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MFN 06-466 Supplement 5

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 170 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-102 S03**

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI originally transmitted and supplemented via References 1, 2, and 3, and supplemented by an additional NRC request for clarification in Reference 4.

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

Sincerely,

Charles W. Bagnal
for

Richard E. Kingston
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 06-393, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 79 Related to ESBWR Design Certification Application*, October 11, 2006
2. E-Mail from Shawn Williams, U.S. Nuclear Regulatory Commission, to Frostie White, GE Hitachi Nuclear Energy, dated April 17, 2007 (ADAMS Accession Number ML071070246)
3. MFN 07-632, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 116 Related to ESBWR Design Certification Application*, November 15, 2007
4. MFN 08-317, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 170 Related to ESBWR Design Certification Application*, March 28, 2008

Enclosure:

1. MFN 06-466 Supplement 5 - Response to Portion of NRC Request for Additional Information Letter No. 170 Related to ESBWR Design Certification Application - Containment Systems - RAI Number 6.2-102 S03

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	eDRF	0000-0071-3265R1

Enclosure 1

MFN 06-466 Supplement 5

Response to Portion of NRC Request for Additional Information Letter No. 170 Related to ESBWR Design Certification Application

Containment Systems

RAI Number 6.2-102 S03

NRC RAI 6.2-102 S03:

(a) *The GEH risk assessment in the response to RAI 6.2-102 S02 assumes that the isolation valves would be closed automatically by Q-DCIS on high radiation in the PCCS pools. Please supplement the risk assessment assuming the isolation valves would have no automatic functions. Actuation of the isolation valves will be dependent on operator identification of the event and approved emergency procedures to verify the need and means of isolation. Please provide results of this configuration and a comparison of the risk associated with using automatic isolation valves and without isolation valves.*

(b) *Please include in the DCD a description of inspections to be performed on the PCCS heat exchangers to detect possible degradation and justify the leakage rates assumed in the risk assessment through the PCCS heat exchanger in RAI 6.2-102 S02.*

GEH Response:

(a) If the Passive Containment Cooling System (PCCS) containment isolation valves were designed as remote-manual operated from the main control room through the Safety-Related Distributed Control and Information System (Q-DCIS), the postulated spurious isolation due to software common cause faults would still apply in the risk assessment. As with spurious software common cause failure (CCF) for automatically actuated equipment (for example, Isolation Condenser System containment isolation valves or control rod drive pump trip), the software itself generates the faulty actuation signal with a probability of 1E-4 during the mission time; the CCF of software is assumed to have the capability to simulate the operator's request for isolation valve actuation. There are fewer potential failure modes for the spurious isolation with only remote-manual operated valves, but the 1E-4 probability is a bounding estimate and its use is accepted and consistent with all current ESBWR Probabilistic Risk Assessment (PRA) analyses. The as-designed, as-modeled PCCS has a system failure rate of approximately 8E-7 during the mission time. The consequences of a 1E-4 failure rate due to spurious actuation of postulated containment isolation valves are severe, as shown in the GEH response to Supplement 2 of this RAI (MFN 06-466 Supplement 4, dated March 11, 2008). As such, a recovery of the failed spuriously isolated valves would be necessary to avoid excessively skewed PRA results. The steps in the recovery action are as follows:

(1) Recognition – The operators would be able to recognize the inadvertent PCCS isolation relatively quickly because all 6 loops would isolate/alarm, and none of the operators had manually actuated the valves.

(2) Recovery – Physically re-opening the isolation valves from a position local to the valves is not feasible because of their location. The isolation valves would either be in the upper drywell (DW), or submerged at the bottom of the Isolation Condenser/Passive Containment Cooling pool as close as possible to the upper DW. Re-opening the isolation valves from the main control room

via the Q-DCIS cannot be credited because it was the failure of the Q-DCIS software that initially created the condition. Instead, a procedure would have to be developed to specially treat these types of recoveries according to detailed design of the instrumentation and control system.

The specialized, detailed recovery of this failure would be inconsistent with the rest of the baseline design certification PRA model. No operator recovery of failed equipment is currently modeled, and there isn't enough detailed design information and/or procedures to develop a model for, and give credit to, this type of recovery.

To be consistent with the design certification, the CCF software isolation would be considered and not recovered. For example, the isolation condenser system (ICS) is failed by CCF of Q-DCIS software to spuriously isolate its containment isolation valves; no recovery is credited. Current design information does not support the development of a recovery model for this type of postulated failure. As such, the PRA results and insights for only remote-manual operated PCCS isolation valves are the same as those presented in the response to RAI 6.2-102 Supplement 2 for automatically actuated PCCS isolation valves. The results in that supplement can be compared directly to the baseline PRA results in NEDO-33201, ESBWR Probabilistic Risk Assessment, Revision 3, Section 7 and Section 8.

(b) The PCCS is designed in a way to allow in-service inspection during refueling outages. As described in DCD Tier 2, Revision 5, Subsection 6.2.2.4, ultrasonic testing of tube-to-header welds and eddy current testing of the tubes can be performed without removal of the units.

The scope and frequency of the inspections will be determined as part of the in-service inspection program per the requirements of ASME Boiler and Pressure Vessel Code, Section XI.

DCD Impact:

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