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Proprietary Notice
This letter forwards proprietary information in accordance with 10CFR2.390. Upon the removal of Enclosure 1, the balance of this letter may be considered non-proprietary.

MFN 09-776 Supplement 2

Docket No. 52-010

January 31, 2010

U.S. Nuclear Regulatory Commission
Document Control Desk
Washington, D.C. 20555-0001

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 405 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-24 S01 Parts 2, 3, and 4**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to a portion of the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by the Reference 1 NRC letter. The GEH response to Parts 2, 3, and 4 of RAI Number 6.4-24 S01 is provided in Enclosure 1 and contains GEH proprietary information as defined by 10 CFR 2.390. GEH customarily maintains this information in confidence and withholds it from public disclosure. Enclosure 2 is the non-proprietary version, which does not contain proprietary information and is suitable for public disclosure. The GEH response to Part 1 of RAI Number 6.4-24 S01 was provided in Reference 2.

Enclosure 3 contains markups to DCD Tier 1 and Tier 2 as noted in the Enclosure 1 response.

The affidavit contained in Enclosure 4 identifies that the information contained in Enclosure 1 has been handled and classified as proprietary to GEH. GEH hereby requests that the information of Enclosure 1 be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390 and 9.17.

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

D068
NRO

Sincerely,

Stephen C Moen
for Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

References:

1. MFN 10-011, Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request for Additional Information Letter No.405 Related to ESBWR Design Certification Application,* January 11, 2010
2. MFN 09-776 Supplement 1, Letter from Mr. Richard E. Kingston to U.S. Nuclear Regulatory Commission, *Response to Portion of NRC Request for Additional Information Letter No. 405 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-24 S01 Part 1*, January 22, 2010

Enclosures:

1. MFN 09-776 Supplement 2 - Response to Portion of NRC Request for Additional Information Letter No. 405 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-24 S01 Parts 2, 3, and 4 – **GEH Proprietary Information**
2. MFN 09-776 Supplement 2 - Response to Portion of NRC Request for Additional Information Letter No. 405 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-24 S01 Parts 2, 3, and 4 – **Public Version**
3. MFN 09-776 Supplement 2 - Response to Portion of NRC Request for Additional Information Letter No. 405 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-24 S01 Parts 2, 3, and 4 – **Markups to ESBWR DCD Tier 1 and Tier 2**
4. MFN 09-776 Supplement 2 - Response to Portion of NRC Request for Additional Information Letter No. 405 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-24 S01 Parts 2, 3, and 4 – **Affidavit**

cc:	AE Cubbage	USNRC (with enclosures)
	JG Head	GEH (with enclosures)
	DH Hinds	GEH (with enclosures)
	SC Moen	GEH (with enclosures)
	eDRFsection	0000-0112-7692

Enclosure 2

MFN 09-776 Supplement 2

Response to Portion of NRC Request for

Additional Information Letter No. 405

Related to ESBWR Design Certification Application

Engineered Safety Features

RAI Number 6.4-24 S01 Parts 2, 3, and 4

Public Version

NRC RAI 6.4-24 S01

Justify use of psychometric wet bulb as a valid means to assess heat stress in the ESBWR CRHA, Alternatively amend DCD to provide a heat stress acceptance criterion and index that is in accordance with NUREG-0700 guidance. Provide demonstration that such criterion can be met for the ESBWR environmental footprint. Clarify associated ITAAC.

In letter MFN 09-776, dated December 16, 2009, GEH responded to staff RAI 6.4-24 which requested GEH to justify its proposed CRHA heat stress index and to submit a supporting demonstration that the proposed acceptance criteria using such index would not be exceeded for any location in the proposed ESBWR site envelope. Appendix A of Enclosure 1 of the response contained a supporting sensitivity study. NRC staff has reviewed the RAI response and sensitivity study.

The following additional information is needed.

1. In response to RAI 6.4-24 item number one, GEH stated that the psychometric wet bulb temperature is used as the basis for determining heat stress in the CRHA. The staff views this as an "alternate method" to the NRC guidance in Section 12.2.5.1 of NUREG- 0700 which addresses heat stress in terms of the WBGT index.

While the use of this alternate method may be acceptable, GEH did not provide a necessary and sufficient demonstration of equivalency between WBGT and psychometric wet bulb temperatures for the range of expected control room environmental conditions. The staff understands that psychometric wet bulb measurement may be applicable to control room conditions but that does not provide a sufficient evaluation of why it is better than or equal to WBGT.

