GE-Hitachi Nuclear Energy Americas LLC

James C. Kinsey
Project Manager, ESBWR Licensing

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

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

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 96 Related to ESBWR Design Certification Application – RAI Number 7.1-48**

Enclosure 1 contains the GE-Hitachi Nuclear Energy (GEH) response to the subject NRC RAI transmitted via the referenced letter.

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

Sincerely,

/Kathy Sedney for

James C. Kinsey
Project Manager, ESBWR Licensing

D068

NRO

Reference:

1. MFN 07-231, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 96 Related to ESBWR Design Certification Application,* April 12, 2007

Enclosures:

1. MFN 07-458, Response to Portion of NRC Request for Additional Information Letter No. 96 Related to ESBWR Design Certification Application - RAI Number 7.1-48

cc: AE Cubbage USNRC (with enclosures)
RE Brown GEH/Wilmington (with enclosures)
GB Stramback GEH/San Jose (with enclosures)
eIV 0000-0072-8887

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Enclosure 1

Response to Portion of NRC Request for Additional Information Letter No. 96 Related to ESBWR Design Certification Application

RAI Number 7.1-48

NRC RAI 7.1-48

Update the DCD to address the plant-specific requirements identified in Section 5.2 of the NRC SER on Triconex Topical Report 7286-545-1-A,"Qualification Summary Report." By letter MFN 07-101, dated March 2, 2007, GE stated that GE intends to apply the Triconex architecture for the ESBWR ECCS/ESF function. Triconex Topical Report 7286-545-1-A, "Qualification Summary Report," March 8, 2002, is a generic requirements specification for qualifying a commercially available PLC for safety-related applications. Although this topical report was approved by NRC, the staff safety evaluation defines the basis for acceptance of the report. In the staff's SER section 5.2, 18 items were identified as plant-specific requirements. The DCD should address each of these requirements. Update the DCD Section 7.3 to demonstrate that the ESBWR design has satisfied all the plant-specific requirements identified in Section 5.2 of the NRC safety evaluation report (SER) on Triconex Topical Report 7286-545-1-A, "Qualification Summary Report." Appropriate ITAAC acceptance criteria should be proposed to verify the completion of these plant-specific requirements.

GEH Response

There are 18 plant-specific items identified in the NRC SER each addressed below.

Item #1: Qualification for Temperature and Humidity Conditions

Section 4.1.3.2 of this SE discusses the temperature and humidity conditions for which the Tricon PLC system is qualified. Licensees will be responsible for analysis of the plant-specific environment, and the determination that the Tricon PLC system is suitable for that particular plant usage.

DCD Tier 1, Item 1 of Table 2.2.13-1, "ITAAC for safety system logic and control (SSLC/ESF) system" addresses the basic configuration of the system. Section 1.2.2.1 of DCD Tier 1 defines the verifications for the basic configuration of the system as including temperature and humidity conditions [Subparagraph (3)]. DCD Tier 2, subsection 7.1.6.6.1.5 addresses the temperature and humidity conditions for qualification of Q-DCIS components.

Item #2: Qualification for Radiation Exposure Levels

Section 4.1.3.3 of this SE discusses the radiation exposure levels for which the Tricon PLC system is qualified. Licensees will be responsible for analysis of the plant-specific radiation environment, and the determination that the TRICON PLC system is suitable for that particular plant usage.

DCD Tier 1, Item 1 of Table 2.2.13-1, "ITAAC for safety system logic and control (SSLC/ESF) system" addresses the basic configuration of the system. Section 1.2.2.1 of DCD Tier 1 defines the verifications for the basic configuration of the system as including radiation effects [Subparagraph (3)]. DCD Tier 2, subsection 7.1.6.6.1.5 addresses the radiation conditions for qualification of Q-DCIS components.

Item #3: Qualification for Seismic levels

Section 4.1.3.4 of this SE discusses the seismic levels for which the Tricon PLC system is qualified. The staff found that the Tricon PLC system did not fully meet the guidance of EPRI TR-107330 for seismic requirements, and before using Tricon PLC system equipment in safety-related systems in a nuclear power plant, licensees must determine that the plant-specific seismic requirements are enveloped by the capabilities of the Tricon PLC system.

DCD Tier 1, Item 1 of Table 2.2.13-1, "ITAAC for safety system logic and control (SSLC/ESF) system" addresses the basic configuration of the system. Section 1.2.2.1 of DCD Tier 1 defines the verifications for the basic configuration of the system as including design basis dynamic loads [Subparagraph (2)]. DCD Tier 2, subsection 7.1.6.6.1.5 addresses the seismic qualification of Q-DCIS components.

