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MFN 07-505

Docket No. 52-010

October 18, 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 Nos. 76, 100, 105, and 107 Related to ESBWR Design Certification Application – RAI Numbers 7.1-14 S01, 7.1-27 S01, 7.1-44, 7.1-45, 7.1-47 S01, 7.1-50 S01, 7.1-52, and 7.1-58**

Enclosure 1 contains GEH's responses to the subject NRC RAIs.

The NRC transmitted RAI 7.1-14 Supplement 1 via email from Lauren Quinones, dated April 24, 2007. The original RAI response was transmitted to the NRC via Reference 1.

The NRC transmitted RAI 7.1-27 Supplement 1 via Reference 2. The original RAI response was transmitted to the NRC via Reference 3.

The NRC transmitted RAIs 7.1-44 and 7.1-45 via Reference 4.

The NRC transmitted RAI 7.1-47 Supplement 1 via Reference 5. The original RAI response was transmitted to the NRC via Reference 6.

The NRC transmitted RAI 7.1-50 Supplement 1 via Reference 2. The original RAI response was transmitted to the NRC via Reference 3.

The NRC transmitted RAIs 7.1-52 and 7.1-58 via Reference 7.

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

Sincerely,

Kathy Sedney for

James C. Kinsey
Vice President, ESBWR Licensing

References:

1. MFN 07-143, Letter from James Kinsey to U.S. Nuclear Regulatory Commission, *Summary Report - RAI Resolutions Incorporated in ESBWR Design Control Document, Revision 3, and RAI Response Schedule,* March 12, 2007
2. MFN 07-460, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 105 Related to ESBWR Design Certification Application,* August 16, 2007
3. MFN 07-402, Letter from James Kinsey to U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter Nos. 76, 96, and 100 Related to ESBWR Design Certification Application – RAI Numbers 7.1-9, 7.1-10, 7.1-11, 7.1-12, 7.1-13, 7.1-19, 7.1-20, 7.1-21, 7.1-22, 7.1-23, 7.1-25, 7.1-27, 7.1-28, 7.1-50, 7.1-54, 7.2-50, and 7.3-1*, July 27, 2007
4. MFN 06-388, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 76 Related to ESBWR Design Certification Application*, October 11, 2006
5. MFN 07-492, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 107 Related to ESBWR Design Certification Application*, August 31, 2007
6. MFN 07-430, Letter from James Kinsey to U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 96 Related to ESBWR Design Certification Application – RAI Number 7.1-47*, August 16, 2007
7. MFN 07-327, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 100 Related to ESBWR Design Certification Application,* May 30, 2007

Enclosures:

1. MFN 07-505 -- Response to Portion of NRC Request for Additional Information Letter Nos. 76, 100, 105, and 107 Related to ESBWR Design Certification Application – RAI Numbers 7.1-14 S01, 7.1-27 S01, 7.1-44, 7.1-45, 7.1-47 S01, 7.1-50 S01, 7.1-52, and 7.1-58

cc: AE Cubbage USNRC (with enclosures)
RE Brown GEH/Wilmington (with enclosures)
GB Stramback GEH/San Jose (with enclosures)

eDRF:	RAI 7.1-14 S01	0000-0072-6742
	RAI 7.1-27 S01	0000-0060-7055
	RAI 7.1-44	0000-0072-7490
	RAI 7.1-45	0000-0070-3278
	RAI 7.1-47 S01	0000-0075-4987
	RAI 7.1-50 S01	0000-0074-3463
	RAI 7.1-52	0000-0070-2010
	RAI 7.1-58	0000-0070-3224

MFN 07-505

Enclosure 1

Response to Portion of NRC Request for Additional Information Letter Nos. 76, 100, 105, and 107 Related to ESBWR Design Certification Application

RAI Numbers 7.1-14 S01, 7.1-27 S01, 7.1-44, 7.1-45, 7.1-47 S01, 7.1-50 S01, 7.1-52, and 7.1-58

For historical purposes, the original text of RAI 7.1-14 and the GE response are included.

NRC RAI 7.1-14

How is the ESBWR design in conformance with IEEE-603 Safety System Criterion 5.6, Independence?