The staff requests that GEH provide additional information, including relevant test data that explains why the psychometric wet bulb temperature is an acceptable alternative for WBGT index.

Alternatively, GEH may propose a revised human performance measurement method in terms of the WBGT index and provide an associated acceptance criterion. Revise the DCD accordingly. Discuss how NUREG -0700 guidance for workplace design, particularly Engineering Controls, Work Practices and Water Replacement are addressed in the DCD.

2. In response to Item number two to RAI 6.4-24, GEH described a sensitivity study with different input assumptions than the DB model. There were eight (8) differences listed. Significant differences include a much lower heat load assumed in this sensitivity run (7630 W used instead of 9630 W). Notwithstanding the accompanying explanation on why lower heat loads and higher heat sink temperatures were chosen, the differences in CRHA design and input conditions from that of the design basis make it incomparable with the current CRHA design and performance requirements specified in the DCD. The staff's expectations is that ITAAC demonstration of the heat stress acceptance criterion would be done with the same design-specific input assumptions and preconditions as those used to demonstrate the CRHA bulk temperature acceptance criterion. The staff requests that GEH provide a similar study that demonstrates that the ESBWR CRHA meets a proposed heat stress acceptance criterion, using an suitable heat stress index, for staff review that uses:

a. The same CRHA initial temperature and humidity as the DB analysis

b. The same internal heat loads as the DB analysis

c. The same number of CRHA personnel as the DB analysis

d. The same EFU flow rate as the DB analysis.

e. The same assumptions for heat transfer as the DB analysis.

f. The same initiating preconditions "abnormal functions" as the DB analysis.

3. The outside air input conditions chosen in the sensitivity study are not sufficient to demonstrate that the ESBWR CRHA would achieve 86 deg F or lower wet bulb in the CRHA for any site in the chapter 2 environmental footprint at the end of the 72 hour period.

a. The chosen outside air atmospheric conditions is 88 °F wet bulb temperature (as specified in chapter 2, Table 2.0-1of the DCD) coincident with 88 °F dry bulb (chosen by GEH). The chosen 20°F diurnal swing magnitude and direction allowed the temperature to drop to 68 °F. The staff believes that any diurnal swing should be in the conservative direction (to a higher coincident dry bulb temperature) with respect to the 88 °F wet bulb temperature. For example, a coincident dry bulb of 96 °F (the 2 percent exceedance dry bulb) would be more rational and justifiable input condition. Using this example would result in the need to specify an 8 degree diurnal swing. Submit a sensitivity study with a diurnal temperature swing in a direction that is conservative with respect to the DCD chapter 2 environmental footprint.

Please provide an updated sensitivity study that addresses 2) and 3) above.

4. GEH has added an ITAAC to demonstrate the proposed human performance acceptance criterion in the as-built CRHA will not be exceeded (CRHA average wet bulb temp will be less than of 86°F), using as built site environmental envelope conditions. However the DC environmental footprint permits a site-specific non coincident wet bulb criterion, (such as 88°F in chapter 2 of the DCD) coincident with a dry bulb range of 88 °F (for the DB case) to the corresponding site specific noncoincident dry bulb temperature (such as 116.99°F for the DB case). By clearly defining the magnitude and direction of the diurnal temperature swing, ITAAC 2.16.2-4 Item iii would establish a rational basis for the input ventilation load, and would provide a basis to conclude that the ITAAC would demonstrate that the as built design will satisfy the humidity acceptance criterion for any location in the ESBWR footprint. Please revise the ITAAC and DB analysis to address the following:

a. ITAAC 2.16.2-4 Item iii should be revised to indicate the use of the 0 percent exceedance noncoincident wet bulb temperature as indicated in DCD chapter 2 Table 2.0-1, as updated to the site specific value. It should also be clarified to indicate that the chosen corresponding diurnal swing will be such that the corresponding dry bulb temperature that corresponds to this wet bulb temperature, will be the lowest dry bulb temperature reached in the swing.

<u>GEH Response</u>

NRC Request:

1. In response to RAI 6.4-24 item number one, GEH stated that the psychometric wet bulb temperature is used as the basis for determining heat stress in the CRHA. The staff views this as an "alternate method" to the NRC guidance in Section 12.2.5.1 of NUREG- 0700 which addresses heat stress in terms of the WBGT index.

