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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application ESBWR RAI Numbers 14.3-317**

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 letter dated December 20, 2007 (Reference 1).

Enclosure 1 contains the GEH response to each of the subject RAIs. 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
Reference:

D068
NRO

1. MFN 07-718, Letter from U.S. Nuclear Regulatory Commission to James C. Kinsey, GEH, *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 DCD Tier 1 RAI Number 14.3-317

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)
	eDRFSection	0000-0082-4208 R1

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Enclosure 1

Response to Portion of NRC Request for Additional Information Letter No. 126 Related to ESBWR Design Certification Application RAI Numbers 14.3-317

***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 14.3-317

NRC Summary:

TMSS turbine inlet throttle pressure

NRC Full Text:

In Table 2.11.1-1, For ITAAC #7, AC and generic usage throughout the ITAAC: The staff requests that the applicant provide a discussion of their use of bracketed information? Is this information intended to be subject to revision by the COL holder based on procurement of equipment or is it meant to be a bounding value or Tech Spec value?

See also Table 2.11.2-1, ITAAC #2, 3, and 4.

GEH Response

The bracketed values were bracketed to denote estimated analysis input values that may be subject to change during the detailed design process. The bracketed ITA Acceptance Criteria values of Table 2.11.2-1 have been evaluated and the brackets shall be removed with the values shown on the attached markup.

Table 2.11.1-1 ITAAC #7 regarding nominal turbine inlet pressure has been changed to ITAAC #8 due to the insertion of new ITAAC #7 by GEH in response to RAI 10.2-27 (MFN 08-210, dated March 6, 2008).

Due to design optimization of the main steamlines the assumed pressure drop is reduced to a value below that previously assumed in anticipated operational occurrences and infrequent events (AOO) analysis. This requires reanalysis of those AOOs sensitive to these changes. According to NEDE-33083P, TRACG Application for ESBWR Transient Analysis, the limiting main steam parameters relating to pressurization transients are RPV to turbine stop valve pressure drop, main steam system volume and steamline length. The attached revisions to DCD Tier 2 Revision 4 Chapter 15 reflect changes to anticipated operational occurrence and infrequent event analysis inputs required to support steamline optimization. Existing steamline input is not removed because not all analyses will use the updated inputs related to steamline optimization. The DCD changes related to the results of Abnormal Events analysis required by these input changes are not directly related to the requested information, but will be provided in Revision 5.

The design commitment 2.11.1(8) is being changed to ensure TMSS is designed and built to ensure consistency with the assumptions made in the Abnormal Events analyses. DCD Tier 2, Chapter 15 Table 15.2-1 is revised to document these main steam system parameters and their assumed values.

Main steam system volume is also addressed in Tier 1 Table 2.1.2-3 "ITAAC For The Nuclear Boiler System" design commitment 14. The inspection and acceptance criterion for main steam system volume in Table 2.1.2-3 are changed to reference Tier 1 Table 2.11.1-1 line item 8 to make it consistent with the new Tier 2 Table 15.2-1.

DCD Tier 1 and Tier 2 Chapter 15 will be revised per the attached markups.

DCD Impact

DCD Tier 1, Table 2.1.2-3, Subsection 2.11.1, Table 2.11.1-1 and Table 2.11.2-1 will be revised as shown on the attached markups.

DCD Tier 2, Chapter 15, Table 15.2-1 will be revised as shown on the attached markup.

Attachment 1

DCD Revision 5 Tier 1 Markups

Table 2.1.2-3 ITAAC For The Nuclear Boiler System

Section 2.11.1-1 Turbine Main Steam System

Table 2.11.1-1 Turbine Main Steam System ITAAC

Table 2.11.2-1 Condensate and Feedwater System ITAAC

DCD Tier 2

Table 15.2-1 Input Parameters, Initial Conditions and Assumptions used in AOO and Infrequent Event Analyses

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.~~See Table 2.11.1-1, Item 8.	~~Report(s) document that the combined steamline volume is greater than or equal to 135 m^3 (4767 ft^3).~~See Table 2.11.1-1, Item 8.

2.11 POWER CYCLE

The following subsections describe the major power cycle (i.e., generation) systems for the ESBWR.

