HITACHI

GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

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

T 910 819 6192
F 910 362 6192
rick.kingston@ge.com

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U.S. Nuclear Regulatory Commission
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Subject: Response to Portion of NRC Request for Additional Information Letter No. 229 Related to ESBWR Design Certification Application - Emergency Core Cooling Systems - RAI Numbers 6.3-83 and 6.3-87

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) responses to the subject NRC RAIs transmitted via the Reference 1 letter. DCD Markups related to this response are provided in Enclosure 2.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

D068
A002
NRO

Reference:

1. MFN 08-611, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 229 Related to ESBWR Design Certification Application*, July 30, 2008

Enclosures:

1. MFN 08-802 - Response to Portion of NRC Request for Additional Information Letter No. 229 Related to ESBWR Design Certification Application - Emergency Core Cooling Systems - RAI Numbers 6.3-83 and 6.3-87
2. MFN 08-802 - Response to Portion of NRC Request for Additional Information Letter No. 229 Related to ESBWR Design Certification Application - Emergency Core Cooling Systems - RAI Number 6.3-87 - DCD Markups

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	eDRF	RAI 6.3-83: 0000-0091-0386
		RAI 6.3-87: 0000-0090-7006

Enclosure 1

MFN 08-802

Response to Portion of NRC Request for Additional Information Letter No. 229 Related to ESBWR Design Certification Application

Emergency Core Cooling Systems

RAI Numbers 6.3-83 and 6.3-87

NRC RAI 6.3-83:

DCD Revision 5, Tier 2, Table 6.3-5a summarizes the ECCS line breaks and break sizes. Table 6.3-5 summarizes ECCS-LOCA performance analyses. Table 6.3-5 should document all calculation results for line breaks listed in Table 6.3-5a.

GEH Response:

DCD Tier 2, Table 6.3-5 summarizes Emergency Core Cooling Systems - Loss-of-Coolant Accident (ECCS-LOCA) performance analyses for only the most limiting line break sizes from DCD Tier 2, Table 6.3-5a. There are three other non-limiting break size cases in Table 6.3-5a for which ECCS-LOCA performance analysis sensitivity results were provided in a previous RAI response discussed below. Therefore, these non-limiting break size cases were not included in Table 6.3-5.

Calculation results for the pipe breaks at different locations including Gravity-Driven Cooling System (GDCS) equalizing line (EQL), depressurization valve stub tube (DPV), and Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) suction line (SDC) breaks were not listed in Table 6.3-5 since these cases were reported in the response to RAI 6.3-46 (MFN 07-049, dated March 20, 2007), and were not analyzed for DCD Tier 2, Revision 5, because these cases were non-limiting. These three additional cases were part of the sensitivity study to confirm that the pipe break sizes selected for LOCA analyses in Table 6.3-5 were indeed the most limiting break locations/sizes.

DCD Impact:

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

NRC RAI 6.3-87:

In DCD Revision 5, Tier 2, Table 6.3-1, Item B.6:

Hydraulic Control Units (HCU) water during SCRAM is credited in the LOCA analysis (No units or values are given). Even though the HCUs are classified as Safety Class-2 in Table 3.2-1, the HCUs are not considered as safety grade and only safety grade equipment is allowed in the LOCA analysis. Justify the use of HCU SCRAM water in the LOCA analysis. Chapter 15 was revised to remove the credit taken for the CRD system in the transient and accident analyses.

GEH Response:

The statement in the RAI that "[Hydraulic Control Units] HCUs are not considered as safety grade" is not consistent with the GEH classification system. DCD Tier 2, Subsection 3.2.3, indicates that structures, systems, and components (SSCs) assigned to Safety Classes 1, 2 and 3 are considered to be safety-related SSCs. As defined in 10 CFR 50.2, safety-related SSCs are "relied upon to remain functional during and following design basis events to assure:

(1) The integrity of the reactor coolant pressure boundary;

(2) The capability to shut down the reactor and maintain it in a safe shutdown condition; or

(3) The capability to prevent or mitigate the consequences of accidents which could result in potential offsite exposures comparable to the applicable guideline exposures set forth in § 50.34(a)(1) or § 100.11 of this chapter, as applicable."

Assigning the HCUs to Safety Class 2 means GEH considers them to be safety-related components that are relied upon to remain functional during and following design basis events and can be credited to prevent or mitigate the consequences of accidents. GEH generally considers "safety grade" to be a synonym for "safety-related", but does not use the term "safety grade" because it lacks a clear definition in regulations.

The process by which the HCUs contribute to water addition following a loss-of-coolant accident (LOCA) to the reactor pressure vessel (RPV) is as follows. Upon initiation of scram, the scram valve in the associated HCU opens to apply the hydraulic insert forces to its respective fine motion control rod drives (FMCRDs) using high pressure water stored within the precharged accumulator (the nitrogen-water accumulator having previously been pressurized with charging water from the CRD Hydraulic System). Once the hydraulic force is applied, the control rod inserts rapidly. The water displaced from the FMCRD by this process is discharged into the RPV.

So what is being credited in the DCD Tier 2, Chapter 6, LOCA analysis is the displacement of 8.9 m^3 of water into the lower plenum of the RPV during scram, which is a naturally occurring byproduct of the performance of the safety-related scram function. Given that the scram function is credited for all design basis events that require a scram, it is appropriate to take credit in the LOCA analysis for this additional water from the HCUs that enters the RPV naturally during the scram process.

Unlike the ECCS-LOCA performance analysis, the long-term reactor water level response is not a primary concern in the DCD Tier 2, Chapter 15 transient analyses, where most events are effectively terminated once reactor scram occurs. While this HCU water source could also have been credited in the Chapter 15 transient analysis, it is not needed to meet transient design requirements and was thus conservatively ignored in that analysis. The same is not true in the LOCA analysis, where the conservative (relative to 10 CFR 50.46 acceptance criteria) design requirement to prevent core uncovery requires consideration of water sources other than just the Gravity-Driven Cooling System. This is why the LOCA analysis takes credit for water addition from the HCUs during scram, the liquid inventory in the Standby Liquid Control System tanks, and the drainable volume of water in the Isolation Condenser System condensate return lines. All SSCs associated with ensuring these water sources remain available post-LOCA are safety-related for the ESBWR.

DCD Impact:

DCD Tier 2, Table 6.3-1, Item B.6, will be revised as noted in the attached markup.

Enclosure 2

MFN 08-802

Response to Portion of NRC Request for Additional Information Letter No. 229 Related to ESBWR Design Certification Application

Emergency Core Cooling Systems

RAI Number 6.3-87

DCD Markups

Table 6.3-1

Significant Input Variables to the ECCS-LOCA Performance Analysis

B.6 Hydraulic Control Units		
Variable	**Units**	**Value**
Water Added During Scram	m^3 [ft^3]	~~Credited~~8.9 [314.3]
C. Fuel Parameters *		
Variable	**Units**	**Value**
Fuel type	—	See Chapter 4
Peak Linear Heat Generation Rate (Bounding)	kW/m [kW/ft]	44 [13.4]
Initial Minimum Critical Power Ratio (Bounding)	—	1.22

[1] ECCS/LOCA performance was analyzed with ADS capacity of 1440 kg/s (1.143×10^7 lbm/hr). Sensitivity study has confirmed that the variations of chimney and downcomer minimum levels are both under 0.1 m (0.328 ft.), for ADS capacity between 1440 and 1380 kg/sec (1.143×10^7 and 1.095×10^7 lbm/hr). The minimum chimneys water levels are well above the TAF.