While the use of this alternate method may be acceptable, GEH did not provide a necessary and sufficient demonstration of equivalency between WBGT and psychometric wet bulb temperatures for the range of expected control room environmental conditions. The staff understands that psychometric wet bulb measurement may be applicable to control room conditions but that does not provide a sufficient evaluation of why it is better than or equal to WBGT.

The staff requests that GEH provide additional information, including relevant test data that explains why the psychometric wet bulb temperature is an acceptable alternative for WBGT index.

Alternatively, GEH may propose a revised human performance measurement method in terms of the WBGT index and provide an associated acceptance criterion. Revise the DCD accordingly. Discuss how NUREG -0700 guidance for workplace design, particularly Engineering Controls, Work Practices and Water Replacement are addressed in the DCD.

GEH Response:

Item 1 has been addressed in MFN 09-776 Supplement 1, dated January 22, 2010, RAI Number 6.4-24 S01 Part 1.

NRC Request:

2. In response to Item number two to RAI 6.4-24, GEH described a sensitivity study with different input assumptions than the DB model. There were eight (8) differences listed. Significant differences include a much lower heat load assumed in this sensitivity run (7630 W used instead of 9630 W). Notwithstanding the accompanying explanation on why lower heat loads and higher heat sink temperatures were chosen, the differences in CRHA design and input conditions from that of the design basis make it incomparable with the current CRHA design and performance requirements specified in the DCD. The staff's expectations is that ITAAC demonstration of the heat stress acceptance criterion would be done with the same design-specific input assumptions and preconditions as those used to demonstrate the CRHA bulk temperature acceptance criterion. The staff requests that GEH provide a similar study that demonstrates that the ESBWR CRHA meets a proposed heat stress acceptance criterion, using an suitable heat stress index, for staff review that uses:

a. The same CRHA initial temperature and humidity as the DB analysis

b. The same internal heat loads as the DB analysis

c. The same number of CRHA personnel as the DB analysis

d. The same EFU flow rate as the DB analysis.

e. The same assumptions for heat transfer as the DB analysis.

f. The same initiating preconditions "abnormal functions" as the DB analysis.

GEH Response:

A similar CRHA heat up analysis has been performed that uses the same input assumptions and methodology as the design basis analysis (NEDE- 33536P), including the inputs from items a through f above, with the exception of the outside air conditions. The outside air conditions used in the analysis are described in item 3 in this RAI response. The analysis results in a CRHA maximum bulk average Wet Bulb Globe

Temperature (WBGT) of 31.1°C (88.1°F), which is less than the acceptance criteria of 32.2°C (90°F). The dry bulb temperature and humidity profiles for the sensitivity calculation are shown Figure 6.4-24S01-1P2.

[[..(3)]]

Figure 6.4-24S01-1P2

NRC Request:

3. The outside air input conditions chosen in the sensitivity study are not sufficient to demonstrate that the ESBWR CRHA would achieve 86 deg F or lower wet bulb in the CRHA for any site in the chapter 2 environmental footprint at the end of the 72 hour period.

a. The chosen outside air atmospheric conditions is 88 °F wet bulb temperature (as specified in chapter 2, Table 2.0-1 of the DCD) coincident with 88 °F dry bulb (chosen by GEH). The chosen 20°F diurnal swing magnitude and direction allowed the temperature to drop to 68 °F. The staff believes that any diurnal swing should be in the conservative direction (to a higher coincident dry bulb temperature) with respect to the 88 °F wet bulb temperature. For example, a coincident dry bulb of 96 °F (the 2 percent exceedance dry bulb) would be more rational and justifiable input condition. Using this example would result in the need to specify an 8 degree diurnal swing. Submit a sensitivity study with a diurnal temperature swing in a direction that is conservative with respect to the DCD chapter 2 environmental footprint.

Please provide an updated sensitivity study that addresses 2) and 3) above.

GEH Response:

A conservative dry bulb diurnal swing magnitude and direction, for the analysis in item 2, has been chosen based on climatological data.

An evaluation of the diurnal dry bulb and wet bulb temperature swings under humid conditions was performed. General information on the areas with the most hot/humid temperatures in the US was obtained from "Wet-Bulb Globe Temperature, A Global Climatology", USAF, October 1990. According to the report the US gulf coast has the highest Wet Bulb Globe Temperatures (WBGT). There is an isotherm of 32.2°C (90°F) WBGT encircling Bay City Texas to the Florida panhandle. The southeast has high wet bulb temperatures. The ASHRAE Fundamentals 2005 Handbook was used to obtain the maximum wet bulb temperature at a sample of nuclear plant sites, including ESBWR COLA sites.

