



GE Energy

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**Subject: Response to Portion of NRC Request for Additional Information
Letter No. 50 Related to ESBWR Design Certification Application –
Initial Test Program – RAI Numbers 14.2-5, 14.2-7, and 14.2-9
through 14.2-12**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

If you have any questions about the information provided here, please let me know.

Sincerely,

A handwritten signature in cursive script that reads "Kathy Sedney for".

David H. Hinds
Manager, ESBWR

D068

Reference:

1. MFN 06-300, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 50 Related to ESBWR Design Certification Application*, August 16, 2006

Enclosure:

1. MFN 06-376 – Response to Portion of NRC Request for Additional Information Letter No. 50 Related to ESBWR Design Certification Application – Initial Test Program – RAI Numbers 14.2-5, 14.2-7, and 14.2-9 through 14.2-12

cc: AE Cabbage USNRC (with enclosures)
GB Stramback/GE/San Jose (with enclosures)
eDRFs 0059-3085, 0059-3288, 0059-3513,
0058-4183, 0058-4196, 0058-4204

ENCLOSURE 1

MFN 06-376

Response to Portion of NRC Request for

Additional Information Letter No. 50

Related to ESBWR Design Certification Application

Initial Test Program

RAI Numbers 14.2-5, 14.2-7, and 14.2-9 through 14.2-12

NRC RAI 14.2-5

Section 1.j of Regulatory Guide (RG) 1.68 states that the initial test program should include in its pre-operational phase the testing of instrumentation and control systems that (1) control normal operation of the facility, (2) provide information and alarms in the control room to monitor the operation and status of the facility, (3) establish that the facility is operating within design and license limits, (4) permit or support the operation of engineered safety features, and (5) monitor and record important parameters during and following postulated accidents. Also, section 1.j of RG 1.68 includes provisions to verify redundancy and electrical independence of these instrumentation and control systems.

Consistent with the above RG:

- (a) Specify whether the fault tolerant digital controllers will be tested as part of the feedwater control system (FWCS) pre-operational test; and*
- (b) Specify whether the redundancy and electrical independence of the FWCS will be verified as part of the system pre-operational test.*

If these tests will be performed, provide the appropriate test descriptions in the DCD Tier 2, Section 14.2.8.1.2. Otherwise, provide adequate justification for not performing the tests.

GE Response

- (a) The Fault Tolerant Digital Controllers (FTDC) will be tested as part of the Feedwater Control System (FWCS) factory acceptance tests or preoperational tests. Testing of the FTDC is detailed in the ESBWR DCD/Tier 2, Document 26A6642AW, Rev. 1, Chapter 7 "Instrumentation and Control Systems" subsection 7.7.3.4. These tests will include simulated failure of redundant channels of the FTDC to demonstrate that there is no loss of FWCS functions due to the loss of a single channel of the FTDC and are performed as part of the ESBWR DCD/Tier 2, Document 26A6642BN, Rev. 1, Subsection 14.2.8.1.2, *General Test Methods and Acceptance Criteria*, bulleted item:
 - *"Proper operation of instrumentation and controls in the required combinations of logic and instrument channel trips, including verification of setpoints"*
- (b) The redundancy and electrical independence of the FWCS will be verified by preoperational tests as detailed in the ESBWR DCD/Tier 2, Document 26A6642AW, Rev. 1, Chapter 7 "Instrumentation and Control Systems" subsection 7.7.3.4 and 7.7.3.5. These tests will simulate the failure of a power supply to a FTDC to demonstrate that there is no loss of FWCS functions due to the loss of the power supply in a single channel of the FTDC and are performed as part of the ESBWR DCD/Tier 2, Document 26A6642BN, Rev. 1, Subsection 14.2.8.1.2, *General Test Methods and Acceptance Criteria*, bulleted item:
 - *"Proper operation of instrumentation and controls in the required combinations of logic and instrument channel trips, including verification of setpoints"*

Therefore no DCD change will be made in response to RAI 14.2-5 item (a) or (b).

