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**
Review Section:	**14.02 – Initial Plant Test Program – Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**09/04/2015**

Question No. 14.02-21

Demonstrate how the Plant Protection System (PPS) Test described in APR1400 FSAR Tier 2, Section 14.2.12.1.24 meets the requirements of Criterion XI of Appendix B to 10 CFR Part 50. 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 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. RG 1.68, “Initial Test Programs for Nuclear Power Plants” provides guidance on the initial test program.

APR1400 FSAR Tier 2, Section 14.2.12.1.24 provides the initial test for the PPS. The staff reviewed this test and finds that additional information is required regarding the objectives, prerequisites, test methods, and acceptance criteria to determine whether this test meets the requirements of Criterion XI of Appendix B to 10 CFR Part 50. The staff requests the applicant to address the following items described below.

1) Item 1.0 provides the test objectives of this test. Item 1.1 states, “to demonstrate the proper operation of the [PPS].” This test objective does not contain specific criteria that need to be met. In addition, the staff finds that portions of the test methods listed under Section 14.2.12.1.24, Item 3.0, “Test Method,” appear to be test objectives. For example, Item 3.11 under “Test Methods” states, “Verify proper operation of the core protection calculator system by input/output and internal function tests.” In this case, verifying the proper operation of the core protection calculator system should be a test objective. As such, the staff requests the applicant to provide specific objectives that should be met with this test.

2) Item 2.0, provides prerequisites for the PPS test. The staff finds that these prerequisites are not sufficiently specific to determine what systems need to be functional to perform this

test. For example, it states “Support systems required for operation of the trip circuit breakers, ESF-CCS and PPS are operational” It is not clear what these support systems are. It is also unclear what inputs to the PPS is required for the completion of this test. In addition, clarify whether the factory acceptance testing needs to be complete prior to conducting this test. As such, the staff requests the applicant to provide specific prerequisites that should be met with this test.

3) The staff needs the following clarification in order to evaluate Item 3.0, “Test Methods.”

a) Test Method Item 3.3, it states, “Using simulated reactor trip signals, trip each reactor trip circuit breaker with the breaker in the test position. Observe circuit breaker operation.” Clarify what is the objective of this test (e.g. verify RTSS functionality). In addition, it is unclear what is meant by “with the breaker in the test position.” Does this mean that the breaker is under test bypass? If so, are all the breakers under bypass or just one? The staff also requests the applicant to clarify these same issues for Item 3.4 with the circuit breakers in the operate position.

b) Test Method Item 3.5 states “Exercise the bistable comparators using internal and external test circuitry and observe the setpoints and operation of the appropriate ESFAS logic.” How do you observe the setpoints? Are the setpoints supposed to change when the bistable comparators are exercised? What is meant by exercised? Does this test intend to verify each Engineered Safety Feature Actuation System (ESFAS) function within the bistable? How do you observe the operation of the appropriate ESFAS logic (e.g. observe the output of the bistable)? Are reactor trip functions of the bistable comparators not verified? In addition, is the bistable comparator equivalent to the bistable processor specified in APR1400 FSAR Tier 2, Chapter 7?

c) Test Method Item 3.6 states “Check the operation of trip channel bypass features including, where applicable, observation of the setpoints at which the trip bypasses are cancelled automatically.” How do you observe this setpoint? What specifically is being checked with the operation of the trip channel bypass features (e.g. the capability to bypass, the modification of the voting logic when a channel is bypassed)? Does this test verify operating bypass or maintenance bypass?

d) Test Method Item 3.7 states “Test manual trips and observe relay operation.” However, the operation of the manual RT switches is not specified as a prerequisite. Is operation of manual RT switches required as a prerequisite? Is operation of manual RT switches required as a prerequisite?

e) Test Method Item 3.8 states, “Check that low pressurizer pressure and low steam generator pressure trip setpoints track the process variable at the prescribed rate…” Where is this prescribed rate specified?

f) Test Method Item 3.9 states, “using the installed testing devices, observe test functions and verify proper [local coincidence logic] LCL operation.” What are the installed testing devices? Where is it described? What specific LCL function is being verified here (e.g. voting logic function, voting modifications when channels are bypassed or signal faults are detected)?

g) Test Method Item 3.10 states, “Using manually initiated semi-automatic test functions to trip reactor trip breakers and ESF-CCS interfaces, observe interlock, alarm, and interface operation.” Which specific interfaces does this test refer to (e.g. with non-safety systems, with the ESFAS components)?

h) Test Method Item 3.11 states “verify proper operation of the core protection calculator input/output and internal function test.” Specify the specific internal function tests that are verified.

i) Test Method Item 3.12 states, “Inject signals into appropriate sensor or sensor terminals and measure the elapsed time to achieve tripping of the reactor trip circuit breaker or actuation of the ESFAS actuation relays. Trip or actuation paths may be tested in several segments.” It appears that this test intends to verify the response time for the performance of the RT and ESFAS functions from sensor to final actuation device. Does this test verify the response time for every RT and ESFAS function?

j) Is there a specific integrated test that verifies the functionality of the entire RT and ESFAS train? If not, provide an integrated test to verify the functionality of the entire RT and ESFAS train.

k) RG 1.68, Section A-1.j, “Instrumentation and Control Systems” specify that “tests should be conducted, as appropriate, to verify redundancy and electrical independence.” What tests are performed to verify redundancy and electrical independence within the PPS?