Item #4: Qualification for EMI/RFI: Conducted or Radiated Emissions

Section 4.1.3.5 of this SE discusses the conducted or radiated EMI/RFI emissions or susceptibility for which the Tricon PLC system is qualified. Since the Tricon PLC system did not satisfy the guidance of EPRI TR-102323, it is the responsibility of the licensees to measure or otherwise determine the worst case EMI/RFI environment that would exist at the time the protective function provided by the Tricon PLC system would be required, and then to ensure that the conducted and radiated EMI/RFI emissions and susceptibility capabilities of the Tricon PLC system envelop this environment, and that the system will not affect surrounding equipment.

DCD Tier 2, subsection 7.1.6.6.1.5 addresses the EMC compatibility of Q-DCIS components. DCD Tier 2, subsection 7.1.3.2 addresses the EMI/RFI and EFT (surge) qualification of Q-DCIS components. DCD Tier 2, subsection 7.1.6.4 lists and discusses the specific regulatory requirements for EMI/RFI, and EFT qualification of Q-DCIS components. These design requirements are applied to the procurement of safety-related components in accordance with the GE Quality Assurance Plan (see DCD Chapter 17). A separate ITAAC to demonstrate design conformance with EMI/RFI is not proposed based on the assurance of the established design controls.

Item #5: Surge withstand capability

Section 4.1.3.6 of this SE discusses the surge withstand capabilities for which the Tricon PLC system is qualified. Licensees will be responsible for the analysis of the plant-specific surge environment, and the determination that the Tricon PLC system is suitable for that particular plant usage.

DCD Tier 2, subsection 7.1.3.2 addresses the EMI/RFI and EFT (surge) qualification of Q-DCIS components. DCD Tier 2, subsection 7.1.6.4 lists and discusses the specific regulatory requirements for EMI/RFI, and EFT qualification of Q-DCIS components. These design requirements are applied to the procurement of safety-related components in accordance with the GE Quality Assurance Plan (see DCD Chapter 17). A separate ITAAC to demonstrate design conformance with EMI/RFI is not proposed based on the assurance of the established design controls.

Item #6: Electrostatic Discharge (ESD) Withstand Capability

Section 4.1.3.7 of this SE discusses the ESD withstand capability, and the fact that the Tricon PLC system was not tested for this capability. Before installing and using the Tricon PLC system, licensees must have in place administrative or physical controls to ensure that no activity which would require opening the cabinet can take place while the Tricon PLC system is required to provide its protective function, unless the particular cabinet and all channels within that cabinet are placed in a trip or bypassed condition according to plant procedures. An alternative solution is for licensees to perform sufficient testing and analysis to demonstrate that the ESD withstand capability of the Tricon PLC system envelops the plant-specific requirements.

DCD Tier 2, Subsection 7.3.5.5, addressing the ESD withstand capability will be revised as shown.. This revision to the DCD is consistent with Triconex discussions of the ESD withstand capability of the Tricon PLC System with the NRC staff from a meeting dated 11/18/2004 (accession number ML043380096). With the imposition of these requirements, a separate ITAAC to demonstrate ESD withstand capability is not proposed.

Item #7: Safety-Related to Nonsafety-related Isolation from Credible Voltages

Section 4.1.3.8 of this SE discusses the Class 1E to non-1E isolation capabilities for which the Tricon PLC system is qualified. Licensees will be responsible for analysis of the plant-specific maximum credible applied voltages produced by non-1E interfaces, and for ensuring that this value is enveloped by the Tricon PLC system capacity, and that the Tricon PLC system is suitable for that particular plant usage.

MFN 07-402 provides DCD Tier 1 changes to reflect ITAAC for design conformance to IEEE Std. 603 in Table 2.2.15-2. ITAAC for Criterion 5.6, Independence addresses the design of the safety to non-safety isolation.

Item #8: Software Installation Plan Development

Section 4.2.2.5 of this SE discusses the software installation plan. The staff determined that the software installation plan is the responsibility of the licensee, and must be developed before the Tricon PLC system software can be used for safety-related applications in nuclear power plants.

The IPS software quality development plan complies with the Standard Review Plan, Branch Technical Position (BTP) 14, "Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Systems". The SIP is presented in NEDE-33226, "ESBWR I&C Software Management Plan," (SMP) submitted by MFN-07-384, dated July 24, 2007. For ITAAC, refer to DCD Tier 1, Table 3.2-1, Item 5.