2.11.1 Turbine Main Steam System

Design Description

The Turbine Main Steam System (TMSS) supplies steam generated in the reactor to the Turbine Generator, moisture separator reheaters, steam auxiliaries and turbine bypass system. The TMSS does not include the seismic interface restraint, main turbine stop valves or bypass valves.

The TMSS consists of four lines from the seismic interface restraint to the main turbine stop valves. The TMSS is nonsafety-related. Regulatory Guide 1.26 Quality Group B portions of the TMSS are designed in accordance with ASME Boiler and Pressure Vessel Code, Section III, Class 2 requirements. The TMSS is located in the Reactor Building steam tunnel and Turbine Building.

(1) The functional arrangement of the TMSS is as described in Subsection 2.11.1.

(2) The ASME Code Section III components of the TMSS retain their pressure boundary integrity under internal pressures that will be experienced during serviceat their design pressure.

(3) Upon receipt of an MSIV closure signal, the SAIV(s) close(s)and required MSIV fission product leakage path TMSS drain valve(s) open(s).

(4) The SAIV(s) fail(s) closed and required MSIV fission product leakage path TMSS drain valve(s) fail(s) open on loss of electrical power to the valve actuating solenoid or on loss of pneumatic pressure.

(5) TMSS piping, which consists of the piping (including supports) for the MSL from the seismic interface restraint (or seismic guide) to the turbine stop valves (non-inclusive), turbine bypass valves (non-inclusive) and the connecting branch lines 6.35 cm. (2.5 in.) and larger up to and including the first isolation valve which is either normally closed or capable of automatic closure during all modes of normal reactor operationincluding the SAIV(s) from the seismic interface restraint to the main stop and main turbine bypass valves and the required MSIV fission product leakage path, is classified as Seismic Category II.

(6) The integrity of the as-built main steam valveMSIV leakage path to the condenser (main steam piping, bypass piping, required drain piping, and main condenser) is not compromised by non-seismically designed systems, structures and components.

(7) The non-seismic portion of the MSIV leakage path to the condenser (main steam piping from the stop valve (inclusive) to turbine nozzle, bypass piping, required drain piping, and main condenser) maintains structural integrity under SSE loading conditions.

(7)(8)The TMSS piping is sized to ensure that reactor pressure vessel (RPV) dome to turbine stop valve pressure drop, total main steam system volume, and steamline length are

~~provides a nominal turbine inlet (throttle) pressure that is~~ consistent with assumptions in Abnormal Event analyses.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.11.1-1 provides a definition of the inspections, tests, and/or analyses, together with associated acceptance criteria for the TMSS.

Table 2.11.1-1

Turbine Main Steam System ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. The non-seismic portion of the MSIV leakage path to the condenser (main steam piping from the stop valve (inclusive) to turbine nozzle, bypass piping, required drain piping, and main condenser) maintains structural integrity under SSE loading conditions	An analysis of the as-built non-seismic portion of the MSIV leakage path to the condenser will be performed to verify that it maintains structural integrity under SSE loading conditions.	A report exists and demonstrates that the as-built non-seismic portion of the MSIV leakage path to the condenser (main steam piping from the stop valve (inclusive) to turbine nozzle, bypass piping, required drain piping, and main condenser) maintains structural integrity under SSE loading conditions.
78. The TMSS piping is sized to ensure that RPV dome to turbine stop valve pressure drop, total main steam system volume, and steamline length areprovides a nominal turbine inlet (throttle) pressure that is consistent with assumptions in Abnormal Event analyses.	Inspection and/or analysis of the as-built TMSS piping will be performed to confirm RPV to turbine calculated pressure drop, total main steam system volume, and steamline length are consistent with assumptions in Abnormal Events analyses.the nominal turbine inlet (throttle) pressure.	A report exists and concludes that the TMSS piping is sized to be consistent with these Abnormal Events analyses inputs: a) Minimum Steamline Pressure Drop from RPV Dome to Turbine Throttle: 0.146 MPa (21.2 psi) b) Minimum Main Steam System Volume: 103.3 m^3 (3648 ft^3) c) Minimum Steamline Length: 65.26 m (214.1 ft) provides a nominal turbine inlet (throttle) pressure of [6.57 MPaG (953 psig)].