IEEE-603-1991, Safety System Criterion 5.6, Independence: The application document (DCD, Tier 2) should demonstrate the independence between

(a) redundant portions of a safety system,

(b) safety systems and the effects of design basis events, and

(c) safety systems and other systems. Three aspects of independence should be addressed in each case:

- *Physical independence,*
- *Electrical independence, and*
- *Communications independence.*

If some of the activities will be performed beyond the design certification stage, then the DCD, Tier 2, should identify the COL action requirements. Appropriate ITAAC acceptance criteria should be proposed to verify this commitment.

GE Response

This NRC RAI was resolved as part of Enclosure 1 to MFN 07-143, March 12, 2007, "Non-docketed RAI Resolutions Incorporated in DCD Revision 3 – No Further Action Planned," with the following comment:

The DCD Section 7.1 has been updated to demonstrate conformance with IEEE-603, Safety System Criterion 5.6, Independence.

NRC RAI 7.1-14 S01

Received by e-mail from Lauren Quinones - 04/24/07:

IEEE Std 603, Section 5.6 requires that components of each RPS division are totally separated physically and independent from components of other division. Figure 8.14, "Uninterruptible AC Power Supply" indicated that two RPS power feeders from division 1, two RPS power feeders from division 2, and none from divisions 3 and 4. Fig. 8.1-4 is not consistent with design basis addressed in DCD 7.1 and 7.2.

GEH Response

Reference DCD Tier 2, Subsection 8.3.1.1.3. The fifth paragraph has been updated in Revision 4 as described in the response to NRC RAI 8.3-56 S01 transmitted to the NRC by letter, MFN 07-294 Supplement 1, July 6, 2007.

DCD Impact

No additional changes will be made to the DCD in response to NRC RAI 7.1-14 S01.

For historical purposes, the original text of RAI 7.1-27 and the GE response are included.

NRC RAI 7.1-27

How is the ESBWR design in conformance with IEEE-603 Sense and Command Features 6.5, Capability for Testing and Calibration of System Inputs?

IEEE-603-1991, Sense and Command Features 6.5, Capability for Testing and Calibration of System Inputs:

The most common method used to verify the availability of the input sensors is by cross checking between redundant channels that have available instrumentation signal displays. When only two channels of signal displays are provided, the DCD, Tier 2, should state the basis used to ensure that an operator will not take incorrect action when the two channel signals differ. The DCD, Tier 2, should state the method to be used for checking the operational availability of non-indicating sensors. Standard Review Plan, Chapter 7, BTP 7-17, Revision 4 - 06/1997, "Guidance on Self-Test and Surveillance Test Provisions," discusses issues that should be considered in sensor checks and surveillance tests for digital computer I&C systems. Appropriate ITAAC acceptance criteria should be proposed to verify this commitment.

GE Response

DCD Tier 2, Revision 3, Subsection 7.1.6.6.1.21 addresses capability for testing and calibration of system inputs. Consideration of the guidance in BTP 7-17 and checking of the operational availability of safety-related non-indicating sensors, which is performed as part of the periodic tests, is described in DCD Tier 2, Revision 3, Subsections 7.1.2.5, 7.1.3.4, 7.2.1.13, 7.2.2.5, 7.2.3.4, 7.3.3.4, 7.3.5.4, 7.5.2.4, 7.6.1.4, 7.7.1.4, and 7.7.2.4.

ITAAC for IEEE Std. 603, Criterion 5.7 and 6.5, Capability for Testing and Calibration of System Inputs, will be added to DCD Tier 1, Revision 4, Subsection 2.2.15, and Tables 2.2.15-1 and 2.2.15-2, as shown in Enclosure 2.

DCD Impact

ITAAC for IEEE Std. 603, Criterion 5.7 and 6.5, Capability for Testing and Calibration of System Inputs, will be added to DCD Tier 1, Revision 4, Subsection 2.2.15, and Tables 2.2.15-1 and 2.2.15-2, as shown in Enclosure 2.

NRC RAI 7.1-27 S01

The process radiation monitoring system (PRMS) should also comply with Sections 5.7 and 6.5 of IEEE 603 requirements.

GEH Response

PRMS conforms to IEEE Std. 603, Sections 5.7 and 6.5. DCD Tier 2, Subsection 7.5.3.4, Revision 4, was revised as shown below.

DCD Tier 1, Table 2.2.15-1, Rev. 4, will be revised to include PRMS as an applicable system for IEEE Std. 603, Criteria 5.7 and 6.5.

DCD Impact

DCD Tier 2, Subsection 7.5.3.4, Rev. 4, was revised as shown below in response to NRC RAI 7.1-27 S01.