Item #9: Software Maintenance Plan Development

Section 4.2.2.6 of this SE discusses the software maintenance plan. Although Triconex has an acceptable software maintenance plan, the staff determined that a plant-specific software maintenance plan is also required, and it is the responsibility of licensees to develop this software maintenance plan before the TRICON PLC system software can be used for safety-related applications in nuclear power plants.

Refer to ESBWR I&C SMP, NEDE –33226P issued to the NRC by MFN-07-384, dated July 24, 2007. The Software Operation and Maintenance Plan (SOMP) described in the SMP defines the software process and activities used to operate and maintain the software product during plant operation. For ITAAC, refer to DCD Tier 1, Table 3.2-1, Items 1 and 6.

Item #10: Software Operations Plan Development

Section 4.2.2.8 of this SE discusses the software operations plan. The staff determined that licensees will be required to develop a software operations plan before using the Tricon PLC system software for safety-related use in nuclear power plants.

Refer to ESBWR I&C SMP, NEDE –33226P issued to the NRC by MFN-07-384, dated July 24, 2007. The Software Operation and Maintenance Plan (SOMP) described in the SMP defines the software process and activities used to operate and maintain the software product during plant operation. For ITAAC, refer to DCD Tier 1, Table 3.2-1, Item 6.

Item #11: Software Safety Plan Development

Section 4.2.2.9 of this SE discusses the software safety plan. The staff determined that licensees will be required to develop a software safety plan before using the Tricon PLC system software for safety-related applications in nuclear power plants.

Refer to ESBWR I&C Software Quality Assurance Plan (SQAP) NEDE –33245P issued to the NRC by MFN-07-384, dated July 24, 2007. The SQAP contains the Software Safety Plan (SSP) description. For ITAAC, refer to DCD Tier 1, Table 3.2-1, Item 8.

Item #12: Software Verification and Validation

Section 4.2.2.10 of this SE discusses verification and validation. Although Triconex did not strictly follow guidelines of IEEE Std 1012, the staff determined that the combination of the internal Triconex review, the TÜV certification, and the review by MPR and ProDesCon provided acceptable verification and validation for software that is intended for safety-related use in nuclear power plants. However, the staff noted that a significant portion of its acceptance is predicated upon the independent review by TÜV-Rheinland, and licensees using any Tricon PLC system beyond Version 9.5.3 must ensure that similar or equivalent independent V&V is performed; without this, the Tricon PLC system will not be considered acceptable for safety-related use at nuclear power plants. Should licensees use future Tricon PLC systems beyond Version 9.5.3 which have not received TÜV-Rheinland certification, the staff will review the acceptability of the independent V&V during the plant-specific safety evaluation.

Refer to ESBWR I&C Software Quality Assurance Plan (SQAP) NEDE –33245P issued to the NRC by MFN-07-384, dated July 24, 2007. The SQAP contains the software verification and validation plan description. For ITAAC, refer to DCD Tier 1, Table 3.2-1, Item 9.

Item #13: Impact of Tristation 1131 Use of Tricon PLC Operability

Section 4.2.3 of this SE discusses the use of the TriStation 1131. Section 4.2.3 of this SE noted that the Triconex PLC system is designed such that the Tricon PLC system should not be connected to a TriStation PC during safety-related operation. The plant-specific procedures which ensure that the TriStation PC is not connected to the Tricon PLC system during safety-related operation will be reviewed by the staff during the plant-specific safety evaluation. In addition, the testing of the operational software produced by the TriStation 1131, and these test plans, procedures, and results will be reviewed by the staff during the plant-specific safety evaluation.

While the TRICON is performing safety-related functions, it will not be connected to the TriStation 1131 PC during normal operation. Refer to NEDE –33226P, "ESBWR I&C Software Management Plan," (SMP) issued to the NRC by MFN-07-384, dated July 24, 2007. The SOMP described in the SMP defines the process and activities used to operate and maintain the software product during plant operation. For ITAAC, refer to DCD Tier 1, Table 3.2-1, Item 6.

Item #14: Plant Specific Application Program

Section 4.2.4 of this SE discusses the application programs, which are inherently plant specific, and therefore are not included in the scope of this SE.

The Invensys software quality development plan complies with the Standard Review Plan, Branch Technical Position (BTP) 14, "Guidance on Software Reviews for Digital Computer-Based Instrumentation and Control Systems". The application software programmed for the SSLC/ESF and the associated test plans, procedures, and results will be governed by NEDE-33245P, "ESBWR - I&C Software Quality Assurance Plan (SQAP)." For ITAAC, refer to DCD Tier 1, Table 3.2-1, Item 3.

