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Subject: Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application, DCD Tier 1, RAI Numbers 14.3-252, 14.3-260, 14.3-265 and 14.3-345

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated December 20, 2007 (Reference 1). RAI Numbers 14.3-252, 14.3-260, 14.3-265 and 14.3-345 are addressed in Enclosure 1.

Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.

If you have any questions or require additional information, please contact me.

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-718, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request For Additional Information Letter No. 126 Related To ESBWR Design Certification Application*, dated December 20, 2007

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application, DCD Tier 1, RAI Numbers 14.3-252, 14.3-260, 14.3-265 and 14.3-345

cc:	AE Cubbage	USNRC (with enclosure)	
	GB Stramback	GEH/San Jose (with enclosure)	
	RE Brown	GEH/Wilmington (with enclosure)	
	DH Hinds	GEH/Wilmington (with enclosure)	
	eDRF	0000-0081-3372	NRC RAI 14.3-252
		0000-0081-3372	NRC RAI 14.3-260
		0000-0081-3372	NRC RAI 14.3-265
		0000-0081-3372	NRC RAI 14.3-345

Enclosure 1

MFN 08-086, Supplement 43

*Response to Portion of NRC Request for

Additional Information Letter No. 126

Related to ESBWR Design Certification Application

DCD Tier 1

RAI Numbers 14.3-252, 14.3-260, 14.3-265, 14.3-345

***Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.**

NRC RAI 14.3-252

NRC Summary:

If necessary, add a control parameter for three channel redundancy

NRC Full Text:

If the redundant nature of the FWCS is being taken credit for in any analysis, then an adequate description of the type of redundancy (parts of, such as processor only, or complete three channel design etc.) and a specific ITAAC should be created to confirm with loss of one, and two, channels FWCS output is maintained.

GEH Response

The FWCS is equipped with two triple-redundant, fault-tolerant digital controllers (FTDC) including power supplies. Each FTDC (one level controller and one temperature controller) consists of three parallel processing controllers, each controller containing the hardware and software for execution of the control algorithms. Failure of any two temperature controllers, or failure of any two level controllers will cause a loss of FWCS output.

A specific ITAAC has been created to confirm that with loss of one controller, FWCS output is maintained. The loss of any two FWCS controllers is not a design commitment and additional ITAAC is not required.

DCD Impact

DCD Tier 1, Subsection 2.2.3, Item 5 and Table 2.2.3-4, Item 5 have been added as noted in the attached markups.

NRC RAI 14.3-260

NRC Summary:

Reinsert Figure 2.2.9-1 from Revision 3

NRC Full Text:

Without an adequate description to make a reasonable regulatory determination of "triple redundant", the interfacing systems, power or gateways, Figure 2.2.9-1, Simplified Block Diagram, which was in Revision 3, should be reinserted. Also, to what credit is the "triple redundancy" used for? Simply stating it has no regulatory significance. If there is any credit taken then the test to specifically confirm with loss of one, and two, channels SB&PC output is maintained. (As was done in Revision 3).

GEH Response

The fault-tolerant digital controller (FTDC) used by the SB&PC system is credited in the safety analyses as follows:

The SB&PC system is equipped with a triple-redundant, fault-tolerant digital controller including power supplies and input/output signals. The FTDC consists of three parallel processing channels, each containing the hardware and software for execution of the control algorithms. The FTDC is designed to a high degree of reliability. Based on Subsection 7.7.5, the Mean Time to Failure (MTTF) of the SB&PC Controller is at least 1,000 years. The actual reliability of the SB&PC controller is expected to be much better than the specified minimum MTTF requirement of 1,000 years.

DCD Tier 1, Revision 3, Figure 2.2.9-1 has been replaced with a new ITAAC, Item 4, in DCD Tier 1, Table 2.2.9-3. This new ITAAC will test the loss of one and two SB&PC controllers.

DCD Impact

DCD Tier 1, Subsection 2.2.9, Item 4 and Table 2.2.9-3, Item 4 have been added as noted in the attached markups.

NRC RAI 14.3-265

NRC Summary:

Applicability Matrix should be completed For Table 2.2.15-1, ITAAC Applicability Matrix (to IEEE 603)

NRC Full Text:

The applicant has presented an Applicability Matrix showing only certain sections of IEEE-603 (the particular version not stated) applicable to certain systems. However, if the intent is to the substantiate conformance to IEEE-603, ALL sections of this standard must be addressed and the table completed. It should be identified why certain sections do not require ITAAC, and how compliance is substantiated or links could be provided to existing non system based ITAAC. As an example, this could be ITAAC for IEEE Sections 5.4 Equipment Qualification or Section 5.3 Quality.

GEH Response

DCD Tier 1, Subsection 2.2.15, will be revised as noted in the attached markup. This markup adds the following sections from IEEE 603: 5.4, 5.5, 5.8, 5.10, 5.11, 5.12, 5.13, 5.14, 5.15, 6.3 (combined with Criterion 5.6), 6.4, 8.1, 8.2, and 8.3 (combined with Criteria 6.7 and 7.5). These sections supplement the existing sections: 5.1, 5.2, 5.6, 5.7, 5.9, 6.1, 6.2, 6.5, 6.6, 6.7, 6.8, 7.1, 7.2, 7.3, 7.4, and 7.5.

Criterion 5.3 will not be listed as a separate IEEE 603 ITAAC because demonstration of the adequacy of the 10 CFR 50, Appendix B, Quality Assurance Program for the designers, fabricators, installers, maintainers, and owners of applicable safety-related equipment is performed independently throughout the project life cycle.