DCD Tier 1, Table 2.2.15-1, Rev. 4, will be revised as shown below in response to NRC RAI 7.1-27 S01.

7.5.3.4 Testing and Inspection Requirements

The capability for testing and calibration is discussed in Subsections 11.5.6.1, 11.5.6.2, and 11.5.6.3 and complies with the requirements of IEEE Std. 603, Sections 5.7 and 6.5.

Table 2.2.15-1

ITAAC Applicability Matrix [1]

IEEE Std. 603 Criterion	Applicable System (Tier 1 Subsection) [2]												
	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)	CMS (2.15.7)	SPTM (2.15.7)
5.1	-	-	-	X	-	X	X	X	-	X	X	-	-
5.2 and 7.3	-	-	-	-	-	X	X	X	-	-	-	-	-
5.6	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
5.9	-	-	-	X	X	X	X	X	-	-	-	-	-
6.1 and 7.1	-	-	-	-	-	X	-	X	-	-	-	-	-
6.2 and 7.2	-	-	-	-	-	X	-	X	-	-	-	-	-
6.6 and 7.4	-	-	-	X	-	X	-	X	-	-	-	-	-
6.7 and 7.5	-	-	-	X	-	X	-	X	-	-	-	-	-
6.8	X	-	X	X	-	X	X	X	X	-	-	X	X

(1) A dash means not applicable.

(2) Safety-related portions only

NRC RAI 7.1-44

Provide clarification for "Most sensors have a provision for actual testing and calibration." In DCD Tier 2, Revision 1, Section 7.1.2.3.6, in Capability for Test and Calibration, this statement is provided: "Most sensors have a provision for actual testing and calibration during reactor operation." Two exceptions are defined:

- *Confirm operation of MSIV and turbine stop valve limit switches;*
- *Independent functional testing of the air header dump valves during each refueling outage (not operation) and operation of at least one valve can be confirmed following each scram.*

Please confirm all temperature, pressure, differential pressure sensors plus remaining limit switches and instrument valves would have this provision (i.e. testing and calibration during reactor operation). Otherwise please provide a listing of those that actually will have this capability. Reviewer Question Summary Full Text –17-

GEH Response

DCD Tier 2, Chapter 7, Revision 3, replaced Subsection 7.1.2.3.6 with Subsection 7.1.6, et al. Subsection 7.1.6.6.1, et al, addresses compliance with IEEE Std. 603.

DCD Tier 2, Revision 3, Subsections 7.1.6.6.1.8 (IEEE Std. 603, Section 5.7) and 7.1.6.6.1.21 (IEEE Std. 603, Section 6.5) address the capability for test and calibration of safety-related systems during power operation. Safety-related sensors are designed with the capability for test and calibration during reactor operation with the following two exceptions in the Reactor Protection System:

- Main Steam Isolation Valve limit switches
- Turbine Stop Valve limit switches

These limit switches are not accessible during reactor operation. While they are tested/checked for operability during reactor operation; they cannot be calibrated until the reactor is shutdown. DCD Tier 2, Subsections 7.1.6.6.1.8 and 7.2.1.13.1 will be revised to add the two RPS sensor exceptions, as indicated above.

With regard to the testing of air header dump valves, this has been addressed adequately in DCD Tier 2 Subsections 4.6.3.4, 4.6.3.5, 7.2.1.13 (also, refer to Figure 7.2-2), and 14.2.8.1.4.

The ITAAC that demonstrate conformance with "Capability for Test and Calibration" (IEEE-603-1991, Safety System Criteria 5.7 and 6.5) are in DCD Tier 1, Revision 4, Subsection 2.2.15, Tables 2.2.15-1, and 2.2.15-2.

DCD Impact:

DCD Tier 2, Subsections 7.1.6.6.1.8 and 7.2.1.13.1 will be revised as shown below as a result of the response to NRC RAI 7.1-44.

7.1.6.6.1.8 Capability for Testing and Calibration (IEEE Std. 603, Section 5.7)

The capability for testing and calibration of safety-related system equipment is provided during power operation and duplicates the performance of the safety-related function as closely as practicable, as discussed in Sections 7.2 through 7.8. Tests may be performed in overlapping segments when testing one safety-related function. Maintenance bypasses of individual functions are provided in the safety-related system channels when it is not practical to perform a test during power operation without the bypasses. For example, the safety-related functions of each safety-related channel can be tested on-line with the tested channel bypassed from the two-out-of-four voting trip logic. The I&C equipment has built-in self-diagnostic functions to identify critical failures such as loss of power and data errors. Q-DCIS meets the requirements outlined in this section. More descriptions of system testing and calibration are included in the system description subsections of the respective safety-related systems as outlined in Table 7.1-2.