4) Item 5.1, under “Acceptance Criteria” states that “The PPS performs as described in Sections 7.2 and 7.3.” The staff finds the information provided in this reference includes a significant amount of design information. However it is unclear what specific design criteria is being referenced as acceptance criteria for this test. Clarify what specific design criteria within FSAR Tier 2 Sections 7.2 and 7.3 provide the acceptance criteria for the PPS test.

Response

The test plans presented in Section 14.2 of the DCD Tier 2 are being upgraded. 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, the noted items will be addressed 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)

A document upgrade has been completed to the test plans in Section 14.2.12.1 which included various changes to 14.2.12.1.24 as well (ref. submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003). The following responses to the items requested in this

RAI will refer to changes that were made in that submittal and in some instances result in additional changes to 14.2.12.1.24 which will also be discussed.

1) The Objectives in DCD Tier 2 Section 14.2.12.1.24 will be updated to add nine items pertaining to specific test objectives to demonstrate the proper operation of the plant protection system (PPS). Two objectives in the proposed upgrade, verification of the interlock functions and demonstration of redundancy, electrical independence, coincidence, and fail safe on loss of power, will be deleted since they were inappropriately added and are not pertinent to the PPS test. Objective 1.1 will be further clarified to demonstrate proper operation of the bistable logic and coincidence logic of the PPS since the other added objectives in their entirety demonstrate proper operation of the system. Item 3.11 which appeared to be an objective rather than a test method will be removed entirely from Section 14.2.12.1.24 since it is related to the core protection calculator system (CPCS) and is not appropriate to be included in the PPS test.

2) The prerequisites in 14.2.12.1.24 will be revised to clarify more specifically the support systems that are needed for the test. Item 2.2 will be added to describe that the software of the PPS and engineered safety features – component control system (ESF-CCS) needs to be installed. Item 2.5 will be clarified to describe the specific interface systems required for completion of the test; namely, CPCS, reactor trip switchgear system (RTSS), and ESF-CCS. Factory acceptance testing does not need to be added as a prerequisite since it is a requirement of the vendor in accordance with the procurement specification and verified by the Quality Assurance program.

3) Clarifications to Test Methods:

   a) The objective of the test regarding Items 3.3 and 3.4 is to confirm the functionality of the trip circuit breaker (TCB) in each division of the RTSS. This test is performed for each TCB. The TCB can be switched from the CONNECT position to the TEST position or vice versa. When in the TEST position, the TCB is operational for test purposes only. When in the CONNECT position, the TCB becomes fully operational either for testing or for normal operation. Item 3.3 will be revised to specify the TCBs in the RTSS and the operate position in Item 3.4 will be corrected to the CONNECT position.

      Item 3.2 will be deleted since it is an unnecessary test item for verifying the PPS functionality. As a result, Items 3.3 and 3.4 will be re-numbered as Items 3.2 and 3.3.

   b) The bistable comparison logic is part of the bistable application program loaded in the bistable processor. The bistable logic test is performed based on the manual test procedures using the maintenance and test panel (MTP). While the bistable comparison logic test is performed, the setpoints of each trip parameter can be observed in the operator module (OM) in the main control room (MCR). The engineered safety features actuation system (ESFAS) function is not verified by performing the bistable comparison logic test. Therefore, the wording of Item 3.5 will be changed accordingly. Note that Item 3.5 will be re-numbered as Item 3.4 as a result of the deletion of 3.2 discussed previously.

The main purpose of the bistable logic test is to verify that a partial pre-trip and trip signals are properly initiated by simulating the pre-trip and trip conditions for each trip parameter. Therefore, an additional item (Item 3.5) will be added to the test methods to perform a coincidence logic test using the MTP and observing the operation of the appropriate coincidence logic.

c) Item 3.6 is to verify the operating bypass function. The trip parameters associated with the operating bypass function are high logarithmic power level, departure from nucleate boiling ratio (DNBR), local power density (LPD), and low pressurizer pressure as described in DCD Tier 2 Section 7.2.1.6, “Bypasses.”

In order for these trip parameters to be in the operating bypass state, the permissive conditions, as provided in Table 7.2-1 of DCD Tier 2, must be received prior to the operating bypass. Once the permissive signal is detected, manual operation by the operator is accomplished. After the operating bypass for each of the above trip parameters is enabled, the operating bypass is automatically removed whenever the permissive condition is lost or not satisfied.

Table 7.2-1 of DCD Tier 2 provides the operating bypass permissive and removal conditions for the stated trip parameters. While DNBR/LPD, high log power level, and CPC CWP operating bypass permissive signals are received as a contact input via the digital input module within a bistable processor rack, the low pressurizer pressure operating bypass permissive condition is set by the pressurizer pressure input via an analog input module based on the operating bypass setpoint.