DCD Impact

DCD Tier 1, Subsection 2.2.15, will be revised as noted in the attached markup.

NRC RAI 14.3-345

NRC Summary:

Separation criteria

NRC Full Text:

For ITAAC Table 2.1.2-3 Item 6a, there is a reference to Table 2.1.2-2. However, the divisions that are the subject of ITAAC verification are not clearly identified in Table 2.1.2-2 (i.e., there is no clear correlation between Table 2.1.2-1 and the ITAAC in Section 2.13). The staff requests that the applicant provide a clear identification of the divisions in Table 2.1.2-2 to facilitate completion of the ITAAC per Section 2.13.

Also, there are no clear criteria provided for physical separation as discussed in Item 6b. and likewise, no such criteria provided in the Section 2.2.15 ITAAC to which this is referred. The staff requests the applicant to provide suitable justification for this approach or provide the necessary criteria.

GEH Response

DCD Tier 1, Section 2.1.2, and ITAAC Table 2.1.2-3, Items 6a & 6b will be revised as noted in the attached markup for clarity and appropriate cross references for the verification of the ITAAC. The Items referenced in ITAAC 6a and 6b are contained in the response to RAI 14.3-265, which is in this letter (MFN 08-086, Supplement 43). No reference to divisions will be provided in Table 2.1.2-2. Identification of the divisions will be established during detailed design.

DCD Impact

DCD Tier 1, Section 2.1.2, and Table 2.1.2-3, Items 6a & 6b will be revised as noted in the attached markup to provide correct references to ITAAC verification in Table 2.2.15-2.

2.2.3 Feedwater Control System

Design Description

The Feedwater Control System (FWCS), automatically or manually, controls RPV water level by modulating the supply of feedwater flow to the RPV, the low flow control valve (LFCV), individual reactor feed pump ASD, or the RWCU/SDC system overboard control valve (OBCV).

The FWCS changes reactor power by automatically or manually controlling FW temperature by modulating the 7th FW heater steam heating valves or the high-pressure FW heater bypass valves.

Functional Arrangement

(1) FWCS functional arrangement is defined in Table 2.2.3-1.

Functional Requirements

(2) FWCS automatic functions, initiators, and associated interfacing systems are defined in Table 2.2.3-2.

(3) FWCS controls are defined in Table 2.2.3-3.

(4) FWCS minimum inventory of alarms, displays, and status indications in the main control room are addressed in Section 3.3.

(5) FWCS controllers are fault tolerant.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.2.3-4 defines the inspections, tests, and/or analyses, together with associated acceptance criteria for the FWCS.

Table 2.2.3-4

ITAAC For Feedwater Control System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The FWCS functional arrangement is defined in Table 2.2.3-1.	Inspections and tests will be performed on the FWCS functional arrangement using simulated signals and simulated actuators.	Inspection and test report(s) document(s) that FWCS functional arrangement is as defined in Table 2.2.3-1.
2. FWCS automatic functions, initiators, and associated interfacing systems are defined in Table 2.2.3-2.	Test(s) and type test(s) will be performed on the as-built system using simulated signals.	Test and type test report(s) document the system performs the functions defined in Table 2.2.3-2.
3. FWCS controls are defined in Table 2.2.3-3.	Inspection(s), test(s) and type test(s) will be performed on the as-built system using simulated signals and manual actions.	Test and type test report(s) document that the system controls and interlocks exist, can be retrieved in the main control room, or are performed in response to simulated signals and manual actions as defined in Table 2.2.3-3.
4. FWCS minimum inventory of alarms, displays, and status indications in the main control room are addressed in ~~Section~~ Table 3.3~~.~~-1, Item 6.	See ~~Section~~ Table 3.3~~.~~-1, Item 6.	See ~~Section~~ Table 3.3~~.~~-1, Item 6.
5. FWCS controllers are fault tolerant.	a. Test(s) will be performed simulating failure of each FWCS temperature controller. b. Test(s) will be performed simulating failure of each FWCS level controller.	a. Test and type test report(s) document that failure of any one FWCS temperature controller will not affect FWCS output. b. Test and type test report(s) document that failure of any one FWCS level controller will not affect FWCS output.

2.2.9 Steam Bypass and Pressure Control System

Design Description

The Steam Bypass and Pressure Control (SB&PC) System controls the reactor pressure during reactor startup, power generation, and reactor shutdown by control of the turbine bypass valves and signals to the Turbine Generator Control System (TGCS), which controls the turbine control valves.

Functional Arrangement

(1) SB&PC System functional arrangement is defined in Table 2.2.9-1.

Functional Requirements

(2) SB&PC System functions and initiating conditions are defined in Table 2.2.9-2.

(3) SB&PC System minimum inventory of alarms, displays, and status indications in the main control room (MCR) are addressed in Section 3.3.

(4) SB&PC controllers are fault tolerant.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.2.9-3 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria for the SB&PC system.