Safety-related sensors are designed with the capability for test and calibration during reactor operation, with the following two exceptions in the Reactor Protection System:

- Main Steam Isolation Valve limit switches
- Turbine stop valve limit switches

These limit switches are not accessible during reactor operation. While they are tested/checked for operability during reactor operation; they cannot be calibrated until the reactor is shutdown.

7.2.1.13.1 System Testing: Operational Verifiability

The RPS is designed so that its individual operating elements can be periodically and independently tested to demonstrate that RPS reliability is being maintained.

The RPS design (and the design of other systems providing the RPS with instrument channel inputs) permits verifying, with a high degree of confidence, and during reactor operation, the operational availability of each of the input sensors utilized by the RPS (that is, channel checks continuously performed by the plant computer function).

The instrument channels are periodically calibrated and adjusted to verify that necessary precision and accuracy is being maintained. Such periodic checking and testing during plant operation is possible without loss of scram capability and without causing an inadvertent scram.

Safety-related sensors are designed with the capability for test and calibration during reactor operation, with the following two exceptions in the Reactor Protection System:

- Main Steam Isolation Valve limit switches
- Turbine stop valve limit switches

These limit switches are not accessible during reactor operation. While they are tested/checked for operability during reactor operation; they cannot be calibrated until the reactor is shutdown.

Safety-related RPS equipment is designed to allow inspection and testing during periodic shutdowns of the nuclear reactor and during refueling shutdowns.

NRC RAI 7.1-45

Provide differences between SSLC/RTIF used in ABWR versus SSLC/RTIF used in ESBWR

DCD, Tier 2, Revision 1, Section 7.1.1.2.1: It is stated that the "ESBWR SSLC/RTIF architecture concept is identical to that of the ABWR SSLC/RTIF," and "Such RTIF hardware and software platform structure concept is identical to that of the ESBWR." In order to take any credit for the ABWR Safety System Logic and Control/Reactor Trip and Isolation Function (SSLC/RTIF) the following will have to be explained:

1) What is meant by "architectural concept" and "hardware and software platform structure concept"

2) The exact differences between the ESBWR and the ABWR SSLC/RTIF would have to be identified. Also, these differences substantiated in terms of design specifications as well as application and procurement documents.

3) Most importantly, the safety significance of the differences would have to be addressed by the applicant.

GEH Response

From Revision 2 to Revision 3 of the DCD, Section 7.1 was completely rewritten to enhance the description of the ESBWR DCIS. The existing description was combined with the communication information previously included in Section 7.9 to provide a better picture of the integrated system. Information from DCD Tier 2, Revision 1, Subsection 7.1.1.2.1 moved to various Sections throughout Chapter 7. The ESBWR SSLC/RTIF architecture concept and hardware/software platform structure concept are no longer compared to that of ABWR. Since comparison to ABWR design has been removed, credit for ABWR SSLC/RTIF is not sought for ESBWR design, exact differences need not be specified (as requested in item 2 above), and the safety significance of any differences need not be specified (as requested in item 3 above).

To answer item 1 above, the ESBWR RTIF and SSLC/ESF "architectural concept" and "hardware and software platform structure concept" refer to the equipment used (such as cabinets and chassis), their physical arrangement/layout, and the associated software/programming. While it is intended that the concepts are to be like ABWR design to the extent possible in order to simplify the development of the ESBWR design, it is only for guidance and not a requirement. The design concepts for ESBWR RTIF and SSLC/ESF cabinets are independent of the ABWR design and are described throughout DCD, Tier 2, Section 7.1. Subsection 7.1.2 includes a list of the Q-DCIS major cabinets, systems, and functions (which include RTIF, NMS, SSLC/ESF) along with references to the other subsections in Chapter 7 that further describe them.

The recently submitted Licensing Topical Report (LTR), "Application of Nuclear Measurement Analysis and Control (NUMAC) for the ESBWR Reactor Trip System", March 2007 (MFN 07-160) gives further clarification on RTIF architecture and hardware/software structure. Information on the architecture, hardware, and software used for SSLC/ESF can be found in Licensing Topical Report, "ESBWR I&C TRICON (SSLC/ESF) Platform Application", NEDE-33388P, Class III (Proprietary) September 2007 (MFN 07-515) and "ESBWR I&C TRICON (SSLC/ESF) Platform Application", NED0-33387, Class I (Non-proprietary).

