GE-Hitachi Nuclear Energy Americas LLC

James C. Kinsey
Project Manager, ESBWR Licensing

PO Box 780 M/C A-55
Wilmington, NC 28402-0780
USA

T 910 675 5057
F 910 362 5057
jim.kinsey@ge.com

MFN 07-473

Docket No. 52-010

September 11, 2007

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 95 – Related to ESBWR Design Certification Application – RAI Numbers 14.2-64 through 14.2-66, 14.2-68 through 14.2-73, 14.2-76, 14.2-80**

Enclosures 1 and 2 contain GEH's response to the subject NRC RAIs transmitted via the Reference 1 letter.

If you have any questions or require additional information regarding the information provided here, please contact me.

Sincerely,

Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

D068

NRO

Reference:

MFN 07-204, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 95 Related to the ESBWR Design Certification Application*, March 27, 2007.

Enclosures:

1. MFN 07-473 – Response to Portion of NRC Request for Additional Information Letter No. 95 – Related to ESBWR Design Certification Application – RAI Numbers 14.2-64 through 14.2-66, 14.2-68 through 14.2-73, 14.2-76, 14.2-80
2. MFN 07-473 – Response to Portion of NRC Request for Additional Information Letter No. 95 – Related to ESBWR Design Certification Application – RAI Numbers 14.2-64 through 14.2-66, 14.2-68 through 14.2-73, 14.2-76, 14.2-80– DCD Tier 2 Markup Pages

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH Wilmington (with enclosures)
	RE Brown	GEH Wilmington (with enclosures)
	eDRF	72-8061, 73-3683, 73-5693, 73-6363, 73-6920, 73-6924, 70-3365, 70-3376, 73-6069, 73-7359, 73-6217

Enclosure 1

MFN 07-473

Response to Portion of NRC Request for

Additional Information Letter No. 95

Related to ESBWR Design Certification Application

RAI Numbers 14.2-64 through 14.2-66, 14.2-68 through 14.2-73, 14.2-76, 14.2-80

NRC RAI 14.2-64

Prerequisites should be added by saying "Equipment or components which can not be actuated without damage or upsetting the plant are isolated using necessary means to block device actuation. Also, continuity of wiring up to the actuation equipment is verified."

GEH Response

Actuation of equipment or components during either preoperational or startup test programs should not cause damage or upset the plant to an extent that damage is caused. We do recognize there are components designed for single use actuation (example squib valves) and agree we should acknowledge the acceptability of isolation of these devices to prevent them from being actuated during preoperational tests.

DCD Impact

The ESBWR utilizes single use squib valves in three systems; Automatic Depressurization System (ADS); Gravity Driven Cooling System (GDCS) and the Standby Liquid Control System (SLCS). Preoperational tests of these three systems will have a statement added to the prerequisites allowing isolation of these single use components prior to the test. Accordingly DCD Tier 2, Subsections 14.2.8.1.1 Nuclear Boiler System, 14.2.8.1.3 SLCS and 14.2.8.1.65 GDCS will have the prerequisite section revised, as noted in enclosure 2, by adding the following statement:

> To prevent actuation of single use squib valves during the logic portion of this testing process, the valve(s) may be isolated electrically to prevent actuation. This isolation, verification of the firing signal during the test, and reconnection process must be controlled within the test document.

NRC RAI 14.2-65

In DCD Tier 2, Section 14.2.8.1.2, Feedwater Control System Preoperational Test, the following tests should be added for attributes of the triplicate, fault-tolerant digital controller (FTDC):

- *Single and Three Element control*
- *Independence of controllers by taking each one, and then all combinations of two, out of service and verifying that the system is functioning properly*
- *Manual Feedpump Control - verify each Reactor Feed Pump (RFP) can be fully controlled through the FTDC*

GEH Response

GEH has reviewed the requested additions and provides the following responses;

Verification of the Single and Three Element controller is already encompassed within the statement to demonstrate the proper overall response of the control system. This will be done while using simulated signals for inputs. No change to the DCD is required.