Detailed climatological data from three weather stations was obtained from the National Oceanic and Atmospheric Administration (NOAA). The stations selected were Pensacola, FL; Corpus Christi, TX; and Baton Rouge, LA. Although Corpus Christi is not within the 32.2°C (90°F) WBGT isotherm, the data was considered because data obtained from a previous review of world humidity data indicated it has a high wet bulb temperature. Pensacola and Baton Rouge are within the 32.2°C (90°F) WBGT isotherm, and reflect some of the highest wet bulb temperature readings located near existing nuclear sites. Note that digital Local Climatological Data reports are not available for the nuclear plant sites because they are located remote from major cities. The three cities selected are the closest available to potential sites for which digital climatological data is available. It is not necessary to search all the US meteorological stations for the absolute highest wet bulb conditions because a site specific evaluation will be performed as noted in DCD Tier 1 Table 2.16.2-4 Item 4.

During July of 1980, a heat wave swept the southeast US, which resulted in historically high wet bulb temperatures. Data from Pensacola, FL was examined where the wet bulb temperature reached 31.1°C (88°F) on 13-July-1980, and the average dew point on that day was 26.1°C (79°F), the high for the month. This value was again reached two days later, on 15-July-1980 (these were the 2 highest average dew point days).

The period including 72 hours prior and following the high wet bulb temperature was evaluated to find the period with highest wet bulb and WBGT temperatures. The 72 hour period with the highest wet bulb and WBGT temperatures begins at 12 July 1980, 18:00 hrs. There are three overnight lows in wet bulb and dry bulb temperature, occurring at 06:00 hrs. The highest low in wet bulb temperature is 27.2°C (81°F), with a corresponding 28.9°C (84°F) dry bulb temperature. The other two lows are 26.7°C (80°F) wet bulb temperature with a corresponding 29.4°C (85°F) dry bulb temperature.

A simplified diurnal swing encompassing the highest wet bulb high and highest wet bulb low is 33.3°C (92°F) dry bulb/31.1°C (88°F) wet bulb and 28.9°C (84°F) dry bulb/28.9°C (84°F) wet bulb, which is a dry bulb temperature swing of 4.4°C (8°F).

The simplified diurnal swing was determined using the following method. The maximum and the minimum wet bulb temperatures were determined for the worst three day period over which the 0% exceedance wet bulb temperature occurs, which includes the maximum three day average dew point and wet bulb temperature. The coincident dry bulb temperature (33.3°C/92°F) for the maximum wet bulb temperature (31.1°C/88°F) is taken as the maximum dry bulb and wet bulb temperatures for three days. The coincident dry bulb temperature (28.9°C/84°F) for the highest overnight low wet bulb temperature (27.2°C/81°F) over the three day period is taken as the minimum dry bulb temperature. The overnight low wet bulb temperature in the CONTAIN analysis is 28.9°C (84°F), which is conservative relative to the 27.2°C (81°F) wet bulb temperature. The difference between the coincident maximum dry bulb temperature (33.3°C/92°F) and the highest overnight low dry bulb temperature (28.9°C/84°F) is used as the diurnal swing. The diurnal swing determined by this method is referred to as the High Humidity Diurnal Swing.

The details of the requested sensitivity study, which contains the High Humidity Diurnal Swing, are conservative with respect to the DCD Chapter 2 environmental footprint based on climatological data. This evaluation applied the peak wet bulb temperature of 31.1°C (88°F) for the 72 hour period considered. These details are contained in this RAI response submittal and have been added to the DCD as shown in the attached markups.

NRC Request:

4. GEH has added an ITAAC to demonstrate the proposed human performance acceptance criterion in the as-built CRHA will not be exceeded (CRHA average wet bulb temp will be less than of 86°F), using as built site environmental envelope conditions. However the DC environmental footprint permits a site-specific non coincident wet bulb criterion, (such as 88°F in chapter 2 of the DCD) coincident with a dry bulb range of 88 °F (for the DB case) to the corresponding site specific noncoincident dry bulb temperature (such as 116.99°F for the DB case). By clearly defining the magnitude and direction of the diurnal temperature swing, ITAAC 2.16.2-4 Item iii would establish a rational basis for the input ventilation load, and would provide a basis to conclude that the ITAAC would demonstrate that the as built design will satisfy the humidity acceptance criterion for any location in the ESBWR footprint. Please revise the ITAAC and DB analysis to address the following:

a. ITAAC 2.16.2-4 Item iii should be revised to indicate the use of the 0 percent exceedance noncoincident wet bulb temperature as indicated in DCD chapter 2 Table 2.0-1, as updated to the site specific value. It should also be clarified to indicate that the chosen corresponding diurnal swing will be such that the corresponding dry bulb temperature that corresponds to this wet bulb temperature, will be the lowest dry bulb temperature reached in the swing.