Table 2.2.9-3

ITAAC For The Steam Bypass and Pressure Control System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the SB&PC System is as defined in Table 2.2.9-1.	Inspections of the as-built system will be conducted.	Inspection reports(s) document that the as-built SB&PC system conforms to the functional arrangement as defined in Table 2.2.9-1.
2. SB&PC system functions and initiating conditions are as defined in Table 2.2.9-2.	Tests will be performed on the SB&PC system using simulated signals.	Test report(s) confirm that the SB&PC system is capable of performing the functions defined in Table 2.2.9-2.
3. SB&PC system minimum inventory of alarms, displays, and status indications in the main control room (MCR) are addressed in Section 3.3.	See Section 3.3	See Section 3.3.
4. SB&PC controllers are fault tolerant.	a. Test(s) will be performed simulating failure of each SB&PC controller. b. Test(s) will be performed simulating failure of any two SB&PC controllers.	a. Test report(s) document that failure of any SB&PC controller has no effect on SB&PC valve position demand signal. b. Test report(s) document that failure of any two SB&PC controllers generates a turbine trip signal.

2.2.15 Instrumentation & Control Compliance With IEEE Std. 603

Design Description

The design descriptions related to IEEE Std. 603 criteria are provided below. Safety-related Instrumentation and Control systems are designed to the following criteria from IEEE Std. 603 as listed in Table 2.2.15-1. An X in the table identifies the system for which an ITAAC applies. Refer to the Tier 1 Subsections cited in the table for additional design descriptions applicable to the listed systems. Note that only the safety-related portions of the listed systems are addressed.

(1) Criterion 5.1, Single Failure: The listed systems are designed to ensure that safety-related functions required for design basis events (DBE) are performed in the presence of: (a) single detectable failures within safety-related systems concurrent with identifiable but non-detectable failures; (b) failures caused by the single failure; and (c) failures and spurious system actions that cause or are caused by the design basis event requiring the safety-related functions, as identified in the applicable failure modes and effects analysis (FMEA).

(2) Criteria 5.2 and 7.3, Completion of Protective Actions: The listed systems are designed so that, (a) once initiated (automatically or manually), the intended sequences of safety-related functions of the execute features continue until completion, and (b) after completion, deliberate operator action is required to return the safety-related systems to normal.

(3) Criterion 5.4, Equipment Qualification: The listed systems are qualified by type test, previous operating experience, or analysis, or any combination of these three methods, to substantiate that the safety-related system will be capable of meeting, the performance requirements specified in the design basis through the equipment qualification process described in Section 3.8.

(4) Criterion 5.5, System Integrity: The listed system's performance is adequate to ensure completion of protective actions over the range of transient and steady-state conditions of both the energy supply and the environment enumerated in the design basis through the equipment qualification process described in Section 3.8.

(5) ~~Criterion 5.6~~Criteria 5.6 and 6.3, Independence: For the listed systems, physical, electrical, and communications independence between redundant portions of safety-related systems, between safety-related systems and the effects of a DBE, and between safety-related systems and nonsafety-related systems exist, as identified in the applicable FMEA.

(6) Criteria 5.7 and 6.5, Capability for Test & Calibration: The listed systems have the capability to have their equipment tested and calibrated while retaining their capability to accomplish their safety-related functions.

(7) Criterion 5.8, Information Displays: Information display systems are designed to be accessible to the operators, display variables for manually controlled actions, display system status information, provide indication of bypasses, and display post-accident monitoring variables in accordance with the HFE process described in Section 3.3 and the post accident monitoring design process described in Section 3.7.

(8) Criterion 5.9, Control of Access: The listed systems have features that permit administrative control of access to safety-related system equipment.

(9) Criterion 5.10, Repair: Safety-related systems are designed to facilitate the timely recognition, location, replacement, repair, and adjustment of malfunctioning equipment.

(10) Criterion 5.11, Identification: The listed safety-related systems are distinctly identified for each redundant portion.

(11) Criterion 5.12, Auxiliary Features: Other auxiliary features cannot degrade the safety-related systems below an acceptable level.

(12) Criterion 5.13, Multi-Unit Stations: The operation or failure of structures, systems, and components shared between units at a multi-unit generating station do not affect the performance of the safety-related functions of the systems listed in Table 2.2.15-1.

(13) Criterion 5.14, Human Factors Considerations: Human factors are incorporated in the design in accordance with the HFE design process described in Section 3.3.

(14) Criterion 5.15, Reliability: Analysis of the adequacy of the reliability of the safety-related system design is performed as part of the design reliability assurance program described in Section 3.6.

(15) Criteria 6.1 and 7.1, Automatic Control: The listed systems provide the means to automatically initiate and control the required safety-related functions.

(16) Criteria 6.2 and 7.2, Manual Control: The listed systems have features in the main control room to manually initiate and control the automatically initiated safety-related functions at the division level.

(17) Criterion 6.4, Derivation of System Inputs: Sense and command feature inputs for the listed systems are derived from signals that are direct measures of the desired variables specified in the design bases.

(18) Criteria 6.6 and 7.4, Operating Bypasses: The listed systems automatically (1) prevent the activation of an operating bypass, whenever the applicable permissive conditions for an operating bypass are not met, and (2) remove activated operating bypass(es), if the plant conditions change so that an activated operating bypass is no longer permissible.

(19) Criteria 6.7, ~~and~~ 7.5, and 8.3, Maintenance Bypasses: The listed systems are capable of performing their safety-related functions, when one division is in maintenance bypass.

(20) Criterion 6.8, Setpoint: The listed system setpoints for safety-related functions are determined by a defined setpoint methodology.

(21) Criterion 8.1, Electrical Power Sources: The listed systems receive power from safety-related power supplies in the same division.

(22) Criterion 8.2, Non-electrical Power Sources: The listed systems receive non-electric power from safety-related sources.