When the low pressurizer pressure input goes below the operating bypass setpoint (a preset value), then the operating bypass can be manually enabled by the operator. If the pressurizer pressure input goes above the operating bypass removal setpoint (the other preset value), then the operating bypass is automatically removed. DCD Tier 2 Section 7.2.1.4, “Reactor Trip Initiation Signals” provides the related description in Item (f) “Low pressurizer pressure”: *The trip can be manually bypassed by the operator if the pressure decreases below a preset value. The bypass is automatically removed as pressure is increased above the preset value.*

Item 3.6 will be modified to clarify the test method to simply check the operation of the operating bypass logic and switches to align more closely with the intent of the test as discussed above.

d) A prerequisite Item 2.6 will be added to ensure that the manual reactor trip and ESFAS switches in the MCR and RSR are operational. In addition, Item 3.7 will be modified to clarify that the manual RPS trips and ESFAS actuation are being tested and observation of relay operation will be deleted.

e) Since low pressurizer pressure and low steam generator pressure trip parameters are not rate limited variables, the reference to a “prescribed rate” in Item 3.8 will be replaced to state “a fixed value” as described in DCD Tier 2, Table 7.2-4, “Reactor Protection System Design Input,” Note 4.

f) Section 4.2.1.10, “MTP Function” of the Safety I&C System technical report states that the MTP is the local human system interface (HSI) for maintenance and testing of the PPS. Therefore, the PPS testing functions are initiated from the MTP located in the I&C equipment room. Items 3.9 and 3.10 were to verify the final output of the PPS; namely, the reactor trip output and ESFAS initiation generation output. These items (Items 3.9 and 3.10) will be merged into a single item, Item 3.9, and the previous reference to installed testing devices, observation of test functions and verification of proper local coincidence logic operation will be deleted.

g) For tripping the reactor TCB from the MTP, the specific interface system is the RTSS. Once the trip occurs in one division, then the TCB of the corresponding division will be opened; its alarm and status indication will be provided via the MTP and OM. For initiating ESFAS, the interface system is ESF-CCS. Once one of the ESFAS signals is initiated, then the related alarm and status indication of the corresponding ESF-CCS division will be provided via the MTP and OM. As stated previously in f) above, Items 3.9 and 3.10 will be merged into Item 3.9 and the test method description clarified.

h) As stated in response to sub-question 1), the CPCS test item 3.11 will be deleted from Section 14.2.12.1.24.

i) The response time test stated will be performed for every RT and ESFAS trip parameter. The response time test results should be within the response time requirements specified in DCD Tier 2 Table 7.2-5 for each trip parameter.

j) The functionality of the entire division of the reactor trip path is verified through the divided, but overlapped portions of the tests as shown in Figure 4-6, “Overlap in Functional Testing for the PPS” of the Safety I&C System technical report and Figure 7.2-11, “PPS Testing Overlap” of DCD Tier 2. To be more specific, the overlap between the following tests verifies the entire division of the reactor trip path as shown in Figure 7.2-11 of DCD Tier 2: transmitter test, analog input test, bistable logic test, reactor trip local coincidence logic test, reactor trip initiation test, and engineered safety features local coincidence logic test.

   Section 3.4.10, “Regulatory Guide 1.118, “Periodic Testing of Electric Power and Protection Systems”, Rev. 3 - endorses IEEE Std. 338-1987” states, “Overlap in the RPS and ESFAS division tests is provided to assure that the entire division is functional.”

   Also, Section 7.3.3.5, “Periodic Testing Method” states, “Testing is overlapped to provide reasonable assurance that the entire division is tested.”

k) PPS is demonstrated through the testing specified in Tier 1 Section 2.5.1.1 and Table 2.5.1-5 ITAAC Item 3.b.

4) The Acceptance Criteria Item 5.1 is to ensure that the safety functions of the PPS specified in Sections 7.2 and 7.3 are met; that is, to successfully generate reactor trip and ESFAS initiation signals.

Item 5.1 will be modified as follows:
The PPS performs the safety functions as described in Sections 7.2 and 7.3.

An additional eight Acceptance Criteria items (Items 5.3 to 5.10) have been added to the test to ensure that the pertinent objectives have been met and include, adequate operation of the power supplies, fiber optic interconnections, PPS/APC-S interconnection, alarm operation, manual trip operation from the MCR/RSR, bistable trip function, operating bypass function, and trip channel bypass function.

Impact on DCD

Section 14.2.12.1.24 of DCD Tier 2 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 Environmental Report.

5.0 ACCEPTANCE CRITERIA

5.1 The ESF-CCS performs as described in Subsection 7.3.1.

5.2 ESF-CCS should operate as specified in the related design specification.

5.3 Manual control of ESF-CCS should operate as specified in related design specifications.

5.4 Interface operation to GC and LC should be as specified in the related design specification.

5.5 MTP/ITP should operate as specified in the related design specification.

5.6 Interface operation to IPS, QIAS-N and OM Display should be as specified in the related design specification.

5.7 Alarms should be provided as specified in the related design specification.

5.8 Transfer switches for remote control room should operate as specified in the related design specification.

5.9 ESF - CCS power supplies should operate as specified in the related design specification.

5.10 ESF-CCS should meet the requirement of redundancy, electrical independence, coincidence, and safe failure on loss of power as specified in the related design specification.

