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Subject: Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application, RAI Numbers 14.3-284, 14.3-303, 14.3-305, 14.3-312

The purpose of this letter is to submit the GE Hitachi Nuclear (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).

The GEH response to RAI Numbers 14.3-284, 14.3-303, 14.3-305, and 14.3-312 is addressed in Enclosure 1. The enclosed changes will be incorporated in the upcoming DCD Revision 5 submittal.

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 RAI Numbers 14.3-284, 14.3-303, 14.3-305, 14.3-312

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	0000-0080-7237 (RAI 14.3-284)
	0000-0080-4821 (RAI 14.3-303, 14.3-312)
	0000-0082-7602 (RAI 14.3-305)

Enclosure 1

MFN 08-086 Supplement 27

Response to Portion of NRC Request for

Additional Information Letter No. 126

Related to ESBWR Design Certification Application

RAI Numbers 14.3-284, 14.3-303, 14.3-305, 14.3-312

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 14.3-284

NRC Summary:

Each valve

NRC Full Text:

Section 2.1.2, Nuclear Boiler System, Design Description (10): For clarity, the staff requests the applicant to reword to say "Each pneumatically operated valve..." rather than "The ...valve(s)..."

Clarify whether all valves fail at once if there are multiple valves?

GEH Response

DCD Tier 1, Revision 4, Section 2.1.2, Design Description (10) with its corresponding ITAAC is one of the generic standard ITAAC that was included as part of the Tier 1 upgrade effort for Revision 4. Subsequent evaluation and review of Section 2.1.2 reveals that the operation of the valves shown in Figure 2.1.2-1 is adequately covered (including the fail-safe position) by the following:

- Design Description (15) and (16) for Main Steam Isolation Valves and
- Design Description (23) for Safety Relief Valves.

The generic standard Design Description with its corresponding ITAAC was inadvertently included in Section 2.1.2. Since the function of NBS valves is adequately covered elsewhere, Design Description (10) will be removed from Section 2.1.2. The GEH response to RAI 14.3-305 (included in this letter) addresses the removal of the corresponding ITAAC (10) in Table 2.1.2-3.

Adequate redundancy exists in the ESBWR design to ensure safety is not compromised. The failure modes and effects analyses for pneumatically operated valves assumes that each valve will fail to its safe position regardless of the number of valves that fail. Where multiple NBS valves are designed to perform the same safety-related action and to perform the actions simultaneously (for example, the MSIVs protective features), then such valves will fail at once to their safe position.

DCD Impact

DCD Tier 1 Section 2.1.2 (10) will be deleted as noted in the attached markup.

(7) Each mechanical train of safety-related NBS equipment located in the Reactor Building outside the drywell is physically separated from the other trains.

(8) ~~Instrumentation and Control~~Isolation Capability

a. The MSIVs close upon command

b. The FWIVs close upon command

~~a.~~c. NBS minimum inventory of alarms, displays, and status indications in the main control room are addressed in section 3.3~~Control Room alarms, displays, and/or controls provided for the NBS are defined in Table 2.1.2-2.~~

~~b.The MSIVs close upon any of the following conditions:~~

~~-Main Condenser Vacuum Low (Run mode)~~

~~-Turbine Area Ambient Temperature High~~

~~-MSL Tunnel Ambient Temperature High~~

~~-MSL Flow Rate High~~

~~-Turbine Inlet Pressure Low~~

~~-Reactor Water Level Low~~

(9) ~~Repositional~~ Repositionable valves (not including the DPVs (squib-activiated valves) or safety/relief valves) designated in Table 2.1.2-2 as having an active safety-related function open, close, or both open and also close under ~~design~~ differential pressure, fluid flow, and temperature conditions.

(10) ~~The pneumatically operated valve(s) shown in Figure 2.1.2-2 closes (opens) if either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost.~~Deleted

(11) Check valves designated in Table 2.1.2-1 as having an active safety-related function open, close, or both open and also close under ~~design~~ system pressure, fluid flow, and temperature conditions.

(12) The throat diameter of each MSL flow restrictor is sized for design choke flow requirements.

(13) Each MSL flow restrictor has taps for two instrument connections to be used for monitoring the flow through ~~each~~ its associated MSL.

(14) The combined steamline volume from the RPV to the main steam turbine stop valves and steam bypass valves is sufficient to meet the assumptions for AOOs and infrequent events.

(15) The MSIVs are capable of fast closing under design differential pressure, fluid flow and temperature conditions.