Inspections, Tests, Analysis and Acceptance Criteria

Table 2.2.15-2 provides a definition of the inspections, tests, and/or analyses, together with and acceptance criteria for the systems listed in Table 2.2.15-1.

Table 2.2.15-1

ITAAC Applicability Matrix (1)(2)

IEEE Std. 603 Criterion	NBS (2.1.2)	CRDS (2.2.2)	SLC System (2.2.4)	NMS (2.2.5)	RSS (2.2.6)	RPS (2.2.7)	LD&IS (2.2.12)	SSLC/ESF (2.2.13)	PRMS (2.3.1)	ICS (2.4.1)	GDCS (2.4.2)	CS* (2.15.1)	CMS (2.15.7)	SPTM (2.15.7)	RBHVS (2.16.2.1)	CBHVS (2.16.2.2)	EFU (2.16.2.3)
5.1	-	-	-	X	-	X	X	X	-	X	X	X	-	-	X	X	X
5.2 and 7.3	-	-	-	-	-	X	X	X	-	-	-	X	-	-	-	-	-
5.3	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	(3)	-	(3)	(3)	(3)	(3)	(3)
5.4	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X
5.5	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X
5.6 and 6.3	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.7 and 6.5	X	X	X	X	-	X	X	X	-X	X	X	X	X	X	X	X	X
5.8	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X
5.9	-	-	-	X	X	X	X	X	-	-	-	-	-	-	-	-	-
5.10	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X
5.11	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X
5.12	-	-	-	X	-	X	X	X	-	X	X	-	-	-	X	X	X
5.13	-	-	-	X	-	X	X	X	-	X	X	-	-	-	-	-	-
5.14	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X
5.15	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X
6.1 and 7.1	-	-	-	-X	-	X	-X	X	-X	-	-	-	-	-	X	X	X
6.2 and 7.2	-	-	-	-X	-	X	-X	X	-X	-	-	X	-	-	X	X	X
6.4	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	-X	X
6.6 and 7.4	-	-	-	X	-	X	-	X	-	-	-	-	-	-	-	-	-
6.7, ~~and~~ 7.5, and 8.3	-	-	-	X	-	X	-	X	-	-	-	-	-	-	X	X	X
6.8	X	-	X	X	-	X	X	X	X	-	-	-	X	X	-	-	-
8.1	X	X	X	X	X	X	X	X	X	X	X	-	X	X	X	X	X
8.2	-	X	-	-	-	-	X	-	-	X	X	-	-	-	X	X	X

(1) A dash means not applicable.

(2) Safety-related portions only.

(3) No ITAAC is required for this criterion. See the description of the 10 CFR 50, Appendix B, Quality Assurance Program that is applied to the design, fabrication, construction, and test of the safety-related structures, systems, and components provided as part of the preliminary safety evaluation report as required by 10 CFR 50.34(a)(7).

*CS=Containment System

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. Criterion 5.1, Single Failure: The Criterion 5.1 systems listed in Table 2.2.15-1 are designed to ensure that safety-related functions required for design basis events (DBE) are performed in the presence of: (a) single detectable failures within safety-related systems concurrent with identifiable but non-detectable failures; (b) failures caused by the single failure; and (c) failures and spurious system actions that cause or are caused by the DBE requiring the safety-related functions, as identified in the applicable FMEA.	Block level FMEA of the Criterion 5.1 systems listed in Table 2.2.15-1 show that they perform safety-related functions required for design basis events in the presence of: (a) single detectable failures within safety-related systems concurrent with identifiable but non-detectable failures; (b) failures caused by the single failure; and (c) failures and spurious system actions that cause or are caused by the DBE requiring the safety-related functions, as identified in the applicable FMEA. {{Design_Acceptance_Criteria}}	Analysis report(s) conclude(s) that the systems identified in Table 2.2.15-1 for Criterion 5.1 ensure(s) that safety-related functions required for design basis events are performed in the presence of: (a) single detectable failures within safety-related systems concurrent with identifiable but non-detectable failures; (b) failures caused by the single failure; and (c) failures and spurious system actions that cause or are caused by the DBE requiring the safety-related functions, as identified in the applicable FMEA. {{Design_Acceptance Critera}}
2. Criteria 5.2 and 7.3, Completion of Protective Actions: The Criteria 5.2 and 7.3 systems listed in Table 2.2.15-1 are designed so that, (a) once initiated (automatically or manually), the intended sequences of safety-related functions of the execute features continue until completion, and (b) after completion, deliberate operator action is required to return the safety-related systems to normal.	a. Inspection of the current revision of the simplified logic diagrams (SLDs) for the Criteria 5.2 and 7.3 systems listed in Table 2.2.15-1 verifies that the design shows (a) "seal-in" features that are provided to enable system-level safety-related functions to go to completion, and (b) "manual reset" features that are provided to require deliberate operation action to return the safety-related systems to normal. {{Design Acceptance Criteria}}	a. Inspection report(s) conclude(s) that the current revision of the SLDs show (a) "seal-in" features, and (b) "manual reset" features. {{Design Acceptance Criteria}}