We do agree to add a statement to verify, by demonstration, the loss and then restoration of a single processor in the FTDC will not cause substantial change to the system output signals, nor require operator action beyond recognition of an alarm when the processor is out of service. However, the simultaneous loss of two processors will not be demonstrated as that condition goes beyond the fault tolerant design of the FWCS. This position is consistent with Tier 1 Chapter 2 ITAAC for the FWCS, see DCD Tier 1 Table 2.2.3-2 item 2.

We agree to add a statement to preoperational test each Motor Driven Reactor Feed Pump (MDRFP) using the manual control mode of the controller to the extent practical.

DCD Impact

DCD Tier 2, Subsection 14.2.8.1.2 will be revised, as shown in enclosure 2, by addition of two more bulleted statements that read as follows:

- Independence of system functional operation from loss of operation of one of the redundant channels of the FTDC controllers/processors will be confirmed by test. Testing involves using simulated input signals and removing, then restoring the normal operation of each one of the three channels. During testing, important control system outputs are monitored and their response is used for confirming the system remains properly functional.
- Verification of each Motor Driven Reactor Feed Pump (MDRFP) will be made using the controller's manual control mode with a flow path through the long path recycle line. Maximum test flow rate to be consistent with the equipment limitations.

NRC RAI 14.2-66

In DCD Tier 2, Section 14.2.8.1.5, Rod Control and Information System Preoperational Test, "the proper functioning of instrumentation" should include status signals from hydraulic control units (HCUs) and failure indication of any one position detector for an individual fine motion control rod drive (FMCRD).

GEH Response

There are two issues being addressed:

1. status signals from hydraulic control units (HCU)
2. failure indication of any one position detector for a fine motion control rod drive (FMCRD)

Background for Item 1:

Each individual HCU uses a nitrogen-water accumulator. The HCU is provided with instrumentation to detect accumulator trouble, i.e., low nitrogen pressure and high water level. A loss of nitrogen decreases the nitrogen pressure and actuates a pressure switch. A float type level switch actuates an alarm if water leaks past the piston barrier and collects in the accumulator instrumentation block. Several tests are discussed in the DCD Tier 2 as follows:

Per DCD Subsection 4.6.3.1, HCU Tests include "correct operation of the accumulator pressure and level switches is verified".

Per DCD Subsection 4.6.3.3, Operational Tests include "CRDHS pressures can be observed from instrumentation in the control room. Scram accumulator pressures can be observed on the nitrogen pressure gauges".

Per DCD Subsection 4.6.3.5, Surveillance Tests include "During operation, accumulator pressure and level at the normal operating value are verified. Experience with CRD systems of the same type indicates that weekly verification of accumulator pressure and level is sufficient to assure operability of the accumulator portion of the CRD system".

As discussed in Subsection 7.7.2.2.1, the Rod Action and Position Information (RAPI) panels in the Rod Control and Information System (RC&IS) monitor whether the HCU accumulator water pressure and level status are normal or abnormal.

Background for Item 2:

The control rod drive system (CRDS) provides the RC&IS with continuous rod position indication from the two position signal detectors from each FMCRD. The output of each position detector is sent to a separate channel of the RC&IS for normal monitoring of control rod positions and executing normal control rod movement commands. Both channels perform the same functions and outputs of the two channels are continuously compared and must agree. Any disagreement results in a rod block signal. If one position detector fails for an individual

FMCRD, the failed position detector can be bypassed, and the unit can continue to operate without power restrictions.

The RC&IS and FMCRD status data and control rod position data are also provided to the N-DCIS. The Nonsafety-Related Distributed Control and Information System (N-DCIS) performs the nonsafety-related control and monitoring functions and operator interface for systems including RC&IS and CRDS. The N-DCIS provides extensive self-diagnostics that monitor communication power and other failures. Process diagnostics include system alarms and the ability to identify sensor failures. All of the process and self-diagnostic system alarms are provided in the main control room (MCR). This is discussed in DCD Tier 2 Subsection 7.1.4.