NRC RAI 14.2-7

Section 1.b.(1) of RG 1.68 states that the initial test program should include the testing of the control rod drive (CRD) system in its pre-operational phase, including testing to verify the correct failure mode on loss of power. Consistent with the above RG, specify whether the correct failure mode on loss of power will be verified as part of the CRD system pre-operational test.

If this test will be performed, please provide the appropriate test description in the DCD Tier 2, Section 14.2.8.1.4. Otherwise, provide adequate justification for not performing the test.

GE Response

The correct failure mode is verified as part of DCD/Tier 1, Table 2.2.2-1 "ITAAC For Control Rod Drive System," Tests 4 and 7. These tests are conducted by removing power from the CRD, thus simulating a loss of power event. This is described in DCD/Tier 1, Section 2.2.2:

"To cause a scram, the RPS provides a signal to de-energize the scram solenoid pilot valve (SSPV) that vents the control air from the scram valve, which then opens by spring action. Loss of either electrical power to the SSPV or loss of control air pressure causes scram."

The DCD/Tier 2, Subsection 4.6.1.2.3 Scram Pilot Valve Assembly, provides the detail of how a SSPV is de-energized and causes a scram:

"The scram pilot valve assembly is solenoid operated and is normally energized. Upon loss of electrical signal (such as the loss of external AC power) to the solenoids, the inlet port closes and the exhaust port opens."

DCD/Tier 2 tests that implement the DCD/Tier 1, Table 2.2.2-1, Tests 4 and 7, requirements are described in Subsection 4.6.3, et al.:

"Acceptance Tests - The after-installation, pre-startup tests (Chapter 14) include normal and scram motion."

Subsection 14.2.8.1.4, enforces the described tests in the last bulleted item:

- *"Proper operation of hydraulic control units and associated valves"*

Therefore no DCD change will be made in response to RAI 14.2-7.

NRC RAI 14.2-9

Section 1.j of RG 1.68 states, in part, that the initial test program should include the testing of instrumentation and control systems that permit or support the operation of engineered safety features in its pre-operational phase. The preoperational test description of the LD&IS does not include testing criteria for the following manual control functions:

- 1. Actuation of each main steam isolation valve (MSIV) test switch*
- 2. MSIV isolation switches*
- 3. MSIV logic reset*
- 4. Reactor water cleanup (RWCU)/ shutdown cooling (SCD) isolation switch*
- 5. Containment isolation manual switch*
- 6. Containment isolation logic reset*
- 7. Reactor Building HVAC isolation*

Consistent with the above RG, specify whether the above manual controls will be tested during the LD&IS pre-operational test.

If these tests will be performed, provide the appropriate test descriptions in the DCD Tier 2, Section 14.2.8.1.8. Otherwise, provide adequate justification for not performing the tests.

GE Response

The Leak Detection and Isolation System (LD&IS) performs the overall containment isolation and main steam line isolation initiation logic. As part of the LD&IS preoperational tests, the following item from Subsection 14.2.8.1.8 includes the preoperational tests of all of the test switches, manual switches, isolation switches, and logic resets for the LD&IS:

- *“Proper operation of instrumentation and controls in all combinations of logic and instrument channel trip”*

No DCD change will be made in response to RAI 14.2-9.

NRC RAI 14.2-10

Section 1.j of RG 1.68 states, in part, that the initial test program should include in its pre-operational phase the test of instrumentation and control systems that permit or support the operation of engineered safety features. The test program should include testing of instrumentation and controls used for shutdown from outside the control room. The pre-operational test description of the remote shutdown system (RSS) does not include testing to demonstrate proper operation of individual systems and equipment when operated from the remote shutdown panel. Consistent with the above RG, specify whether the individual systems and equipment included in the remote shutdown panel will be tested during the pre-operational test phase.

If this test will be performed, provide the appropriate test description in the DCD Tier 2, Section 14.2.8.1.12. Otherwise, provide adequate justification for not performing the test.

GE Response

The Remote Shutdown System (RSS) consists of the control and instrumentation available at the dedicated remote shutdown panel and other local and remote locations intended to be used during a safe shutdown from outside the control room.

