HITACHI

GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

P.O. Box 780
3901 Castle Hayne Road, M/C A-55
Wilmington, NC 28402 USA

T 910.675.6192
F 910.362.6192
rick.kingston@ge.com

MFN 08-641

Docket No. 52-010

August 18, 2008

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: Response to Portion of NRC Request for Additional Information Letter No. 209 Related to ESBWR Design Certification Application – DCD Tier 2 Section 3.9 – Mechanical Systems and Components – RAI Number 3.9-200, -203 & -204

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) received from the NRC via Reference 1 (RAI 3.9-200, -203 and -204).

Enclosure 1 contains the GEH response to NRC RAI 3.9-200, -203 and -204 that was received from the NRC on June 9, 2008 via NRC Letter 209 (MFN 08-517, Reference 1).

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 08-517, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 209 Related to ESBWR Design Certification Application*, June 9, 2008

Enclosure:

1 Response to Portion of NRC Request for Additional Information Letter No. 209 Related to ESBWR Design Certification Application – DCD Tier 2 Section 3.9 – Mechanical Systems and Components – RAI Number 3.9-200, 3.9-203 and 3.9-204

cc:	AE Cubbage	USNRC (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	eDRF	0000-0087-6884 (RAI 3.9-200, -203, -204)

Enclosure 1

MFN 08-641

Response to Portion of NRC Request for

Additional Information Letter No. 209

Related to ESBWR Design Certification Application

Mechanical Systems and Components

RAI Numbers 3.9-200, 3.9-203, 3.9-204

NRC RAI 3.9-200

NRC Summary:
GDCS check valve design and orientation

NRC Full Text:
Discuss the evaluation of potential impact of vertical orientation of check valves in the ESBWR Gravity-Driven Cooling System (GDCS). As described in Section 6.3, "Emergency Core Cooling Systems," of the ESBWR Design Control Document (DCD) Tier 2, Revision 4, the GDCS is required to inject cooling water into the reactor by gravity flow following a loss of coolant accident (LOCA). In a presentation to the Advisory Committee on Reactor Safeguards (ACRS) on May 8, 2008, GEH indicated that the GDCS might include vertically mounted check valves. In a letter dated March 27, 2008 (MFN 08-084), GEH had indicated that the GDCS check valves might be horizontally or vertically mounted. Under specific LOCA depressurization scenarios, there could be significant reactor coolant pressure present when the GDCS squib valve actuates and reverse flow through the GDCS line might occur until the flow closes the check valve. In light of these possible GDCS design features, please provide the following information:

a) Discuss the design and analysis of applicable components for waterhammer loading due to the reverse acceleration and stoppage of the GDCS water column from the check valve closure, including performance of tests and analysis of affected pressure boundary and active system components.

b) Discuss the design and analysis of applicable components for loading due to the formation of steam in the GDCS piping during depressurization of hot reactor coolant following a LOCA and the subsequent condensation-induced waterhammer during GDCS injection, including performance of tests and analysis of affected pressure boundary and active system components.

c) Discuss the consideration of the force on the valve disk necessary for closure of the check valve in the vertically-mounted position under all conditions of reverse flow.

d) Discuss the provisions to provide assurance that for all conditions of GDCS injection, the valve disk of the vertically mounted check valve will be stable and in the fully open position, without damage or wear caused by chatter or flutter of the disk.

e) Discuss the potential for the GDCS check valves in vertical flow lines to remain partially open under slow pressure increase conditions of the reactor coolant system that could allow backflow to the cooling water pools.

f) Discuss the specifications for the inservice testing program for the GDCS check valves in vertical flow lines to provide reasonable assurance of their operational readiness based on their application and performance requirements.

GEH Response

The GDCS check valves will either be installed in a horizontal piping run and be held normally open by a spring, or in a vertical piping run and be held normally open by gravity. In either case, the net force keeping the valve open will be minimized to a value sufficient to ensure the valve is open with no differential pressure (DP). One conceptual configuration is a nozzle check valve in a vertical pipe, oriented such that gravity opens the valve. To minimize the reverse flow/DP required to close the valve, valve opening would be resisted by a light spring, sized such that the valve is fully open with no DP (disk weight is equal to the spring force at fully open). Discussions with a valve vendor determined that this type of valve in this configuration would close with a fraction of 1 psi DP in the reverse direction.