DCD Impact

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

For historical purposes, the original text of RAI 7.1-47 and the GE response are included.

NRC RAI 7.1-47

Update the DCD Section 7.1 to demonstrate that the ESBWR design has complied with RG 1.209. The NRC issued Regulatory Guide (RG) 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer-based Instrumentation and Control systems in Nuclear Power Plants" in March 2007. Update DCD Section 7.1 to demonstrate that the ESBWR design has complied with RG 1.209.

GE Response

The ESBWR design will incorporate the guidance of Regulatory Guide (RG) 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer-based Instrumentation and Control systems in Nuclear Power Plants," dated March 2007. GE will revise DCD Tier 2, Subsections 7.1 and 3.11, and Chapter 1 Table 1.9-21 to demonstrate ESBWR compliance with RG 1.209, as described below.

DCD Impact

DCD Tier 2 will be revised as shown below.

7.1.6.6.1.5 Equipment Qualification (IEEE Std. 603, Section 5.4)

It is required that safety-related ~~system~~ equipment be designed to meet the safety-related functional performance requirements over the range of normal, abnormal, and Design Basis Accident environmental conditions for the area in which it is located. Equipment qualification typically includes EMI qualification, seismic qualification, and other environmental condition qualification such as temperature, humidity, radiation, and pressure. Q-DCIS systems are designed to meet the equipment qualification requirements set forth in 10 CFR 50.49, RG 1.209, RG 1.89, RG 1.100, IEEE Std. 603, ~~and other associated equipment qualification requirements~~IEEE Std. 323, and IEEE Std. 344. The qualification ~~was~~ is established using qualification methods set forth in ~~GE's Environmental Qualification Program. (See~~ Reference 7.1-2~~)~~. Q-DCIS components are designed to be qualified to operate in the normal, ~~and~~ abnormal, and DBA environments in which they are located.

For environmental qualification, the following areas are addressed:

Temperature and Humidity: Q-DCIS components are designed to be qualified using type testing~~,~~ as the preferred method ~~and~~, and analysis to demonstrate that the components will perform all specified functions correctly when operated within the specified temperature range and relative humidity range. ~~The components will be qualified in accordance with RG 1.89 (IEEE Std. 323 - 1974) and IEEE Std. 323 - 1983. All~~

~~qualification will be based on type testing. The designers of the HVAC systems will be required to confirm that the maximum control room temperature plus mounting panel temperature rise, allowing for the heat load of the Q-DCIS equipment, does not exceed the temperature limit, and that control room humidity is maintained within limits.~~

Pressure: Q-DCIS components are designed to be qualified (by analysis) to perform safety-related functions~~to specification~~ for any absolute pressure in the range specified. ~~The design of the HVAC systems surrounding the Q-DCIS components ensures that the maximum control room pressure does not exceed the specified limit.~~

Radiation: Q-DCIS components are designed to be qualified (by analysis) to perform safety-related functions ~~within specification limits~~ over their service life under the specified radiation conditions. The design ensures that the maximum radiation levels at the equipment locations do not exceed the allowed limits.

Seismic Qualification: Q-DCIS components are designed to be qualified (by type testing and analysis) to demonstrate that the components will perform all safety-related~~specified~~ functions correctly when operated within the specified seismic limits, and when mounted in accordance with the specified mounting methods. Q-DCIS components are to be qualified in accordance with the requirements of RG 1.100 (IEEE Std. 344~~—1975~~). Qualification is based on type testing. The design ensures that the maximum seismic accelerations at the mounting locations of the equipment do not exceed the allowed limits.

EMI Qualification: Q-DCIS components in conformance with RG 1.180, when mounted in accordance with the specified mounting methods, are designed to be qualified by type testing and analysis to demonstrate that the components will perform safety-related ~~all specified~~ functions correctly when operated within the specified EMI limits. Q-DCIS equipment is designed to be not susceptible to electromagnetic disturbances from neighboring modules and does not cause electromagnetic disturbances to neighboring modules. The EMI qualification design follows the requirements specified in Mil Std. 461E and IEC 61000-4, depending on the specific requirement conditions. Q-DCIS equipment is qualified to perform within its specifications continuously while exposed to EMI environmental limits at the hardware mounting location. ~~Reference 7.1-3 is used for the envelope limits.~~ The EMI susceptibility and emissions testing is performed by type testing. In addition to the equipment design considerations, plant-specific actions are required to establish practices to control emission sources, maintain good grounding practices, and maintain equipment and cable separation.

