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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 98 Related to ESBWR Design Certification Application - Design of Structures, Components, Equipment, and Systems - RAI Number 3.4-9**

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 NRC letter dated May 29, 2007. GEH response to RAI Number 3.4-9 is addressed in Enclosure 1.

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

Sincerely,

Kathy Sedney for

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 07-317, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, General Manager, Regulatory Affairs, Request for Additional Information Letter No. 98 Related to the ESBWR Design Certification Application, May 29, 2007

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 98 Related to ESBWR Design Certification Application – Design of Structures, Components, Equipment, and Systems – RAI 3.4-9

cc:	AE Cubbage	USNRC (with enclosure)
	GB Stramback	GEH/San Jose (with enclosure)
	RE Brown	GEH/Wilmington (with enclosure)
	eDRF	0000-0076-1041

Enclosure 1

MFN 07-584

Response to Portion of NRC Request for

Additional Information Letter No. 98

Related to ESBWR Design Certification Application

Design of Structures, Components, Equipment, and Systems

RAI Number 3.4-9

NRC RAI 3.4-9

With regard to internal flooding additional information is needed to support the following conclusions in DCD Tier 2, Revision 3, section 3.4.1:

- *The resulting flood level in the Reactor Building (RB) lower elevation is 20 cm (8 in) and that maximum flood level is lower than the Control Rod Drive Hydraulic Control Unit room elevation.*
- *Safety-related components in the lower elevation of RB are located above the maximum flood level.*
- *The maximum water depth of 40 cm (16 in) in the lowest floor of the Control Building (CB) is below Distributed Control and Information System room floor elevation.*
- *Water in the lower elevation of the CB from pipe failures in the heating, ventilation and air conditioning (HVAC) rooms is retained in the HVAC rooms by the installation of 200 mm (8 in) high curbs in the access doors, chases and other floor openings, as well as by normally closed isolation valves in the drain lines.*

GE should provide calculations to demonstrate the resulting flood level in each of the above cited areas. The calculations should include physical dimensions (e.g., floor length, width and height, and calculated floor areas) of each area, and maximum volume of flood water in each area.

GEH Response

The following demonstrates the resulting flood level in each of the above-cited areas due to internal flooding and is based on calculations 092-134-C-M-01401, Flood Protection Calculation – Chilled Water System in Control Building, Rev. 0 dated 10/15/07 and 092-134-F-M-01400, Flood Protection Analysis, Rev. 2 dated 10/17/07. These calculations are available for audit at GEH offices in Wilmington, NC at NRC's convenience:

(1) The flooding level in the lower elevation of the Reactor Building:

The worst case is the draining of the suppression pool through a crack in the Fuel and Auxiliary Pools Cooling System (FAPCS) suction line. Considering the draining from the maximum level to the anti-siphoning device level, the water volume drained in this case reaches 81 m^3 (2860 ft^3).

The following area is considered for the rooms at EL -11500 (divisions 2 and 4 present the smallest area, separated by watertight doors from divisions 1 and 3 (see DCD Tier 2 Figure 1.2-1)):

Room (divisions 2 and 4)	Area m^2/ft^2
1103, 1160, 1161	260/2799
1102, 1162, 1163	252/2712
Total	512/5511
Total -20% equipment	410/4413

Considering the maximum volume of 81 m^3 (2860 ft^3), the water level in the bottom of the Reactor Building would reach 20 cm (8 in) in the event of flooding.

(2) Safety-related components in the lower elevation of the RB being located above the maximum flood level:

The safety-related components in the lowest elevation are the Hydraulic Control Unit (HCU) equipment located in rooms 1110, 1120, 1130 and 1140 (see DCD Tier 2 Figure 1.2-1). These rooms are located at EL -11200 while the lowest elevation is EL -11500, and consequently, no flood affects these rooms. Furthermore, for additional protection, the access doors from EL -11500 to the HCU rooms are watertight.

(3) The maximum water depth of 40 cm (16 in) in the lowest floor of the Control Building (CB) being below Distributed Control and Information System room floor elevation:

Fire Protection System (FPS) actuation leads to a volume of 57 m^3 (2013 ft^3) as the worst case.

The corridors, stairwells, and elevator area at EL -7400 (see DCD Tier 2 Figure 1.2-2) of the CB have the following free areas:

Room	Area m^2/ft^2
3100	53/570
3190, 3191	23/248
3101	52/560
3192	16/172
Total	144/1550

(Note: Because no components are located in these rooms, the total area is considered free)

Considering the worst case volume of 57 m^3 (2013 ft^3) and the uniform spreading of water in these rooms, the flood level would reach 40 cm (16 in). The following rooms house safety-related equipment: 3110, 3120, 3130 and 3140 (see DCD Tier 2 Figure 1.2-2). These rooms are located at EL. -6800, which is 60 cm (24 in) above the lowest elevation. Furthermore, for additional protection, the access doors to the safety-related rooms are watertight.

(4) Flooding in the HVAC rooms:

Safety-related equipment in the HVAC rooms is protected from flooding by structural barriers. It is also separated from nonsafety-related equipment by elevated thresholds in the access doors to Control Room Habitability Area (CRHA) emergency ventilation equipment and 30 cm (12 in) high curbs in rooms with coils served by the Chilled Water System (CWS). The water discharged from leakage cracks (from the CWS or FPS) is routed by means of curbs to stairwells and thereby directs the potential flooding to lower elevations of the building. Detection and isolation means are provided to limit the flooding to 57 m^3 (2013 ft^3) in the lower elevation of the Control Building. Due to a design change the 20 cm (8 in) curbs have been increased to 30 cm (12 in).