GEH Response:

The 0% exceedance non-coincident wet bulb temperature and corresponding dry bulb temperature occurs during the hottest part of the day. Therefore the lowest dry bulb temperature in the diurnal swing is lower than the dry bulb temperature that corresponds to the 0% exceedance wet bulb temperature. A conservative diurnal swing has been determined and added to the DCD as shown in the attached markups.

DCD Tier 1 ITAAC 2.16.2-4 Item iii has been revised as shown in the attached markup to indicate the 0% Exceedance Value for wet bulb (non-coincident) temperature, as indicated in DCD Tier 2 Chapter 2 Table 2.0-1, is used in the analysis. This value can be updated to the site specific value by the COL applicant via DCD Tier 2 Section 2.0-1-A. Additionally, ITAAC 2.16.2-4 Item iii has been revised to clarify that the High Humidity Diurnal Swing is used in the analysis as described in item 2 of this RAI response. The method for determining the High Humidity Diurnal Swing has been added to DCD Tier 2 Appendix 3H as shown in the attached markups.

DCD Impact

No changes to GE-Hitachi Nuclear Energy, "Control Building and Reactor Building Environmental Temperature Analysis for ESBWR," NEDE-33536P, Class III (Proprietary), Revision 0, December 2009, NEDO-33536, Class I (Non-proprietary), Revision 0, December 2009 will be made in response to this RAI.

DCD Tier 2, Section 3H.3.2.1 will be revised as noted in the attached markup.

DCD Tier 2, Table 3H-14 will be revised as noted in the attached markup.

DCD Tier 2, Table 3H-15 will be revised as noted in the attached markup.

DCD Tier 2, Table 2.0-1 will be revised as noted in the attached markup.

DCD Tier 1, Table 2.16.2-4 will be revised as noted in the attached markup.

Enclosure 3

MFN 09-776 Supplement 2

Response to Portion of NRC Request for Additional Information Letter No. 405 Related to ESBWR Design Certification Application Engineered Safety Features RAI Number 6.4-24 S01 Parts 2, 3, and 4 Markups to ESBWR DCD Tier 1 and Tier 2

Table 2.16.2-4

ITAAC For The Control Building Habitability HVAC Subsystem

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	iii. A Control Building and Reactor Building Environmental Temperature Analysis for ESBWR will be performed using the as-built design inputs established in Table 2.16.2-4 Item 4i and using the ~~ESBWR~~ 0% ~~e~~Exceedance Value for wet bulb (non-coincident) temperature and corresponding ~~temperature~~High Humidity Diurnal ~~s~~Swing. A reconciliation analysis will be performed for the as-built features and heat loads, and limiting outdoor conditions.	iii. The CRHA maximum bulk average wet bulb globe temperature is 32.2° C (90.0° F) or less on a loss of active cooling for the first 72 hours following a design basis accident, given post design basis accident conditions and as reconciled to as-built features and heat loads, and to limiting outdoor conditions.
5. Independence is provided between safety-related divisions, and between safety-related divisions and nonsafety-related equipment.	i. Tests will be performed on CRHA isolation damper and EFU operation by providing a test signal in only one safety-related division at a time. ii. Inspection of the as-built safety-related divisions in the system will be performed.	i. The test signal exists only in the safety-related division under test in the as-built CRHA isolation damper and EFU control. ii. Physical separation and electrical isolation exists between as-built CRHA isolation dampers and EFU safety-related divisions. Physical separation or electrical isolation exists between safety-related divisions and nonsafety-related equipment as defined in RG 1.75.