3.11 ENVIRONMENTAL QUALIFICATION OF MECHANICAL AND ELECTRICAL EQUIPMENT

(4) U.S. Nuclear Regulatory Commission (NRC) Regulatory Guides:
   a. Regulatory Guide 1.63-1987 "Electric Penetration Assemblies in Containment Structures for Nuclear Power Plants."
   b. Regulatory Guide 1.73-1974 "Qualification Tests of Electric Valve Operators Installed Inside the Containment of Nuclear Power Plants."
   c. Regulatory Guide 1.89-1984 "Environmental Qualification of Certain Electric Equipment Important to Safety for Nuclear Power Plants."
   d. Regulatory Guide 1.131-1977 "Qualification Tests of Electric Cables, Field Splices and Connections for Light-Water-Cooled Nuclear Power Plants."
   e. Regulatory Guide 1.153-1996 "Criteria for Safety Systems."
   f. Regulatory Guide 1.183-2000 "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactor."
   g. Regulatory Guide 1.209-2007 "Guidelines for Environmental Qualification of Safety-Related Computer-based Instrumentation and Control systems in Nuclear Power Plants."

3.11.2.2 Qualification Program, Methods and Documentation

10 CFR 50.49(b) electrical equipment that is located in a harsh environment is qualified by test or other methods as described in IEEE 323 and permitted by 10 CFR 50.49(f) (Reference 3.11 2). Equipment type test is the preferred method of qualification.

Safety-related mechanical equipment that is located in a harsh environment is qualified by analysis of materials data, which are generally based on test and operating experience.

The mechanical and electrical equipment shall have a design life of 60 years. The design life shall be verified using methods and procedures of qualification and documentation as stated in IEEE-323 and as addressed herein.

The qualification program and methodology are described in detail in the NRC approved licensing Topical Report on GE's environmental qualification program (Reference 3.11-3). This report also addresses compliance with the applicable portions of the General Design Criteria of 10 CFR 50, Appendix A, and the Quality Assurance Criteria of 10 CFR 50, Appendix B. Additionally, the report describes conformance to Regulatory Guides and IEEE Standards referenced in SRP 3.11.

Safety-related eEquipment located in a mild environment, as defined by 10 CFR 50.49 paragraph (c), are qualified per IEEE Std. 323. Q-DCIS equipment located in areas characterized as mild environments, will also meet RG 1.209, and type testing is the

preferred method. Q-DCIS will meet RG 1.180 for EMI/RFI and the documentation will be consistent with the applicable elements of IEEE Std. 323, Section 7.1.~~subject to the loads specified, and margins as defined in IEEE Standard 323 are not applicable. A mild environment is one where a postulated event, such as a Loss-of-Coolant Accident (LOCA) or High Energy Line Break (HELB) does not cause any significant change in the environment of the particular location. For example, the Control Room is in a mild environment. If there is any change in conditions resulting from a postulated event, the requirements of IEEE Standard 323 shall apply.~~

~~The vendors of equipment located in a mild environment are required to submit a certificate of compliance certifying that the equipment has been qualified to assure its required safety-related function in its applicable environment. This equipment is qualified for dynamic loads as addressed in Sections 3.9 and 3.10. Further, a surveillance and maintenance program shall be developed to ensure the operability during its design life.~~

~~The vendor shall specify qualified life, shelf life and activities of maintenance surveillance, periodic testing and any parts replacement required to maintain qualification of equipment provided in accordance with this document.~~

The procedures and results of qualification by tests, analyses or other methods for the safety-related equipment shall be documented, maintained, and reported as mentioned in Subsection 3.11.5. ~~The requirements for this documentation are presented in GE's environmental qualification program (Reference 3.11-3).~~

Table 1.9-21 NRC Regulatory Guides Applicability to ESBWR						
RG No.	**Regulatory Guide Title**	**Appl. Rev.**	**Issued Date**	**ESBWR Appli-cable?**	**Comments**	
1.209	Guidelines for Environmental Qualification of Safety-Related Computer Based Instrumentation and Control Systems in Nuclear Power Plants	0	03/2007	Yes		

NRC RAI 7.1-47 S01

The Regulatory Guide (RG) 1.209, "Guidelines for Environmental Qualification of Safety-Related Computer-Based Instrumentation and Control Systems in Nuclear Power Plants," Position (4) states that for safety-related computer-based I&C systems intended for implementation in a mild environment, the NRC staff takes exception to Section 7.1 of IEEE Std. 323-2003. In Tier 1 Section 1.2.2.1 Item (3) stated that "Equipment located in a mild environment during or following a DBA need not be tested or analyzed" This statement should be deleted.