Item #15: Component Aging Analysis

Section 4.3.3 of this SE discusses the component aging analysis, which determined that the chassis power supplies and backup batteries are susceptible to significant, undetected aging mechanisms. Before installing Tricon PLC system equipment in a nuclear power plant, licensees must have procedures in place to ensure periodic replacement of these components.

Aging degradation of these components can be effectively addressed through periodic replacement prior to onset of significant loss of performance. Periodic preventive maintenance is an activity performed at regular intervals to preclude problems that could occur before the next preventive maintenance (PM) interval as discussed in subsection 17.4.9 of DCD, Tier 2, 26A6642BW, Rev. 3. For ITAAC, refer to Table 3.6-1.

Item #16: Response time Characteristics

Section 4.3.5 of this SE discusses the response time characteristics of the Tricon PLC system software safety plan. The staff determined that the actual response time for any particular system will depend upon the actual system configuration, and may vary significantly from simple to complex systems. The determination of the response time for the particular system intended for safety-related use for a particular plant application, and the determination that this response time satisfies the plant specific requirements in the accident analysis in Chapter 15 of the safety analysis report is the responsibility of the licensee.

The SSLC/ESF platform operating the ESBWR specific application will be tested during factory acceptance testing. The testing will specifically confirm required response times. There is no credible failure mode that can change the system response time. In addition, a DCIS or specific ECCS system preoperational test will be conducted to verify the ability to transmit and receive data from interfacing systems within specified response times and data rate requirements (see subsection 14.2.8.1.7). Also refer to the ESBWR SMP that contains a hardware/software specification description of the algorithms and functions too complex to be delineated in the logic diagrams, including response time requirements. For ITAAC, refer to DCD Tier 1, Table 3.2 1, Items 1 and 6.

Item #17: Diversity and Defense-in depth (D3)

Section 4.3.10 of this SE discusses diversity and defense-in-depth. A review of the differences between the Tricon PLC system and the non-safety control system implemented at a particular nuclear power plant, and the determination that plant specific required diversity and defense-in- depth continue to be maintained must be addressed in a plant-specific D-in-D&D evaluation.

This will be addressed by Licensing Topical Report NEDO 33251, "ESBWR I&C Defense-In-Depth and Diversity report," Revision1, (scheduled submittal August 31, 2007, as stated in MFN-07-265 dated June 1, 2007). The NEDO-33251 Revision1 update will include vendor-specific information for the SSLC/ESF platform. For ITAAC, refer to Table 2.2.14-1.

Item #18: Qualification Summary Report "Applications Guide" Recommendations

Triconex has made a number of determinations of items and criteria to be considered when applying the Tricon PLC system to a specific plant application. These are contained in the "Applications Guide," provided as Appendix B to the "Qualification Summary Report," Triconex document number 7286-545. A number of these are the same as those discussed above, but the "Applications Guide" goes beyond regulatory compliance to include good engineering practice and applications suitability determinations. It is expected that licensees intending to use the Tricon PLC system will consider each item in this guide, and document the appropriate decisions and required analysis.

This will be addressed by the LTR, "ESBWR SSLC/ESF platform application," Rev.0, that will be issued to the NRC by September 28, 2007 as stated in MFN-07-265, dated June 1, 2007.

DCD Impact

DCD subsection 7.3.5.5 will be revised as shown below:

7.3.5.5 *Instrumentation and Control Requirements*

...

The SSLC/ESF component design accommodates electrostatic discharge (ESD) withstand capability. Administrative controls ensure that the associated channel is bypassed prior to opening any system cabinet. Alternatively, administrative actions consistent with standard electronics ESD control practices are required prior to opening a cabinet. These practices implement manufacturer recommendations.

Logic and controls for SSLC/ESF are located on each divisional SSLC/ESF cabinet in the equipment room in the CB, with key controls and system operating status available on the operator interface section in the MCR. The SSLC/ESF controls are used infrequently. Such controls typically do not require operator action during plant operation or during accident or transient conditions, and mainly are used for test and maintenance purposes. However, conditions such as equipment failure, maintenance, or testing, may require the operator ~~manually to bypass a division of sensors or a division of trip logic. Under the bypass status, SSLC/ESF continues to run in automatic mode using the unaffected logic in the remaining divisions.~~to gain access to an SSLC/ESF cabinet. If required the affected division's sensors may be bypassed such that they do not provide trip inputs to other divisions, and the division can be disconnected from its actuators so that its logic remains functional. After maintenance or other access the affected division's diagnostics, self-testing, and actuator/sensor monitoring will confirm correct operation.