Per DCD Subsection 7.7.2.4, the RC&IS equipment is designed with consideration for on-line testing capabilities. These on-line diagnostics such as identifying and isolating failure of I/O signals, buses, power supplies, processors and inter-processor communications can be performed without interrupting the normal operation of the N-DCIS. Periodic surveillance, using off-line tests with simulated input signals, verifies the overall system integrity. Because of the single channel bypass capabilities, RC&IS operation continues while repair or maintenance work is being performed on the dual-channel scope of the RC&IS equipment.

Conclusion

From the discussion above, there are already tests and on-line diagnostics from both the RC&IS and N-DCIS that provide proper functioning of the status signals from the HCUs and rod position detector failure for an individual FMCRD.

DCD Impact

DCD Tier 2, Subsection 14.2.8.1.5 will be revised, as shown in enclosure 2, to add a new bullet item after the third bullet as follows:

- Proper functioning of instrumentation used to monitor status signals from hydraulic control units (HCUs) and failure indication of any one position detector for an individual FMCRD;

NRC RAI 14.2-68

In DCD Tier 2, Section 14.2.8.1.6, Safety System Logic and Control Preoperational Test, add tests for the following:

- *bypass interlocks and resulting indication;*
- *"fail safe" logic test for the reactor protection system (RPS) de-energization to trip;*
- *a "fail as is" logic test for the engineered safety feature (ESF) energization to trip.*

GEH Response

The features suggested in the RAI are part of each individual safety-related system, which are covered by SSLC and they are being verified as a part of those systems. Reactor Protection System logic testing is described in 14.2.8.1.9. Additionally, the following tests will be added to DCD Tier 2, Subsection 14.2.8.1.6:

- Verify proper operation of instrumentation and controls in appropriate design combinations of logic and instrument channel trip;
- Verify bypass logic and bypass indications;

The ITAAC that will demonstrate conformance with "Operating Bypasses" and "Maintenance Bypasses" (IEEE-603-1991, Safety System Criteria 6.6 and 7.4, and 6.7 and 7.5) have been added to DCD Tier 1, in Subsection 2.2.15, Tables 2.2.15-1, and 2.2.15-2. Refer to MFN 07-402, Enclosure 2, "DCD Tier 1 Changes," for DCD markups.

The preoperational test descriptions provided are considered appropriate to describe functional testing of logic that may be either fail-safe or fail-as-is. Subsection 14.2.8 discusses the level of detail for the descriptions of each preoperational test and the planned availability of the actual test procedures prior to their intended use.

DCD Impact

DCD Tier 2 Subsection 14.2.8.1.6 will be revised, as shown in enclosure 2, as a result of the response to RAI 14.2-68.

NRC RAI 14.2-69

In DCD Tier 2, Section 14.2.8.1.6, Safety System Logic and Control (SSLC) Preoperational Test, should any SSLC specific testing instruments be available, such as a dedicated diagnostic instrument surveillance test controller (STC), as an aid in performing SSLC functional logic testing, including trip, initiation, and interlock logic?

GEH Response

Specific instruments required to test SSLC will be provided in the actual test procedures. The self-test/diagnostic features of the SSLC are verified as part of the preoperational test as currently outlined in Subsection 14.2.8.1.6. A dedicated diagnostic instrument such as a surveillance test controller (STC) is not a feature currently attributed to the SSLC distributed control and information system platform

DCD Impact

No DCD revisions are planned as a result of the response to RAI 14.2-69.

NRC RAI 14.2-70

DCD Tier 2, Section 14.2.8.1.6, Safety System Logic and Control Preoperational Test, should include functional checks of the digital trip logic module (DTLM) and the safety system output logic unit (OLU) as described by the appropriate design specification.

