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Subject: Response to Portion of NRC Request for Additional Information Letter No. 103 Related to ESBWR Design Certification Application - Control Room Habitability - RAI Numbers 6.4-7 and 6.4-16

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI transmitted via the Reference 1 letter.

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

Reference:

1. MFN 07-414, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, *Request for Additional Information Letter No. 103 Related to ESBWR Design Certification Application*, July 23, 2007

Enclosure:

1. MFN 08-056 - Response to Portion of NRC Request for Additional Information Letter No. 103 Related to ESBWR Design Certification Application - Control Room Habitability - RAI Numbers 6.4-7 and 6.4-16

cc:	AE Cubbage	USNRC (with enclosures)
	DH Hinds	GEH/Wilmington (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	eDRF	RAI 6.4-7: 0000-0075-7933
		RAI 6.4-16: 0000-0075-7608

Enclosure 1

MFN 08-056

Response to Portion of NRC Request for Additional Information Letter No. 103 Related to ESBWR Design Certification Application

Control Room Habitability

RAI Numbers 6.4-7 and 6.4-16

NRC RAI 6.4-7:

DCD, Tier 2, Revision 3, Section 6.4.3, states that the heat sink "consists of the thermal mass of concrete that makes up the ceilings and walls of these rooms" in the control room habitability area (CRHA).

This RAI requests additional information on the role of the heat sink after 72 hours into the design basis accident.

A. *Thoroughly discuss in the DCD how the temperature in the control room is to be maintained for the entire 30 day design basis accident period. Include the initial temperature assumptions and CRHA heat loads that are assumed in the heat sink calculation. Identify the equipment and their power sources necessary to maintain the temperature (heat sink, recirculation air handling units (AHUs), chillers, cooling water pumps, etc) for the full 30 day period.*

B. *After 72 hours into the design basis accident, will the operation of the chillers, cooling water pumps, and recirculation AHUs be needed so that the heat sink is not needed? Are these items powered from the same portable non-safety diesel generator units used to power the EFU's after 72 hours? Are connections established to allow rapid hook up of the portable diesel generators?*

C. *Identify in the DCD the non-safety-related components included in the regulatory treatment of non-safety systems (RTNSS) program that are needed to maintain CRHA temperature.*

D. *Change number 125 to Section 8 for Rev. 3 of the DCD states "The transportable AC generator referenced has been deleted from the ESBWR design." Are the portable generators part of the ESBWR design? Are these the same portable non-safety diesel generator units used to power the EFU's after 72 hours as described in Section 6.4.4, Emergency Mode? If these portable diesel generators have been removed from the ESBWR design, what have they been replaced with?*

GEH Response:

DCD Tier 2, Subsection 6.4.3, states that the heat sink "consists of the thermal mass of concrete that makes up the ceilings and walls of these rooms" in the control room habitability area (CRHA), which is part of the ESBWR passive design characteristics and does not require additional equipment to maintain the CRHA temperature during the first 72 hours after a design basis accident (DBA).

A. During the first 72-hour period following a DBA the passive heat sink is credited for limiting the temperature rise inside each room of the CRHA as stated in DCD Tier 2, Subsection 6.4.3. For more details about the post-accident responses in the 72-hour post-accident period, see the responses to RAI 6.4-16 and RAI 9.4-33. After the 72-hour period, B2 Regulatory Treatment of Non-Safety Systems (RTNSS) diesel generators can supply power to the CRHAVS that provides cooling of the CRHA. In the event that the B2 RTNSS diesel generators are not available, the B1 RTNSS portable AC generator will provide power to the CRHA emergency lighting and safety-related emergency filter units (EFUs), which will ensure CRHA

habitability. There is no other equipment that is necessary to maintain the CRHA temperature before or after 72 hours.

The B1 RTNSS power supply and safety-related EFUs ensure that the control room remains habitable in the post 72-hour accident period. Throughout the entire 30 day DBA period, the CRHA complies with 10 CFR 50 Appendix A, General Design Criteria (GDC) 19 with respect to control room habitability with the use of B2 or B1 RTNSS components. B2 and B1 RTNSS functions and criteria are described in DCD Tier 2, Subsection 19A.1.

For the heat sink calculation, the initial temperature for the CRHA is at the maximum normal operating condition found in DCD Tier 2, Table 9.4-1. The CRHA heat loads can be found in DCD Tier 2, Table 3H-12 for the first 72 hours after a DBA. After 72 hours when B2 RTNSS power is unavailable, the expected heat loads in the CRHA are composed of the operators, minimal emergency lighting, and the EFU fan motor, which amounts to a conservative estimate of 1700 watts.

B. After 72 hours, operation of the chillers, cooling water pumps, and associated power sources obviates the need for the passive heat sink when the B2 RTNSS generators are available. Additionally, B1 RTNSS non-safety portable generators will be used to power the EFUs after 72 hours, which will maintain the CRHA habitability when B2 RTNSS equipment is unavailable. The portable AC generators included in the design will have the capability of rapid connections to supply the EFU fan motor.

