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**
Application Section:	**14.2.12.1.23 – Engineered Safety Feature - Component Control System**
Date of RAI Issue:	**09/04/2015**

Question No. 14.02-20

Demonstrate how the Engineered Safety Feature – Component Control System (ESF-CCS) Test described in APR1400 FSAR Tier 2, Section 14.2.12.1.23 of 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 14.2.12.1.23 provides the initial test for the ESF-CCS. 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 provide the following information stated below.

1) The test objective for this test states, “to demonstrate the proper operation of the [ESFCCF].” This test objective does not contain specific criteria that needs to be met. In addition, the staff finds that portions of the test methods listed under Section 14.2.12.1.23,

   Item 3.0, “Test Method,” appear to be test objectives. For example, Item 3.9 under “Test Methods” states, “Exercise automatic and manual test functions to verify control functions of ESF-CCS.” In this case, verifying the operation of the control functions of the ESF-CCS

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 ESF-CCF 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 ESFAS are operational.” It is not clear what these support systems (e.g. plant protection system) are? It is also unclear what inputs to the ESF-CCS is required for the completion of this test. In addition, clarify whether the factory acceptance testing need to be complete as a prerequisite for this test. 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) Item 3.7 states, “Simulate inputs to the appropriate circuits and observe trip initiation.” What is meant by appropriate circuits? What criteria define the appropriate circuits? What specific trip initiation is being observed?

   b) Item 3.8 states, “Exercise manual control functions to the safety depressurization shutdown cooling system to verify proper operation.” What are the criteria for proper operation (e.g. cooling at specified rate)?

   c) Item 3.9 states “Exercise automatic and manual test functions to verify control function of ESF-CCS”. Where are the automatic and manual test functions defined? How does the test functions verify control function of the ESF-CCS?

   d) Item 3.10 states, “Test control transfer function from the main control room (MCR) to the remote shutdown room (RSR) and observe the status of plant equipment.” It is the staff’s understanding that plant equipment state does not change when the control is transferred from the MCR to the RSR. As such, either clarify what is the intent of this test item or provide justification for why the equipment state would change.

   e) RG 1.68, Appendix 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 ESF-CCS?

4) Item 5.0, “Acceptance Criteria” states that “The ESF-CCS performs as described in Subsection 7.3.1.” 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 Subsection 7.3.1 provide the acceptance criteria for the ESFCCS 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)

KHNP provided an upgraded test plan for the Engineered Safety Features – Component Control System (ESF-CCS) test as a result of the broad effort described in the original response (ref. MKD/NW-16-0156L dated February 24). As a result of the questions contained in the RAI, additional detail on the ITP was needed. Therefore, KHNP is providing a rewrite of the ESF-CCS test plan to address the specific issues noted.

1) An introductory paragraph is being added that provides the basis for conducting the test, which is to confirm that the installation of the ESF-CCS has been appropriately performed and the interfaces and plant components will function properly.

   The test objectives for the ESF-CCS have been rewritten to include specific objectives for the component operation within the system and to include the various interfaces such as inter-cabinet interfaces and with other I&C systems that need to be met.

2) The prerequisites for the ESF-CCS tests have been enhanced to include the specific systems such as digital controllers, I/O modules, data communication, wired interfaced, etc. that need to be functional before the test can be performed. The completion of the factory acceptance tests has also been added as a prerequisite.

3) a) An explanatory paragraph has been added to the test method section that provides clarification that the test methods do not confirm the performance of the mechanical and electrical systems which is the accomplished through the other testing that is performed. It also provides detail on how the tests are performed separately within each division. Item 3.7 has been replaced with several steps that establish the appropriate signals that are used as inputs, the applicable circuits that are being tested, and the specific trips that are initiation and observed. For instance item 3.3 now provides detail on the ESF actuation signal generated by the PPS, item 3.5 provides detail on the loss of offsite power and EDG sensor inputs to the ESF-CCS, 3.7 uses the DPS to generate diverse actuation signals, etc.

   b) Item 3.8 is deleted since subsection 3.1 includes manual control for each ESF plant component.

   c) Item 3.9 is deleted since automatic test function is not proper terminology. Each test is performed by manual input. The manual inputs are described in subsection 3.0, TEST METHOD.

   d) Item 3.10 is rewritten in subsection 3.2. The plant equipment state does not change when the control is transferred from the MCR to the RSR.

e) To verify redundancy and electrical independence within the ESF-CCS, the tests in subsection “3.0 TEST METHOD” are conducted separately for each safety division. Observations are performed both within the division under test and concurrently of the other divisions. This is described in subsection 3.0 TEST METHOD.