GEH Response

The terms DTLM and OLU are typically used in the NUMAC platform and may not be applicable to the Safety System Logic and Control. Without identifying specific components within an instrument channel and division of logic, guidance will be updated in DCD Tier 2 subsection 14.2.8.1.6, to test the instrumentation and controls in the appropriate design combinations of logic and instrument channel trip. Terms such as digital trip modules/digital trip logic modules (i.e., signal comparator modules), voting logic units and output logic units, etc., are not called out specifically because their use and designation may vary depending on the logic platform. This level of detail is addressed in the actual test procedures. The factory acceptance test(s) and preoperational tests (inclusive of the tests of individual systems) will thoroughly test that the logic (whether) individual chassis or integrated logic (in a common controller), input and output signals, operator interface and links to Nonsafety-Related Distributed Control and Information System (N-DCIS) are functioning correctly.

Subsection 14.2.8 discusses the level of detail for the descriptions of each preoperational test and the planned availability of the actual test procedures prior to their intended use.

DCD Impact

DCD Tier 2 Subsection 14.2.8.1.6 will be revised as shown in enclosure 2.

NRC RAI 14.2-71

In DCD Tier 2, Section 14.2.8.1.7, Distributed Control and Information System (DCIS) System Preoperational Test, tests should be added to check the dual redundancy of the safety-related (Q-DCIS) data network by removing all of each ring of the network and verifying the system is still operating properly, as well as verifying indications to the operator showing one loop is out of service.

GEH Response

The DCIS is composed of Safety-Related (Q-DCIS) and Nonsafety-Related (N-DCIS) equipment, the architectures, relationships, and acceptance criteria of which are described throughout DCD Section 7.1. The configuration of the Q-DCIS network is not as implied by this RAI request to "check the dual redundancy of the safety-related (Q-DCIS) data network by removing all of each ring of the network ...".

DCD Subsection 7.1.3 describes the Q-DCIS as the data processing and transmission network that encompasses the four independent and separate data multiplexing divisions (Divisions 1, 2, 3, and 4) corresponding to the four divisions of safety-related electrical and I&C equipment. These four divisions are physically and electrically isolated and contain multiple redundant fiber optic cable communications pathways. In DCD Subsection 7.1.3.3, the paragraph beginning "The dual redundant data communication...", indicates that the redundant data communications pathways (referred to as "communication channels") within each division of the Q-DCIS, along with the four redundant divisions of the Q-DCIS satisfy the single failure criterion of IEEE Std. 603, Section 5.1. This will be rewritten to indicate that it is the four redundant divisions that satisfy the single failure criterion. Power and communication within each division of Q-DCIS is redundant only in order to support reliability and to allow self-diagnostics to be communicated in the presence of a single failure but is not required. DCD Subsection 7.1.6.6.1.2 gives further detail on conformance to IEEE Std. 603, 5.1.

As indicated in Subsection 14.2.8.1, the methods described in Subsection 14.2.8 are general, not specific. Specific testing to be performed and the applicable acceptance criteria for each preoperational test is documented in test procedures to be made available to the NRC prior to their intended use and is in accordance with the system specifications and associated equipment specifications. The tests demonstrate that the installed equipment and systems perform within the limits of those specifications. In DCD Tier 2, Subsection 14.2.8.1.7, DCIS System Preoperational Test, tests will not be added to check the redundancy of the Q-DCIS data network.

DCD Impact

In DCD Tier 2, Subsection 7.1.3.3, the first sentence of the paragraph beginning "The dual redundant data communication...", will be revised as follows:

> "The ~~dual redundant data communication channels per division and the~~ four redundant divisions of the Q-DCIS satisfy the single failure criterion of IEEE Std. 603, Section 5.1."

