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MFN 06-508
Supplement 2

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U.S. Nuclear Regulatory Commission
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Subject: **Response to Portion of NRC Request for Additional Information E-mail from S. Williams Related to ESBWR Design Certification Application -- Passive Containment Cooling System, RAI Number 5.4-57 S01**

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 E-mail from Shawn Williams, Reference 1. The previous response was submitted via Reference 3 in response to NRC Letter No. 77, Reference 2. RAI Number 5.4-57 S01 is addressed in Enclosure 1.

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

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. E-mail from U.S. Nuclear Regulatory Commission (Shawn Williams) to GEH, *Request For Additional Information Related to ESBWR Design Certification Application (RAI 5.4-57 S01)*

2. MFN 06-391, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 77 Related to ESBWR Design Certification Application,* dated October 11, 2006

3. MFN 06-508, Letter from David Hinds to the U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 77 – Isolation Condenser and Passive Containment Cooling System – RAI Numbers 5.4-53 and 5.4-57*, dated December 8, 2006

Enclosure:

1. Response to Portion of NRC Request for Additional Information E-mail Related to ESBWR Design Certification Application, Passive Containment Cooling System, RAI Number 5.4-57 S01

cc:

AE Cubbage	USNRC (with enclosure)
DH Hinds	GEH/Wilmington(with enclosure)
GB Stramback	GEH/San Jose (with enclosure)
RE Brown	GEH/Wilmington (with enclosure)
eDRF	0000-0056-4647

Enclosure 1

MFN 06-508, Supplement 2

Response to Portion of NRC Request for

Additional Information E-Mail

Related to ESBWR Design Certification Application

Passive Containment Cooling System

RAI Number 5.4-57 S01

For historical purposes, the original text of RAI 5.4-57 and the GE response are included. The attachments (if any) are not included from the original response to avoid confusion.

NRC RAI 5.4-57

Please provide additional information for the passive containment cooling system (PCCS) heat exchanger for the staff to assess its design. (A level of detail similar to that requested for the IC in RAIs 5.4-20, 5.4-53 through 5.4-56 should be provided).

GE Response

Note: For this response it has been assumed the requested RAI coverage noted above was intended to be 5.4-20 and 5.4-54 through 5.4-56.

First it should be noted that the PCC heat exchanger, as with the IC heat exchanger, is of the external tube design. The tubes are 304L stainless steel and are immersed in a pool of deionized water at ambient temperature and pressure. Since this system is only used post LOCA, it is exposed to only these conditions for essentially its entire life. The post LOCA environment is flowing steam at a maximum of 171°C (340°F) for 72 hours. Under these conditions corrosion of stainless steel is extremely limited as are other potential forms of material degradation.

Responses relative to the previously referenced RAIs are as follows:

Relative to RAI 5.4-20 Response.

(A) The heat exchanger tubes are not fastened to tubesheets. The Stainless Steel (SA-213) tubes are welded to the upper and lower header drum pipes. The welding will be performed according to ASME Code Section III, Division 1 NC-4000 for tube-to-header welds. The weld surface will be examined by liquid penetration methods, and the welds volumetrically examined by radiography.

(B) There are bends in the length of the heat exchanger tubes that connect to the upper and lower header. The bends in the tubes vary from 6 degrees (from center) to 42 degrees. The tube bends will be made by induction bending. The induction bending process is carried out at approximately the solution heat treatment temperature for stainless steel (T > 1900°F). Consequently, the bends are reannealed and stress relieved as part of the bending process.

The heat exchanger tubes will be ultrasonically examined after final heat treatment and before bending according to ASME Code Section III, Division 1, NC-2550. After bending, the tubes will be dye-penetrant examined according to ASME Code Section III, Division 1, NC-2556.

(C) No Crevices exist in the PCC tubes or the tube-to-header welds. However, crevices do exist in the bolted header cover flanges.

(D) At this stage of the design process, detailed report/calculation for the design of support structures for the PCC tubes on the poolside are not available. The supports will follow the design requirements detailed in DCD Tier 2, Revision 2, Subsection 3.9.3.7.

(E) Heat treatment criterion is a solution heat treatment for stainless steel SA-213 tubes -. Other stainless steel components will also be solution heat treated according to the applicable ASME specification.

(F) A schematic of the PCC tube arrangement on the heat exchanger drum is available in GE letter MFN-106-96, SBWR –Summary of Meeting with GE to discuss PANTHERS-PCC Test Data Evaluation for the SBWR Design (Proprietary Information), dated May 17, 1996. The minimum clearance between the PCC tubes is 19 mm in the x or y directions.

(G) The Summary of Meeting with GE to discuss PANTHERS PCC Test Data Evaluation in MFN-106-96 includes more detail schematics of the PCC heat exchanger modules. These diagrams support the request for more detailed design drawings.

Relative to RAI 5.4-54 Response.

Part A. As noted above, the lifetime environment for the PCC heat exchanger is very benign for stainless steel. For design conditions of ambient temperature deionized water general corrosion of Type 304L will be extremely limited and pitting is very unlikely. Likewise, stress corrosion is not a concern for a low carbon stainless steel at these temperatures. No other environmental degradation mechanisms are considered likely to be active.

Part B. The response to RAI 5.4-54 Part B is applicable to the PCC heat exchanger.

Relative to RAI 5.4-55/56 Responses.

The Responses to RAIs 5.4-55 and 5.4-56 with respect to inspection are applicable to the PCC heat exchanger. However, the corrosion allowance for stainless steel is lower than for nickel alloy. In ambient temperature deionized water the corrosion rate for 300 series stainless steels is vanishingly low. Even if it is assumed the tubes experienced reactor operating temperatures, the BWR corrosion allowance for 60 years is only 0.114 mm (0.0045 inch). As described in previous RAI responses, these corrosion allowances are based on internal GE data from laboratory testing. Actual corrosion rates are substantially lower than the design allowances.

DCD Impact

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

NRC RAI 5.4-57 S01

Received by e-mail from S. Williams

For the PCCS, provide the same information as requested in the enclosed supplemental questions for 5.4-53 and 5.4-58. In addition, discuss whether the cracking that occurred in the earlier ICs (refer to your response to RAI 5.4-54) Supplemental RAI Request for Chapter 5 (GE Letters MFN 06-479, MFN 06-50, MFN 06-508, and MFN 06-502) could occur in the PCCS heat exchanger. If so, discuss what inspections should be performed to ensure timely detection of the cracking?

GEH Response

Supplemental question to 5.4-53: Since the IC units are part of the primary pressure boundary, there is a potential for radiation leaks to occur during normal operation. However, the PCCS does not have the same level of concern related to radiation leaks. PCCS units do not experience any pressure during normal operation and the only potential for radiation leakage is during a LOCA. Therefore, additional operator actions to address radiation leaks (as a potential result of PCCS cracking) will not be necessary for the PCCS system.

For the response to the supplemental question to 5.4-58, see the response to S01 to RAI 5.4-20, item (C).

The previous cracking observed in ICs was identified as transgranular stress corrosion cracking (TGSCC), associated with chloride contamination. For the PCCS system, the water chemistry is required to be maintained within certain limits, including chloride levels. As noted in the previous response, the PCCS heat exchanger is located in containment and does not see any significant operational pressure stresses during normal operation.

Based on this TGSCC is considered highly unlikely, and augmented inspections are not considered necessary.

DCD Impact

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