14.2.12.1.24 Plant Protection System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate the proper operation of the ~~plant protection system (~~PPS~~)~~ bistable logic and coincidence logic of the

1.2 To ~~determine~~verify the ~~reactor protection system (~~RPS~~)~~ and the ~~engineering safety features actuation system (~~ESFAS~~)~~ response times

1.3 To verify the operation of the manual reactor trip

1.4 To verify the PPS related alarm functions

1.5 To verify the process input/output inter-connection and the input accuracy of PPS

1.6 To verify the operation of the PPS interface to the MTP and Interface and Test Processor (ITP)

1.7 To verify the integrity of signal path using manual testing functions and verify the operation of the manual testing functions on the MTP

1.8 To verify the operation of watchdog timer of PPS

delete ~~1.9 To verify the operation of the interlock functions of PPS~~

1.9 ~~1.10~~ To verify the operation of the operating bypasses functions of PPS

1.10 ~~1.11~~ To verify the operation of the PPS power supplies

1.11 ~~1.12~~ To verify the operation of the reactor trip circuit breaker in the reactor trip switchgear system (RTSS)

delete ~~1.13 To demonstrate redundancy, electrical independence, coincidence, and safe failure on loss of power.~~

2.0 PREREQUISITES

2.1 Construction activities on the trip circuit breaker and plant protection system and ESF-CCS have been completed.

2.2 PPS and ESF-CCS ~~system~~ software is installed.

delete

2.3 PPS instrumentation has been calibrated.

2.~~3~~4 External test instrumentation is available and calibrated.

2.~~4 Support~~5 The interface systems ~~required~~ for ~~operation of the trip circuit breakers, ESF-CCS, and PPS~~PPS such as CPCS, RTSS and ESF-CCS are operational.

3.0 TEST METHOD

2.6 Manual reactor trip switches and ESFAS switches in the MCR and RSR are operational.

3.1 Energize power supplies and verify output voltage.

~~3.2 Simulate ground faults and observe operation of the ground fault detectors.~~

~~3.3~~3.2 Using simulated reactor trip signals, trip each reactor trip circuit breaker located in the RTSS with the breaker in the ~~test~~ position. Observe the reactor trip circuit breaker operation.

TEST

3.~~4~~ 3 Repeat Step 3.~~3~~2 with the reactor trip circuit breakers in the ~~operate~~ position.

CONNECT

3.~~5 Exercise~~4 Perform the bistable ~~comparators~~ logic test using ~~internal and external test circuitry~~the MTP and observe the setpoints used in the bistable logic and operation of the appropriate ~~ESFAS~~bistable logic.

3.5 Perform the coincidence logic test using the MTP and observe the operation of the coincidence logic.

logic and switches

3.6 Check the operation of ~~trip channel~~operating bypass ~~features~~ ~~including, where applicable, observation of the~~ ~~observe the~~ ~~setpoints at which the trip~~operating ~~bypasses are canceled automatically~~ removed.

delete

Delete

3.7 Test the manual RPS trips and ~~observe relay operation~~ESFAS actuation.

3.8 Check that low pressurizer pressure and low steam generator pressure trip setpoints track the process variable with a fixed value ~~at the prescribed rate~~ and can be manually reset to the proper margin below the process variable.

3.9 Using the ~~installed~~MTP initiation testing ~~devices, observe test functions and verify proper local coincidence logic (LCL) operation.~~

~~3.10 Using manually initiated semi-automatic test functions to~~function, trip the reactor trip circuit breakers and ~~ESF-CCS interfaces~~initiate ESFAS, and then observe ~~interlock,~~ alarm, and interface operation. for each division at a time

~~3.11 Verify proper operation of the core protection calculator system by input/output and internal function tests.~~

~~3.12~~3.10 Inject signals into appropriate sensors or sensor terminals and measure the elapsed time to achieve tripping of the reactor trip circuit breakers or ~~actuation~~initiation of the ESFAS ~~actuation relays.~~ . Trip or actuation paths ~~may~~can be tested ~~in several segments~~by overlapped testing method.

3.11 Check each bistable trip parameter's trip channel bypass feature, which blocks the trip condition at the LCL logic so that the channel trip does not occur as long as the trip channel bypass is enabled.

4.0 DATA REQUIRED

4.1 Power supply voltages

4.2 ~~Resistance for ground fault detector operation~~

~~4.3 Circuit~~Reactor trip circuit breaker and indicator operation

~~4.4 Point of actuation of bistable comparators~~

4.3 Bistable logic trip/pre-trip setpoints

4.4~~.5~~ Reset margin and rate of setpoint change of variable setpoints

4.~~6~~5 Maximum and minimum values of variable setpoints

4.~~7~~6 RPS and ESF trip and actuation path response times

4.~~8~~ 7 LCL operation

5.0 ACCEPTANCE CRITERIA

5.1 The PPS performs the safety functions as described in Sections 7.2 and 7.3.

5.2 The total response time of each RPS and ESFAS trip or actuation path is verified to be conservative with respect to the times used in the safety analysis.

5.3 Power Supplies should ~~operate as specified in the related design specification.~~ be properly operated as specified in Subsection 7.2.2.3.