NRC RAI 14.2-72

In DCD Tier 2, Section 14.2.8.1.7, DCIS System Preoperational Test, tests should be added to verify that all types of actuation signals are transmitted from the Q-DCIS remote multiplexer units (RMUs) to the safety related equipment.

GEH Response

Preoperational tests will have to demonstrate that the safety-related system works on demand as a system from sensor to actuator. While GEH has defined the sensors, command/communication systems (DCIS), and actuators in different subsystems (for instance Q-DCIS, N-DCIS, Reactor Protection System, Leak Detection and Isolation System, and Diverse Protection System), proper system function from sensor to actuator still needs to be demonstrated. From a 10 CFR 50.55a(h) viewpoint, the safety-related system must include the sense, command, and actuate features within the safety-related system that performs a safety-related function.

DCD Section 7.1 (Subsections 7.1.2.7 and 7.1.3.6) states that the Q-DCIS does not include the remote multiplexer unit (RMU) wiring from the sensors, the wiring to the actuators, or the sensors. Testing listed in Chapter 14, Subsection 14.2.8.1.7, does not contain a requirement that all alarms, inputs, and outputs for all systems are functional. These verifications are left to the individual system preoperational tests for each of the systems listed in Subsection 14.2.8 (Individual Test Descriptions) because the sensors, actuators, and wiring between them and the RMU belong to those systems. Because the signals for those systems are transmitted/communicated via the DCIS, the DCIS needs to be functional before the other systems' preoperational tests can be performed. The general test methods and acceptance criteria listed in Subsection 14.2.8.1.7 are specific to the DCIS system and many of them are not tested as part of the other systems' preoperational tests. Therefore, testing per these methods demonstrates that the DCIS is functional.

The capability to receive and display alarm conditions from individual systems also needs to be part of the individual systems' tests. The input tests of each system will ensure both calibration and continuity of the signal from the field sensor, through the RMUs to the logic and VDU's. The output signal testing will ensure both calibration and continuity of the signal from the logic and VDU's through the RMUs to the field actuator. With the exception of squib valves (see response to RAI 14.2-64), the output testing will include actual operation of the actuator to ensure that the DCIS output is electrically compatible with its connected actuator.

As indicated in Subsection 14.2.8.1, the methods described in Subsection 14.2.8 are general, not specific. Specific testing to be performed and the applicable acceptance criteria for each preoperational test is documented in test procedures to be made available to the NRC prior to their intended use and is in accordance with the system specifications and associated equipment specifications. The tests demonstrate that the installed equipment and systems perform within the limits of those specifications. In DCD Tier 2, Subsection 14.2.8.1.7, DCIS Preoperational Test, tests will not be added to verify that all types of actuation signals are transmitted from the Q-DCIS RMUs to the safety related equipment.

The ITAAC's that will demonstrate conformance with "Completion of Protective Actions" (IEEE-603-1991, Safety System Criteria 5.2 and 7.3) have been added to DCD Tier 1. Refer to MFN 07-402, Enclosure 2, "DCD Tier 1 Changes" for DCD markups.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 14.2-73

In DCD Tier 2, Section 14.2.8.1.8, LD&IS Preoperational Test, additional detail is necessary to identify the interfacing functions and systems that must be available. This would include the following:

- *Drywell pressure signals, or simulated, from the RPS*
- *The reactor mode switch signals from the RPS*
- *The interlock from the RPS bypassing the main steam isolation valve (MSIV) isolation when not in the "RUN" mode*

GEH Response

ESBWR DCD Tier 2, Rev. 03, Subsection 14.2.8.1.8, 5th bullet requires the Leak Detection and Isolation System (LD&IS) Preoperational Test to demonstrate "Proper interface with related systems in regard to the input and output of leak detection indications and isolation initiation commands". These indications include: the Drywell pressure signals, or simulated, from the RPS; and the reactor mode switch signals from the Reactor protection System (RPS). Also, the 6th bullet of Subsection 14.2.8.1.8 "Proper operation of bypass switches and related logic" includes the interlock from the RPS bypassing the Main Steam Isolation Valves (MSIV) when not in "RUN" mode. The LD&IS interfacing diagram is provided in Figure 7.3-3.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 14.2-76