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	b. Test(s) for the Criteria 5.2 and 7.3 systems listed in Table 2.2.15-1 will be performed to show that (a) once initiated (automatically or manually), the intended sequences of safety-related functions of the "execute features" continue until completion, and (b) after completion, deliberate operator action is required to return the safety-related systems to normal.	b. Test report(s) conclude(s) that for the Criteria 5.2 and 7.3 systems listed in Table 2.2.15-1, (a) once initiated (automatically and manually), the intended sequences of safety-related functions of the "execute features" continue until completion, and (b) after completion, deliberate operator action is required to return the safety-related systems to normal.
3. Criterion 5.4, Equipment Qualification: The listed systems are qualified by type test, previous operating experience, or analysis, or any combination of these three methods, to substantiate that the safety-related system will be capable of meeting, the performance requirements specified in the design basis through the equipment qualification process described in Section 3.8.	See Section 3.8	See Section 3.8

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4. Criterion 5.5, System Integrity: The listed system's performance is adequate to ensure completion of protective actions over the range of transient and steady-state conditions of both the energy supply and the environment enumerated in the design basis through the equipment qualification process described in Section 3.8.	See Section 3.8	See Section 3.8

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. ~~Criterion 5.6~~ Criteria 5.6 and 6.3, Independence: For the ~~Criterion 5.6~~ Criteria 5.6 and 6.3 systems listed in Table 2.2.15-1, there is physical, electrical, and communications independence between redundant portions of a safety-related system, between safety-related systems and the effects of a DBE, and between safety-related systems and nonsafety-related systems, as identified in the applicable FMEA.	a. Block level FMEA will be performed to verify that the designs of the ~~Criterion 5.6~~Criteria 5.6 and 6.3 systems listed in Table 2.2.15-1 have physical, electrical, and communications independence between redundant portions of a safety-related system, between safety-related systems and the effects of a DBE, and between safety-related systems and nonsafety-related equipment, as identified in the applicable FMEA. {{Design Acceptance Criteria}} b. Inspection(s) will be performed to demonstrate that the ~~Criterion 5.6~~Criteria 5.6 and 6.3 systems listed in Table 2.2.15-1 have physical independence between redundant portions of a safety-related system, between safety-related systems and the effects of a DBE, and between safety-related systems and nonsafety-related equipment, as identified in the applicable FMEA. .	a. Analysis report(s) conclude(s) that the designs of the ~~Criterion 5.6~~Criteria 5.6 and 6.3 listed in Table 2.2.15-1 have physical, electrical, and communications independence between redundant portions of a safety-related system, between safety-related systems and the effects of a DBE, and between safety-related systems and nonsafety-related equipment, as identified in the applicable FMEA. {{Design Acceptance Criteria}} b. Inspection report(s) conclude(s) that the ~~Criterion 5.6~~Criteria 5.6 and 6.3 systems listed in Table 2.2.15-1 have physical independence between redundant portions of a safety-related system, between safety-related systems and the effects of a DBE, and between safety-related systems and nonsafety-related equipment, as identified in the applicable FMEA.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	c. Type test(s), test(s), and / or analysis(es) will be performed to demonstrate that the ~~Criterion 5.6~~ Criteria 5.6 and 6.3 systems communication interface modules listed in Table 2.2.15-1 have electrical and communications independence between redundant portions of a safety-related system, between safety-related systems and the effects of a DBE, and between safety-related systems and nonsafety-related equipment.	c. Type test(s), test(s), and / or analysis(es) report(s) conclude(s) that the ~~Criterion 5.6~~ Criteria 5.6 and 6.3 systems communication interface modules listed in Table 2.2.15-1 have electrical and communications independence between redundant portions of a safety-related system, between safety-related systems and the effects of a DBE, and between safety-related systems and nonsafety-related equipment.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6. Criteria 5.7 and 6.5, Capability for Test and Calibration: The Criteria 5.7 and 6.5 systems listed in Table 2.2.15-1 have the capability to have their equipment tested and calibrated while retaining their capability to accomplish their safety-related functions.	a. Inspection(s) of the current revision of the SLDs of the Criteria 5.7 and 6.5 systems listed in Table 2.2.15-1 will be performed to verify that both the automatic and manual circuitry have the capability to have the safety-related systems' equipment tested and calibrated while retaining the safety-related systems' capability to accomplish their safety-related functions. {{Design Acceptance Criteria}}	a. Inspection report(s) conclude(s) that the current revision of the SLDs of the Criteria 5.7 and 6.5 systems listed in Table 2.2.15-1 have the capability to have the safety-related systems' equipment tested and calibrated while retaining the safety-related systems' capability to accomplish their safety-related functions. {{Design Acceptance Criteria}}
	b. Test(s) of Criteria 5.7 and 6.5 systems listed in Table 2.2.15-1 will be performed to demonstrate that the design allows for tripping or bypass of individual functions in each safety-related system channel.	b. Test report(s) conclude(s) that for the ~~Criterion~~ Criteria 5.7 and 6.5 systems listed in Table 2.2.15-1 individual functions in each safety-related system channel can be tripped or bypassed.
	c. Test(s) of Criteria 5.7 and 6.5 systems listed in Table 2.2.15-1, will be performed to demonstrate that the digital computer-based I&C systems' self-test features confirm computer system operation on system initiation.	c. Test report(s) conclude(s) that for the Criteria 5.7 and 6.5 systems listed in Table 2.2.15-1, the digital computer-based I&C systems' self-test features confirm computer system operation on system initiation.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. Criterion 5.8, Information Displays: Information display systems are designed to be accessible to the operators, display variables for manually controlled actions, display system status information, provide indication of bypasses, and display post-accident monitoring variables in accordance with the HFE process described in Section 3.3 and the post accident monitoring design process described in Section 3.7.	See Sections 3.3 and 3.7	See Section 3.3 and 3.7
8. Criterion 5.9, Control of Access: The design of the Criterion 5.9 systems listed in Table 2.2.15-1 have features that permit administrative control of access to safety-related system equipment.	Inspection of system design specification(s) for the Criterion 5.9 systems listed in Table 2.2.15-1 will be performed to confirm that access control features are specified for safety-related systems equipment. {{Design Acceptance Criteria}}	Inspection report(s) conclude(s) that within the system design specification(s) of the Criterion 5.9 systems listed in Table 2.2.15-1, access control features are specified for safety-related systems equipment. {{Design Acceptance Criteria}}