5.4 Fiber optic interconnections ~~Tests~~ should ~~provide the indications as specified in the related design specification.~~ be provided as specified in Subsection 7.2.1.2.

5.5 PPS/APC-S Interconnection should ~~provide as specified in the related design specification.~~ be provided as specified in Subsection 7.2.1.

5.6 Alarm operations should be provided ~~as specified in the related design specification~~. be provided as specified in Subsections 7.2.1.3 and 7.2.1.4.

5.7 Manual trip operation from MCR and RSR should be ~~as specified in the related design specification.~~ be provided as specified in Subsection 7.2.1.3.

5.8 Bistable trip function operations should be ~~as specified in the related design specification.~~ provided as specified in Subsection 7.2.1.

delete

~~5.9 Interlock functions should operate as specified in the related design specification.~~

5.9

~~5.10~~ Operating bypass operation should be ~~as specified in the related design specification.~~ provided as specified in Subsection 7.2.1.6.

5.10

~~5.11~~ Trip channel bypass operation should be ~~as specified in the related design specification.~~ provided as specified in Subsection 7.2.1.6.

14.2.12.1.25 Ex-Core Neutron Flux Monitoring System

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To verify the proper functional performance of the ex-core neutron flux monitoring system

1.2 To verify the proper performance of audio and visual indicators

2.0 PREREQUISITES

2.1 Construction activities on the ex-core neutron flux monitoring system have been completed and system software is intalled.

2.2 Ex-core neutron flux monitoring system instrumentation has been calibrated.

2.3 External test equipment has been calibrated and is operational.

2.4 Support systems required for operation of the ex-core neutron flux monitoring system are operational.

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. 14.02-25

Demonstrate that the Steam Bypass Control System (SBCS) Test described in Section APR1400 FSAR Tier 2, 14.2.12.1.29 verifies that the SBCS operates properly for the different modes described in APR1400 FSAR Tier 2 Section 7.7.1.1.d, "Steam bypass 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 14.2.12.1.29 describes the initial test for the SCBS. APR1400 FSAR Tier 2, Section 7.1.1.1.d describes the three signals generated for the two different modes of operation for the SBCS control of the turbine bypass valve, including the modulation mode, the quick opening mode, and a valve permissive signal. The staff reviewed the test methods specified in Item 3.0 of this test and could not find where the different modes of operation or signals generated for the turbine bypass valve are tested. Modify this test to include testing for the SBCS for all the modes/signals described in APR1400 FSAR Tier 2, Section 7.1.1.1.d.

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 action 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)

The test method in APR1400 FSAR Tier 2, Section 14.2.12.1.29 will be revised to verify that the SBCS tests the two different modes (the modulation mode and the quick opening mode) and the three types of control signals (the modulation signal, the quick opening signal, and the valve permissive signal). The appropriate changes were previously proposed in KHNP's ITP upgrade effort.

Impact on DCD

DCD Subsection 14.2.12.1.29 will be revised as indicated in the Attachment which was included in KHNP submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003 and is attached for information.

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.

4.0 DATA REQUIRED

4.1 Input signal values

4.2 Status of interfacing control board equipment

4.3 RRS output response

4.4 Status of outputs received at interfacing equipment

5.0 ACCEPTANCE CRITERIA

5.1 The RRS performs as described in Subsection 7.7.1.1 a.

5.2 TAVG loop 1 and 2 should be within design value.

5.3 TAVG should be within design value.

5.4 TLI should be within design value.

5.5 Reactor power should be within design value.

5.6 CEA motion demand should be within design value.

14.2.12.1.29 Steam Bypass Control System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate the proper operation of the ~~steam bypass control system (~~SBCS~~)~~

2.0 PREREQUISITES

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

2.2 SBCS 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 operation of the SBCS are operational.

3.0 TEST METHOD

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

3.2 Using installed and external test equipment, vary system inputs, and observe output responses at the SBCS and at interfacing equipment.

3.3 Verify proper response of the turbine bypass valves and position indicators with three types of valve signals which are a modulation signal, a quick opening signal, and permissive signal.

Dynamic operation of the turbine bypass valves is demonstrated during hot functional testing, and capacity testing of the turbine bypass valves is demonstrated during power ascension testing.

4.0 DATA REQUIRED

4.1 Input signal values

4.2 Status of interfacing control board equipment

4.3 SBCS output response

4.4 Status of outputs received at interfacing equipment

5.0 ACCEPTANCE CRITERIA

5.1 The SBCS performs as described in Subsections 7.7.1.1 d and 10.4.4.

5.2 SG steam flow 1, flow 2 and total flow should be as specified in the related design specification.

5.3 SG steam flow signal validation should be as specified in the related design specification.

5.4 Steam header pressure 1 and 2 should be as specified in the related design specification.

5.5 Pressurizer pressure 1 and 2 should be as specified in the related design specification.

5.6 Pressurizer pressure deviation should be as specified in the related design specification.

5.7 TAVG should be as specified in the related design specification.

5.8 Reactor power should be as specified in the related design specification.

5.9 Turbine load index should be as specified in the related design specification.

5.10 Quick open block for main and permissive should be as specified in the related design specification.

5.11 Reactor power cutback and quick open of related valve should be as specified in the related design specification.

5.12 Emergency off and condenser interlock should be as specified in the related design specification.

5.13 Automatic motion inhibit should be as specified in the related design specification.

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.