DCD Tier 2, Section 14.2.8.1.11, Plant Automation System Preoperational Test, should provide additional detail as to the tests involved; examples would include:

- *For redundant controllers, tests would be done to confirm response to simulated controller failures*
- *The capability of the plant automation system (PAS) to automatically decouple from plant control and revert to plant operation in manual mode*

GEH Response

DCD Tier 2, Rev.03, Subsection 7.7.4, "Plant Automation System (PAS)," describes the PAS as a power generation control system, which does not perform or ensure any safety-related function, and is not required to achieve or maintain safe shutdown. Therefore the PAS is nonsafety-related and has no safety design basis. Events requiring control rod scram are sensed and controlled by the safety-related Reactor Protection System (RPS), which is completely independent of the PAS. Similarly, events that require Engineered Safety Feature (ESF) response are sensed and controlled by safety-related systems, which are also completely independent of the PAS. In addition, preoperational testing and factory testing required by the software and hardware testing plans will ensure that the installed equipment satisfies the system design requirements.

As indicated in Subsection 14.2.8.1, the methods described in Subsection 14.2.8 are general, not specific. Specific testing to be performed and the applicable acceptance criteria for each preoperational test is documented in test procedures to be made available to the NRC approximately 60 days prior to their intended use and is in accordance with the system specifications and associated equipment specifications. These tests will demonstrate that the installed equipment and systems perform within the limits of those specifications. Therefore DCD Tier 2, Subsection 14.2.8.1.11, Plant Automation System Preoperational Test, does not require revision.

DCD Impact

No DCD changes will be made in response to this RAI.

NRC RAI 14.2-80

In DCD Tier 2, Section 14.2.8.2.12, Feedwater Control, the Criteria section should be expanded to include Open and Closed Loop testing to check the dynamic flow response of the main feedwater actuators and the dynamic response of the master level controller, respectively.

GEH Response

GEH has reviewed the requested additions and provides the following response:

During the preoperational test, Feedwater Control System (FWCS) open loop and closed loop testing will be performed.

In control system open loop testing, the demand of the low flow controller or the Adjustable Speed Drive (ASD) feedwater pump speed controller will be adjusted and the feedwater flow will be monitored to check the dynamic response of the feedwater low flow control valve actuator position or VFD pump speed.

In control system closed loop testing, the master level controller's setpoint will be adjusted and the feedwater flow and reactor water level will be monitored to check the dynamic response of the feedwater control system.

DCD Impact

DCD Tier 2, Subsection 14.2.8.2.12 "Criteria" description will be revised, as shown in enclosure 2, as a result of the response to RAI 14.2-80.

Enclosure 2

MFN 07-473

Response to Portion of NRC Request for

Additional Information Letter No. 95

Related to ESBWR Design Certification Application

RAI Numbers 14.2-64 through 14.2-66, 14.2-68 through 14.2-73, 14.2-76, 14.2-80

DCD Tier 2 Markup Pages

14.2.8.1.1 Nuclear Boiler System Preoperational Test

Purpose

The objective of this test is to verify that the valves, actuators, instrumentation, trip logic, alarms, annunciators, and indications associated with the Nuclear Boiler System (NBS) function as specified.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. The Depressurization Valve (DPV) engineering development tests have been completed as described in Subsection 6.3.2.8.2. The DPV factory operability tests, including response tests and flow tests, have been completed. The Reactor Pressure Vessel (RPV) and Main Steam Lines (MSL) can accept water during the test. The nitrogen gas and instrument air are available to support operation of MS valves. Electrical power is available to support Main Steam (MS) valves, instrumentation, and system operation. To the extent necessary, the interfacing systems are available to support the specific system testing and the appropriate system configurations. To prevent actuation of single use squib valves during the logic portion of this testing process, the valve(s) may be isolated electrically to prevent actuation. This isolation, verification of the firing signal during the test, and reconnection process must be controlled within the test document.

