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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 103 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.4-31**

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 July 23, 2007, Reference 1. GEH response to RAI Number 9.4-31 is addressed in Enclosure 1.

Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.

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

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

D068
NRO

Reference:

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

Enclosure:

1. Response to Portion of NRC Request for Additional Information Letter No. 103 Related to ESBWR Design Certification Application - Auxiliary Systems - RAI Number 9.4-31.

cc: AE Cubbage USNRC (with enclosure)
GB Stramback GEH/San Jose (with enclosure)
RE Brown GEH/Wilmington (with enclosure)
DH Hinds GEH/Wilmington (with enclosure)
eDRF 0000-0083-4453, Revision 2

Enclosure 1

MFN 08-343

*Response to Portion of NRC Request for

Additional Information Letter No. 103

Related to ESBWR Design Certification Application

Auxiliary Systems

RAI Number 9.4-31

***Verified DCD changes associated with this RAI response are identified in the enclosed DCD markups by enclosing the text within a black box. The marked-up pages may contain unverified changes in addition to the verified changes resulting from this RAI response. Other changes shown in the markup(s) may not be fully developed and approved for inclusion in DCD Revision 5.**

NRC RAI 9.4-31

A. *In DCD Tier 2, Revision 3, Section 9.4.1, the applicant stated that the emergency filter unit (EFU) was operated from the safety-related battery supply for a 72-hour duration. In Section 19A.3.1.3, it is stated that "for longer term operation, the system can be powered from a small, portable AC power generator that is kept on the plant site."*

   Is this portable generator dedicated to the EFU system as a power source? Please clarify how many portable generators are provided for this purpose. If there is only one, what actions would be needed to restore power to the EFU? What are the testing requirements and reliability goals for the portable generator system under the RTNSS Program? Are there conveniently located isolation busses provided where the portable generator can be hooked up to provide power to the EFU? Does this portable generator also power the chiller and recirculation AHU that is necessary to restore temperature control in the control room habitability area (CRHA)?

B. *In DCD Tier 2, Revision 3, Section 19A.8.4.12, it is stated that the "portable AC generator that recharges the batteries that power the control room habitability area ventilation is not risk significant ..." The EFU is operated from one of the four safety-related battery trains.*

   Would this portable AC generator be hooked up to recharge one or more of these trains after 72 hours? Explain how GDC 19 is met if the loss of the portable AC generator results in the loss of the EFU.

GEH Response

A. Operation of the CRHAVS system is described in DCD Tier 2, Revision 4, Subsection 9.4.1 and Section 6.4. The EFU fans are automatically started following an event, and if offsite or standby diesel power is unavailable, are powered by a safety-related battery. In addition, backup power to each 100% capacity EFU fan can be provided by its respective ancillary diesel generator. These ancillary diesel generators were evaluated by design change and provide the function of the small portable AC generator previously referenced in DCD Tier 2 Revision 3, Subsection 9.4.1 as described under RAI.14.3-219 (MFN 08-086, Supplement 8 dated March 5, 2008). In addition to supplying power to the EFU fans, the ancillary diesel generators provide power to the PCC vent fans, Main Control Room A/C units, reactor pressure vessel makeup fill (FPS/FAPCS) and other auxiliary loads.

The two ancillary diesel generators automatically start on a loss of all AC power. This provides assurance that AC power to the EFU fans is restored before the safety-related batteries become exhausted. The ancillary diesel generators are credited with supporting operation of the EFU fans after 72 hours from the start of the event. This is a nonsafety-related function that satisfies the criteria for Regulatory Treatment of Non-Safety Systems (RTNSS).

Design Commitment and Inspection, Tests and Analyses, and Acceptance Criteria (ITAAC) are provided addressing the specific RTNSS functions credited for the CRHAVS in Tier 1 of the DCD.