Factory and preoperational tests in conformance with Section 1.j of RG 1.68 will be performed to demonstrate the proper functioning of the control and instrumentation associated with the RSS panel.

DCD/Tier 2, Subsection 14.2.8.1.12 “Remote Shutdown System Preoperational Test” will be revised in the next revision as noted.

~~Proposed DCD/Tier 2 Revision~~

14.2.8.1.12 Remote Shutdown System Preoperational Test

Purpose

Verify the feasibility and operability of intended remote shutdown functions from the remote shutdown panel and other local and remote locations outside the main control room, which are utilized during a safe shutdown from outside the main control room.

Prerequisites

The construction tests have been successfully completed and the Startup Coordinating Group has reviewed the test procedure and approved the initiation of testing. Additionally, control power shall be supplied to the remote shutdown panel and the required system and component interfaces shall be available, as needed, to support the specified testing.

General Test Methods and Acceptance Criteria

The Remote Shutdown System (RSS) consists of the control and instrumentation available at the dedicated remote shutdown panel(s) and other local and remote locations intended to be used during a safe shutdown from outside the control room.

Much of the specified testing can be accomplished in conjunction with, or as part of, the individual system and component preoperational testing. However, the successful results of such testing shall be documented as part of this test, as applicable. Performance shall be observed and recorded during a series of individual component and integrated system factory and preoperational tests to demonstrate the following:

- Proper functioning of the control and instrumentation associated with the RSS;
- Proper operation of pumps and valves, including establishment of system flow paths using RSS control;
- Proper functioning of RSS switches, including verification of proper override of main control room functions and proper indication in the MCR that these functions have been overridden;
- Proper operation of prohibit and permissive interlocks and bypass functions after transfer of control;
- Proper system operation while powered from primary and alternate electrical sources; and
- The ability to establish and maintain communication among personnel performing the remote shutdown operation.

NRC RAI 14.2-11

Section 1.m of RG 1.68 states that the initial test program should include the test of the equipment and components used to handle or cool irradiated and non-irradiated fuel in its pre-operational phase . The test description should include verification of redundancy and electrical independence. The pre-operational test description of the fuel and auxiliary pools cooling system (FAPCS) does not include provisions for verifying electrical independence and redundancy. Also, the FAPCS has 8 modes of operation in which different flow paths are necessary to achieve cooling and cleaning capability.

Consistent with the above RG:

- (a) Specify whether the redundancy and electrical independence of the FAPCS will be verified as part of the FAPCS pre-operational test; and*
- (b) Specify whether all the FAPCS modes of operation will be tested during the pre-operational phase.*

If these tests will be performed, provide the appropriate test descriptions in the DCD Tier 2, Section 14.2.8.1.14. Otherwise, provide adequate justification for not performing the tests.

GE Response

The Fuel and Auxiliary Pools Cooling System (FAPCS) is a nonsafety-related system with the exception of those piping and components required to provide containment isolation and flow paths for emergency makeup of the Isolation Condenser and Passive Containment Cooling (IC/PCCS) pool and the spent fuel pool with water supplies from offsite following an accident

Factory and preoperational tests in conformance with RG 1.68 will be performed to demonstrate the proper functioning of the control and instrumentation associated with the FAPCS. These tests will include verifying the redundancy and electrical independence of the safety related instrumentation. The tests will be performed for all modes of operation.

DCD/Tier 2, Subsection 14.2.8.1.4 “Fuel and Auxiliary Pools Cooling System Preoperational Test” will be revised in the next revision as noted.

~~Proposed DCD/Tier 2 Revision~~

14.2.8.1.4 Fuel and Auxiliary Pools Cooling System Preoperational Test

Purpose

To verify that the operation of the Fuel and Auxiliary Pools Cooling System (FAPCS), including the pumps, heat exchangers, controls, valves, 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 required interfacing systems shall be available, as needed, to support the specified testing and the appropriate system configurations.