14.2.8.1.2 Feedwater Control System Preoperational Test

Purpose

The objective of this test is to verify proper operation of the Feedwater Control System (FWCS) and meet design requirements.

Prerequisites

The construction tests have been successfully completed, and the Condensate and Feedwater System preoperational test (Subsection 14.2.8.1.44) has been completed. The RWCU/SDC System and Feedwater System low flow control valve are available to support FWCS testing. The SCG has reviewed the test procedures and approved the initiation of testing. FWCS components shall have an initial calibration in accordance with vendor instructions. Factory acceptance tests of Fault Tolerant Digital Controller (FTDC) features and requirements as described in Subsection 7.7.3.4 and 7.7.3.5 have been successfully completed. Required interfacing systems shall be available, as needed, to support the specified testing and the appropriate system configurations.

General Test Methods and Acceptance Criteria

Testing of the FWCS during the preoperational phase may be limited by the absence of an acceptable feedwater recirculation flow path. Comprehensive flow testing is conducted during the startup phase.

Performance shall be observed and recorded during a series of individual component and overall system response tests to demonstrate the following:

- Proper operation of instrumentation and controls in the required combinations of logic and instrument channel trips, including verification of setpoints;
- Proper functioning of instrumentation and alarms used to monitor system operation and status;
- Proper operation of system valves, including timing and stroke, in response to control demands (including RWCU/SDC dump valve response to the low flow controller);
- Proper operation of interlocks and equipment protective devices within the FWCS;
- Verification of loss of feedwater heating signal to initiate Selected Control Rod Run-In (SCRRI);
- Verification of feedwater level control level setdown logic on reactor low water level (Level 3) signal;
- Verification of feedwater runback on reactor high level (Level 8) signal;
- Verification of feedwater runback on Anticipated Transient Without Scram (ATWS) trip signal;
- Proper communication and interface with other control systems and related equipment; and
- Proper overall response of the control system including the final control element. This will include control system response to simulated control system malfunctions and simulated plant transients at full flow including MSIV closure

and Turbine Trip without bypass capability. (Control system response will be verified, and mechanical / electrical component responses will be tested to the extent possible practical under preoperational test conditions.).

- Independence of system functional operation from loss of operation of one of the redundant channels of the FTDC controllers/processors will be confirmed by test. Testing involves using simulated input signals and removing, then restoring the normal operation of each one of the three channels. During testing, important control system outputs are monitored and their response is used for confirming the system remains properly functional.
- Verification of each Motor Driven Reactor Feed Pump (MDRFP) will be made using the controller's manual control mode with a flow path through the long path recycle line. Maximum test flow rate to be consistent with the equipment limitations.

14.2.8.1.3 Standby Liquid Control System Preoperational Test

Purpose

The objective of this test is to verify that the operation of the Standby Liquid Control (SLC) system, including accumulator, tanks, control, logic, and instrumentation, is as specified.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. The reactor vessel shall be available for injecting demineralized water. Required interfacing systems shall be available, as needed, to support the specified testing and the appropriate system configurations. To prevent actuation of single use squib valves during the logic portion of this testing process, the valve(s) may be isolated electrically to prevent actuation. This isolation, verification of the firing signal during the test, and reconnection process must be controlled within the test document.

14.2.8.1. 5 Rod Control and Information System Preoperational Test

Purpose

The objective of this test is to verify that the RC&IS functions are as designed.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. All electrical connections for rod position indication and RC&IS have been completed. All RC&IS cabinet power is available and system power supplies calibrated.

