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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 26 – Isolation Condenser System – RAI Numbers 5.4-36, 5.4-37 and 5.4-39**

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

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Reference:

1. MFN 06-141, Letter from U.S. Nuclear Regulatory Commission to David Hinds, *Request for Additional Information Letter No. 26 Related to ESBWR Design Certification Application*, May 3, 2006

Enclosure:

1. MFN 06-513 – Response to Portion of NRC Request for Additional Information Letter No. 26– Isolation Condenser System – RAI Numbers 5.4-36, 5.4-37 and 5.4-39

cc:	AE Cubbage	USNRC (with enclosures)
	GB Stramback	GE/San Jose (with enclosures)
	eDRF	0061-9494

Enclosure 1

MFN 06-513

Response to Portion of NRC Request for

Additional Information Letter No. 26

Related to ESBWR Design Certification Application

Isolation Condenser Design

RAI Numbers 5.4-36, 5.4-37 and 5.4-39

NRC RAI 5.4-36:

If the IC pool is below the saturation temperature (i.e. 110 degrees F) and does not boil, can heat removal still be adequately maintained?

GE Response:

Yes. If the IC pool is below the saturation temperature and does not boil, the IC heat removal rate can still be adequately maintained.

The IC tube thermal resistance consists of three components: the primary side (or tube side) condensate film, the IC tube wall, and the secondary side (or pool side) film (nucleate boiling). The IC thermal resistance is primarily controlled by the condensate film and the IC tube wall. Typically, the outside film resistance is on the order of 10% of the total. Also, the heat transfer rate is proportional to the temperature difference. Lower pool temperature corresponds to higher temperature difference across the tube wall and results in higher heat transfer rate.

DCD Impact:

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

NRC RAI 5.4-37:

The ICS and depressurization vales (DPVs) are connected to common stub lines from the reactor vessel. In the early stages of reactor coolant system (RCS) depressurization, if the ICS is in operation, blowdown through the DPVs may draw fluid back from the cold side of the IC, as well as from the upper part of the reactor vessel. Depressurization loads will also have an effect on the ICS, which serves as the primary boundary between the RCS and the environment, since the IC pools are outside of the containment. Since ICS is part of the ECCS, ICS is supposed to be physically separate from DPV which is also part of the ECCS. Discuss the ramifications of the common-tie between the ICS and DPVs on the stub line from the reactor vessel. Explain why the physical separation criterion for ECCS systems is not met. Describe in detail the potential system interactions, and explain why there is no negative impact due to the cross-tie between IC steam line and DPVs.

GE Response:

The cross-tie between IC steam line and DPVs in the ESBWR produces no significant negative impact on the loads and safety margins. The key details are as follow:

(1) During a LOCA event, the peak operation of ICS occurs during the early part of the depressurization and before the DPV openings;

(2) At the time of first DPV opening, there is no subcooled water inside the IC drain line and in the downcomer region. The total dynamic head (DPV flow + IC steam flow) inside the stub tube is small and will not induce back flow into the IC tubes;

(3) Failure of one IC drain valve or one DPV valve will not prevent the operation of the other system connecting to the common stub line;

(4) Based on (1) and (3), the common-tie between the ICS and DPVs on the stub line has no significant impact on the safety margins [refer to (5) below]. Therefore, the physical separation of these two systems is not necessary; and

(5) Parametric studies were performed with and without the function of the IC heat transfer (i.e., no IC condensation). The results indicate that the long-term containment pressure is slightly higher for the case without the function of IC heat transfer.

The following paragraphs provide additional details on the system interactions.

The nozzles for the stub line and the IC drain line connect to the RPV at elevations of 21.9 and 13.0 m, respectively (reference to the RPV bottom). The bottom of IC tubes is approximately at 6 m above the stub line elevation, or approximately 15 m above the IC drain line nozzle elevation.

In the early stages of reactor coolant system (RCS) depressurization (0 ~ 500 seconds, before the opening of DPVs), the ICS are in operation and condense significant amount of steam flow (~ 36 kg/s per IC, MSL break case) from the RPV. The steam flow to the ICS reduces as the RPV pressure decreases and the downcomer water level drops. The first group of ADS valves open after the downcomer level drops below the Level 1.0 setpoint (11.5 m from the RPV bottom, Table 6.3-1, DCD Rev. 2). Consequently, both the RPV pressure and the steam flow to the ICS reduce further after the first ADS valve opening. The first group of DPV valves opens at 50 seconds after the first ADS valve opening. At this time, the RPV pressure decreases to about 700 kPa (100 psia), the DPV flow is about 7.5 kg/s per DPV and the IC steam flow reduces to about 4 kg/s per IC. The total velocity inside the stub tube is in the range of 35 m/s. The dynamic head is in the range of 2.2 kPa (0.3 psia), which is small compared to the static head of two-phase mixture in the vertical portion of the IC drain line.

At the time of DPV opening, the RPV downcomer as well as the IC drain lines are filled with saturated two-phase mixture due to the fast depressurization resulting from the opening of ADS valves. As the result of additional depressurization from the DPV opening, the downcomer two-phase level could swell up a few meters from the Level 1.0 position, and get closer to or below the stub line elevation. However, there is no subcooled water inside the IC drain line, or inside the downcomer near by the nozzle elevations of the IC drain line or the stub line.

In addition, there are loop seals at the lowest elevation of the IC drain lines, near by the injection nozzles. The loop seal provides extra static head; in addition to the 15 meters of static head of the two-phase mixture inside the vertical portion of the IC drain line, to prevent any flow reversal in the IC drain line and steam inlet line due to the DPV opening.

DCD Impact:

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

NRC RAI 5.4-39:

Since the ICS pools communicate with the passive containment cooling system (PCCS) pools, any pool heatup caused by ICS operation will affect the PCCS pool temperature, and hence the operation of the PCCS. Provide a discussion of the pool design features that limit system interactions involving the IC that may degrade the plant response during a LOCA.

GE Response:

The ICS and PCCS are installed in separate heat exchanger rooms, one system per heat exchanger room (Figure 6.2-2, DCD Rev. 2). These individual heat exchanger rooms connect to the IC/PCC inner expansion pool, which replenishes water to the individual heat exchanger room. This configuration limits the direct interactions between the IC and PCCS heat exchangers. During a LOCA event, the peak operation of ICS occurs during the early part of the depressurization (0 ~ 500 seconds). The PCCS removes the long-term decay heat from 0 to 72 hours. Both the IC and PCCS are designed to operate with subcooled and saturated pool water.

DCD Impact:

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