Table 2.11.2-1

Condensate and Feedwater System ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1. The functional arrangement of the C&FS is as described in Subsection 2.11.2.	Inspections of the as-built system will be conducted to confirm the functional arrangement.	A report exists and documents that the as-built C&FS conforms to the functional arrangement described in Subsection 2.11.2
2. The C&FS provides sufficient feedwater flow and volume to mitigate Abnormal Events.	An analysis and/or type testing of the as-built C&FS and feedwater pumps will be performed to confirm the minimum capacity of three feedwater pumps.	A report exists and concludes that three operating feedwater pumps are capable of supplying {135%} of the rated feedwater flow at {7.34 MPa gauge (1065 psig)}.
3. The C&FS limits maximum feedwater flow to mitigate Abnormal Events.	Analysis and/or type testing of the as-built C&FS and feedwater pumps will be performed to confirm that the C&FS limits maximum feedwater flow.	A report exists and concludes that the maximum capacity of three feedwater pumps at {7.34 MPa gauge (1065 psig)} is less than or equal to {155%} of rated feedwater flow.
4. The C&FS, in conjunction with the feedwater control system, provides sufficient feedwater flow after MSIV isolation to mitigate Abnormal Events.	Inspection and/or analysis of the as-built feedwater system will be performed to confirm that the C&FS provides sufficient feedwater flow after MSIV isolation.	A report exists and concludes that the C&FS, in conjunction with the feedwater control system, provides feedwater flow greater than or equal to {240 seconds} of rated feedwater flow after MSIV isolation.

Table 2.11.2-1

Condensate and Feedwater System ITAAC

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The C&FS, in conjunction with the feedwater control system, limits the maximum feedwater flow for a single pump following a single active component failure or operator error to mitigate Abnormal Events.	Testing and/or analysis of the as-built C&FS and feedwater pumps and/or type testing of a single feedwater pump will be performed to confirm that the C&FS limits the maximum feedwater flow from a single pump.	A report exists and concludes that the C&FS, in conjunction with the feedwater control system, limits the maximum feedwater flow for a single pump to {75%} of rated flow following a single active component failure or operator error.
6. The C&FS, in conjunction with the feedwater control system, is designed so that the loss of feedwater heating is limited in the event of a single operator error or equipment failure.	Inspection and/or analysis of the as-built feedwater system will be performed to confirm that the C&FS, in conjunction with the feedwater control system, limits the loss of feedwater heating in the event of a single operator error or equipment failure.	A report exists and documents that the C&FS, in conjunction with the feedwater control system, is designed so that the loss of feedwater heating is limited to a final feedwater temperature reduction less than or equal to {55.6°C (100°F)} in the event of a single operator error or equipment failure.
7. The C&FS, in conjunction with other Power Cycle Systems, provides a nominal full load final feedwater temperature that is consistent with assumptions in Abnormal Event analyses.	Inspection and/or analysis of the as-built feedwater system and other Power Cycle Systems will be performed to confirm the final nominal feedwater temperature.	A report exists and concludes that the C&FS, in conjunction with other Power Cycle Systems, provides a nominal full load final feedwater temperature of {216°C (420°F)}.
8. The C&FS has a nominal feedwater flow rate at rated conditions that is consistent with inputs and assumptions in Abnormal Event analyses.	Testing and/or analysis of the as-built C&FS and feedwater pumps and/or type testing of a single feedwater pump will be performed to confirm the nominal feedwater flow rate at rated conditions.	A report exists and concludes that the C&FS has a nominal feedwater flow rate at rated conditions of {2429 kg/s (19.3×10^6 lb/hr)}.

Table 15.2-1

Input Parameters, Initial Conditions and Assumptions used in AOO and Infrequent Event Analyses

Parameter	Value
Total Delay Time from TSV or TCV to 80% of Total BPV Capacity	0.17
TCV Closure Times, s Fast Closure Analysis Value (Bounding) Assumed Minimum Servo (Slow) Closure Analysis Value	 0.08 2.5
TSV Closure Times, s	0.100
% of Rated Steam Flow that can pass through 3 Turbine Control Valves	85 (Partial Arc)
Minimum Steamline Pressure Difference Between the Vessel Dome Pressure and the Turbine Throttle Pressure, MPa (psi)Inlet Pressure, MPaG (psig)(2)	6.570.146 (95321.2)
Fuel Lattice	N
Core Leakage Flow, % (1)	9.4
MCPR Operating Limit	1.30
Control Rod Drive Position versus Time	Table 15.2-2 & 3
Core Design used in TRACG Simulations Exposure:	Reference 15.2-2 Middle of Cycle and End of Cycle
Safety Relief Valve (SRV) and Safety Valve (SV) capacity, %NBR (103% accumulation)(31) At design pressure, MPaG (psig) Quantity InstalledNumber of SRVs Number of SVs	89.5 8.618 (1250) 108 88
Safety Function Delay, s	0.2
Safety Function Opening Time, s	1.5