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9. Criterion 5.10, Repair: Safety-related systems are designed to facilitate the timely recognition, location, replacement, repair, and adjustment of malfunctioning equipment.	Inspection of system design specification(s) for the Criterion 5.10 systems listed in Table 2.2.15-1 will be performed to confirm that safety-related systems are designed to facilitate the timely recognition, location, replacement, repair, and adjustment of malfunctioning equipment.	Inspection report(s) conclude(s) that the system design specification(s) of the Criterion 5.10 systems listed in Table 2.2.15-1 are designed to facilitate the timely recognition, location, replacement, repair, and adjustment of malfunctioning equipment.
10. Criterion 5.11, Identification: The listed safety-related systems are distinctly identified for each redundant portion.	a. Inspection(s) will be performed of the "current revision" of the project design manual. {{Design Acceptance Criteria}}	a. Inspection report(s) conclude(s) that the "current revision of the project design manual describes a method that distinctly identifies each redundant portion of the listed safety-related systems and that does not rely on separate reference material. {{Design Acceptance Criteria}}
	b. Inspection(s) will be performed of the as-installed safety-related systems identification system.	b. Inspection report(s) conclude that the redundant portions of the as-installed safety-related systems are identified.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
11. Criterion 5.12, Auxiliary Features: Other auxiliary features cannot degrade the safety-related systems below an acceptable level.	Block level FMEA will be performed to verify that the designs of other auxiliary features of the Criterion 5.12 systems listed in Table 2.2.15-1 do not have failure modes that can degrade the safety-related systems below an acceptable level. {{Design Acceptance Criteria}}	Analysis report(s) conclude that the designs of other auxiliary features of the Criterion 5.12 systems listed in Table 2.2.15-1 do not have failure modes that can degrade the safety-related systems below an acceptable level. {{Design Acceptance Criteria}}

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
12.Criterion 5.13, Multi-Unit Stations: The operation or failure of structures, systems, and components shared between units at a multi-unit generating station do not affect the performance of the safety-related functions of the systems listed in Table 2.2.15-1.	Analysis(es) will be performed of the safety-related systems plant-specific interfaces with shared structures, systems, and components at a multi-unit generating station using the following nonconcurrent criteria for single-failure analysis for shared systems: a. The safety-related systems of all units shall be capable of performing their required safety-related functions with a single failure assumed within the shared systems or within the auxiliary supporting features or other systems with which the shared systems interface. b. The safety-related systems of each unit shall be capable of performing their required safety-related functions, with a single failure initiated concurrently in each unit within the systems that are not shared.	Analysis report(s) conclude that the operation or failure of shared structures, systems, and components at a multi-unit generating station do not affect the performance of the safety-related functions of the systems listed in Table 2.2.15-1.
13.Criterion 5.14, Human Factors Considerations: Human factors are incorporated in the design in accordance with the HFE design process described in Section 3.3.	See Section 3.3.	See Section 3.3.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
14. Criterion 5.15, Reliability: Analysis of the adequacy of the reliability of the safety-related system design is performed as part of the design reliability assurance program described in Section 3.6.	See Section 3.6.	See Section 3.6.
15. Criteria 6.1 and 7.1, Automatic Control: The Criteria 6.1 and 7.1 systems listed in Table 2.2.15-1 provide the means to automatically initiate and control the required safety-related functions.	a. Inspection(s) will be performed of the current revision of the SLDs for the Criteria 6.1 and 7.1 systems listed in Table 2.2.15-1 to verify that the design automatically initiates and controls the required safety-related functions. {{Design Acceptance Criteria}}	a. Inspection report(s) conclude(s) that the current revision of the SLDs for the Criteria 6.1 and 7.1 systems listed in Table 2.2.15-1 show(s) that the design automatically initiates and controls the required safety-related functions. {{Design Acceptance Criteria}}
	b. Test(s) will be performed to demonstrate that the Criteria 6.1 and 7.1 systems listed in Table 2.2.15-1 automatically initiate and control the required safety-related functions.	b. Test report(s) conclude(s) that the Criteria 6.1 and 7.1 systems listed in Table 2.2.15-1 automatically initiate and control the required safety-related functions.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
16. Criteria 6.2 and 7.2, Manual Control: The Criteria 6.2 and 7.2 systems listed in Table 2.2.15-1 have features in the main control room to manually initiate and control the automatically initiated safety-related functions at the division level.	a. Inspection(s) will be performed of the SLDs for the Criteria 6.2 and 7.2 systems listed in Table 2.2.15-1 to verify that they have main control room features that are capable of manually initiating and controlling automatically initiated safety-related functions at the division level. {{Design Acceptance Criteria}} b. Test(s) will be performed to demonstrate that the Criteria 6.2 and 7.2 systems listed in Table 2.2.15-1 have main control room features that manually initiate and control automatically initiated safety-related functions at the division level.	a. Inspection report(s) conclude(s) that the SLDs for the Criteria 6.2 and 7.2 systems listed in Table 2.2.15-1 have main control room features that are capable of manually initiating and controlling automatically initiated safety-related functions at the division level. {{Design Acceptance Criteria}} b. Test report(s) conclude(s) that the Criteria 6.2 and 7.2 systems listed in Table 2.2.15-1 have main control room features that manually initiate and control automatically initiated safety-related functions at the division level exist(s).

