

KHNPDCDRAIsPEm Resource

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Subject: APR1400 Design Certification Application RAI 198-8208 (14.2 - Initial Plant Test Program)
Attachments: image001.jpg; APR1400 DC RAI 198 ICE1 8208.pdf

KHNP,

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

Thank you,

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Mail Envelope Properties (3178c97712db490789289b685ff30d16)

Subject: APR1400 Design Certification Application RAI 198-8208 (14.2 - Initial Plant Test Program)
Sent Date: 9/4/2015 6:08:19 PM
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Issue Date: 09/04/2015

Application Title: APR1400 Design Certification Review – 52-046

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

Docket No. 52-046

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

Application Section: 14.2

QUESTIONS

14.02-19

Provide the acceptance criteria used to select plant features to be tested in the initial test program in order to meet 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. This regulatory guide states that "The [Initial Test Program] (ITP) should be designed to demonstrate the performance of SSCs and design features that will be used during normal facility operations, as well as the performance of standby systems and features that must function to maintain the plant in a safe condition in the event of malfunctions or accidents. The startup tests should be sequenced so that plant safety is never entirely dependent on the performance of untested SSCs." Further SRP Section 14.2, Acceptance Criteria, Item 1.B states that the ITP should describe the criteria for selection of plant features to be tested by the applicant. The staff cannot find the acceptance criteria the applicant used for the selection of plant features to be tested in APR1400 FSAR Tier 2, Section 14.2. As such, the staff requests the applicant to modify FSAR Tier 2, Section 14.2 to include this information.

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,

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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 [ESF-CCF].” 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

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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 ESF-CCS test.

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 needs 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.

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- 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?

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- 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.

14.02-22

Demonstrate how the Ex-Core Neutron Flux Monitoring System (ENFMS) Test described in APR1400 FSAR Tier 2, Section 14.2.12.1.25 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 14.2.12.1.25 provides the initial test for the ENFMS. The staff reviewed this test and finds that additional information is required to determine whether this test meets the requirements of Criterion XI of Appendix B to 10 CFR Part 50. Specifically, the staff requests the applicant to address the following items described below.

- 1) Item 1.1 under "Objective" states that the objective is to "verify the proper functional performance of the [ENFMS]." Test Method Item 3.1 states, "Using appropriate test instrumentation, simulate and vary input signals to the startup, safety, and control channels of the ex-core neutron flux monitoring system." In addition Acceptance Criteria Item 5.1 states, "The [ENFMS] performs as described in Subsection 7.7.1.1 h." It is unclear to the staff whether this test will verify the functional performance of all channels of the ENFMS or only the non-safety related channels since Subsection 7.7.1.1 h only describes the non-safety related portion of the ENFMS. Clarify this discrepancy.
- 2) Item 2.0, "Prerequisites" does not specify whether the factory acceptance testing need to be complete prior to this test. Clarify this issue.
- 3) 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." Since the ENFMS contains both safety and non-safety related channels, what tests are

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performed to verify sufficient electrical independence between the safety and non-safety related channels of the ENFMS?

14.02-23

Demonstrate how the Fixed In-Core Nuclear Signal Channel Test described in APR1400 FSAR Tier 2, Section 14.2.12.1.26 meets the requirements of General Design Criterion (GDC) 1 of Appendix A to 10 CFR Part 50.

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 14.2.12.1.26 describes the initial test for the fixed in-core nuclear instrumentation system. The staff reviewed this test and finds that additional information is required to determine whether this test meets the requirements of GDC 1 of Appendix A to 10 CFR Part 50. Specifically, the staff requests the applicant to address the following items described below.

- 1) Item 1.0, "Objective" only provides two objectives for this test, Item 1.1, "To measure cable insulation resistance," and Item 1.2, "To verify proper amplifier operation." The in-core instrumentation system consists of more than just the in-core instrumentation, but also the core exit thermocouples (CET) instrumentation. It is unclear whether Item 1.2 will verify the proper operation of both the in-core instrumentation and the CET instrumentation. Clarify this in FSAR Section 14.2.12.1.26. In addition, the proper amplifier operation is only one function performed by the in-core instrumentation system. Are other functions verified (e.g. sending amplified signals to the information processing system (IPS)?
- 2) The staff finds that the Item 2.0, "Prerequisites" does not specify that the proper location of each in-core detectors are verified, which is important to verify the accuracy of the instrument measurements in order to ensure the proper mapping of the core. Provide this as a prerequisite or justify why it is not needed.

14.02-24

Demonstrate how the Reactor Regulating System (RRS) Test described in APR1400 FSAR Tier 2, Section 14.2.12.1.28 meets the requirements of General Design Criterion (GDC) 1 of Appendix A to 10 CFR Part 50.

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.

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APR1400 FSAR Tier 2, Section 14.2.12.1.28 describes the initial test for the RRS. The staff reviewed this test and finds that additional information is required regarding the pre-requisites for the RRS test. Specifically, Prerequisite Item 2.2 states, "RRS software is installed and instrumentation has been calibrated." The staff reviewed the tests proposed in the initial test program for other software-based instrumentation and control (I&C) systems and did not find software installation a prerequisite for these systems. Clarify whether software installation should be a prerequisite for those other I&C system tests.

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.

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

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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.

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.

14.02-28

Demonstrate how the manual control functions of the auxiliary feedwater system (AFWS) are verified as part of 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 14.2.12.1.34 provides the initial test descriptions for the AFWS. Test Method Item 3.9 verifies the proper operation of the AFWS in response to signals from the plant protection system and the diverse protection system. However, the staff could not identify a test method item that verifies the AFWS response to manual controls. Identify where this function is verified in the initial test program or modify APR1400 FSAR Tier 2, Section 14.2.12.1.34 to include this information.