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. 1)

KHNP has revised the ITP Acceptance Criteria for the Feedwater Control System Test to include the conditions specified in Section 7.1.1.1.c. The changes to the ITP were transmitted to the NRC previously in KHNP submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003.

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.

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.

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.

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.

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.

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:	**14.02**
Date of RAI Issue:	**09/04/2015**

Question No. 14.02-27

Provide specific objectives and corresponding test methods for the reactor power cutback system (RPCS) test specified in APR1400 FSAR Tier 2, Section 14.2.12.1.32.

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 14.2.12.1.32 describes the initial test for the RPCS. The test objective for this section states, “To demonstrate proper operation of the [RPCS].” However, based on the test method and corresponding reference to APR1400 FSAR Tier 2 Subsection 7.7.1.1 e, "Reactor power cutback system," it is not clear what the specific functions are being verified with this test. Specifically, APR1400 FSAR Tier 2, Section 7.1.1.1.e states that the RPCS reduces reactor power by dropping of pre-selected groups of full strength regulating core element assemblies (CEAs) and subsequently sending control signals to the turbine to rebalance turbine and reactor power. The staff finds that these RPCS functions should be verified in this test and should be identified as test objectives. The corresponding test method and acceptance criteria should support demonstrating how these functions are verified in the initial test program. Modify APR1400 FSAR Tier 2, Section 14.2.12.1.32 to include this information.

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. 1)

The test specified in 14.2.12.1.32 is to ensure that given a simulated input signal that the RPCS output is reasonable. The RPCS function is tested during power ascension tests with the interface systems. Specifically, the functional test of RPCS with the CEAs position and balance between turbine and reactor power is performed by dropping of pre-selected CEA groups as described in ITP 14.2.12.4.6 “Unit Load Rejection Test.”

KHNP’s submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003 revised Objective 1.3 and Acceptance Criteria 5.4 to include assurance that the RPCS functions properly. Since the verification of RPCS function is included in section 14.2.12.4.6, it is not necessary to also include it in section 14.2.12.1.32.

Impact on DCD

DCD Section 14.2.12.4.6 will be changed as included in KHNP’s submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003 and is attached for information.

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.

14.2.12.4.6 Unit Load Rejection Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate that full load rejections from 100% power can be accommodated without initiating a Reactor Protection System (RPS) signal or an ESFAS signal, without opening any primary and/or secondary safety valves

1.2 To demonstrate that the ~~plant responds and~~house load operation is ~~controlled as designed following a 100 percent~~capable during the load rejection ~~with~~transient

1.3 To assess the performance of SBCS, FWCS, RRS, PPCS & PLCS, RPCS ~~in service~~, DRCS and TCS following full load rejection from 100% power

2.0 PREREQUISITES

2.1 The reactor is operating above 95 percent power.

2.2 The RRS, PPCS, PLCS, FWCS, SBCS, ~~FWCS, RRS, CEDMCS,~~ and RPCS~~, and pressurizer pressure and level control~~ are in automatic operation.

3.0 TEST METHOD

3.1 A switchyard breaker(s) is tripped so as to subject the turbine to the maximum credible overspeed condition.

3.2 Plant behavior is monitored to provide reasonable assurance that the RRS, CEDMCS, SBCS, RPCS, FWCS, and pressurizer pressure and level control systems maintain the monitored parameters.

4.0 DATA REQUIRED

4.1 ~~Plant condition prior to load rejection~~

~~4.2 The following acceptance criteria parameters are monitored prior to and throughout the transient:~~

~~4.2.1 Pressurizer~~Many plant data are obtained including reactor power, CEA positions, RCS temperatures, pressurizer pressure and level

~~4.2.2 RCS hot leg temperatures~~

~~4.2.3 SG~~, steam generator pressures and levels, steam and feedwater flows, POSRV and MSSV opening status, etc.

~~4.3 Additional key plant parameters are monitored for baseline data.~~

4.2 Sequence of events data are obtained.

5.0 ACCEPTANCE CRITERIA

~~5.1 The measured values of the acceptance criteria parameters in step 4.2 (above) are within the single-valued acceptance limits based on test predictions using methodology described in Subsection 15.0.2.~~

~~5.2 A reactor trip does not occur during the test.~~

~~5.3 The RPCS operates as described in Subsection 7.7.1.1 e.~~

5.1 The RPS shall not initiate a reactor trip.

5.2 The ESFAS shall not be actuated.

5.3 The primary (POSRV) and/or secondary (MSSV) safety valves shall not open.

5.4 The ~~plant responds as described in Subsection 15.2.1~~RPCS shall drop the selected CEA groups into the core.

5.5 The 100% power load rejection shall be accommodated without tripping the turbine and with the turbine generator supplying house loads.

