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Subject: **Response to Portion of NRC Request for Additional Information Letter Nos. 100 and 105 Related to ESBWR Design Certification Application - RAI Numbers 7.1-55, 7.1-57, 7.2-41, Supplement 1, 7.2-50, Supplement 1, 7.9-6, Supplement 1**

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 letters dated May 30, 2007 and August 16, 2007. GEH responses to RAI Numbers 7.1-55, 7.1-57, 7.2-41, Supplement 1, 7.2-50, Supplement 1, 7.9-6, Supplement 1, are addressed in Enclosure 1.

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

Sincerely,

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 07-327, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GE, *Request For Additional Information Letter No. 100 Related To ESBWR Design Certification Application*, dated May 30, 2007

2. MFN 07-460, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GE, *Request For Additional Information Letter No. 105 Related To ESBWR Design Certification Application*, dated August 16, 2007

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter Nos. 100 and 105 Related to ESBWR Design Certification Application - RAI Numbers 7.1-55, 7.1-57, 7.2-41, Supplement 1, 7.2-50, Supplement 1, 7.9-6, Supplement 1

cc:

AE Cubbage	USNRC (with enclosure)
GB Stramback	GEH/San Jose (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
eDRF Sections:	
	0000-0068-6404 (RAI 7.1-55)
	0000-0074-8068 (RAI 7.1-57)
	0000-0075-4328 (RAI 7.2-41, Supplement 1)
	0000-0074-5547 (RAI 7.2-50, Supplement 1)
	0000-0075-7446 (RAI 7.9-6, Supplement 1)

MFN 07-596

Enclosure 1

Response to Portion of NRC Request for Additional Information Letter Nos. 100 and 105 Related to ESBWR Design Certification Application - RAI Numbers 7.1-55, 7.1-57, 7.2-41, Supplement 1, 7.2-50, Supplement 1, 7.9-6, Supplement 1

NRC RAI 7.1-55

DCD Tier 2, Rev. 3, Section 7.1.3.2 states "The components of Q-DCIS in the reactor building (RB) and control building (CB) will be located in a controlled environment for safety-related equipment. The remote multiplexer unit (RMUs) in the RB and safety-related logic cabinets located in the CB will be provided with appropriate cooling to maintain the required environmental conditions." Describe the "appropriate cooling" method and if it is safety related. What are the environmental conditions which the logic cabinets will be qualified to without the appropriate cooling? Is it beyond the normal mild environment?

GEH Response

The "appropriate cooling" mentioned in DCD Tier 2, Section 7.1.3.2 refers to the cooling of the RB and CB rooms containing Q-DCIS RMUs in the RB and safety-related logic cabinets located in the CB. The room cooling is accomplished by nonsafety-related HVAC during normal operation, when either offsite or diesel generator power is available. No active cooling of RB and CB rooms containing Q-DCIS RMUs in the RB and safety-related logic cabinets located in the CB is required during Design Basis Events (DBEs) in which the system is operating on battery power.

DCD Tier 2, Revision 4, Section 7.1.3.2 will be changed to clarify that (a) Q-DCIS RMUs in the RB and safety-related logic cabinets located in the CB are located in a mild environment, (b) to indicate that the rooms containing Q-DCIS RMUs in the RB and safety-related logic cabinets located in the CB are cooled by nonsafety-related HVAC during normal operation, when either offsite or diesel generator power is available, and (c) that no active cooling of RB and CB rooms containing Q-DCIS RMUs in the RB and safety-related logic cabinets located in the CB is required during DBEs, because cooling is passive when the system is operating on battery power.

The qualification requirement during DBE is 45°C (113°F) for safety-related logic cabinets in CB, (see DCD 26A6642AN Tier 2, Rev. 04, Appendix 3H, Table 3H-10).

The safety-related logic cabinets required qualification temperature is not beyond the normal mild environment temperature, 50°C (122°F), (see DCD 26A6642AN Tier 2, Rev. 04, Appendix 3H, Table 3H-13).

DCD/LTR Impact

DCD Tier 2, Rev. 4, Section 7.1.3.2 will be revised as shown in the attached markup.