4) The acceptance criteria section has been expanded and aligned. Each acceptance criterion for the ESF-CCS test has been rewritten to correspond to the test objective and the test method, with the same section number designation. The test acceptance is confirmed for each separate safety division completed under the test, with confirmation that no unexpected interactions with other safety divisions occurs.

Impact on DCD

Section 14.2.12.1.23 of the APR1400 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.

5.6 Specified initially closed valves can be power removed from the valve and switches at the MCR and RSR. Also the following initially open valves can close and be power removed at the MCR and RSR

5.7 SIT Subsystem level instrument alarm setpoints are verified

5.8 SIT Subsystem pressure instrument alarm setpoints are verified

5.9 SIT control valve interlocks are verified

5.10 SIT venting capability is demonstrated by each vent valve depressurizing SIT in less than required time

5.11 SIT hydraulic performance is demonstrated by each of the four SITs discharging its contents to the RCS from an initial wide range level and pressure which is provided by vendor, and the resistance coefficients in high flow and low flow mode are within required design range

5.12 Valves response to specified differential pressure between SITs and RCS pressure

14.2.12.1.23 Engineered Safety Features – Component Control System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate the proper operation of the ~~engineered safety features – component~~ESF-CCS

1.2 To verify the operation of the manual control ~~system (~~of ESF-CCS~~)~~

1.3 To verify the proper operation of actuation logic of each ESFAS function

1.4 To verify the proper interface among ESC-CCS, group controller, and loop controller

1.5 To verify the operation of the maintenance and test panel/interface and test processor for ESF-CCS

1.6 To verify the proper indication and alarms for ESF-CCS

1.7 To verify the operation of the operator module for ESF-CCS

1.8 To verify RSR Transfer function

1.9 To verify the operation of the ESF-CCS power supplies

1.10 To demonstrate redundancy, electrical independence, coincidence, and safe failure on loss of power.

2.0 PREREQUISITES

2.1 Construction activities on the ~~engineered safety feature actuation system (~~ESFAS~~)~~ have been completed and system software is installed.

2.2 ESFAS instrumentation has been calibrated.

2.3 External test instrumentation is available and calibrated.

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

3.0 TEST METHOD

3.1 Energize power supplies and observe output voltages.

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

3.3 Individually de-energize each group relay and monitor contact operation.

3.4 Test manual trips and monitor relay operation.

3.5 De-energize all combinations of the two-out-of-four trip logic for each of the actuation systems (SIAS, CIAS, CSAS, MSIS, AFAS) and observe actuation of the appropriate trip circuit and associated alarms.

3.6 De-energize combinations of the one-out-of-two trip logic for each balance-of-plant ~~(BOP)~~ ESFAS (CREVAS, FHEVAS, CPIAS) and observe actuation of the appropriate trip circuit and associated alarms.

3.7 Simulate inputs to the appropriate circuits and observe trip initiations.

3.8 Exercise the manual control functions to the safety depressurization and shutdown cooling system to verify proper operation.

3.9 Exercise automatic and manual test functions to verify control functions of ESF-CCS.

3.10 Test control transfer function from the main control room ~~(MCR)~~ to the remote shutdown room ~~(RSR)~~ and observe the status of plant equipment.

4.0 DATA REQUIRED

4.1 Power supply voltages

4.2 Resistance for ground fault detector operation

4.3 Response to manual trips

4.4 Response to logic trips

4.5 Trip setpoints

4.6 Automatic and manual test function outputs and displays

4.7 Response to control transfer function

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~~)~~

Replaced with following pages

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The internal functions of the ESF-CCS are confirmed through factory acceptance testing. The basis of this in-plant test is to confirm the correct installation of the ESF-CCS, including inter-cabinet cable interfaces, and interfaces to other I&C systems, plant instrumentation and the controlled plant components. This test includes samples that overlap the digital functions previously tested in the factory to confirm that the correct operation of those functions has not been adversely affected by plant installation activities.

1.0 OBJECTIVES

1.1 To verify the operation of the manual controls for each ESF component from the MCR, including the correct ESF component response and status feedback.

1.2 To verify bumpless transfer of control from the MCR to the RSR, and the operation of the RSR manual controls, including the correct ESF component response.

1.3 To verify the interface of the PPS ESF actuation signals with associated alarms, including the correct ESF component response, for actuation and reset.

1.4 To verify the operation of the ESF actuation signals generated internally within the ESF-CCS with associated alarms, including the correct ESF component response, for actuation and reset. This test does not confirm instrument calibration.

1.5 To verify the operation of the emergency diesel generator (EDG) Load Sequencer with associated alarms. This test does not confirm instrument calibration.