Table 2.0-1

Envelope of ESBWR Standard Plant Site Parameters[1]

[*Maximum Ground Water Level:*	*0.61 m (2 ft) below plant grade*
Extreme Wind:	***Seismic Category I, II and Radwaste Building Structures*** *- 100-year Wind Speed (3-sec gust):* [13] *67.1 m/s (150 mph)* *- Exposure Category: D* ***Other Seismic Category NS Standard Plant Structures*** *- 50-year Wind Speed (3-sec gust): 58.1 m/s (130 mph)*
Maximum Flood (or Tsunami) Level: [2]	*0.3 m (1 ft) below plant grade*
Tornado:	*- Maximum Tornado Wind Speed:* [3] *147.5 m/s (330 mph)* *- Maximum Rotational Speed: 116.2 m/s (260 mph)* *- Translational Speed: 31.3 m/s (70 mph)* *- Radius: 45.7 m (150 ft)* *- Pressure Drop: 16.6 kPa (2.4 psi)* *- Rate of Pressure Drop: 11.7 kPa/s (1.7 psi/s)* *- Missile Spectrum:* [3] *Spectrum I of SRP 3.5.1.4, Rev 2 applied to full building height.*
Precipitation (for Roof Design):	*- Maximum Rainfall Rate:* [4] *49.3 cm/hr (19.4 in/hr)* *- Maximum Short Term Rate: 15.7 cm (6.2 in) in 5 minutes* *- Maximum Ground Snow Load* [5] *for normal winter precipitation event: 2394 Pa (50 lbf/ft²)* *- Maximum Ground Snow Load*[5] *for extreme winter precipitation event: 7757 Pa (162 lb/ft²)*
Ambient Design Temperature: [6]	***2% Annual Exceedance Values*** *- Maximum: 35.6°C (96°F) dry bulb* *26.1°C (79°F) wet bulb (mean coincident)* *27.2°C (81°F) wet bulb (non-coincident)* *- Minimum: -23.3°C (-10°F)* ***1% Annual Exceedance Values*** *- Maximum: 37.8°C (100°F) dry bulb* *26.1°C (79°F) wet bulb (mean coincident)* *27.8°C (82°F) wet bulb (non-coincident)* *- Minimum: -23.3°C (-10°F)* ***0% Exceedance Values*** *- Maximum: 47.2°C (117°F) dry bulb* *26.7°C (80°F) wet bulb (mean coincident)* *31.1°C (88°F) wet bulb (non-coincident)* *4.4°C (8°F) High Humidity Diurnal Swing* [17] *- Minimum: -40°C (-40°F)*

Table 2.0-1

Envelope of ESBWR Standard Plant Site Parameters[1] (continued)

Soil Properties: [16]	- *Minimum Static Bearing Capacity* [7]*: Greater than or equal to the maximum static bearing demand multiplied by a factor of safety appropriate for the design load combination.* - *Maximum Static Bearing Demand:* ~~(7)~~ *Reactor/Fuel Building:* 699 kPa (14,600 lbf/ft^2) *Control Building:* 292 kPa (6,100 lbf/ft^2) *Firewater Service Complex:* 165 kPa (3,450 lbf/ft^2 - *Minimum Dynamic Bearing Capacity* [7]*: Greater than or equal to the maximum dynamic bearing demand multiplied by a factor of safety appropriate for the design load combination.* - *Maximum Dynamic Bearing Demand (SSE + Static):* ~~(7)~~ *Reactor/Fuel Building:* *Soft:* 1100 kPa (23,000 lbf/ft^2) *Medium:* 2700 kPa (56,400 lbf/ft^2) *Hard:* 1100 kPa (23,000 lbf/ft^2) *Control Building:* *Soft:* 500 kPa (10,500 lbf/ft^2) *Medium:* 2200 kPa (46,000 lbf/ft^2) *Hard:* 420 kPa (8,800 lbf/ft^2) *Firewater Service Complex (FWSC):* *Soft:* 460 kPa (9,600 lbf/ft^2) *Medium:* 690 kPa (14,400 lbf/ft^2) *Hard:* 1200 kPa (25,100 lbf/ft^2 - *Minimum Shear Wave Velocity:* [8] 300 m/s (1000 ft/s) - *Liquefaction Potential:* *Seismic Category I Structures*: *None under footprint of Seismic Category I structures resulting from site-specific SSE.* *Other than Seismic Category I Structures*: *See Note (14)* - *Angle of Internal Friction (in-situ and backfill)*: $\geq$ 35 degrees - *Backfill on sides of and underneath Seismic Category I structures* ~~(not applicable if the fill material is concrete)~~ *Product of peak ground acceleration* α *(in g), Poisson's ratio* ν *and density* γ: $\alpha(0.95\nu+0.65)\gamma$: 1220 kg/m^3 (76 lbf/ft^3) maximum *Product of at-rest pressure coefficient* k_0 *and density:* $k_0\gamma$: 750 kg/m^3 (47 lbf/ft^3) minimum ~~At-rest pressure coefficient:~~ ~~k_0: 0.36 minimum~~ *Soil density:* γ: 2000~~1900~~ kg/m^3 (125~~119~~ lbf/ft^3) minimum