RAI 7.1-55 DCD Revision 4 Markup

7.1.3.2 Q-DCIS Description

Q-DCIS remote multiplexer unit (RMUs) in the RB and safety-related logic cabinets located in the CB are located in a mild environment. The rooms containing Q-DCIS this equipment are cooled by nonsafety-related HVAC during normal operation when either offsite or diesel generator power is available. When no active cooling is available, such as when the system is operating on battery power during DBEs, the cooling is passive.

NRC RAI 7.1-57

During a public meeting with GE on April 24 and 26, 2007, the staff requested GE to identify in the DCD Tier 1 documentation which specific ITAACs are DAC-related vs. typical as- built verification ITAAC. Please address this request.

GEH Response

As discussed in the April meeting, GEH identified the use of the DAC process for ITAAC related to the safety-related control system design associated with DCD Tier 2, Chapter 7, by adding the annotation {{DAC}} to certain ITAAC in the following DCD Tier 1, Revision 4, sections and subsections:

- Subsection 2.2.15 (new) addresses the safety-related control systems' compliance with IEEE Std. 603-1991.
- Section 3.7 addresses the design process for determining the post accident monitoring instrumentation requirements.

DCD Impact

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

For historical purposes, the original text of NRC RAI 7.2-41 and the GE response are included.

NRC RAI 7.2-41

Describe the Bypass function shown in DCD, Tier 2, Revision 1,Figure 7.2-1 "RPS Functional Block Diagram." Please identify the inputs and outputs of the bypass unit.

GE Response

DCD, Tier 2, Revision 1, Figure 7.2-1 was revised in Revision 2 to depict the bypass function as the "sensor bypass" and the "DTLU bypass." These bypasses correspond to the "division of sensors bypass" and the "division of logic (division out-of-service) bypass," respectively, discussed in DCD, Tier 2, Revision 2 Subsection 7.2.1.2.4. Additional discussion of these bypasses is provided in DCD, Tier 2, Revision 2, Subsection 7.2.1.2.4.1 "Division of Trip Logic."

DCD/LTR Impact

There are no changes to DCD required by this response.

NRC RAI 7.2-41 S01

RAI 7.2-41, Supplement 1 (MFN-07-015, February 12, 2007). The response did not address the "inputs and outputs of the bypass units". Such as if the sensor bypass is enabled what is the output of the TLU? Is the division out of service at this point? Is that the same output as for the TLU bypass? Is the TLU placed in "inop" in both cases? Isn't the division bypassed when either bypass is enabled?

GEH Response

The inputs and outputs of the bypass unit are discussed in subsections 7.2.1.2.4.1 and 7.2.1.5.2.2 of DCD Tier 2 Revision 4, and Subsection 5.1.2.8 of NUMAC LTR NEDO-33288 Revision 0. The input signals are identified as Division of Sensors Bypass, Division of Logic Bypass (Division-Out-Of-Service Bypass), and Special Isolated Main Steam Line Operational Bypass. Each BPU sends separate output signals for division of sensors bypass and special MSL operational bypass to the TLU in each of the four divisions. For the Division of Logic Bypass (Division-Out-Of-Service Bypass) each BPU also sends separate output signals to the four divisions of RPS OLU and MSIV OLU.

If the sensor bypass is enabled what is the output of the TLU?

A Division of Sensors Bypass in any division bypasses all trip-initiating signals from the bypassed division at the DTM trip input to the each of the four divisional TLUs. The effect of the channel of sensors bypass is to convert the TLU logic from two-out-of-four trip to two-out-of-three trip logic. TLU output remains the same. The Division of Sensors Bypass permits any one (or all) of the safety-

related RPS input sensor channels of one division to be repaired, replaced, or maintained off-line.

Is the division out of service at this point? Is that the same output as for the TLU bypass? Is the TLU placed in "inop" in both cases?

The channel sensors maintenance bypass function and the division-out-of-service maintenance bypass function are independent.

For Division of Sensors Bypass, "Yes"; that Division of sensors is "inop" for issuing a trip signal to any division. However, "No" the associated division TLU is not out of service (not "inop") and will continue to function to vote any two channels and issue a trip to its divisional OLUs.