Design Commitment, Inspections, Tests, Analysis and RTNSS Acceptance Criteria associated with the ancillary diesel generators will be described in DCD Tier 2 Chapter 8 and included under DCD Tier 1 Revision 5, Table 2.13.4, Standby On Site Power Supply.

The ancillary diesel generators provide power to their own buses to provide backup AC power to the EFU fans and other RTNSS loads described above. These ancillary diesel generators do not power the control room chiller but will support cooling of the control room using an auxiliary air conditioning unit and the recirculation AHU.

B. The ancillary diesel generators may be aligned to power the four divisions of Q-DCIS (without charging the divisional 250 vdc batteries). Each ancillary diesel generator powered bus supplies its respective EFU. The failure of one ancillary diesel generator will not affect the EFU supplied by the other bus.

10 CFR 50 Appendix A, GDC 19, "Control Room," requires that a control room be provided from which actions can be taken to operate the nuclear reactor safely under normal conditions and to maintain the reactor in a safe condition under accident conditions, including a LOCA. DCD Tier 2, Chapter 19A, "Regulatory Treatment Of Non-Safety Systems (RTNSS)," states that the ESBWR is designed so that passive systems are able to perform all safety functions for 72 hours after an initiating event without the need for active systems or operator actions. After 72 hours, nonsafety-related systems can be used to replenish the passive systems or to perform safety and post-accident recovery functions directly. The ancillary diesel generators are designated as RTNSS requiring additional regulatory oversight because of the necessity of maintaining control room habitability and supporting additional RTNSS functions described in (A) above. Redundant ancillary diesel generators are installed, therefore failure of both ancillary diesel generators resulting in loss of EFU power is considered to be unlikely. These measures will ensure that GDC 19 will be met in the case of a postulated failure of one of the ancillary diesel generators.

DCD Impact

DCD Tier 1, Table 2.16.2-6 is revised in Revision 5 to remove the ITAAC associated with the small portable AC generator previously included in response to RAI 14.3-219 (MFN 08-086, Supplement 8 dated March 5, 2008) as reflected in the attached markup.

DCD Tier 1, Subsection 2.16.2.3 is revised in Revision 5 to delete ITAAC number 9 to reflect removal of the portable AC generator. This is provided in the attached markup.

DCD Tier 2, Subsections 9.4.1.1 and 9.4.1.2 are revised in Revision 5 to reflect that the EFU controls and power are provided through Q-DCIS and reflect the addition of the ancillary diesel generators to provide post 72 hour power to the EFU fan system as shown in the attached markup.

DCD Tier 2, Subsection 6.4.4 is revised in Revision 5 to reflect the addition of the ancillary diesel generators to provide post 72 hour power to the EFU fan system as reflected in the attached markup.

b. The in-leakage does not exceed the unfiltered in-leakage assumed by control room operator dose analysis.

(6) The powered EFU dampers can be remotely operated from the MCR.

(7) EFUs meet the in-place leakage testing requirements of ASME AG-1 and RG 1.52.

(8) Indications and controls for the safety-related components of the EFU system as indicated in Table 2.16.2-5 are available in the MCR.

(9) ~~The dedicated portable AC generator(s), available on site, is capable of providing post 72-hour power to the EFU fan system.~~Deleted

(10) EFUs are tested to meet RG 1.52 requirements for HEPA and carbon filter efficiency.

(11) The standby EFU starts on a low flow signal from the operating EFU.

(12) EFUs maintain habitable conditions in the CRHA for 72 hours.

(13) EFU software that controls the safety-related EFU components is developed in accordance with the software development program described in Section 3.2.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.16.2-6 provides the design commitments, inspections, tests, analyses and acceptance criteria for the EFUs.

2.16.2.4 Turbine Building HVAC System

Design Description

The Turbine Building Ventilation System (TBVS) is nonsafety-related. The TBVS includes the Turbine Building supply air fans and associated AHUs, and the Turbine Building exhaust fans and associated filter trains.