DCD Impact

DCD Tier 2 Subsections 3.4.1.4.1 and 3.4.1.4.2 will be revised in the next update as noted in the attached markup.

seismically qualified. The main source of floodwater is from the fire protection standpipe hose stations. A nominal volume of 57 m^3 (15,000 gal) is provided for the FPS considering two 7.9 l/s (125 gpm) fire hoses are in service for one (1) hour. This results in a flooding level in the lowest floor of the CB of 40 cm (16 in) in the corridors, stair towers and elevator rooms, assuming that the water propagates into these rooms by flowing through embedded drains and under the doors. This maximum water depth is below the Distributed Control and Information System (DCIS) room floor elevation; see Figure 1.2-2 (rooms 3110, 3120, 3130 and 3140).

To prevent flooding in the Control Room Habitability Area (CRHA) emergency ventilation equipment from failures of liquid carrying systems in the Heating, Ventilation and Air Conditioning (HVAC) rooms, the water is routed by the installation of 300 mm (12 in) high curbs in the access doors, chases and other floor openings, as well as by normally closed isolation valves in the drain lines and elevated thresholds in the access doors to CRHA emergency ventilation equipment, to discharge the potential flooding water to the building stairwells.

In addition, for further protection, the DCIS room access doors are watertight. Normally closed valves are installed in the drain pipes of the DCIS rooms. Moreover, the access doors from the access tunnel to the CB at El. -2000 are watertight.

Therefore, the separation of electrical trains in independent zones, along with measures to direct the water to drains, maintains the safety function of the systems housed in the CB.

There is no flooding hazard in the Main Control Room because the potential flood water from chilled water portion inside CRHA envelope is detected and isolated.

3.4.1.4.2 Reactor Building

The potential sources of water in the Reactor Building include the Reactor Component Cooling Water System (RCCWS); Chilled Water System (CWS); Reactor Water Cleanup/Shutdown Cooling (RWCU/SDC) system; Control Rod Drive (CRD) system, including the CRD pump suction from the Condensate Storage and Transfer System (CS&TS) and Condensate and Feedwater System (C&FS); Fire Protection System (FPS); Fuel Auxiliary Pools Cooling System (FAPCS); Hot Water System (HWS); Makeup Water System (MWS); and Standby Liquid Control (SLC) system.

The large number of pools in the ESBWR is contained within thick concrete walls designed for maximum hydrostatic loads combined with seismically induced hydrodynamic loads. GDCS pools inside containment are similarly contained within robust structural members designed for hydrostatic loads combined with seismically induced hydrodynamic loads. These pools are not considered as potential sources of flood.

The piping of the RCCWS, CWS, CRD pump suction (CS&TS/C&FS), MWS, and FPS are seismically analyzed. These are moderate energy fluid systems and therefore only through-wall pipe cracks are considered.

The maximum flooding volume expected is from a through-wall pipe crack in the FPS or in the FAPCS suction lines from the suppression pool. The flooding volume from either of these sources is greater than flooding due to any failure in high and moderate energy piping or tanks.

The maximum volume of the suppression pool for flooding is limited to the difference between the maximum level and the anti-siphoning provision in the suction line elevation.

This results in a flood level of 20 cm (8 in) in the RB lower elevation. This maximum flood level is lower than the CRD Hydraulic Control Unit (HCU) room elevation, see Figure 1.2-1 (rooms 1110, 1120, 1130 and 1140). Other safety-related components in the lower elevation are located above the maximum flood level. Therefore, no flood in this RB elevation could affect the safety-related equipment or plant's safe shutdown capability.

For further protection, the HCU room access doors and the access doors to the RB at El. -1000 are watertight.

The SLC system accumulators for Division 1 and 2 are located in fully independent rooms in El. 17500 of the RB. Therefore, SLC system high energy pipe break or tank failure flooding of one division cannot affect the other.

Flooding in the electrical rooms is limited to the actuation of the fire protection system. The separation of the electrical trains in independent zones, along with measures to direct the water to drains, maintains the safety function of the systems housed in the RB.

The main steam tunnel contains the main steam and main feedwater piping and their isolation valves. In the event of a feedwater pipe break or leak in the main steam tunnel, water is drained to the Turbine Building. The safety-related components in the main steam tunnel are located above the maximum flood level or are designed to function when flooded.

3.4.1.4.3 Adjacent Flooding Events

- **Turbine Building.** – There are no components in the Turbine Building (TB) that could affect the safe shutdown of the reactor.

  The TB is subject to flooding from a variety of potential sources including the Circulating Water System (CIRC), Condensate and Feedwater System (C&FS), Plant Service Water System (PSWS), Reactor Component Cooling Water System (RCCWS), Turbine Component Cooling Water System (TCCWS), CWS and FPS.

  The bounding flooding source for the TB is a CIRC pipe or expansion joint failure. Level switches are located in the TB to limit flooding in the TB in the event of a failure in the CIRC (see Subsection 10.4.5.6). In any case, flooding in the TB could not affect the RB or CB because a 1.5 m (4.9 ft.) high flooding barrier is provided in the access tunnel to the RB and CB (see Figure 1.2-13). A hypothetical massive flooding in the TB would run out of the building to the yard through relief panels.

- **Fuel Building** – There are no safety-related components in the Fuel Building (FB) that could be affected by flooding in the FB. The FPS, CWS, RCCWS, HWS, FAPCS, MWS and CS&TS (Condensate Storage Tank) are the primary sources of flooding in the FB. In any case, flooding in the Fuel Building could not affect the RB because the connection points in the lower elevation are watertight.

- **Radwaste Building** – The Radwaste Building (RW) does not contain safety-related equipment. The radwaste tunnel and other connections with the CB and RB are designed to prevent flooding from spreading in the RW to CB or RB. The primary sources of flooding in the RW are the Liquid Waste Management System (LWMS), the building