General Test Methods and Acceptance Criteria

Performance shall be observed and recorded during a series of individual component and integrated system, factory, and preoperational tests to demonstrate the following:

- Proper operation of instrumentation and equipment in all combinations of logic and instrument channel trip, including isolation and bypass of the non-safety-related fuel pool cleanup filter/demineralizers;
- Proper functioning of instrumentation and alarms used to monitor system operation and availability, including those associated with pool water level;
- Proper redundancy and electrical independence of the safety related FAPCS controls and instrumentation;
- Proper operation of system valves, including timing, under expected operating conditions;
- Verification that drywell spray nozzles, headers and piping are free of debris;
- Proper operation of pumps and motors in all design operating modes;
- Acceptable pump NPSH under the most limiting design flow conditions; verify NPSH acceptability when cooling IC pool after testing ICs during startup testing;
- Proper system flow paths and flow rates, including pump capacity and discharge head;
- Proper water levels are maintained in GDCS pools when the system is operating in the GDCS cooling and cleanup mode;
- Proper pump motor start sequence and margin to actuation of protective devices;
- Proper operation of interlocks and equipment protective devices in pump, motor, and valve controls;
- Proper operation of permissive, prohibit, and bypass functions;
- Acceptability of pump/motor vibration levels and system piping movements during both transient and steady-state operation;

- Proper functioning of pool anti-siphon devices and acceptable leakage from pool drains, sectionalizing devices, and gaskets or bellows;
- Proper operation of FAPCS during all modes of operation;
- Proper operation of filter/demineralizer units and their associated support facilities;
and
- Smooth transfer from one pool to another and acceptable transfer time.

NRC RAI 14.2-12

Section 1.k.(1) of RG 1.68 states that the initial test program should include the test of the equipment and components used to monitor or measure radiation levels in its pre-operational phase. The test description should include testing to verify redundancy and electrical independence. The pre-operational test description of the area radiation monitor (ARM) system does not include provisions for verifying electrical independence and redundancy. Consistent with the above RG, specify whether the redundancy and electrical independence of the ARM system will be verified as part of the ARM system pre-operational test.

If this test will be performed, provide the appropriate test description in the DCD Tier 2, Section 14.2.8.1.14 . Otherwise, provide adequate justification for not performing the test.

GE Response

The initial test program will include the test of the equipment and components used to monitor or measure radiation levels in its preoperational phase. The test description will include testing to verify electrical independence. In DCD Tier 1, Table 2.3.2-1 "ITAAC For The Area Radiation Monitoring System" provides the preoperational testing information for the ARM system. The ARM System has no plant safety-related functions or system interlocks and, though there will be several monitors covering different areas in the plant, redundancy at the monitor level is not required. The system shall be powered from the Non-Divisional Uninterruptible 120 VAC bus. The fail-safe design will initiate a local alarm and an alarm in the MCR on interruption of power, component failure, or loss of signal. The following preoperational test description will be added to the DCD/Tier 2.

- *Proper functioning following power interruption to each ARM monitor, including appropriate local and MCR alarms has no affect on the functionality of other ARM monitors.*

DCD/Tier 2, Subsection 14.2.8.1.17 "Area Radiation Monitoring System Preoperational Test" will be revised in the next revision as noted.

-Proposed DCD/Tier 2 Revision-

14.2.8.1.17 Area Radiation Monitoring System Preoperational Test

Purpose

To verify the ability of the Area Radiation Monitoring (ARM) System to indicate and alarm normal and abnormal general area radiation levels throughout the plant.

Prerequisites

The construction tests have been successfully completed and the SCG has reviewed the test procedure and approved the initiation of testing. Sensors and digital radiation monitors have been calibrated according to vendor instructions.

General Test Methods and Acceptance Criteria

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

- Proper calibration of detector assemblies and associated equipment using a standard radiation source or portable calibration unit;
- Proper functioning of sensors, monitors, displays, and alarms; and
- Proper system trips in response to high radiation and downscale/inoperative conditions.
- Proper functioning following power interruption to each ARM monitor, including appropriate local and MCR alarms has no affect on the functionality of other ARM monitors.