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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.

14.02-30

Justify why operation of the ex-core neutron flux monitoring system (ENFMS) is not a prerequisite for the Internal Vibration Monitoring System (IVMS) Test.

General Design Criterion (GDC) 1, "Quality standards and records" of Appendix A, "General Design Criteria for Nuclear Power Plants" to 10 CFR Part 50 states, in part, that structures, systems, and components 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 14.2.12.1.41 provides the initial test descriptions for the IVMS test. APR1400 FSAR Tier 2, Section 7.7.1.5, "Nuclear Steam Supply System Integrity Monitoring System," states that the IVMS monitors the motion of the reactor internals by using the ex-core neutron flux signals from the ENFMS detectors. However, the operation of the ENFMS is not required as a prerequisite for this test. Justify why the operation of the ENFMS is not required for this test.

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14.02-31

Justify why all the automatic functions performed by the diverse protection system (DPS) are not verified in the DPS test described in APR1400 FSAR Tier 2, Section 14.2.12.1.49.

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 14.2.12.1.49 provides the initial test description for the DPS. The objective of this test is to verify the proper operation of the DPS. However, the test methods for this test only verify the operation of the reactor trip switch system (RTSS) trip circuit breaker and operation of the alternate auxiliary feedwater actuation signals using simulated input signals. It is not clear to the staff whether the simulated signals will be injected into the DPS. The staff requests the applicant to clarify this in the test methods description of this section. In addition, APR1400 FSAR Tier 2, Section 7.8 and the referenced technical reports identify additional automatic safety actuation signals performed by the DPS. The staff requests the applicant to justify why these functions are not verified in this initial test.

14.02-32

Demonstrate how the operation of the low-level interlock is verified in the pre-core pressurizer performance test described in APR1400 FSAR Tier 2, Section 14.2.12.1.53.

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 14.2.12.1.53 provides the initial test description for the pre-core pressurizer performance test. The acceptance criterion for this test states that the pressurizer performs as described in Subsections 7.7.1 and 5.4.10. APR1400 FSAR Tier 2, Subsection 7.7.1.1 b. "Pressurizer pressure and level control systems," states that the control system has a low-level interlock and a high-pressure interlock. The low-level interlock shuts off all the heaters when the level falls below a setpoint. The staff could not identify where the proper response of the heaters to the pressurizer low-level interlock is verified in this test. As such, the staff requests the applicant to demonstrate how the response of the pressurizer heaters to this interlock is verified in this test.

14.02-33

Demonstrate how the test objective to verify proper operation and sequencing of the control element drive mechanism (CEDM) is accomplished in the pre-core CEDM performance test described in APR1400 FSAR Tier 2, Section 14.2.12.1.54.

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,

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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 14.2.12.1.54 provides the initial test description for the pre-core CEDM performance test. Test objective 1.3 specifies the verification of the proper operation and sequencing of the CEDM. APR1400 FSAR Tier 2, Section 7.7.1.1 a., "Reactivity control systems," states that there are five modes of control: sequential group movement in manual and automatic control, manual group movement, manual individual CEA movement, and standby. The digital rod control system (DRCS) and Information Processing System (IPS) monitor proper sequential motion and provide an alarm for out-of-sequence conditions. The staff could not identify which test method will verify the proper sequencing of the CEDM. Provide a test method to verify this test objective.

14.02-34

Demonstrate how the test objective of the Post-Core Instrument Correlation Test stated APR1400 FSAR Tier 2, Section 14.2.12.2.9 can be accomplished with the test methods described in this section.

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 14.2.12.2.9 provides the post-core instrument correlation test. The test objective states, "To demonstrate proper operation of the plant protection system (PPS), core protection calculators (CPCs), information processing system (IPS), and qualified indication and alarm system (QIAS)." However, the test methods only require the PPS, CP, IPS and QIAS readouts and the main control room instrument readings to be obtained. It does not appear that these test methods will demonstrate the proper operation of the PPS, CPC, IPS, and QIAS. In addition, the acceptance criteria for this test states, "The IPS, QIAS, PPS, and CPCs perform as described in Sections 7.2 and 7.7." Sections 7.2 and 7.7 of the APR1400 FSAR Tier 2 contain a significant amount of design descriptions for these systems. It is unclear what specific design criteria need to be met for these systems with this test. As such, the staff requests the applicant to identify the specific acceptance criteria that need to be met with this test.

14.02-35

Clarify whether the Post-Core Ex-Core Neutron Flux Monitoring System (ENFMS) Test described in APR1400 FSAR Tier 2, Section 14.2.12.2.11 is only applicable to the non-safety channels of the ENFMS.

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

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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 14.2.12.2.11 describes the post-core ENFMS test. The acceptance criteria for this test states that the "[ENFMS] performs as described in Subsection 7.7.1.1.h." APR1400 FSAR Tier 2 Subsection 7.7.1.1 h., "Ex-core neutron flux monitoring system (non-safety channel)," only describes the operation of the non-safety channels of the ENFMS. As such, it is not clear to the staff whether this test is only applicable to the non-safety channels or whether it is also supposed to test the safety channels. The staff requests the applicant to clarify the scope of this test (i.e. whether it is for both safety and non-safety channels of the ENFMS or just the non-safety channels). In addition, if this test is only applicable to the non-safety channel of the ENFMS, the staff requests the applicant to identify where the safety channels of the ENFMS are tested in the post core initial test program.

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 °C (350 °F), reduce the reactor coolant temperature by at least 10 °C (50 °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 °F. As such, it is not clear how reducing the temperature by 50 °F from 350 °F would reach cold shutdown conditions of 210 °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.

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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.