2.12.1.30 verify that the FWCS operates as required in all conditions specified in APR1400 FSAR Tier 2 Section 7.7.1.1.c, "Feedwater control system."

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 important to safety shall be tested to quality standards commensurate with the importance of the safety functions to be performed.

APR1400 FSAR Tier 2, Section 14.2.12.1.30 provides the initial test for the FWCS. APR1400 FSAR Tier 2, Section 7.1.1.1.c states, "The steam generator level is controlled during the following conditions: 1) steady state operations, 2) 1 percent per minute turbine load ramps between 5 percent and 15 percent NSSS power, and 5 percent per minute turbine load ramps between 15 percent and 100 percent NSSS power...." The staff reviewed the test methods specified in Item 3.0 of this test and could not find where all the conditions that require the operation of the FWCS tested. For example, Section 7.1.1.1.c states "As NSSS power increases above the valve transfer setpoint, 10 percent of the full power main feedwater flow rate goes to the downcomer valve while the remainder of the feedwater is injected into the economizer valve." Where is this design criterion verified? Modify this test to include testing for the FWCS during all conditions described in APR1400 FSAR Tier 2, Section 7.1.1.1.c.

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 are 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. 2)

KHNP has revised the ITP Acceptance Criteria for the Feedwater Control System Test to include the conditions specified in Section 7.7.1.1.c. The changes to the ITP were transmitted to the NRC previously in KHNP submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003.

Supplemental Response

The testing of the FWCS during all plant conditions is covered by several tests and are listed below along with the applicable plant conditions. These tests are better performed during power ascension rather than during preoperational testing since the plant conditions are more appropriate for conducting meaningful tests of the system design.

- 1) Steady-state operations and transient conditions:
 - Section 14.2.12.4.3 Control Systems Checkout Test
- 2) 5 percent per minute turbine load ramps between 15 percent and 100 percent NSSS power (accommodating 1 percent per minute turbine load ramps between 5 percent and 15 percent NSSS power):
 - Section 14.2.12.4.2 Unit Load Transient Test
- 3) 10 percent turbine load steps between 15 percent and 100 percent NSSS power (accommodating 1 percent turbine load steps between 5 percent and 15 percent NSSS power):
 - Section 14.2.12.4.2 Unit Load Transient Test
- 4) Loss of one of three operating feedwater pumps:
 - Section 14.2.12.4.19 Loss of One Main Feedwater Pump
- 5) Load rejection of any magnitude:
 - Section 14.2.12.4.6 Unit Load Rejection Test
- 6) As NSSS power increases above the valve transfer setpoint, 10 percent of the full power main feedwater flow rate goes to the downcomer valve while the remainder of the feedwater is injected into the economizer valve:
 - Section 14.2.12.4.3 Control Systems Checkout Test
 - Section 14.2.12.4.13 Feedwater and Auxiliary Feedwater Systems Test

DCD Tier 2 Section 14.2.12.4.3 will be changed to clearly describe that a test is performed to verify the flow percentage. The overall performance of the plant control systems is tested and verified throughout the power ascension test.

Impact on DCD

DCD Tier 2 Section 14.2.12.1.30 will be changed as shown in KHNP submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003 and is attached for information.

[DCD Tier 2 Section 14.2.12.4.3 will be revised as indicated in the attached markup.](#)

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 and Environmental Report.

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5.14 Turbine runback demand should be as specified in the related design specification.

5.15 Turbine bypass valve 1-8 digital and analog outputs should be as specified in the related design specification.

5.16 Main and permissive controller outputs should be as specified in the related design specification.

5.17 Dedicated controllers on safety console should be as specified in the related design specification.

5.18 SBCS valve stroke test should be as specified in the related design specification.

14.2.12.1.30 Feedwater Control System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate the proper operation of the ~~feedwater control system (FWCS)~~

1.2 To verify operation of the EWS and the IFPDs for FWCS

2.0 PREREQUISITES

2.1 Construction activities on the FWCS and interfacing equipment have been completed.

2.2 FWCS software is installed and instrumentation has been calibrated.

2.3 External test equipment has been calibrated and is operational.

2.4 Support systems required for the operation of the FWCS are operational.

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2.5 Cabling has been completed between the FWCS and interfacing equipment.

3.0 TEST METHOD

3.1 Using actual or simulated interface inputs to the FWCS, observe receipt of these signals at the FWCS.

3.2 Using installed and external test instrumentation, vary all input signals to the system and observe output responses at the FWCS and at interfacing equipment.

3.3 Monitor the system during initial operation and verify proper operation.

4.0 DATA REQUIRED

4.1 Input signal values

4.2 Status of interfacing control board equipment

4.3 FWCS output response

4.4 Status of output received at interfacing equipment

5.0 ACCEPTANCE CRITERIA

5.1 The FWCS performs as described in Subsections 7.7.1.1 c and 10.4.7.

5.2 Feedwater Temperature should be as specified in the related design specification.

5.3 Main steam header pressure should be as specified in the related design specification.

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- 5.4 Feedwater common header pressure should be as specified in the related design specification.
- 5.5 Total feedwater flow should be as specified in the related design specification.
- 5.6 SG level should be as specified in the related design specification.
- 5.7 Downcomer feedwater flow should be as specified in the related design specification.
- 5.8 Input signals from the interfacing systems should be as specified in the related design specification.
- 5.9 Reactor trip override should be as specified in the related design specification.
- 5.10 Feedwater pump speed and valve position demand programs should be as specified in the related design specification.
- 5.11 Feedwater pump and valve M/A controllers should be as specified in the related design specification.
- 5.12 Steam/feedwater flow error should be as specified in the related design specification.
- 5.13 SG level setpoint should be as specified in the related design specification.
- 5.14 Pressure setpoint signal should be as specified in the related design specification.
- 5.15 Feedwater pump speed setpoint Bias should be as specified in the related design specification.

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4.0 DATA REQUIRED

4.1 ~~Time dependent~~ Many plant data:4.1.1 ~~Pressurizer level and pressure~~4.1.2 ~~are obtained including reactor power, CEA positions, RCS temperatures~~4.1.3 ~~CEA position~~4.1.4 ~~Power level and demand~~4.1.5 ~~Steam, pressurizer pressure and level, steam generator pressures and levels, steam and pressures~~ feedwater flows, etc.4.1.6 ~~Feedwater and steam flow~~4.1.7 ~~Feedwater temperature~~

5.0 ACCEPTANCE CRITERIA

, and feedwater flow split

5.1 The control systems maintain the reactor power, RCS temperature, pressurizer pressure and level, ~~and steam generator levels~~ pressure and ~~pressures~~ level within their control bands during steady-state operation and are capable of returning these parameters to within their control bands in response to transient operation ~~as described in Subsection 7.7.1.1.~~

14.2.12.4.4 Reactor Coolant and Secondary Chemistry and Radiochemistry Test1.0 ~~OBJECTIVE~~ OBJECTIVES

1.1 To ~~conduct~~ determine that chemistry tests treatment can be established and performed in accordance with approved chemistry procedures