The Turbine Building Ventilation System is designed to minimize exfiltration of air to adjacent areas by maintaining a slightly negative pressure in the Turbine Building (by exhausting more air than is supplied) relative to adjacent areas.

(1) The basic configuration of the Turbine Building Ventilation System (TBVS) is as described in Subsection 2.16.2.4.

(2) The TBVS provides post 72-hour cooling for DCIS in the Turbine Building and room cooling for the Nuclear Island Chilled Water System and RCCW pumps.

Inspections, Tests, Analyses and Acceptance Criteria

Table 2.16.2-7 provides the design commitments, inspections, tests, analyses and acceptance criteria for the Turbine Building HVAC System.

2.16.2.5 Fuel Building HVAC System

Design Description

The Fuel Building HVAC system (FBVS) does not perform any safety-related functions, except for automatic isolation of the Fuel Building ventilation systems to mitigate the consequences of fuel handling accidents with significant radiological releases. The Fuel Building HVAC

Table 2.16.2-6

ITAAC For Emergency Filter Units

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
7. EFUs meet the in-place leakage testing requirements of ASME AG-1 and RG 1.52.	EFUs will be in-place leak tested in accordance with ASME AG-1, Section TA, to meet the requirements of RG 1.52.	Test report(s) document that the as-built EFUs meet the acceptance criteria for in-place testing per RG 1.52 when tested in accordance with RG 1.52 and ASME AG-1, Section TA.
8. Indications and controls for the safety-related components of the EFU system as indicated in Table 2.16.2-5 are available in the MCR.	Inspection of the MCR will be performed to verify that the safety-related functions of the EFU system are available.	Inspection report(s) document that indications and controls for the safety-related components of the EFU system as indicated in Table 2.16.2-5 are available in the MCR.
9. ~~The dedicated portable AC generator(s), available on site, is capable of providing post 72-hour power to the EFU fan system.~~Deleted	~~Inspection will be performed to verify that the dedicated portable AC generator(s) is available on site.~~Deleted	~~Inspection report(s) document that the dedicated portable AC generator(s), capable of providing post 72-hour power to the EFU fan system, is physically located on site.~~Deleted
10. EFUs are tested to meet RG 1.52 requirements for HEPA and carbon filter efficiency.	a. Each charcoal adsorber will be tested in accordance with ASME AG-1, Section FE; and Regulatory Guide 1.40. b. HEPA filters will be tested in accordance with ASME AG-1, Section FC.	a. Test report(s) document that the as-built EFU filter efficiency meet the acceptance criteria for in-place testing in accordance with ASME AG-1.

The following isolation dampers penetrate the CRHA boundary envelope as shown on Figure 6.4-1:

a. Smoke purge intake CRHA isolation dampers, two (2) dampers.

b. Normal Outside Air Intake Supply CRHA isolation dampers, two (2) dampers.

c. Restroom exhaust CRHA isolation dampers, two (2) dampers.

d. Smoke purge exhaust CRHA isolation dampers, two (2) dampers.

e. EFU supply CRHA isolation dampers, two (2) dampers per division, total of four (4) dampers.

Interaction With Other Zones and Pressure-Containing Equipment

During normal operation the CRHA is heated, cooled, ventilated, and pressurized by either of a redundant set of recirculating air handling units and either of a redundant set of outside air intake fans for ventilation and pressurization purposes. See Figure 6.4-1 and Subsection 9.4.1 for a complete description of the CRHAVS.

During a radiological event or an SBO, the EFU maintains a positive pressure in the CRHA to minimize infiltration of airborne contamination. Interlocked double-vestibule type doors maintain the positive pressure, thereby minimizing infiltration when a door is opened.

The CRHA remains habitable during emergency conditions. To make this possible, potential sources of danger such as steam lines, pressure vessels, CO_2 fire fighting containers, etc. are located outside of the CRHA.