14.2.12.4.7 Shutdown from Outside the Main Control Room Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate that the ~~plant~~reactor can be ~~maintained in hot standby~~ tripped from outside the ~~main~~ control room~~ (MCR) following a reactor trip~~

1.2 To demonstrate ~~the potential for safely cooling down~~that the plant ~~from~~ can be placed in the hot standby ~~to cold shutdown conditions~~condition from outside the control room~~.~~

1.3 To demonstrate that the plant can be controlled and maintained in the hot standby condition for at least 30 minutes from outside the control room

2.0 PREREQUISITES

2.1 The reactor is operating in the range of 10 to 25 percent of rated power with plant systems in their normal configuration with the turbine-generator in operation.

2.2 The capability to cool down the plant from the ~~remote shutdown console (RSC)~~RSC has been demonstrated during pre-core or post-core hot functional tests.

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:	**14.02 - Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**09/04/2015**

Question No. 14.02-36

Demonstrate how the test objective for safely cooling down the plant from hot standby to cold shutdown conditions from outside the main control room (MCR) is met with the test methods described in APR1400 FSAR Tier 2, Section 14.2.12.4.7, "Shutdown from Outside the Main Control Room 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 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. RG 1.68, “Initial Test Programs for Nuclear Power Plants” provides guidance on the initial test program.

APR1400 FSAR Tier 2, Section 14.2.12.4.7 describes the shutdown from outside the MCR test. Objective 1.2 of this test states, “to demonstrate the potential for safely cooling down the plant from hot standby to cold shutdown conditions from outside the MCR.” Test method 3.5 states, “Following the hot standby demonstration, starting from approximately 176.7 ^{o}C (350 ^{o}F), reduce the reactor coolant temperature by at least 10 ^{o}C (50 ^{o}F) from outside the control room using the [remote shutdown console].” Per APR1400 FSAR, Tier 2, Chapter 16, Table 1.1-1, "MODES," Mode 5, cold shutdown, the reactor coolant temperature must be less than 210 ^{o}F. As such, it is not clear how reducing the temperature by 50 ^{o}F from 350 ^{o}F would reach cold shutdown conditions of 210 ^{o}F. As such, the staff requests the applicant to resolve this inconsistency to demonstrate how safely cooling down the plant from hot standby to cold shutdown conditions will be achieved in this test.

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 described in the attached markup and DCD Tier 2 section 14.2.12.1.48, the capability to cool down the plant to the cold shutdown condition from the remote shutdown room is demonstrated during pre-core hot functional testing. Therefore, during power ascension tests, the objective of the shutdown from outside the main control room test is to demonstrate the plant can be placed in the hot shutdown condition and maintained for at least 30 minutes from outside the control room. According to NRC Regulatory Guide 1.68.2 Revision 2, licenses do not need to demonstrate cold shutdown capability immediately following the test to achieve and maintain a safe hot shutdown from outside the control room. KHNP submitted a revised DCD Tier 2 section 14.2.12.4.7 as a result of the upgrade effort described in the original response (ref. KHNP submittal MKD/NW-16-0156L dated February 24, 2016; ML16056A003). As a result of subsequent review, the ITP for Shutdown for Outside the Main Control Room Test will be further enhanced as indicated on the attached markup to make additional clarifications to the test objectives, test method and acceptance criteria to meet NRC Regulatory Guide 1.68.2 Revision 2.

Impact on DCD

DCD Tier 2 section 14.2.12.4.7 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 the Technical/Topical/Environmental Report.

14.2.12.4.7 Shutdown from Outside the Main Control Room Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate that the ~~plant~~reactor can be ~~maintained in hot standby~~ tripped from outside the ~~main~~ control room ~~(MCR) following a reactor trip~~

cooled down to

shutdown

1.2 To demonstrate ~~the potential for safely cooling down~~that the plant ~~from~~ can be ~~placed in~~ the hot ~~standby~~ ~~to cold shutdown conditions~~condition from outside the control room~~.~~

1.3 To demonstrate that the plant can be controlled and maintained in the hot ~~standby~~ condition for at least 30 minutes from outside the control room

shutdown

2.0 PREREQUISITES

to the cold shutdown condition

2.1 The reactor is operating in the range of 10 to 25 percent of rated power with plant systems in their normal configuration with the turbine-generator in operation.

2.2 The capability to cool down the plant from the ~~remote shutdown console (RSC)~~RSC has been demonstrated during pre-core ~~or post-core~~ hot functional tests.

remote shutdown room (RSR)

RSR

2.3 The remote shutdown console instrumentation is operating properly.

2.4 The communication system between the MCR and ~~remote shutdown location~~ has been demonstrated to be operational.

2.5 The remote shutdown instrumentation controls and systems have been ~~preoperationally~~ tested.

pre-operationally

3.0 TEST METHOD

MCR

3.1 The operating crew evacuates the MCR (standby crew remains in the ~~control room~~).

3.2 The reactor is tripped from outside the MCR.

Replace with the last page "A"

3.3 The reactor is brought to hot standby by the minimum shift operating crew from outside the MCR and is maintained in this condition for at least 30 minutes.

3.4 Transfer of control to the RSC is demonstrated from switches near the MCR exits and at appropriate locations inside the channelized equipment rooms.

3.5 Following the hot standby demonstration, starting from approximately 176.7 °C (350 °F), reduce the reactor coolant temperature by at least 10 °C (50 °F) from outside the control room using the RSC.