1.6 To verify the operation of all ESF system process interlocks and automatic control signals with associated alarms, including the correct ESF component response for actuation and reset. This test does not confirm instrument calibration.

1.7 To verify the interface of the diverse protection system (DPS) actuation signals with associated alarms, including the correct ESF component response, for actuation and reset.

1.8 To verify the interface of the diverse manual ESF actuation (DMA) switches, for each ESF component with a DMA interface, including the correct ESF component response.

1.9 To verify the operation of redundant ESF-CCS power supplies.

2.0 PREREQUISITES

2.1 Factory acceptance tests have been completed for the ESF-CCS.

2.2 Construction activities for the ESF-CCS have been completed. This includes:

Installation and power-up of ESF-CCS electronic components, including digital controllers and I/O modules.

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Connection of digital data communication interfaces, both wired and fiber-optic, between ESF-CCS internal components (e.g., operator modules) and to/from other plant systems.

Connection of wired interfaces between ESF-CCS internal components (e.g., conventional switches and indicators), to/from other plant systems, and to/from plant sensors and controlled plant components. Instrument calibration is not a prerequisite.

2.3 There are no unexpected ESF-CCS self-diagnostic alarms. Self-diagnostic alarms may exist for temporary test conditions; any self-diagnostic alarms are justified.

2.4 Electrical and mechanical systems, which contain the plant components controlled by the ESF-CCS, are configured to allow short term component state changes during the ESF-CCS tests. These state changes confirm correct ESF control and correct component status feedback processing.

3.0 TEST METHOD

The ESF-CCS tests are conducted to confirm the correct ESF-CCS control of the ESF plant components, not to confirm the performance of the plant's mechanical and electrical systems. Each method, below, corresponds to the test objective with the corresponding 1.X/3.X number designation. To verify redundancy and electrical independence within the ESF-CCS, these tests are conducted separately for each safety division with observations within the division under test and concurrent observations of the other divisions.

3.1 Manually change the state of each ESF plant component using each unique MCR human systems interface. This includes manual control from an ESF-CCS soft control module (ESCM), and control from each minimum inventory (MI) control for ESF components that have MI control. Distribute the tests across all ESCMs; but any single component is controlled from only one ESCM. Observe component status feedback and alarms.

3.2 Manually transfer control between the MCR and RSR using the master transfer switches. Manually change the state of the ESF plant components credited for safe shutdown using the ESCMs in the RSR. Observe component status feedback and alarms. This test is conducted on a sample basis, at least one component in each plant electrical and mechanical system, since the ability to change the state of all ESF components was confirmed in Section 14.2.12.1.23, subsection 3.1.

3.3 Manually initiate each ESF actuation signal generated by the PPS using the MCR system-level MI switches, then manually reset the signals. Observe component status feedback and alarms. This test repositions multiple ESF plant components concurrently; if multiple ESF plant components cannot be repositioned during this test, the ESF-CCS component outputs can be disconnected and monitored. This monitoring is conducted on a sample basis, at least one component in each ESF actuation group, since the ability to change the state of all ESF components was confirmed in Section 14.2.12.1.23,

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subsection 3.1.

3.4 Manually initiate each ESF actuation signal generated directly by the ESF-CCS using the MCR MI switches, then manually reset the signals. Observe component status feedback and alarms. This test repositions multiple ESF plant components concurrently; if multiple ESF plant components cannot be repositioned during this test, the ESF-CCS component outputs can be disconnected and monitored. This monitoring is conducted on a sample basis, at least one component in each ESF actuation group, since the ability to change the state of all ESF components was confirmed in Section 14.2.12.1.23, subsection 3.1. In addition, stimulate the sensor inputs to the ESF-CCS to generate these same ESF actuation signals automatically.

3.5 Stimulate the loss of offsite power (LOOP) and EDG sensor inputs to the ESF-CCS to initiate load shed and group sequence signals. Observe component status feedback and alarms. This test repositions multiple ESF plant components concurrently; if multiple ESF plant components cannot be repositioned during this test, the ESF-CCS component outputs can be disconnected and monitored. This monitoring is conducted on a sample basis, at least one component in each sequence group, since the ability to change the state of all ESF components was confirmed in Section 14.2.12.1.23, subsection 3.1.

3.6 Stimulate the sensor inputs to the ESF-CCS for process interlocks and automatic control signals, then manually reset the signals. Observe component status feedback and alarms. This test repositions multiple ESF plant components concurrently; if multiple ESF plant components cannot be repositioned during this test, the ESF-CCS component outputs can be monitored. This monitoring is conducted on a sample basis, at least one component actuated by each interlock/control signal, since the ability to change the state of all ESF components was confirmed in Section 14.2.12.1.23, subsection 3.1.