GEH Response

GEH concurs and the statement: "Equipment located in a mild environment during or following a DBA need not be tested or analyzed" has been deleted from DCD 26A6641AB Tier 1 Revision. 4.

Additionally, the following changes were made in DCD Tier 1 Revision 4:

- Section 1.2.2.1 that contained the above statement was deleted.
- Section 1.1 "Definitions and General Provisions" added a definition of Environmental Qualification, which addresses mild environment for safety related digital I&C equipment (for purposes of ITAAC).
- Section 3.8 "Environmental Qualification of Mechanical and Electrical Equipment" has been added. This section addresses the ITAAC for safety-related digital I&C equipment located in a mild environment and includes "Type tests, analyses, or a combination of type tests and analyses will be performed on safety-related digital I&C equipment located in a mild environment."

DCD Impact

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

For historical purposes, the original text of RAI 7.1-50 and the GE response are included.

NRC RAI 7.1-50

Propose appropriate design acceptance criteria (DAC or ITAAC) to verify the completion the NMS/RPS NUMAC design. By letter MFN 07-004, dated January 20, 2007, GE intended to submit Revision 1 of NEDO-33288 providing the basic structure and overview of the NMS/RPS NUMAC in October 2007, and Revision 2 of NEDO-33288 providing qualification reports in March 2008. Since the Revision 1 and Revision 2 submittals will occur beyond the design certification stage, appropriate design acceptance criteria (DAC or ITAAC) should be proposed. Propose appropriate design acceptance criteria (DAC or ITAAC) to verify the completion the NMS/RPS NUMAC design.

GE Response

NEDO-33288, Revision 0, "Application of Nuclear Measurement Analysis and Control (NUMAC) for the ESBWR Reactor Trip System," directly supports ESBWR design certification. Revisions 1 and 2 to this Licensing Topical Report (LTR) will incorporate documentation that will be used to close some ITAAC pertaining to ESBWR compliance with IEEE Std. 603-1991 and other system functional requirements already set forth in DCD Tier 1 Revision 3.

Appropriate ITAAC will be included in DCD Tier 1 for compliance with IEEE Std. 603-1991 under a new DCD Tier 1 Subsection 2.2.15. In addition, design acceptance criteria (DAC or ITAAC) related to the system specific functional requirements, have been already listed under Subsections 2.2.5 and 2.2.7 of DCD Tier 1, Revision 3, for safety-related systems NMS and RPS, respectively.

DCD/LTR Impact

A new subsection (2.2.15) will be included in DCD Tier 1 for compliance with IEEE Std. 603-1991 as shown in Enclosure 2.

No impact to LTR NEDO-33288, Revision 0.

NRC RAI 7.1-50 S01

Because the LTR NEDO-33288 Revision 1 and Revision 2 will not be submitted before the final SER for design certification, this issue should be in the DAC process.

GEH Response

DCD Tier 1, Subsection 2.2.15, Revision 4, includes DAC ITAAC and ITAAC to verify RPS/NUMAC designs associated with the LTR "Application of Nuclear Measurement Analysis and Control (NUMAC) for the ESBWR Reactor Trip System," NEDO-33288, Revision 1.

Specifically, DCD Tier 1, Table 2.2.15-2, Items 1 and 3, Revision 4, document the block level FMEA to be performed to verify the RPS/NUMAC design. The FMEA will be attached to NEDO-33288, Revision 1, as part of the NUMAC qualification program.

Future revisions of NEDO-33288, previously identified as Revision 2 in MFN 07-004, will be issued as Supplements to Revision 1 because these revisions will provide information that will support and supplement the requirements described in Rev. 1. These supplements will provide information intended to close the DCD Tier 1, Subsection 2.2.15, ITAAC related to documenting the adequacy of the final design configuration of the NUMAC hardware and environmental qualification.

DCD Impact

No additional changes to the DCD will be made as a result of this response to NRC RAI 7.1-50 S01.