C. The B1 RTNSS AC power supply is used after 72 hours to power the safety-related EFU to maintain the CRHA habitability. The B1 RTNSS power supply is readily available throughout the entire DBA. When B2 RTNSS power supplies are available, it obviates the need for the B1 RTNSS power supply. DCD Tier 2, Subsection 9.4.1.1 states, "For longer-term operation, from after 72 hrs out to 7 days, a small portable AC power generator that is kept on the plant site can power the EFU fan system". Additionally, the AC power supply RTNSS criterion is described in DCD Tier 2, Table 19A-2, which is titled "RTNSS Systems."

D. The portable generators that were deleted from DCD Tier 2, Revision 3, Chapter 8, are not currently part of the ESBWR design, and do not need to be replaced. These are different from the portable generators that are used to power the EFUs after 72 hours and performed a different function. Further description of the deleted generators can be found in DCD Tier 2, Revision 2, Subsection 8.3.1.1.2.

DCD Impact:

DCD Tier 2, Subsection 6.4.3 and Subsection 9.4.1.1 will be revised as shown in the attached markups.

6.4.3 Control Room Habitability Area

The CRHA boundary is located on elevation –2000mm in the Control Building. The layout of the CRHA, which includes the MCR, is shown within Figure 1.2-3. The CRHA envelope includes the following areas:

- Main Control Room (Room 3275)
- Shift Supervisor Office (Room 3272)
- Shift Supervisor Conference Room (Room 3273)
- Operator's Area (Room 3270)
- Shift Technical Advisor Office (Room 3271)
- Main control Room Storage Room (Room 3204)
- Electrical Panel Board Room (Room 3205)
- Restroom A (Room 3201)
- Restroom B (Room 3202)

These areas constitute the operation control area, which can be isolated and remain habitable for ~~72 hours~~the duration of a DBA~~ without AC power~~ if high radiation conditions exist. Potential sources of danger such as steam lines, pressurized piping, pressure vessels, CO_2 fire fighting containers, etc. are located outside of the CRHA.

Heat Sink

The function of providing a passive heat sink for the CRHA is part of the CRHA emergency habitability system. The heat sink for each room is designed to limit the temperature rise inside each room during the 72-hour period following a loss of CRHAVS operation. The heat sink consists of the thermal mass of the concrete that makes up the ceilings and walls of these rooms. After the 72-hour period, the normal CRHAVS may be used for heat removal if either offsite or nonsafety-related onsite power supplies are available. Otherwise, an EFU powered from a small portable dedicated electrical generator, along with the passive heat sink, maintains the habitability of the CRHA.

Radiation Protection

Description of control room instrumentation for monitoring of radioactivity is given in Sections 11.5 and 12.3.

Shielding Design

The design basis LOCA dictates the shielding requirements for the CRHA. Main control room shielding design bases are discussed in Section 12.3. Descriptions of the design basis LOCA source terms, main control room shielding parameters, and evaluation of doses to main control room personnel are presented in Section 15.4. The main control room location in the plant with respect to designated radiation zones is shown in Figure 12.3-3.

9.4.1.1 Design Bases

Safety (10 CFR 50.2) Design Bases

Only the CRHAVS performs safety-related design basis functions in support of CRHA habitability. The habitability requirements for the CRHA are discussed and described in Section 6.4.

The CRHAVS provides the following safety-related design basis functions:

- Monitors the CRHA air supply for smoke and radioactive particulate and/or iodine concentrations;
- Isolates the normal CRHA air supply and restroom exhaust, starts an EFU fan, and aligns the air supply through an EFU, upon a high radiation detection signal in the CRHA normal air supply, or upon an extended loss of AC power to support operation of a CRHA normal air supply fan; and
- Isolates the normal CRHA air supply and restroom exhaust upon detection of smoke in the CRHA normal air supply.

The portions of the CRHAVS which penetrate the CRHA envelope are nonsafety-related and designed as Seismic Category I to provide isolation of the CRHA envelope from the outside and surrounding areas in the event of a design basis accident (DBA). The EFU portion of the subsystem is safety-related and designed and supported as Seismic Category I including the air intakes, ductwork, dampers, fans, instrumentation and controls. The remaining CRHAVS functions are nonsafety-related. The penetrations contain safety-related isolation dampers or valves that fail closed upon a loss of control signal, power, or instrument air. EFUs are automatically actuated upon radiological isolation of the CRHA envelope or an extended loss of AC power.

CBVS equipment and ductwork whose failure could affect the operability of safety-related systems or components are designed as Seismic Category II. The remaining portion of the system is nonsafety-related and nonseismic.