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
17. Criterion 6.4, Derivation of System Inputs: Sense and command feature inputs for the listed systems are derived from signals that are direct measures of the desired variables specified in the design bases.	Inspection(s) will be performed of the safety analyses and SLDs. {{Design Acceptance Criteria}}	Inspection report(s) conclude(s) that the sense and command feature inputs for the listed systems are derived from signals that are direct measures of the desired variables specified in the design bases. {{Design Acceptance Criteria}}

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
18. Criteria 6.6 and 7.4, Operating Bypasses: The ~~Criterion~~ Criteria 6.6 and 7.4 systems listed in Table 2.2.15-1 automatically (1) prevent the activation of an operating bypass, whenever the applicable permissive conditions for an operating bypass are not met, and (2) remove activated operating bypass(es), if the plant conditions change so that an activated operating bypass is no longer permissible.	a. Inspections(s) will be performed of the current revision of the SLDs for the ~~Criterion~~ Criteria 6.6 and 7.4 systems listed in Table 2.2.15-1 to verify that the systems are capable of automatically (1) preventing the activation of an operating bypass, whenever the applicable permissive conditions for an operating bypass are not met, and (2) removing activated operating bypasses, if the plant conditions change so that an activated operating bypass is no longer permissible. {{Design Acceptance Criteria}} b. Test(s) will be performed to demonstrate that the ~~Criterion~~ Criteria 6.6 and 7.4 systems listed in Table 2.2.15-1 automatically (1) prevent the activation of an operating bypass, whenever the applicable permissive conditions for an operating bypass are not met, and (2) remove activated operating bypass(es), if the plant conditions change so that an activated operating bypass is no longer permissible.	a. Inspection report(s) conclude that the current revision of the SLDs for the ~~Criterion~~ Criteria 6.6 and 7.4 systems listed in Table 2.2.15-1 show that the systems are capable of automatically (1) preventing the activation of an operating bypass, whenever the applicable permissive conditions for an operating bypass are not met, and (2) removing activated operating bypasses, if the plant conditions change so that an activated operating bypass is no longer permissible. {{Design Acceptance Criteria}} b. Test report(s) conclude(s) that the ~~Criterion~~ Criteria 6.6 and 7.4 systems listed in Table 2.2.15-1 automatically (1) prevent the activation of an operating bypass, whenever the applicable permissive conditions for an operating bypass are not met, and (2) remove activated operating bypass(es), if the plant conditions change so that an activated operating bypass is no longer permissible.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
19. Criteria 6.7 ~~and~~, 7.5, and 8.3~~,~~ Maintenance Bypasses: The ~~Criterion~~Criteria 6.7 ~~and~~, 7.5, and 8.3 systems listed in Table 2.2.15-1 are capable of performing their safety-related functions, when one division is in maintenance bypass.	a. Inspections(s) will be performed of the current revision of the SLDs for the ~~Criterion~~Criteria 6.7, ~~and~~ 7.5 and 8.3 systems listed in Table 2.2.15-1 to verify that the safety-related systems are capable of performing their safety-related functions, when one division is in maintenance bypass. {{Design Acceptance Criteria}} b. Test(s) will be performed to demonstrate that the ~~Criterion~~Criteria 6.7, ~~and~~ 7.5 and 8.3 systems listed in Table 2.2.15-1 perform their safety-related functions, when one division is in maintenance bypass. c. Test(s) will be performed to demonstrate that the Criteria 6.7, 7.5, and 8.3 systems listed in Table 2.2.15-1 perform their safety-related functions, when one power supply division is in maintenance bypass. Criterion 5.15, Reliability:	a. Inspection report(s) conclude(s) that the current revision of the SLDs for the ~~Criterion~~Criteria 6.7, ~~and~~ 7.5, and 8.3 systems listed in Table 2.2.15-1 show that the safety-related systems are capable of performing their safety-related functions, when one division is in maintenance bypass. {{Design Acceptance Criteria}} b. Test report(s) conclude(s) that the ~~Criterion~~Criteria 6.7, ~~and~~ 7.5, and 8.3 systems listed in Table 2.2.15-1 perform their safety-related functions, when one division is in maintenance bypass. c. Test report(s) conclude(s) that the Criteria 6.7, 7.5, and 8.3 systems listed in Table 2.2.15-1 perform their safety-related functions, when one power supply division is in maintenance bypass.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
20. Criterion 6.8, Setpoint: For the Criterion 6.8 systems listed in Table 2.2.15-1, setpoints for safety-related functions are defined, determined and implemented based on a defined setpoint methodology.	Inspection(s), test(s), and/or analysis(es) for the Criterion 6.8 systems listed in Table 2.2.15-1 will be performed to verify that the setpoints for safety-related functions are defined, determined and implemented based on a defined setpoint methodology.	Inspection(s), test(s), or analysis(es) report(s) for the Criterion 6.8 systems listed in Table 2.2.15-1 conclude(s) that the safety-related systems' setpoints for safety-related functions are defined, determined and implemented based on a defined setpoint methodology.
21. Criterion 8.1, Electrical Power Sources: The listed systems receive power from safety-related power supplies in the same division.	a. Inspection(s) will be performed of the "current revision" of the electrical one-line diagrams for the listed systems. {{Design Acceptance Criteria}}	a. Inspection report(s) conclude(s) that the "current revision" of the electrical one-line diagrams show the listed systems receive power from safety-related power supplies in the same division. {{Design Acceptance Criteria}} b. Inspection report(s) conclude(s) that the listed systems receive power from safety-related power supplies in the same division.