3.7 Stimulate the DPS to generate each diverse actuation signal. Observe component status feedback and alarms. This test repositions multiple ESF plant components concurrently; if multiple ESF plant components cannot be repositioned during this test, the ESF-CCS component outputs can be disconnected and monitored. This monitoring is conducted on a sample basis, at least one component in each DPS actuation group, since the ability to change the state of all ESF components was confirmed in 14.2.12.1.23, subsection 3.1.

3.8 Manually change the state of each ESF plant component with a DMA interface, using the DMA switches in the MCR. Observe component status feedback and alarms.

3.9 De-energize each set of ESF-CCS logic power supplies (one at a time for each pair). Repeat this test for I/O power supplies. Observe component status feedback or ESF-CCS outputs. This monitoring is conducted on a sample basis, at least one component controlled from each I/O rack of the ESF-CCS or one ESF-CCS output from each I/O rack of the ESF-CCS.

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4.0 DATA REQUIRED

4.1 Component status feedback and alarms

4.2 Component status feedback or ESF-CCS outputs

5.0 ACCEPTANCE CRITERIA

Each acceptance criteria, below, corresponds to the test objective in Section 14.2.12.1.23 subsection 1.0 and the test method in Section 14.2.12.1.23 subsection 3.0 , with the corresponding 1.X/3.X/5.X number designation. Test acceptance is confirmed for each separate safety division under test, with confirmation of no unexpected interactions with other safety divisions.

5.1 Each ESF plant component responds correctly to the manual control command from a MCR ESCM. Each ESF plant component with a MI control responds correctly to the MCR manual control command from the MI control.

5.2 There are no component state changes when the master transfer switches are activated. Each sampled ESF plant component responds correctly to the manual control command from a RSR ESCM.

5.3 ESF actuation alarms are generated and each ESF plant component, or ESF-CCS sampled output, responds correctly to the ESF actuation signal from the PPS. When the signals are reset all components remain in their actuated position.

5.4 ESF actuation alarms are generated and each ESF plant component, or ESF-CCS sampled output, responds correctly to the ESF actuation signal from the internally generated ESF actuation signals from the SLS. When the signals are reset all components remain in their actuated position. These same ESF actuation signals are generated through sensor stimulation.

5.5 LOOP alarms are generated and each ESF plant component that is controlled by load shed or group sequence signals, or ESF-CCS sampled output, responds correctly to the LOOP load shed and group sequence signals. Load shed signals result in ESF plant components going to their de-energized state. Group sequence signals energize the ESF plant component directly or allow the component to be energized by other ESF actuation signals.

5.6 Interlock alarms are generated and each ESF plant component, or ESF-CCS sampled output, responds correctly to the interlock and control signals. When an interlock is reset all components remain in their interlock demanded position, unless there is a specific reset reposition command in the component’s control logic.

5.7 Each ESF plant component, or ESF-CCS sampled output, responds correctly to the diverse actuation signal from the DPS.

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5.8 Each ESF plant component with a DMA control responds correctly to the manual control command from a MCR DMA switch.

5.9 Power supply failure alarms are generated. There are no state changes for the controlled plant components or the ESF-CCS outputs.

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**
Application Section:	**14.2.12.1.39 – Integrated Engineered Safety Features / Loss of Power Test**
Date of RAI Issue:	**09/04/2015**

Question No. 14.02-29

Demonstrate how the engineering safety feature-component control system (ESF-CCS) functions that mitigate loss of power to Class 1E buses condition are verified in the integrated engineered safety features (ESF)/loss of power test described in APR1400 FSAR Tier 2, Section 14.2.12.1.39. In addition, demonstrate which test method verifies the test objective of demonstrating electrical redundancy, independence, and load group assignment.

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 14.2.12.1.39 provides the initial test descriptions for the integrated ESF/loss of power test. The test objectives for this test include verifying the full operational sequence of the ESF, demonstrating electrical redundancy, independence, and load group assignment, and demonstrating proper plant response to partial and full losses of offsite power. APR1400 FSAR Tier 2, Section 7.3.1.8, "Emergency Diesel Generator Loading Sequencer," describes the operation of the emergency diesel generator loading sequencer upon loss of offsite power. This section discusses the EFS-CCS startup of the emergency diesel generators (EDG)s, shedding of the electrical loads, transfer of Class1E bus connection to the EDGs, and initiation of the EDG load sequencer to reload the safety-related loads. Based on the staff’s review of the integrated ESF/loss of power test methods described in APR1400 FSAR Tier 2, Section 14.2.12.1.39, it is not clear whether these ESF-CCS functions are verified as part of this test. In addition, the staff could not identify a test method that verifies the test objective: “demonstrate electrical redundancy, independence, and load group assignment.” As such the

staff requests the applicant to modify APR1400 FSAR Tier 2, Section 14.2.12.1.39 to address these issues.