Table 15.2-1

Input Parameters, Initial Conditions and Assumptions used in AOO and Infrequent Event Analyses

Parameter	Value
Vessel level Trips (above bottom vessel) Level 9 – (L9), m (in) Level 8 – (L8), m (in) Level 7 – (L7), m (in), high level alarm Normal Water Level, m (in) Level 4 – (L4), m (in), low level alarm Level 3 – (L3), m (in) Level 2 – (L2), m (in) Level 1 – (L1), m (in) Level 0.5 – (L0.5) m (in)	 22.39 (881.5) 21.89 (861.8) 20.83 (820.3) 20.72 (815.7) 20.60 (811.2) 19.78 (778.7) 16.05 (631.9) 11.50 (452.8) 8.45 (332.7)
Maximum APRM Simulated Thermal Power Trip Scram, % NBR Time Constant, s	 115 7
Simulated Thermal Power setpoint as a linear function of feedwater temperature for feedwater temperatures above 222.2°C (432°F)(5) Rate of Change limit on simulated thermal power setpoint(6)	115% at 222.2°C (432°F) 101% at 252.2°C (486°F) 26% / hour
~~Total~~ Minimum Steamline Volume, (total of all lines,including header): Vessel to TSV, m^3 (ft^3)(2)	~~135~~ 103.3 (~~4767~~3648)
Minimum Steamline Length (average of all lines): Flow Path from Vessel to TSV, m (ft)(2)	65.26 (214.1)
CRD Hydraulic System minimum capacity, m^3/hr (gpm), Capacity in kg/s (Mlbm/hr) for 990 kg/m^3 density (61.8 lbm/ft^3)	235.1 (1035) 64.6 (0.513)
Maximum time delay from Initiating Signal (Pump 1 & 2), s If offsite power is not available	10 & 25 145

Table 15.2-1

Input Parameters, Initial Conditions and Assumptions used in AOO and Infrequent Event Analyses

Parameter	Value
Isolation Condensers	
Max Initial Temperature, °C (°F)	40 (104)
Minimum Initial Temperature, °C (°F)	10 (50)
Time To injection valve full open (Max), s[24]	31 (1)
Heat Removal Capacity for 4ICs, MW (% Rated Power)	135 (3%)
Isolation Condensers volume, 4 Units, from steam box to discharge at vessel m^3 (ft^3)	56.1 (1981)

(1) These are calculated steady state values not inputs or assumptions and may change for different initial condition assumptions.

(2) These values are used used in potentially limiting pressurization transients and bound the turbine throttle pressure in Table 10.1-1. Historical values for turbine throttle pressure, 6.57 MPaG, (953 psig) and steamline volume, 135 m^3 (4767 ft^3) and larger steamline length (consistent with volume) are used in non-limiting events and non-pressurization events.

(13) The SRV capacity used in the analysis is less than the ASME rated capacity noted in Table 5.2-2.

(24) In the analysis, after 1 s logic delay, the IC opening valve curve began to open at 15 s for a total opening time of 30 s. For IICI the valve begins to open at 15 s with a opening time of 7.5 s.

(5) As the reactor power changes with changes in the feedwater temperature (Figure 4.4-1), the simulated thermal power trip setpoint also changes with feedwater temperature. The analytical limit is established to allow for feedwater temperature uncertainty effects on setpoint determination.

(6) Rate of change of the simulated thermal power setpoint is established to ensure that the simulated thermal power trip setpoint does not rapidly change with unexpected changes in the feedwater temperature. This simulated thermal power trip rate of change limit is based on the maximum planned rate in the feedwater temperature setpoint discussed in Subsection 7.7.3.2.3