(16) When all four inboard or outboard MSIVs are stroked from a full-open to full-closed position by their actuators~~closed by normal means~~, the combined leakage through the MSIVs for all four MSLs will be less than or equal to the design bases assumption value.

NRC RAI 14.3-303

NRC Summary:

Can be retrieved

NRC Full Text:

In ITAAC Table 2.1.2-3, the staff requests that the applicant clarify the meaning of the phrase "can be verified" in the acceptance criteria for ITAAC #8. Usage of this phrase is awkward with respect to alarms, displays and controls.

Also, the intent of "and/or" should be specified (i.e., is it "and" or "or", can't be both) and its specific usage terminated for ITAAC.

GEH Response

GEH has revised ITAAC Table 2.1.2-3 to clarify the ITAAC confirmation process for the MSIVs and other valves in the Nuclear Boiler System. The term "can be retrieved" and the term "and/or" is not used in the revised requirements. The GEH response to RAI 14.3-302 (MFN 08-086 Supplement 10, dated March 7, 2008) and RAI 14.3-246 (MFN 08-086 Supplement 22, dated April 3, 2008) identify the scope of the changes to ITAAC #8. RAI 14.3-246 removes the terms "can be retrieved" and the term "and/or" from the revised ITAAC 8(c).

GEH agrees that the ITAAC should be as clear and as definitive as possible to minimize any potential issues when, for example, a licensee is preparing to perform and close the ITAAC during plant construction. GEH has made a concerted effort to prepare the ITAAC with this goal in mind. Nevertheless, in some cases, it is inappropriate to limit a COL applicant's selection of ITAAC verification methods since the procedures to perform the ITAAC have not yet been developed.

GEH would prefer to retain the use of "and/or" in certain ITAAC so as not to unduly restrict future licensees from performing the ITAAC in the most comprehensive, efficient, and technically sound manner.

GEH reviews of NRC regulations and guidance has determined the usage of *and/or* is in compliance with applicable requirements and guidance. Those requirements do not mandate the use of one or the other term and do not restrict the use of *and/or*. The style guidelines for developing ITAAC allow for flexibility in selection of inspections, tests, and analyses to be used in establishing compliance with ITAAC obligations.

For example, NUREG 0800, Chapter 14, Section 14.3, in the "ITAAC Entries – Examples" for standard ITAAC, specifically identifies examples where the ITAAC should include usage of the term *and/or*. A specific example for applicants to use when establishing physical separation

requirements (reference page 14.3-59) is identified. The use of *and/or* is common practice in the Part 52 design certification process. The term *and/or* is used in both the AP-1000 DCD and the ABWR DCD, meaning either or both of the requirements identified may be used to confirm ITAAC compliance. GEH used the term *and/or* during the development of ITAAC to permit a limited amount of flexibility in confirming compliance with the requirements of Tier 1 and the ITAAC acceptance criteria. When a licensee performs the ITAAC, it will determine the most appropriate manner in which to accomplish the test, inspection, or analysis to demonstrate that the acceptance criteria are met and will identify the methods used in the ITAAC closure letter.

In summary, "and/or" is a term with specific meaning in the context of a legal requirement, such as in Tier 1. It allows the user to select from the alternatives or to use a combination of alternatives. In this manner, the licensee may prepare the procedure for performing ITAAC to ensure that the acceptance criteria are demonstrated. It minimizes the need for a departure or exemption by recognizing, for those limited few ITAAC, that a test, inspection, or analysis, or a combination of these may be necessary.

DCD Impact

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

NRC RAI 14.3-305

NRC Summary:

Pneumatically operated valves

NRC Full Text:

In ITAAC Table 2.1.2-3, for clarity in ITAAC #10, the staff requests that the applicant consider the following language for the DC: "Each pneumatically operated valve shown in Figure 2.1.2-2 closes or opens to its identified position if either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve is lost."

Likewise, the AC could be reworded to be consistent with the DC:

"Report(s) document that each pneumatically operated valve shown in Table 2.1.2-2 closes or opens to its identified position when either electric power to the valve actuating solenoid valve is lost, or pneumatic pressure to the valve is lost." Also, the staff requests clarification as to whether the report is required or its contents specified by an IEEE standard. If so, please identify.

The staff requests that the ITA for this ITAAC include more specificity with respect to testing. Is it with actual signals, simulated signals, just the valves, the entire circuit, etc.?