For the Division-Out-of-Service Bypass "Yes" that division actuation logic is "inop" as it bypasses TLU trip input to the OLU and permits the RPS TLU of the associated division to be repaired, replaced, or maintained off-line. The Division-Out-of-Service Bypass is used by the RPS OLU and the MSIV OLU. However, "No" the associated division of sensors is not inop or out of service and the sensors will continue to issue valid trip signals to all division TLUs.

Isn't the division bypassed when either bypass is enabled?

No. The channel sensors maintenance bypass function and the division-out-of-service maintenance bypass function are independent. Thus, one division of sensors may be bypassed (taken out of service at the sensor channels level) and, simultaneously, the same division or any other division may be taken out of service at the RPS trip system level. In all cases, the RPS system remains able to trip the reactor if any two (or more) un-bypassed parameters exceed their trip values.

DCD Impact

No DCD change will be made in response to this supplemental RAI.

For historical purposes, the original text of NRC RAI 7.2-50 and the GE response are included.

NRC RAI 7.2-50

In DCD, Tier 2, Revision 1, section 7.2.1.3, Safety Evaluation, compliance to BTP HICB-18 reads "Any portions of RPS and SSLC design that will use commercial grade programmable logic controllers (PLCs) for safety-related functions conform to this BTP (and to BTPs 14, 17, and 21). Such PLCs will be qualified to a level commensurate with safety system requirements." This will require Tier 1 ITAAC which stipulates the Commercial Dedication Process for review.

GE Response

Q-DCIS hardware, embedded and operating system software, and peripheral components conform with the guidance of Branch Technical Position HICB-18. Q-DCIS is built and qualified specifically for ESBWR applications as safety-related and not as commercial grade programmable logic controllers (PLCs). The embedded and operating system software meets the acceptance criteria contained in BTP HICB-14 (Revision 4), for safety-related applications per NEDE-33245P Revision 1 "Licensing Topical Report ESBWR - I&C Software Quality Assurance Plan (SQAP)."

No ITAAC is required since NEDE-33245P Revision 1 "Licensing Topical Report ESBWR - I&C Software Quality Assurance Plan (SQAP)" has already been submitted.

The compliance with Branch Technical Position HICB-18 is modified in DCD Subsections 7.2.1.12, 7.2.2.4.3, and 7.3.5.3.5 to document this guidance.

DCD Impact

DCD 26A6642AW Rev. 03
Changes to Chapter 7

Change to Subsection 7.2.1.12

BTP HICB-18: Guidance on Use of Programmable Logic Controllers in Digital Computer-based Instrumentation and Control Systems.

Q-DCIS hardware, embedded and operating system software, and peripheral components conform with the guidance of Branch Technical Position HICB-18. Q-DCIS is built and qualified specifically for ESBWR applications as safety-related and not as commercial grade programmable logic controllers (PLCs). The embedded and operating system

software meet the acceptance criteria contained in BTP HICB-14, for safety-related applications.

Change to Subsection 7.2.2.4.3

- BTP HICB-18 - Guidance of Use of Programmable Logic Controllers in Digital Computer-based Instrumentation and Control Systems

Q-DCIS hardware, embedded and operating system software, and peripheral components conform with the guidance of Branch Technical Position HICB-18. Q-DCIS is built and qualified specifically for ESBWR applications as safety-related and not as commercial grade programmable logic controllers (PLCs). The embedded and operating system software meet the acceptance criteria contained in BTP HICB-14, for safety-related applications.

Change to Subsection 7.3.5.3.5

- BTP-HICB-18 - Guidance on Use of in Digital Computer-based Instrumentation and Control Systems

Q-DCIS hardware, embedded and operating system software, and peripheral components conform with the guidance of Branch Technical Position HICB-18. Q-DCIS is built and qualified specifically for ESBWR applications as safety-related and not as commercial grade programmable logic controllers (PLCs). The embedded and operating system software meet the acceptance criteria contained in BTP HICB-14, for safety-related applications.

NRC RAI 7.2-50 S01

Response is unacceptable. Per the RAI, the staff is requesting an ITAAC for Commercially Dedicated PLCs and any other devices using commercially available software.