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)

The test methods have been revised to provide the following additional details on the integrated engineered safety features (ESF)/loss of power test described in APR1400 FSAR Tier 2, Section 14.2.12.1.39.

The ESF-CCS functions will be verified by observing the subsequent response and status of the ESF plant components after receipt of the ESF-CCS signal. Clarification was also added pertaining to the generation of ESF actuation signal intitiation.

Additional details were added to the test method to verify electrical redundancy, independence and load group assignment through impacted and non-impacted division observations as specified in subsections 3.1 and 3.3.

The verification of EDG full load capability in Subsection 3.3 was made a separate subsections and the subsection numbers changed accordingly.

Specific criteria is being provided in the Acceptance Criteria rather than referencing DCD sections for appropriate ESF response. Also, clarification is added to the acceptance criteria for redundancy, independence and load group assignments for confirming appropriate response and observing no unexpected interactions with other division components.

Impact on DCD

Section 14.2.12.1.39 of the APR1400 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.

2.5 IRWST is filled to normal operating level.

3.0 TEST METHOD

To verify redundancy and electrical independence within the ESF-CCS and throughout the ESF systems, these tests are conducted separately for each safety division with observations within the division under test and concurrent observations of the other divisions.

3.1 Perform partial and full losses of offsite power. Verify the proper response of ESF systems, alternate power sources, uninterruptible power supplies, and instrumentation and control systems.

Verify the response of the EDG and EDG breaker to ESF-CCS signals for EDG start and EDG connection to the ESF buses. Verify the response of the ESF plant components that are automatically connected to the ESF buses by the load sequencer; this verification confirms that components are re-energized within the correct load group and within the correct sequence time.

3.2 Under loss-of-power conditions, verify operability of systems/components from energized buses and absence of voltage on de-energized buses. Include ESF systems, appropriate heating, ventilation and air conditioning (HVAC) systems, decay heat removal systems, and systems required under post-accident conditions.

Observe the status of ESF plant components that are load shed by the ESF-CCS.

3.3 Demonstrate the proper diesel generator response to loss of power including bus energization, load sequencing, and load-carrying capability. ~~Verify that full load is within the emergency diesel generator design capability.~~

3.4 Verify that full load is within the emergency diesel generator design capability.

~~3.4~~ Demonstrate proper response to actual or simulated engineered safety features actuation signals (ESFAS).

3.5

ESF actuation signals are generated before a LOOP is generated, during a load sequence, and after a load sequence has been completed.

4.0 DATA REQUIRED

4.1 Response to ESFAS signals

4.2 Diesel start times, load sequence times, frequency, voltage, and current

4.3 Valve stroke times

5.0 ACCEPTANCE CRITERIA

5.1 ~~The ESFs respond as described in Chapters 6 and 9 and in Sections 7.3, 8.3, and 10.4.~~

Correct response in accordance with Section 7.3 includes the following:
All components that must be load shed are disconnected from the ESF buses when the LOOP is detected.
The EDG is started when the LOOP is detected.
The EDG is connected to the ESF buses when the EDG has reached the correct load carrying rating.
The ESF controlled plant components are connected to the ESF buses in the correct time sequence and with the correct load groups.

Correct electrical redundancy and independence is confirmed by testing each division separately, separately confirming each division's response, including the response of the EDG, EDG breaker and ESF component load group sequencing, and confirming no unexpected interactions with other safety divisions.

5.2 Electrical redundancy, independence, and load group assignments are as designed.

5.3 Plant response to partial and full losses of offsite power is as designed.

5.4 The diesel generators reenergize loads as designed and full load is within design capability.

In-Containment Water Storage System Test

1.0 ~~OBJECTIVE~~OBJECTIVES

1.1 To demonstrate the proper operation of the in-containment refueling water storage tank (IRWST), holdup volume tank (HVT), and cavity flooding system (CFS)

1.2 To demonstrate the operation of the IRWST remote operated valves

1.3 To demonstrate system alarms and status lights

1.4 To demonstrate system responses to CIAS signals

1.5 To demonstrate the failed position of valves

2.0 PREREQUISITES

2.1 Construction activities on the systems to be tested are complete.

2.2 Plant systems required to support testing are operable or temporary systems are installed and operable.

2.3 Permanently installed instrumentation is operable and calibrated.

2.4 Test instrumentation is available and calibrated.