GEH Response

GEH reviews reveal that ITAAC #10 is one of the generic standard ITAAC that was included as part of the Tier 1 upgrade effort for DCD Revision 4. Additional evaluation and review of Section 2.1.2 determined that the operation of the valves shown in Figure 2.1.2-1 is adequately covered (including the fail-safe position) by:

- ITAAC #15 and #16 for Main Steam Isolation Valves and
- ITAAC #23 for Safety Relief Valves.

The generic standard ITAAC was inadvertently included in Section 2.1.2; and is not necessary. Since the function of NBS valves is adequately covered elsewhere, ITAAC #10 will be removed from Table 2.1.2-3. The GEH response to RAI 14.3-284 (included in this letter) provides for the removal of the corresponding Design Description in Section 2.1.2.

The report(s) mentioned in DCD Tier 1, Revision 4, Table 2.1.2-3, ITAAC #10, Acceptance Criteria is not required to comply with any IEEE standard; rather, it is the ITAAC closure report(s) that documents completion of the ITAAC activity and verifies that the acceptance criteria are met.

DCD Impact

DCD Table 2.1.2-3 will be revised as shown in the attached markup.

Table 2.1.2-3

ITAAC For The Nuclear Boiler System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10 ~~The pneumatically operated valve(s) shown in Figure 2.1.2-2 closes (opens) if either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost.~~Deleted	~~Tests will be conducted on the as-built valve(s).~~Deleted	~~Report(s) document that the pneumatically operated valve(s) shown in Figure 2.1.2-2 closes (opens) when either electric power to the valve actuating solenoid is lost, or pneumatic pressure to the valve(s) is lost.~~Deleted
11. Check valves designated in Table 2.1.2-1 as having an active safety-related function open, close, or both open and also close under ~~design~~ system pressure, fluid flow, and temperature conditions.	Tests of installed valves for opening, closing, or both opening and also closing, will be conducted under system preoperational pressure, fluid flow, and temperature conditions.	Report(s) document that, based on the direction of the differential pressure across the valve, each CV opens, closes, or both opens and also closes, depending upon the valve's safety functions.
12. The throat diameter of each MSL flow restrictor is sized for design choke flow requirements.	Inspections of ~~the~~ ~~each~~ as-built MSL flow restrictor throat diameter will be performed ~~and measurements taken~~	Report(s) document that the throat diameter of each MSL flow restrictor is less than or equal to 355 mm (14 in.).
13. Each MSL flow restrictor has taps for two instrument connections to be used for monitoring the flow through ~~each~~ its associated MSL.	Inspections of the as-built installation of the MSL flow restrictor will be conducted to verify that it provides for two instrument connections.	Report(s) document that the as-built MSL flow restrictor provides for two instrument connections.
14. The combined steamline volume from the RPV to the main steam turbine stop valves and steam bypass valves is sufficient to meet the assumptions for AOOs and infrequent events.	Analyses/calculations will be performed using the as-built dimensions of the steamlines to determine the combined steam line volume. The calculational results will be documented in a report.	Report(s) document that the combined steamline volume is greater than or equal to 135 m^3 (4767 ft^3).

NRC RAI 14.3-312

NRC Summary:

SRV open time

NRC Full Text:

In ITAAC Table 2.1.2-3, for clarity in ITAAC #18, the staff requests that the applicant consider the following wording for the DC: "In the overpressure operation of self-actuated or mechanical lift mode, the time from when the pressure exceeds the SRV lift setting pressure to when the SRV is fully open shall be less than or equal to the design opening time."

In addition, the AC would be more clear as follows: "Report(s) exist and conclude that tests and analyses demonstrate that opening time for the SRVs...."

GEH Response

The response to this RAI was discussed in a telcon with the NRC staff on March 27, 2008. GEH agrees with the NRC request to provide clarification to the ITAAC #18 in Table 2.1.2-3.

RAIs 14.3-312, 14.3-290, and 14.3-346 are linked to the same ITAAC requirements in Table 2.1.2-3. ITAAC 18 was also revised by the GEH response to RAI 14.3-290 and 14.3-346 (MFN 08-086, dated February 6, 2008). The response to RAI 14.3-312 supercedes the GEH response to RAI 14.3-290 and 14.3-346.

The GEH response to RAI 14.3-312 represents the cumulative scope of changes to Table 2.1.2-3, ITAAC 18, that will be included in Revision 5 to the ESBWR DCD.

DCD Impact

DCD Tier 1, Section 2.1.2, Item 18, and Table 2.1.2-3, Item 18, will be revised as noted in the attached markup.

(17) The opening pressure for the SRVs mechanical lift mode satisfies the overpressure protection analysis.

