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MFN 08-204

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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. 34 Related to ESBWR Design Certification Application - Emergency Core Cooling Systems - RAI Number 6.3-13 S01**

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI originally transmitted via the Reference 1 letter and supplemented by an NRC request for clarification in Reference 2.

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

Sincerely,

R. E. Brown for/

James C. Kinsey
Vice President, ESBWR Licensing

D068
A002
NRO

References:

1. MFN 06-198, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 34 Related to ESBWR Design Certification Application*, June 22, 2006
2. E-Mail from Shawn Williams, U.S. Nuclear Regulatory Commission, to Frostie White, GE Hitachi Nuclear Energy, dated February 7, 2007 (ADAMS Accession Number ML070390176)

Enclosure:

1. MFN 08-204 - Response to Portion of NRC Request for Additional Information Letter No. 34 Related to ESBWR Design Certification Application - Emergency Core Cooling Systems - RAI Number 6.3-13 S01

cc:

AE Cubbage	USNRC (with enclosures)
GB Stramback	GEH/San Jose (with enclosures)
RE Brown	GEH/Wilmington (with enclosures)
eDRF	0000-0077-8445

Enclosure 1

MFN 08-204

Response to Portion of NRC Request for Additional Information Letter No. 34 Related to ESBWR Design Certification Application

Emergency Core Cooling Systems

RAI Number 6.3-13 S01

NRC RAI 6.3-13 S01:

This RAI asks GE to include the reactor pressure vessel (RPV) injection line nozzle and equalizing line nozzle throat lengths in ITAAC to ensure that the L/D remains within the applicability range of the TRACG code flow choking model for loss of coolant accident (LOCA) calculations. NEDE-32176P Rev. 3, "TRACG Model Description," April 2006, contains a description of the TRACG04 choked flow model in Section 6.3. Section 6.3.3 gives a description of the calculation of the sonic velocity. In this section (page 6-51), GE states the simplifying assumptions used to calculate the sonic velocity. Under this list, GE states (1 and 2) that they assume equilibrium conditions. GE states that under certain circumstances, the equilibrium assumption may break down. In particular, for break assemblies of very short length, non-equilibrium transport behavior may be important. The following are supplemental questions for GE to address the applicability of the TRACG04 flow choking model to the ESBWR RPV injection line and equalizing line nozzles:

(A) Does TRACG04 have a sub-cooled choking model to account for small L/D throat conditions?

(B) Provide the nozzle throat L/D applicability range for the TRACG04 choking model. Provide the nozzle throat L/D for the pressure suppression test facility critical flow tests and the Edwards Blowdown Tests used to qualify TRACG critical flow model.

(C) State how you will ensure that the L/D for the ESBWR nozzle throats will remain within the TRACG qualification range.

(D) Add the minimum throat diameter of the RPV injection line nozzles to Tier 1 and provide an ITAAC.

GEH Response:

(A) TRACG has a sub-cooled choking model applicable for small L/D throat conditions. The comparisons to data include choked flow for both smooth and abrupt area changes (i.e., orifices), thus validating the model for small L/D (Reference 1, Section 6.3.6).

(B) TRACG is qualified over a range of L/D of 0.0 – 8.68 through direct comparison to test data. Table 6.3-13-1 contains the L/D for the pressure suppression test facility (PSTF) critical flow tests, Marviken, and the Edwards Pipe Tests used to qualify TRACG critical flow model.

Table 6.3-13-1: L/D for Test Facilities used in TRACG Qualification

Facility	L/D Range	Comment
PSTF	4.79 – 8.68	Reference 3, Pages 3-7, 3-9
Marviken	0.33 – 3.6	Reference 1, Page 6-60
Edwards Pipe Tests	0.0	Reference 4, Page 3-106

(C) Using the proposed L/Ds for ESBWR nozzles contained in Table 6.3-13-2 ensures that the L/D for ESBWR remain within TRACG qualification range. Values are nominal unless otherwise indicated.

Table 6.3-13-2: ESBWR Nozzle Lengths and Diameters

NOZZLE	Length (mm)	Diameter (mm)	L/D
Main Steam	506 ± 2.5	353.8 ± 0.25	1.43
Feedwater	400 Min	195.81 +0.25,-0.5	2.04
Standby Liquid Control Injection	4.54	6	0.79
Depressurization Valve (DPV)/Isolation Condenser (IC) Outlet	885.4	387.35 Min	2.29 Max
Reactor Water Cleanup (RWCU)/Shutdown Cooling (SDC) Outlet	624.1	273.05 Min	2.29 Max
Gravity-Driven Cooling System (GDCS)	334.5	75.9	4.41
GDCS Equalizing Line	334.5	50.75	6.59
IC Return	700 Min	193.7 Min	3.61
Water Level Instrumentation (N11, N12) Reactor Pressure Vessel Instrumentation Nozzle (N13)	209	24.3 ± 0.2	8.59
Water Level Instrumentation (N14)	393.8	49.22 ± 0.2	8

(D) The main requirement of the GDCS is to provide sufficient flow to maintain the level above the top of active fuel for 72 hours following an accident. Because there is already an Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) covering this requirement (Reference 2), it is not necessary to have a separate ITAAC for the minimum diameter of the nozzle to ensure that this flow rate is met.

References:

1. GE Nuclear Energy, "Licensing Topical Report TRACG MODEL DESCRIPTION," NEDE- 32176P, Revision 3, April 2006.
2. GE Energy, "Response to Portion of NRC Request for Additional Information Letter No. 34 - Emergency Core Cooling Systems - RAI Numbers 6.3-18 S01 through 6.3-25 S01," MFN 06-241 Supplement 2, April 7, 2007.
3. General Electric Co., "BWR Refill-Reflood Program Task 4.8 – TRAC-BWR Model Qualification for BWR Safety Analysis Final Report," NUREG/CR–2571, EPRI-2377, GEAP-22049, July 1983.

4. GE Nuclear Energy "Licensing Topical Report for TRACG Qualification," NEDE-32177P, Revision 3, August 2007.

DCD Impact:

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