The GDCS squib valves are actuated 150 seconds after a confirmed Level 1 signal. ADS actuation begins 50 seconds after a confirmed Level 1 signal. Therefore, when the GDCS squib valves actuate, reactor pressure is significantly below the normal operating pressure. For the accident cases analyzed, the range of reactor pressures at squib valve actuation is 58 to 218 psig. Based on the safety analyses, up to 130 seconds may pass before reactor pressure drops below the GDCS injection pressure. The GDCS check valves will remain closed during this time and will reopen as reactor pressure reaches the GDCS injection pressure (with a fraction of 1 psi reverse DP). GDCS injection will begin at a low flow rate and gradually increase as the reactor further depressurizes.

a) As discussed above, the reactor pressure when the GDCS squib valves actuate will be significantly less than normal reactor pressure (up to about 218 psig). The GDCS check valves will be designed to minimize the impact loads due to valve closure. For example, a fast-acting design with a lightweight disk, such as a nozzle check valve, will be used, such that damage from deceleration of GDCS system fluid will not occur. Valve qualification will also address these closing conditions and verify acceptable valve performance.

b) The piping between the GDCS pools and the reactor pressure vessel (RPV) is a continuous loop seal and is therefore expected to remain full of water (i.e., no steam voids should exist). In addition, as discussed above, GDCS injection begins at a low flow rate and gradually increases as the reactor depressurizes. Therefore, no rapid pressure changes that could lead to waterhammer are expected during GDCS injection.

c) See the discussion above on check valve operation. The check valve will be designed and qualified to ensure it remains open under normal operating conditions (zero DP) and closes under low reverse DP/flow conditions.

d) As discussed above, after squib valve initiation but before reactor pressure falls below GDCS injection pressure, the check valves will be closed by the reverse flow/DP. The GDCS check valves will begin to open with a fraction of 1 psi reverse DP across the valves and will be fully open when reactor pressure drops to the GDCS injection pressure and forward flow begins, such that no chatter or flutter will occur. Valve qualification will verify check valve performance under these conditions.

e) There are no "slow pressure increase conditions of the reactor coolant system" under either normal or design basis conditions following actuation of the GDCS injection valves (during which time reverse flow through the check valves could occur). During normal operating conditions, there is no DP across the check valves, and the pressures are not changing on either side of the check valves. When the injection squib valves actuate, the pressure on the downstream side of the check valves is decreasing.

f) As shown in DCD, Revision 5, Table 3.9-8 for the GDCS system, the GDCS check valves will be IST tested during refueling outages. Open/close exercise testing, leakage testing and position indication verification testing will be performed. Exercise testing will verify that the valves are held open with no DP or flow and that the valves close on low reverse flow/DP.

DCD Impact

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

NRC RAI 3.9-203

NRC Summary:
Check valves and other valve types in vertical lines in other safety-related or RTNSS systems

NRC Full Text:
Discuss any check valves or other valve types in vertical flow lines in ESBWR safety-related systems or those within the scope of regulatory treatment of nonsafety systems (RTNSS), and the provisions for functional design, qualification and inservice testing of those valves based on their application and performance requirements. Valve orientation can have a significant impact on functional design, qualification, and inservice testing of valves to provide reasonable assurance of the ability to perform their applicable safety functions.

GEH Response

See the response to RAI 3.9-200 for discussion of the GDCS check valves.

Detailed pipe routing has not yet been completed for the ESBWR. To the extent possible, valves will be installed in horizontal piping runs with the valve stems oriented vertically. Installation of a 4-inch or larger valve with a stem oriented more than 15° from vertical will require specific review and approval, as required by Section 3.11.9.6 of NEDE-33271P, *NP-2010 COL Demonstration Project: Project Design Manual* (PDM). The PDM provides the overall design methodology for the ESBWR and is the vehicle through which GEH project management provides instructions and design requirements/guidance to engineers. Inclusion of the above requirements in the PDM assures it becomes part of the detailed design of the plant. The PDM is available for review by the NRC upon request.

For some valve types, installation orientation can affect the performance of the valve. QME-1-2007 requires that orientation be considered when qualifying valves and when extrapolating qualification results for one valve to another valve. As discussed in DCD Tier 2, Section 3.9.3.5, ESBWR valves will either be qualified to QME-1-2007 or a gap analysis will be performed to document and evaluate the differences between the valve qualification and QME-1-2007. Therefore, if a valve is installed with a horizontal stem, either qualification will specifically address the installed orientation or the gap analysis will document why the valve qualification is acceptable in light of the installed valve orientation.

Any degradation that may occur due to installation orientation (e.g., rubbing of guides on gate valves) will be monitored through IST program testing and/or through other periodic testing (e.g., as discussed in Section 3.9.3.8 of DCD Tier 2).

DCD Impact

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

NRC RAI 3.9-204

NRC Summary:
Applicable DCD changes to address valves in vertical lines

NRC Full Text:
Specify appropriate changes to the DCD to ensure adequate functional design, qualification, and inservice testing for valves in vertical flow lines in the ESBWR.

GEH Response

As discussed in the response to RAI 3.9-203, no changes to the DCD are required.

DCD Impact

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