(18) The opening time for the SRVs in the overpressure operation of self-actuated or mechanical lift mode, which is measured from when the pressure exceeds the valve set pressure to when the valve is fully open, shall be less than or equal to the design opening time. ~~The opening time for the SRVs (in the overpressure operation of self-actuated or mechanical lift mode) is measured from when the pressure exceeds the valve set pressure to when the valve is fully open shall be less than or equal to the design opening time.~~

(19) The steam discharge capacity of each SRV satisfies (i.e., is greater than or equal to that used in) the overpressure protection analysis.

(20) The opening pressure for the SVs satisfies (i.e., is less than or equal to that used in) the overpressure protection analysis.

(21) The opening time for the SVs is measured from when the pressure exceeds the valve set pressure to when the valve is fully open shall be less than or equal to the design opening time.

(22) The steam discharge capacity of each SV satisfies (i.e., is greater than or equal to that used in) the overpressure protection analysis.

(23) The relief-mode actuator (and safety-related appurtenances) can open each SRV with the drywell pressure at design pressure.

(24) When actuated by an ~~initiator~~(igniter charge), the booster assembly opens each DPV in less than or equal to the design opening time (opening time to full rated capacity)~~and design conditions~~.

(25) Each DPV minimum flow capacity is sufficient to support rapid depressurization of the RPV (i.e., has a flow capacity that is greater than or equal to the design flow capacity under design basis conditions).

(26) The equipment qualification of the NBS components is addressed in Tier 1, Section 3.8.

(27) The containment isolation portions of the NBS are addressed in Tier 1, Subsection 2.15.1.

(28) Vacuum breakers are provided on SRV discharge lines to reduce the post-discharge reflood height of water in the discharge lines.

(29) The SRV discharge line (SRVDL) vacuum breakers close to prevent steam bypass to the drywell during SRV discharge, and open following a discharge completion to permit pressure equalization with the drywell and prevent ingestion of a water slug into the SRVDL.

(30) The pressure loss coefficient of each of the following components is within the uncertainty band of the pressure loss coefficient used in the natural circulation flow analysis

- Steam separator
- Fuel bundle
- Fuel support piece orifice
- Control rod guide tubes
- Shroud support

Table 2.1.2-3

ITAAC For The Nuclear Boiler System

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
18. The opening time for the SRVs ~~(~~in the overpressure operation of self-actuated or mechanical lift mode~~, which)~~ is measured from when the pressure exceeds the valve set pressure to when the valve is fully open, shall be less than or equal to the design opening time.	Analysis and type tests ~~(at a test facility)~~ will be conducted in accordance with the ASME Code to ensure that the valves open within the design opening time.	Report(s) document that tests and analyses exist and conclude that opening time measured for the SRVs ~~(~~in the overpressure operation of self-actuated or mechanical lift mode~~), which~~ is ~~from when the pressure exceeds the valve set pressure to when the valve is fully open, for the overpressure operation mode is~~ less than or equal to 0.5 second.
19. The steam discharge capacity of each SRV satisfies (i.e., is greater than or equal to that used in) the overpressure protection analysis.	Type tests (at a facility) will be conducted in accordance with the ASME Code for relief valve certification.	Report(s) document that valve capacity stamping on each SRV records the certified capacity at rated setpoint of 138 kg/s (304 lbm/s) minimum.
20. The opening pressure for the SVs satisfies (i.e. is less than or equal to that used in) the overpressure protection analysis.	Type tests (at a facility) or setpoint tests will be conducted in accordance with the ASME Code to certify the valve.	Report(s) document that testing/type testing verifies the mechanical lift nominal setpoint pressure of 8.503 $\pm$ 0.255 MPa gauge (1233 $\pm$ 36.99 psig).
21. The opening time for the SVs is measured from when the pressure exceeds the valve set pressure to when the valve is fully open shall be less than or equal to the design opening time.	Analysis and type tests (at a test facility) will be conducted in accordance with the ASME Code to ensure that the valves open within the design opening time.	Report(s) document that tests and analyses exist and conclude that opening time for the SVs is less than or equal to 0.5 seconds.
22. The steam discharge capacity of each SV satisfies (i.e., is greater than or equal to that used in) the overpressure protection analysis.	Type tests (at a facility) will be conducted in accordance with the ASME Code for relief valve certification.	Report(s) document that valve capacity stamping on each SV records the certified capacity at rated setpoint of 140.2 kg/s (309 lbm/s) minimum.