6.4.4 System Operation Procedures

The CRHA emergency habitability portion of the CRHAVS is not required to operate during normal conditions. The normal operation of the CRHAVS maintains the air temperature of the CRHA within a predetermined temperature range. This maintains the CRHA emergency habitability system passive heat sink at or below a predetermined temperature. The normal operation portion of the CRHAVS operates during all modes of normal power plant operation, including startup and shutdown. For a detailed description of the CRHAVS operation see Subsection 9.4.1.

The COL Applicant will verify procedures and training for control room habitability address the applicable aspects of NRC Generic Letter 2003-01 and are consistent with the intent of Generic Issue 83 (COL 6.4-1-A).

Emergency Mode

Operation of the emergency habitability portion of the CRHAVS is automatically initiated by either of the following conditions:

- High radioactivity in the main control room supply air duct, and
- Extended Loss of AC power.

Operation can also be initiated by manual actuation. Upon receipt of a high radiation level in the main control room supply air duct exceeding the setpoint, the normal outside air intake and restroom exhaust are isolated from the CRHA pressure boundary by automatic closure of the isolation dampers in the system ductwork. At the same time, one of the EFU automatically starts and begins to deliver filtered air from one of the two unique safety-related outside air intake locations. A constant air flow rate is maintained and this flow rate is sufficient to pressurize the CRHA boundary to at least 31 Pa (1/8-inch water gauge) positive differential pressure with respect to the adjacent areas. The EFU system air flow rate is also sufficient to supply the fresh air requirement of 9.5 l/s (20 cfm) per person for up to 21 occupants. (Ref~~. ASHRAE Standard 62~~erence 6.4-3).

With a source of AC power available, the EFU can operate and is controlled indefinitely through Q-DCIS. In the event that offsite or standby diesel~~AC Q-DCIS~~ power is not available, the safety-related battery power supply is sized to provide the required power to the operating EFU fan for 72 hours of operation. For longer-term operation, from ~~after~~ post 72 hrs ~~out to 7 days~~ each EFU fan is powered via an electrical bus supplied by one (1) of two (2) ancillary diesel generators~~, a small portable AC power generator that is kept on the plant site can power the EFU fan system~~. The temperature and humidity in the CRHA pressure boundary following a loss of the normal portion of the CRHAVS remain within the limits for reliable human performance (References 6.4-1 and 6.4-2) over a 72-hour period. The CRHA isolation dampers fail as is on a loss of AC power or instrument air.

Backup power to the safety-related Control Room (CR) EFU fans (post 72 hours) if off site or standby diesel power~~Q-DCIS~~ is not available is provided by ~~a small portable dedicated electrical~~ two (2) ancillary diesel generators. These~~is~~ generators are~~is~~ required to support operation of the Control Room EFU beyond 72 hours ~~through 7 days~~ after an accident. This function is a nonsafety-related function that satisfies the significance criteria for Regulatory Treatment of NonSafety Systems. ~~This AC power generator is kept on the plant site to power the EFU fan system.~~ For a period between 7 days out to 30 days, the EFU can be powered from either off-site power, onsite diesel generator powered PIP bus, or by continued use of the ~~small AC power~~ ancillary diesel generators. The requirements for the ~~CRHAVS portable~~ ancillary generators are described in Appendix 19A.

Upon a loss of preferred power or SBO, the initial ranges of temperature/relative humidity in the CRHA are 22.8 – 25.6°C (73 - 78°F) and 25% - 60% RH. During the first two hours of an SBO, most of the equipment in the MCR remains powered by the nonsafety-related battery supply. After two hours, the nonsafety-related batteries are exhausted, and only a small amount of safety-related equipment remains powered. During the first two hours the environmental conditions are maintained within the normal ranges listed above. This is accomplished via the continued operation of a CRHA recirculation AHU and chilled water pump powered from the same nonsafety-related battery supply that powers the non-safety MCR equipment. Chilled water from a chilled water thermal storage tank is utilized as the heat sink. The cooling function for this two hour period is not a safety function, if this cooling function is lost, the nonsafety-related equipment and their associated heat loads are automatically de-energized.