3.6 Transfer of control back to MCR from RSC is demonstrated, using the switches provided in the channelized equipment rooms.

* Testing is conducted in accordance with NRC RG 1.68.2 (Reference 4).

4.0 DATA REQUIRED

4.1 ~~Time-dependent data:~~

Many plant data are obtained including reactor power, boron concentration, RCS temperatures, pressurizer pressure and level, steam generator pressures and levels, steam and feedwater flows, etc..

~~4.1.1 Pressurizer pressure and level~~

~~4.1.2 RCS temperatures~~

~~4.1.3 Steam generator pressure and level~~

~~4.1.4 CEA drop times~~

5.0 ACCEPTANCE CRITERIA

1 ~~5.1 The ability to achieve and control the reactor at hot standby from outside the MCR is demonstrated as described in Subsection 7.4.1.~~

shall be

5.~~2~~ ~~The potential ability to cool down from hot standby to cold shutdown conditions~~Reactor trip ~~is~~ achieved from outside the control room ~~is demonstrated by reducing~~.

2 shall be

5.~~3~~ Control of the ~~reactor coolant temperature by~~plant ~~is~~ transferred to the RSR ~~and the plant can be stabilized in the hot standby condition.~~

3 from the MCR

cooled down and

5.~~4~~ The plant shall be maintained in the hot ~~standby~~ condition for at least ~~10 °C (50 °F) using the RSC~~30 minutes from ~~outside the control room~~.

shutdown the RSR

"A"

3.3 Transfer of the control from the MCR to the RSR.

3.4 The plant is stabilized in hot standby condition from the RSR. After the stabilization, cool down the plant to hot shutdown condition from the RSR.

3.5 Maintain the plant in hot shutdown condition for at least 30 minutes.

3.6 Transfer of the control back from the RSR to the MCR.

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:	**14.02 –Initial Plant Test Program - Design Certification and New License Applicants**
Application Section:	**14.2**
Date of RAI Issue:	**09/04/2015**

Question No. 14.02-37

Demonstrate how the manual controls in the main control room (MCR) are verified in the initial test program to meet the requirements of Criterion XI of Appendix B to 10 CFR Part 50.

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 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. RG 1.68, “Initial Test Programs for Nuclear Power Plants” provides guidance on the initial test program.

APR1400 FSAR Tier 2, Section 14.2.12.1.48, "Remote Shutdown Console Test," describes the remote shutdown console test which verifies the capability to shutdown the reactor from the remote shutdown console. The staff reviewed the initial test program described in APR1400 FSAR Tier 2, Section 14.2.12 and could not identify where the capability of manual controls in the MCR to shutdown the reactor are verified in the initial test program. APR1400 FSAR Tier 2, Chapter 7 and the referenced Technical Report, APR1400-Z-J-NR-14001, “Safety I&C System” describes several means to control safety-related components from the main control room (MCR), including from the information flat panel display (IFPD), engineered safety feature component control system (ESF-CCF) soft control module (ESCM), diverse manual ESF actuation (DMA) switches, minimum inventory (MI) system-level switches, MI component level switches. Demonstrate how the capability of these manual controls to control safety-related equipment and shutdown the reactor is verified in the initial test program.

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)

Verifying the manual controls to control safety-related equipment required to shutdown the reactor are described in each subsection of the APR1400 DCD Tier 2, Section 14.2.12.

DCD Tier 2, Section 14.2.1 will be revised to include the description that testing of manual controls for the capability to shutdown the reactor will be performed in from the main control room for safety-related equipment.

Impact on DCD

The revised DCD Tier 2, Section 14.2 submitted by KHNP Letter No. MKD/NW-16-0156L, dated February 24, 2016 will be revised as indicated in the attachment associated with this response.

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 Environmental Report.

14.2 Initial Plant Test Program

14.2.1 Summary of Test Program and Objectives

The purpose of this section is to describe the initial test program (ITP) that is performed during initial startup of the APR1400 plant.

The ITP includes testing activities commencing with the completion of construction and installation and ending with the completion of power ascension testing. The results of the testing demonstrate that components and systems operate in accordance with design requirements and meet the requirements of 10 CFR Part 50, Appendix B, Criterion XI (Reference 1). The results confirm that performance levels meet operational safety requirements and verify the adequacy of component and system design and system operability over their operating ranges. The program also aids in establishing baseline performance data and serves to verify that normal operating and emergency procedures accomplish their intended purposes. The ITP consists of operational tests and initial startup tests as the following four phases:

a. Phase I: Preoperational testing

b. Phase II: Fuel loading and post-core hot functional testing

c. Phase III: Initial criticality and low-power physics testing

d. Phase IV: Power ascension testing

The capability of manual controls to control safety-related equipment and shutdown the reactor in the main control room is verified in the ITP for each component and system in Section 14.2.12.

14.2.1.1 Phase I – Preoperational Testing

Phase I of the startup test program consists of two parts.

In Part I, preoperational testing is conducted to demonstrate that structures, systems, and components (SSCs) operate in accordance with design operating modes throughout the full design operating range. Where required, simulated signals or inputs are used to demonstrate the full range of the systems that are used during normal operation. Systems that are not used during normal plant operation but must be in a state of readiness to