The following CRHA components are safety-related and Seismic Category I:

- CRHA Boundary envelope including structures, doors, and components;
- EFUs including HEPA and carbon filters and related system components;
- Ductwork from the CRHA boundary envelope up to and including the CRHA isolation dampers
- Tornado dampers are provided on EFU air intake openings. These dampers are designed to withstand the full negative pressure drop.
- The CBVS outside air intake structures are nonsafety-related and do not require tornado dampers and tornado missile shields.

The CBVS provides a safety-related means to passively maintain habitable conditions in the CRHA following a design basis accident (radiological event concurrent with SBO).

Radiation detected in the CRHA outside air inlet causes the following actions:

- A normally closed EFU outside air inlet to open;
- The normal outside air inlet and restroom exhaust dampers to close; and
- An EFU fan to automatically start.

The CRHA is isolated during SBO conditions and a safety-related EFU provides pressurization and breathing quality air. An EFU is powered from the safety-related battery supply for a 72 hour duration. For longer-term operation, from after 72 hrs out to 7 days, a small portable AC power generator that is kept on the plant site can power the EFU fan system.

The CBVS provides the capability to maintain the integrity of the CRHA with redundant safety-related isolation dampers in all ductwork penetrating the CRHA envelope. The active safety-related components (CRHA isolation dampers and EFUs), that ensure habitability in the CRHA envelope, are redundant. Two trains of safety-related EFUs, including HEPA and Carbon filters, serve the CRHA envelop. Redundant fans are provided for each EFU to allow continued operability during maintenance of electrical power supplies. Therefore a single active failure cannot result in a loss of the system design function.

During normal modes of operation and emergency modes with electrical power available, the CRHA is maintained within the temperature and relative humidity ranges noted in Table 9.4-1 by the nonsafety-related CRHAVS Recirculation AHU. During emergency operation, with an SBO, a nonsafety-related CRHA recirculation air handling unit (AHU), powered from the nonsafety-related Uninterruptible AC Power Supply System, maintains the CRHA within the normal operating temperature range for two hours. This allows the continued operation of certain high heat producing nonsafety-related MCR DCIS electric loads. These nonsafety-related MCR DCIS electrical loads automatically de-energize after two hours or should the redundant CRHA recirculation AHUs become unavailable. In the event the SBO duration extends beyond two hours, the reduced CRHA heat load is passively cooled by the CRHA heat sink, which consists of the internal and external concrete walls, floor, and ceiling, such that the CRHA temperature rise is no greater than 8.3°C (15°F) for 72 hours. After 72 hours, the normal CRHAVS may be used for heat removal if either offsite or nonsafety-related onsite power supplies are available. Otherwise, an EFU powered from a small portable dedicated electrical generator, along with the passive heat sink, maintains the habitability of the CRHA.

NRC RAI 6.4-16:

DCD, Tier 2, Revision 3, Section 6.4.4 states that during the first two hours of a station blackout (SBO) most of the equipment in the main control room (MCR) remains powered by the non-1E battery supply.

A. *For a design basis accident with loss of power is any of the equipment in the MCR powered from the non-1E battery supply. What credit is taken for cooling and the operation of an AHU during this two hour period with respect to temperature rise in the MCR for the first 72 hours and ultimately for the duration of the accident period (30 days). If credit is taken for cooling, please justify the use of non-safety batteries during the design basis accident mitigation and recovery period.*

B. *What manual actions are required during a LOCA with a LOOP to isolate non-safety heat loads due to the potential unavailability of non-1E battery supply? This would be of particular concern during the early stages (first two hours) of the accident. Have these manual actions been identified and evaluated in the analysis?*

GEH Response:

A. The equipment located in the Main Control Room (MCR) powered by the non-1E battery supply are the nonsafety-related Distributed Control and Information System (N-DCIS), and the supplemental recirculation air-handling unit (AHU) and associated cooling equipment. The Control Room Habitability Area (CRHA) temperature analysis assumes loss of both onsite and offsite AC power. There are two more assumptions in the analysis. First, a loss of the normal Control Room Habitability Area HVAC Subsystem (CRHAVS), with the exception of an emergency filter unit (EFU) served by a safety-related power supply. Second, the loss of the supplemental nonsafety-related recirculation AHU and associated chilled water pump. Since these cooling systems are sized to accommodate both the safety-related and the nonsafety-related heat loads in the CRHA, their loss creates a bounding condition where the heat up analysis is based only on the heat loads resulting from the safety-related MCR equipment, operation of an EFU, and passive heat sink for heat removal. With these assumptions, the analysis shows heatup in the CRHA to be less than 8.3°C during the first 72 hours after the initiating event. For the post-accident responses in the remainder of the 30-day post-accident period, see the response to RAI 6.4-7. This approach is in accordance with the design concepts outlined in EPRI Utility Requirements Document for Advanced Light Water Reactors, SECY-94-087 and SECY-95-132.

B. There are no manual actions required to isolate nonsafety-related heat loads during the initial two hours post-accident since these loads automatically isolate upon loss of the CRHAVS.

DCD Impact:

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