Table 2.0-1

Envelope of ESBWR Standard Plant Site Parameters[1] (continued)

Seismology:	*- SSE Horizontal Ground Response Spectra:* [9]	*See Figure 2.0-1*
	- SSE Vertical Ground Response Spectra: [9]	*See Figure 2.0-2*
Hazards in Site Vicinity:	*- Site Proximity Missiles and Aircraft:*	*< about 10^{-7} per year*
	- Volcanic Activity:	*None*
	- Toxic Gases:	*None **
* *Maximum toxic gas concentrations at the Main Control Room (MCR) HVAC intakes:*	*< toxicity limits*	
Required Stability of Slopes: [10]	*- Factor of safety for static (non-seismic) loading*	*1.5*
	- Factor of safety for dynamic (seismic) loading due to site-specific SSE	*1.1*
Maximum Settlement Values for Seismic Category I Buildings : [15]		
Maximum Settlement at any corner of basemat	*- Under Reactor/Fuel Building*	*103 mm (4.0 inches)*
	- Under Control Building	*18 mm (0.7 inches)*
	- Under FWSC Structure	*17 mm (0.7 inches)*
Averaged Settlement at four corners of basemat	*- Under Reactor/Fuel Building*	*65 mm (2.6 inches)*
	- Under Control Building	*12 mm (0.5 inches)*
	- Under FWSC Structure	*10 mm (0.4 inches)*
Maximum Differential Settlement along the longest mat foundation dimension	*- within Reactor/Fuel Building*	*77 mm (3.0 inches)*
	- within Control Building	*14 mm (0.6 inches)*
	- Under FWSC Structure	*12 mm (0.5 inches)*
Maximum Differential Displacement between Reactor/Fuel Buildings and Control Building		*85 mm (3.3 inches)*

Table 2.0-1

Envelope of ESBWR Standard Plant Site Parameters[1] (continued)

Meteorological Dispersion (X/Q): [11]	*EAB X/Q:*		
	0-2 hours:	*2.00E-03 s/m³*	
	LPZ X/Q:		
	0-8 hours:	*1.90E-04 s/m³*	
	8-24 hours:	*1.40E-04 s/m³*	
	1-4 days:	*7.50E-05 s/m³*	
	4-30 days:	*3.00E-05 s/m³*	
* *First value is for unfiltered inleakage. Second value is for air intakes (emergency and normal)*	*Control Room X/Q: **		
	Reactor Building		
	0-2 hours:	*1.90E-03 s/m³*	*1.50E-03 s/m³*
	2-8 hours:	*1.30E-03 s/m³*	*1.10E-03 s/m³*
	8-24 hours:	*5.90E-04 s/m³*	*5.00E-04 s/m³*
	1-4 days:	*5.00E-04 s/m³*	*4.20E-04 s/m³*
	4-30 days:	*4.40E-04 s/m³*	*3.80E-04 s/m³*
	Passive Containment Cooling System / Reactor Building Roof		
	0-2 hours:	*3.40E-03 s/m³*	*3.00E-03 s/m³*
	2-8 hours:	*2.70E-03 s/m³*	*2.50E-03 s/m³*
	8-24 hours:	*1.40E-03 s/m³*	*1.20E-03 s/m³*
	1-4 days:	*1.10E-03 s/m³*	*9.00E-04 s/m³*
	4-30 days:	*7.90E-04 s/m³*	*7.00E-04 s/m³*
	Blowout Panels / Reactor Building Roof		
	0-2 hours:	*7.00E-03 s/m³*	*5.90E-03 s/m³*
	2-8 hours:	*5.00E-03 s/m³*	*4.70E-03 s/m³*
	8-24 hours:	*2.10E-03 s/m³*	*1.50E-03 s/m³*
	1-4 days:	*1.70E-03 s/m³*	*1.10E-03 s/m³*
	4-30 days:	*1.50E-03 s/m³*	*1.00E-03 s/m³*
	Turbine Building		
	0-2 hours:	*1.20E-03 s/m³*	*1.20E-03 s/m³*
	2-8 hours:	*9.80E-04 s/m³*	*9.80E-04 s/m³*
	8-24 hours:	*3.90E-04 s/m³*	*3.90E-04 s/m³*
	1-4 days:	*3.80E-04 s/m³*	*3.80E-04 s/m³*
	4-30 days:	*3.20E-04 s/m³*	*3.20E-04 s/m³*