If power remains unavailable beyond two hours, the remaining CRHA safety-related equipment heat loads are dissipated passively to the CRHA heat sink. The CRHA heat sink limits the temperature rise to that listed in Table 6.4-1. The CRHA is passively cooled by conduction into the walls and ceiling. Sufficient thermal mass is provided in the walls and ceiling of the main control room to absorb the heat generated by the equipment, lights, and occupants.

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, post ~~from after~~ 72 hrs ~~out to 7 days, a small portable AC power generator that is kept on the plant site~~ either of two (2) ancillary diesel generators can power either ~~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 EFU maintains the habitability of the CRHA when RTNSS power supplies are available.

Power Generation Design Bases

The CBVS:

- Provides a controlled environment for personnel comfort and safety. Sufficient outside air is provided to meet the ventilation requirements for acceptable indoor air quality (Ref. ASHRAE 62-2001, Table 2). Table 9.4-1 depicts the area design temperature and humidity design parameters.
- Provides a controlled environment for the proper operation and integrity of equipment in the Control Building during normal, startup and shutdown operations;

The EFU provides sufficient quality air to maintain positive pressure in the CRHA when the CRHA envelope is radiologically isolated. An EFU is automatically actuated when the CRHA envelope is radiologically isolated. Controls to manually isolate the CRHA envelope and to manually actuate the EFUs are also provided.

The CBGAVS consists of:

- Two sets of two 100% capacity supply AHUs;
- Two sets of two 100% capacity return/exhaust fans; and
- Supplemental electric duct heaters.

The CBGAVS serves non-divisional equipment rooms, corridors and other miscellaneous rooms in the Control Building general areas. Set A serves Division I and IV areas. Set B serves Division II and III areas. Each set is configured as a recirculation system that incorporates a common supply and return duct system for the distribution of conditioned air. During normal operation air travels through the AHU stages. Particulates are removed from the air by low and high efficiency filters. Heat is transferred between the air and the heating elements and cooling coils. The outside air intake and exhaust are adjusted to maintain a slightly positive pressure in the Control Building general areas.

System Operation

The CBVS operates during all modes of normal power plant operation, including startup and shutdown. The CBVS is not required to operate during an SBO except the EFUs and the CRHAVS isolation dampers. The CRHA isolation dampers fail closed on a loss of power or instrument air. During a SBO or an event that causes isolation of the CRHA envelope, the CRHA isolation dampers automatically close and the EFU is automatically actuated Upon an isolation of the CRHA envelope, the EFU operates and is controlled indefinitely through the Q-DCIS ~~from an AC power~~ source, or up to 72 hours from the safety-related battery supply. For longer-term operation, from ~~after~~post 72 hrs ~~out to 7 days, a small portable AC power generator that is kept on the plant site can~~two (2) ancillary diesel generators power the EFU fan system. Also, a Recirculation AHU continues operation to maintain the CRHA environment upon the initiation of a CRHA isolation. A Recirculation AHU operates for the first two hours of a SBO; otherwise, certain nonsafety-related heat loads are automatically de-energized. Rooms containing safety-related equipment are passively cooled by heat transfer to the CRHA heat sink for the first 72 hours of a SBO to limit the temperature rise to the maximum temperature limits listed in Table 9.4-1.

Normal Operating Mode:

- Each subsystem of the CBVS is fully operational with one train of its redundant equipment on standby.
- The CRHAVS and CBGAVS operate with one outside AHU and one exhaust/return fan (CBGAVS only) in operation to maintain design conditions in the respective areas served. The outside air intakes and exhausts (CBGAVS only) are adjusted to maintain a slightly positive pressure in the CRHA and CBGA.
- The CRHAVS maintains normal design conditions in the CRHA. One Recirculation AHU and one outside air intake fan are manually selected to start and cause the