Table 2.2.15-2

ITAAC For IEEE Std. 603 Compliance Confirmation

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
22.Criterion 8.2, Non-electrical Power Sources: The listed systems receive non-electric power from safety-related sources.	a. Inspection(s) will be performed on the "current revision" of the P&ID of the listed systems. {{Design Acceptance Criteria}}	a. Inspection report(s) conclude(s) that the "current revision" of the P&ID of the listed systems show non-electric power from safety-related sources. {{Design Acceptance Criteria}}
	b. Inspection(s) will be performed on the as-built mechanical installation of the listed systems.	b. Inspection report(s) conclude(s) that the listed systems receive non-electric power from safety-related sources.

2.1.2 Nuclear Boiler System

Design Description

The Nuclear Boilder System (NBS) generates steam from feedwater and transports steam from the RPV to the main turbine.

(1) The functional arrangement of the NBS ~~System~~ is as described in the Design Description of this Subsection 2.1.2, Tables 2.1.2-1 and 2.1.2-2, and Figures 2.1.2-1, 2.1.2-2, and 2.1.2-3.

(2) ASME Code Section III

a. The components identified in Table 2.1.2-1 as ASME Code Section III are designed, fabricated, installed, and inspected ~~and constructed~~ in accordance with ASME Code Section III requirements.

b. The piping identified in Table 2.1.2-1 as ASME Code Section III is designed, fabricated, installed and inspected ~~and constructed~~ in accordance with ASME Code Section III requirements.

(3) Pressure Boundary Welds

a. Pressure boundary welds in components identified in Table 2.1.2-1 as ASME Code Section III meet ASME Code Section III requirements.

b. Pressure boundary welds in piping identified in Table 2.1.2-1 as ASME Code Section III meet ASME Code Section III requirements.

(4) Pressure Boundary Integrity

a. The components identified in Table 2.1.2-1 as ASME Code Section III retain their pressure boundary integrity at ~~internal pressures that will be experienced during service~~their design pressure.

b. The piping identified in Table 2.1.2-1 as ASME Code Section III retains its pressure boundary integrity at its design pressure.

(5) Seismic Capability

a. The seismic Category I equipment identified in Tables 2.1.2-1 and 2.1.2-2 can withstand seismic design basis loads without loss of safety function.

b. Each ~~of the~~Seismic Category I ~~lines~~ line, identified in Table 2.1.2-1, ~~for which functional capability is required~~ is designed to withstand combined normal and seismic design basis loads without a loss of its ~~functional capability~~safety-related function(s).

(6) Electrical Equipment Separation

~~(6)~~a. Each of the NBS ~~System~~ safety-related ~~divisions~~ electrical equipment identified in Table 2.1.2-2 is powered from its respective safety-related divisonal power supply.

~~a.~~b. Separation is provided between NBS ~~System~~ safety-related ~~divisions~~ electrical equipment, and between safety-related ~~divisions~~ electrical equipment and nonsafety-related cable.

Table 2.1.2-3

ITAAC For The Nuclear Boiler System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
b) Each ~~of the~~Seismic Category I lines~~,~~ identified in Table 2.1.2-1~~, for which functional capability is required~~ is designed to withstand combined normal and seismic design basis loads without a loss of its safety-related function~~al capability~~(s).	Inspection will be performed for the existence of a report verifying that the as-built piping meets the requirements for functional capability.	Report(s) document that a report exists and concludes that each of the as-built Seismic Category I lines, identified in Table 2.1.2-1, is designed to withstand combined normal and seismic design basis loads without a loss of its safety-related function(s)~~for which functional capability is required meets the requirements for functional capability~~.
6a). Each of the NBS ~~System~~ safety-related ~~divisions~~equipment identified in Table 2.1.2-2 is powered from its respective safety-related divisional power supply. .	See Tier 1, Subsection 2.2.15 and Table 2.2.15-2, Items 21a & 21b.~~See Tier 1, Subsections 2.13.1, 2.13.3, or 2.13.5, as appropriate.~~	See Tier 1, Subsection 2.2.15 and Table 2.2.15-2, Items 21a & 21b.~~See Tier 1, Subsection 2.13.1, 2.13.3, or 2.13.5, as appropriate.~~
b) Separation is provided between NBS ~~System~~ safety-related ~~divisions~~ electrical equipment, and between safety-related ~~divisions~~ electrical equipment and nonsafety-related cable.	See Tier 1, Subsection 2.2.15 and Table 2.2.15-2, Items 5a & 5b.~~See Tier 1, Subsection 2.2.15.~~	See Tier 1, Subsection 2.2.15 and Table 2.2.15-2, Items 5a & 5b.~~See Tier 1, Subsection 2.2.15.~~