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Subject: **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**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

If you have any questions about the information provided here, please let me know.

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

D068

Reference:

1. 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*, October 11, 2006

Enclosure:

1. MFN 06-508 – Response to Portion of NRC Request for Additional Information Letter No. 77– Isolation Condenser and Passive Containment Cooling Systems – RAI Numbers 5.4-53 and 5.4-57

cc:	AE Cubbage	USNRC (with enclosures)
	GB Stramback	GE/San Jose (with enclosures)
	eDRF	0061-6772 for RAI 5.4-53
		0062-0409 for RAI 5.4-57

Enclosure 1

MFN 06-508

Response to Portion of NRC Request for

Additional Information Letter No. 77

Related to ESBWR Design Certification Application

Isolation Condenser and Passive Containment Cooling Systems

RAI Numbers 5.4-53 and 5.4-57

<u>NRC RAI 5.4-53</u>:

Provide additional information regarding IC leak detection.

In DCD Tier 2, Revision 1, Section 5.4.6.2.2, it was indicated that a low-level leak (radiation level above background) results in an alarm to the operator. Please discuss how much above background these alarm setpoints will be (e.g., 2 times background). The staff notes that alarm setpoints slightly above background provide an early indication of a leak. In addition, please discuss operator actions to be taken in response to leakage (given that leakage would be an unanticipated occurrence). Please discuss whether the leak rate from a critical size flaw in an IC tube was determined and used in determining when the IC should be isolated. If not, why not? If so, discuss what you considered to be a critical size flaw.

<u>GE Response</u>:

As described in Subsection 5.4.6.2.2 of DCD Tier 2, Rev 2, four radiation monitors are provided for each Isolation Condenser (IC) train. Low-level radiation leak detection above background results in an alarm to the operator that is initiated on a 2-out-of-4 logic. Before high radiation levels exceed site boundary limits, isolation of the leaking IC occurs automatically by closure of steam supply and condensate return line isolation valves, which is initiated on a 2-out-of-4 logic.

ESBWR instrument setpoints are determined by plant-specific analyses using the NRC approved *GE Setpoint Methodology* (reference GE proprietary LTR NEDC-31336P-A) that addresses setpoints, margins, errors, and response times. The high radiation setpoint is selected so as not to exceed site boundary radiation dose limits in accordance with 10 CFR Part 20. The alarm setpoint is selected close enough to background so that an early warning of a leak is detected, but with adequate margin to prevent spurious actuation.

Since only three out of four IC's are needed to remove post reactor isolation decay heat after sustained reactor operation at 100% power, the operator can manually isolate an IC that has alarmed, without affecting the ability of the ICS to function as intended.

The leak rate resulting from an IC tube flaw is not required to be determined since flaw size is not the basis for establishing the setpoints as mentioned above.

<u>DCD Impact</u>:

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

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:

Like the IC heat exchanger, the PCC heat exchanger is designed with external tubes. The tubes are constructed of 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, the PCC heat exchanger is exposed to ambient temperature and pressure conditions for essentially its entire life. The post-LOCA environment is steam flowing 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 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 is performed in accordance with 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) The heat exchanger tubes that connect the upper and lower header have bends in the length of the tubes. The bends in the tubes vary from 6 degrees (from center) to 42 degrees. The tube bends are accomplished 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 re-annealed 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 the GE presentation proprietary attachment to NRC Letter dated May 17, 1996 entitled "Applicant: GE Nuclear Energy (GE) Project: Simplified Boiling Water Reactor (SBWR) Summary of Meeting with GE to discuss PANTHERS-PCC Test Data Evaluation for the SBWR Design (Proprietary Information)". 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 the Item (F) referenced letter includes additional 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 (referenced as 5.4-53):

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, de-ionized 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 activities are applicable to the PCC heat exchanger. However, the corrosion allowance for stainless steel is lower than for nickel alloy. In ambient temperature de-ionized water, the corrosion rate for 300 series stainless steels is extremely 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.