General Test Methods and Acceptance Criteria

Performance shall be observed and recorded during a series of tests to demonstrate the following:

- Proper operation of rod blocks and associated alarms and annunciators in all combinations all design combinations of logic and instrument channel trip, including all positions of the reactor mode switch;
- Proper system response to control rod run-in logic, including that associated with Alternate Rod Insertion (ARI), SCRRI and normal post-SCRAM follow;
- Proper functioning of instrumentation used to monitor Fine Motion Control Rod Drive (FMCRD) subsystem status such as rod position indication instrumentation and that used to monitor rod/drive separation status;
- Proper functioning of instrumentation used to monitor status signals from hydraulic control units (HCUs) and failure indication of any one position detector for an individual FMCRD;
- Proper operation of RC&IS software including verification of gang and group assignments and Automated Thermal Limit Monitors (ATLM), Rod Worth Minimizer (RWM) and automatic rod selection and movement functions; and
- Proper communication with Plant Automation System (PAS).

14.2.8.1.6 Safety System Logic and Control Preoperational Test

Purpose

The objective of this test is to verify proper operation of the Safety System Logic and Control (SSLC).

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedures and approved the initiation of testing. The required AC and DC electrical power sources shall be operational and the appropriate interfacing systems shall be available as required to support the specified testing.

General Test Methods and Acceptance Criteria

The testing consists of the following:

- Verify the self-test portion of the SSLC, including the proper reporting of all detected failures;
- Verify the non-interaction of the SSLC self-test system to confirm that the self-test system does not cause a false indication;
- Verify the correct activation of the inputs to the SSLC such as pushbutton switches, control operating switches, key-operated switches and analog inputs;
- Verify the local indication devices on the SSLC properly indicate the correct status;
- Verify the proper interface with diverse protection system.
- Verify proper operation of instrumentation and controls in appropriate design combinations of logic and instrument channel trip; and
- Verify bypass logic and bypass indications;

14.2.8.1.65 Gravity-Driven Cooling System Preoperational Test

Purpose

The objective of this test is to verify that the operation of the four divisions of the GDCS, including valves, logic and instrumentation, is as specified.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. The reactor vessel shall be ready to accept GDCS flow. The required electrical power shall be available for squib type valve power supply. Instrument calibration and instrument loop checks have been completedTo prevent actuation of single use squib valves during the logic portion of this testing process, the valve(s) may be isolated electrically to prevent actuation. This isolation, verification of the firing signal during the test, and reconnection process must be controlled within the test document.

14.2.8.2.12 Feedwater Control Test

Purpose

The objective of this test is to demonstrate that the stability and response characteristics of the FWCS are in accordance with design requirements for applicable system configurations and operational conditions.

Prerequisites

The preoperational tests are complete and plant management has reviewed the test procedure and approved the initiation of testing. For each scheduled testing iteration, the plant shall be in the appropriate operational configuration with specified prerequisite testing complete. This includes preliminary adjustments and optimization of control system components, as appropriate.

Description

Startup phase testing of the FWCS is intended to demonstrate that the overall response and stability of the system meets design requirements subsequent to controller optimization. Testing begins during plant heatup for any special configurations designed for very low feedwater or condensate flow rates and continues up through the normal full power lineup. Testing shall include all modes of control and encompass all expected plant power levels and operational conditions. Testing is accomplished by manual manipulation of controllers and/or by direct input of demand changes at various levels of control. System response shall also be evaluated under AOO conditions such as an unexpected loss of a feedwater pump or a rapid reduction in core power level and after plant trips such as turbine trip or main steamline isolation. Proper setup of control system components or features designed to handle the nonlinearities or dissimilarities in system response at various conditions shall also be demonstrated. The above testing also serves to demonstrate overall core stability to subcooling changes.

Criteria

The FWCS performance shall be stable such that any type of divergent response is avoided. Through the Open and Closed Loop testing, the response shall be sufficiently fast but with any oscillatory modes of response well damped, usually with decay ratios less than 0.25.