June 9, 2015

Mr. Jerald G. Head
Senior Vice President, Regulatory Affairs
GE Hitachi Nuclear Energy
3901 Castle Hayne Road MC A-18
Wilmington, NC 28401

SUBJECT: REQUEST FOR ADDITIONAL INFORMATION LETTER NUMBER 7 RELATED TO CHAPTER 8 FOR GE-HITACHI NUCLEAR ENERGY ADVANCED BOILING-WATER REACTOR DESIGN CERTIFICATION RULE RENEWAL APPLICATION

Dear Mr. Head:

By letter dated December 7, 2010, GE Hitachi Nuclear Energy submitted for approval an application to renew the Advanced Boiling-Water Reactor design certification rule pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52. The U.S. Nuclear Regulatory Commission (NRC) staff is performing a detailed review of this application to enable the staff to reach a conclusion on whether to grant the renewal application.

The NRC staff has identified that additional information is needed to continue portions of the review. The staff's request for additional information (RAI) is contained in the enclosure to this letter. You are requested to respond within 30 days of the date of this letter.

If changes are needed to the design control document, the staff requests that the RAI response include the proposed wording changes. If you have any questions or comments concerning this matter, I can be reached at 301-415-4093 or by e-mail at adrian.muniz@nrc.gov.

Sincerely,

/RA/

Adrian Muñiz, Project Manager
Licensing Branch 3
Division of New Reactor Licensing
Office of New Reactors

Docket No.: 052-45

eRAI Tracking Nos. 7865

Enclosure: Request for Additional Information

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ADAMS Accession No.: ML15154B692 **NRO-002**

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DATE	6//3/15			

***Approval captured electronically in the electronic RAI system. **via e-mail**

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Request for Additional Information 7
Issue Date: 06/03/2015
Application Title: GEH ABWR DC Renewal
Operating Company: GEH
Docket No. 52-045
Review Section: 08.02 - Offsite Power System
Application Section: section 8.2, 8.3

QUESTIONS

08.02-2

In Request for Additional Information (RAI) response dated August 29, 2014 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML14241A558), GE Hitachi Nuclear Energy, the applicant, discussed its response to RAI 08.02-1 concerning the recent operating experience that involved the loss of one of the three phases of the offsite power circuit (single-phase open circuit condition) at Byron Station and the loss of 2 phases at Forsmark, Sweden.

Based on the review of applicant's response, staff identified the following issues:

Enclosure 1, "Description of the Protection Design Features not included in DCD" states:

> This section explains the design features of the protective relays that provide for monitoring and alarms for detecting the loss of one or more phases or a ground in the electrical system at the UAT or RAT inputs and on the safety-related medium voltage busses and alarming in the Main Control Room so that operators can take manual action, as appropriate, and initiate corrective actions to address the loss of phase condition.

Enclosure 1, "Summary of Monitoring and Alarms Design Features" states:

> Because the ABWR offsite and onsite high and medium voltage circuits will be monitored and alarmed in the Main Control Room, operators can take manual action, as necessary, and initiate corrective actions to address a loss of phase condition.

Enclosure 2, DCD, Section 8.3.1.1.6.3, "Bus Protection" states:

> 6.9 kV bus incoming circuits have inverse time over-current, ground fault, bus differential and under-voltage protection. The under-voltage monitoring is responsive to all three phases. The monitoring is effective for both load shedding and emergency diesel start and protection of the safety-related bus loads for grounds and loss of one or more phases.

Based on the above, the staff determined that the applicant did not provide sufficient design information for staff to conclude that all open phase conditions (OPCs) would be automatically detected and alarmed in the main control room under all operating electrical system configurations and plant loading conditions. In addition, the applicant did not provide sufficient design information concerning the automatic protective features that would be provided to transfer the offsite power circuits to the 6.9 kV safety related buses Division I (E), Division II (F), and Division III (G) if they are functionally degraded due to open-phase conditions. Furthermore, the staff's review of operating reactor licensees' NRC Bulletin 2012-01, "Design Vulnerability in Electric Power System," responses and interactions with the industry representatives in various

public meetings revealed that undervoltage detection and protection schemes cannot detect all OPCs and mitigate the consequences of OPCs under all operating electrical system configurations and plant loading conditions.