NRC RAI 7.1-52

DCD Tier 2, Rev. 2, Section 7.1.1.1 stated that "safety-related reactor trip system and engineered safety feature systems are accomplished by a four-division, separated protection logic system framework called the Safety System Logic and Control (SSLC)." This statement has been removed for Rev. 3. Please explain the significance of removing the RPS/ SSLC connection. Does this mean the RPS logic is now done outside the SSLC logic and cabinets?

GEH Response

The term Safety System Logic and Control (SSLC) has traditionally been used to describe protection system logic. In the design of the ESBWR, which uses distributed controls implemented on diverse logic platforms and hardware, the term "SSLC" created confusion and was therefore changed to "SSLC/ESF" as part of the changes in Revision 3 of the DCD. RPS logic is done outside the SSLC logic and cabinets using a diverse platform from the SSLC. The Reactor Protection System (RPS) and Safety System Logic and Control / Engineered Safety Feature (SSLC/ESF) utilize different hardware and software but both are safety-related and therefore included under the Safety-Related Distributed Control and Information System (Q-DCIS). Each of the systems is made up of four separate divisions of safety-related equipment (cabinets, chassis, sensors, software, etc.), the redundancy and independence of the safety-related logic platforms was not changed.

In Revision 3 of the DCD, Section 7.1 was completely re-written to enhance the description of the ESBWR DCIS. Subsections 7.1.2 and 7.1.3 contain information about the ESBWR Q-DCIS, which includes RPS (in the Reactor Trip and Isolation Function Cabinets), the Neutron Monitoring System (NMS, in its own cabinets), and SSLC/ESF (in its own cabinets). Subsection 7.1.2 states, "For added reliability and diversity, the architecture of the RPS and NMS protection systems is different from the architecture of the SSLC/ESF protection system". Subsection 7.1.2.8.1, paragraph 4 states "The RPS sensors, hardware and logic are diverse from SSLC/ESF logic, ATWS Mitigation logic and Diverse Protection System (DPS) logic." The "significance of removing the RPS/SSLC connection", therefore, is to reflect the diversity of the hardware and software platforms of the RPS and the SSLC.

Section 7.2 provides more detailed information about the RPS functions. Section 7.3 provides more detailed information about the SSLC/ESF.

DCD Impact

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

NRC RAI 7.1-58

DCD Tier 2, Rev 3, Section 7.1.5.5.10, states that "The required resolution of time tagging will be determined, based on the speed of the monitored process variable, the origin (that is, N-DCIS, Q-DCIS, or other gateway) of the data, and the available technology." Explain what is meant by "or other gateway." Does this mean there are gateways to the Q-DCIS other than the N-QDCIS?

GEH Response

There are no gateways to Q-DCIS other than from N-DCIS. The referenced statement refers to gateways for "foreign" nonsafety-related controllers that might require interface to the N-DCIS. Further information on (nonsafety-related) gateways can be found in the response to RAI 7.1-56 and the following sections/subsection of DCD Tier 2, Rev. 3.

- The fourth paragraph in Subsection 7.1.4 (N-DCIS General Description Summary) states that the "N-DCIS provides gateways/datalinks as necessary to allow vendor supplied or prepackaged ("foreign") control systems to be integrated into the ESBWR DCIS."
- The seventh bullet item in Subsection 7.1.4.2 (N-DCIS Nonsafety-Related Design Bases Summary) lists a requirement for N-DCIS to "Provide gateway interfaces to control and logic processing equipment supplied by parties other than the primary N-DCIS equipment supplier."
- The fifth bullet item in Subsection 7.1.5.6 (N-DCIS Hardware) states "N-DCIS gateways/datalinks provide N-DCIS communication with Q-DCIS, foreign controllers, the plant firewall to the TSC/EOF/ERDS, and other nonsafety-related packaged systems."

DCD Impact

DCD Tier 2 Subsection 7.1.5.5.10 (renumbered in Rev. 4) will be modified as follows:

7.1.5.2.4.10 Transient Recording and Analysis and Sequence of Events Recording
Time tagging at the millisecond level is a function of the TRA and the SOE recording. Time tagging is accomplished as closely as possible to the origin of the data. The required resolution of time tagging is based on the speed of the monitored process variable, the origin of the data (~~that is, the~~ N-DCIS or~~, the~~ Q-DCIS~~, or other gateway~~), and the available technology.