GEH Response

The GEH commercial dedication process for software is defined in the previously submitted (refer to MFN 07-384, July 24, 2007) NEDE-33245P Revision 2 "Licensing Topical Report ESBWR - I&C Software Quality Assurance Plan (SQAP)," and NEDE-33226P, Revision 2, "ESBWR I&C Software Management Plan (SMP)." These plans contain the requirements and provisions for the Quality Assurance processes to be followed for commercial dedication of software if utilized in PLCs or other components in safety-related Distributed Control and Information System (Q-DCIS) applications. Additionally, the SQAP addresses nonsafety-related N-DCIS software.

DCD Tier 2, Rev. 4, Section 7.1.1, states that the software for the Q-DCIS and N-DCIS are designed and developed in accordance with the software LTRs NEDE-33226P and NEDE-33245P.

DCD Tier 2, Rev. 4, Section 7.8.2.1, states that reliable software is implemented by ensuring that the quality of the design and requirements specification is controlled under the formal V&V program, which is discussed in the NEDE-33245P.

DCD Rev. 4, Tier 1, Table 3.2-1, provides the ITAAC for software development.

Because the SQAP and SMP are undergoing NRC review for approval within the ESBWR Design Certification scope, and a sufficient ITAAC exists, there is no need for an additional ITAAC for commercially dedicated PLCs or any other devices using commercially available software.

DCD Impact

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

For historical purposes, the original text of NRC RAI 7.9-6 and the GE response are included.

NRC RAI 7.9-6

Regulatory Guide 1.12, Revision 2 – 03/1997, provides guidance for instrumentation to be provided to monitor the earthquake severity. How is this regulatory guide addressed?

GE Response

DCD Tier 2 Section 3.7.4, Revision 3, presents the ESBWR seismic monitoring system conformance with the guidance of Regulatory Guide 1.12, Revision 2, dated March 1997.

NRC RAI 7.9-6 S01

Response is unacceptable. A mimic of the guidance for the possible alternates that the staff is to look for is not sufficient design information. The frequency range should be specifically identified as .2 to 50 Hz or specified by a computational technique, and that technique presented to the staff. If the design is not available, this should be identified as a future Design Certification submittal, ITAAC or COL item. Also, please address the battery characteristics, specific to the Section 4.1 of RG 1.12, in Section 3.7.4.

GE Response

The frequency range of the acceleration sensors used in the ESBWR seismic monitoring system is 0.2 to 50 Hz.

The DCD will be clarified to indicate that the design of the seismic monitoring equipment and instrumentation complies with RG 1.12. Specifically, the design requires sufficient battery capacity to sense and record 25 minutes of seismic motion over a 24-hour period and the battery charger is plugged into an N-DCIS UPS. The seismic monitoring equipment and instrumentation batteries are separate from the batteries that power the N-DCIS UPS described in DCD Tier 2, Subsections 8.1.5.2.2.2 and 7.1.4.

DCD/LTR Impact

DCD Tier 2, Subsections 3.7.4.2 and 3.7.4.2.1 will be revised as shown in the attached markup.

RAI 7.9-6 S01 DCD Markup

3.7.4.2 Location and Description of Instrumentation

The following instrumentation and associated equipment of a solid-state digital type are used to measure plant response to earthquake motion:

- triaxial time-history accelerograph (THA): one in the free field, three in the reactor building (RB) and two in the control building (CB);
- recording and playback equipment; and
- annunciators in the main control room.

The seismic instrumentation and equipment has sufficient battery capacity to sense and record 25 minutes of seismic motion over a 24-hour period. The associated battery charger is connected to a nonsafety-related DCIS (N-DCIS), uninterruptible power supply (see Subsection 7.1.4) in accordance with Regulatory Guide 1.12. Information on the installed instruments is kept and maintained at the plant site as part of pre-earthquake planning as required by Regulatory Guide 1.166.

3.7.4.2.1 Time-History Accelerographs

Time-history accelerographs produce a record of the time-varying acceleration at the sensor location. Each triaxial acceleration sensor unit contains three accelerometers mounted in an orthogonal array (two horizontal and one vertical). All acceleration units have their principal axes oriented and aligned with the building major axes used in development of the mathematical models for seismic analysis. The acceleration sensor for each THA has a dynamic range of 1000:1 zero to peak (i.e., 0.001 g to 1.0 g) and a frequency range between 0.2 Hz to 50 Hz.