Therefore, the applicant is requested to provide the design basis and ITAAC information in accordance with § 52.47, "Contents of applications; technical information," for the Electrical Engineering Branch staff to determine whether it meets the 10 CFR 50 Appendix A, GDC 17, "Electric power systems," requirements regarding the offsite power circuits and onsite electrical power distribution system to provide adequate capacity and capability in view of the design vulnerability identified in Bulletin 2012-01. The information should have sufficient details for the combined operating license applicants to complete the detailed design (e.g., location of relays) and analyses (e.g., setpoints) in final safety analysis report in accordance with §52.79, "Contents of applications; technical information." In addition, GEH is requested to provide the delineation of scope between the DCD and COL applicants in regards to the BL.

The NRC staff position for new reactors with active design safety features, reviewed under 10 CFR Part 50 and 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," the following criteria should be satisfied when evaluating OPCs:

a. The OPC should be automatically detected and alarmed in the main control room under all operating electrical system configurations and plant loading conditions. The detection circuits should be sensitive enough to identify OPCs under all operating electrical system configurations and plant loading conditions for which the offsite power supplies are required to be operable in accordance with plant technical specifications (TSs) and licensing basis for safe shutdown.

b. The detection circuit should minimize spurious indications for an operable offsite power source in the range of voltage perturbations such as switching surges, transformer inrush currents, load or generation variations, lightning strikes, etc., normally expected in the transmission system. If there is potential for OPCs on the high voltage and low voltage side of transformers and interconnecting onsite auxiliary power circuits, the OPCs) should be alarmed in the main control room for operators to take corrective action within reasonable time. Any connections not required to be evaluated, should be documented with adequate justification. In such cases, the consequences of not isolating the degraded power source immediately should be evaluated to demonstrate that any subsequent design bases conditions that require offsite power circuit (s) for safe shutdown do not create plant transients or abnormal operating conditions. Also, the alternate power source(s) can be connected to the safety related buses within in the time assumed in the accident analysis.

c. If offsite power circuit(s) is (are) functionally degraded due to open-phase conditions, and safe shutdown capability is not assured, then the safety related buses should be designed to be transferred automatically to the alternate reliable offsite power source or onsite standby power system within the time assumed in the accident analysis and without actuating any protective devices, given a concurrent design basis event.

d. The design of protection features for open-phase conditions should address the following:

    (i) Power quality issues caused by OPCs such as unbalanced voltages and currents, sequence voltages and currents, phase angle shifts, and harmonic

distortion that could affect Class 1E safety-related buses. The Class 1E loads should not be subjected to power quality conditions specified in industry standards such as Institute of Electrical and Electronic Engineers (IEEE) Standard (Std) 308-2001, "Criteria for Class 1E Power Systems for Nuclear Power Generating Stations," Section 4.5, "Power Quality," with respect to the design and operation of electrical systems as indicated in Regulatory Guide (RG) 1.32 "Criteria for Power Systems for Nuclear Plants."

(ii) Protection scheme should comply with applicable requirements including single failure criteria for Class 1E safety-related systems as specified in 10 CFR Part 50, Appendix A, GDC17 and 10 CFR 50.55a(h)(3) derived from IEEE Std 603-1991," Standard Criteria for Safety Systems for Nuclear Power Generating Stations, as endorsed by RG 1.153, "Criteria for Power, Instrumentation, and Control Portions of Safety Systems."

Questions:

a. Explain the design features that would be provided for the OPCs to be automatically detected and alarmed in the main control room under all operating electrical system configurations and plant loading conditions.

b. Describe the design features that would be provided in the event that offsite power circuit(s) is (are) functionally degraded due to open-phase conditions, and safe shutdown capability is not assured, then the safety related buses should be designed to be transferred automatically to the alternate reliable offsite power source or onsite standby power system within the time assumed in the accident analysis and without actuating any protective devices, given a concurrent design basis event.

c. Provide an ITAAC that demonstrates and verifies the following, including setpoints:

· Monitoring/detecting/Alarming in the control room in the event of the OPCs

· Automatically separates the Class 1E safety-related buses from the off-site power source and transfers safety-related loads to the unaffected offsite power source or the emergency diesel generators.