Table 2.0-1

Envelope of ESBWR Standard Plant Site Parameters[1] (continued)

Meteorological Dispersion (X/Q): [11] ***(continued)***	*Fuel Building*		
	0-2 hours:	*2.80E-03 s/m³*	*2.80E-03 s/m³*
	2-8 hours:	*2.50E-03 s/m³*	*2.50E-03 s/m³*
	8-24 hours:	*1.25E-03 s/m³*	*1.25E-03 s/m³*
	1-4 days:	*1.10E-03 s/m³*	*1.10E-03 s/m³*
	4-30 days:	*1.00E-03 s/m³*	*1.00E-03 s/m³*
* *First value is for unfiltered inleakage. Second value is for air intakes (emergency and normal)*	*Technical Support Center X/Q:**		
	Reactor Building		
	0-2 hours:	*1.00E-03 s/m³*	*1.00E-03 s/m³*
	2-8 hours:	*6.00E-04 s/m³*	*6.00E-04 s/m³*
	8-24 hours:	*3.00E-04 s/m³*	*3.00E-04 s/m³*
	1-4 days:	*2.00E-04 s/m³*	*2.00E-04 s/m³*
	4-30 days:	*1.00E-04 s/m³*	*1.00E-04 s/m³*
	Turbine Building		
	0-2 hours:	*2.00E-03 s/m³*	*2.00E-03 s/m³*
	2-8 hours:	*1.50E-03 s/m³*	*1.50E-03 s/m³*
	8-24 hours:	*8.00E-04 s/m³*	*8.00E-04 s/m³*
	1-4 days:	*6.00E-04 s/m³*	*6.00E-04 s/m³*
	4-30 days:	*5.00E-04 s/m³*	*5.00E-04 s/m³*
	Passive Containment Cooling System / Reactor Building Roof		
	0-2 hours:	*2.00E-03 s/m³*	*2.00E-03 s/m³*
	2-8 hours:	*1.10E-03 s/m³*	*1.10E-03 s/m³*
	8-24 hours:	*5.00E-04 s/m³*	*5.00E-04 s/m³*
	1-4 days:	*4.00E-04 s/m³*	*4.00E-04 s/m³*
	4-30 days:	*3.00E-04 s/m³*	*3.00E-04 s/m³*
Long Term Dispersion Estimates: [12]	***X/Q:***		
	Reactor/Fuel Building Ventilation Stack		*~~3.0E-07~~1.5E-07 s/m³*
	Turbine Building Ventilation Stack		*~~2.0E-07~~1.2E-07 s/m³*
	Radwaste Building Ventilation Stack		*~~2.0E-05~~5.0E-06 s/m³*
	D/Q:		
	Reactor/Fuel Building Ventilation Stack		*~~1.0E-08~~4.8E-09 m⁻²*
	Turbine Building Ventilation Stack		*~~6.0E-09~~3.5E-09 m⁻²*
	Radwaste Building Ventilation Stack		*~~3.0E-08~~1.9E-08 m⁻²*

Notes for Table 2.0-1:

(1) *The site parameters defined in this table are applicable to Seismic Category I, II, and Radwaste Building structures, unless noted otherwise.*

(2) *Probable maximum flood level, as defined in Table 1.2-6 of Volume III of Reference 2.0-4.*

(3) *Maximum speed selected is based on Attachment 1 of Reference 2.0-5, which summarizes the NRC Interim Position on Regulatory Guide 1.76. Concrete structures designed to resist Spectrum I missiles of SRP 3.5.1.4, Rev. 2, also resist missiles postulated in Regulatory Guide 1.76, Revision 1. Tornado missiles do not apply to Seismic Category II buildings. For the Radwaste building, the tornado missiles defined in Regulatory Guide 1.143, Table 2, Class RW-IIa apply.*

(4) *Based on probable maximum precipitation (PMP) for one hour over 2.6 km^2 (one square mile) with a ratio of 5 minutes to one hour PMP of 0.32 as found in Reference 2.0-3. See also Table 3G.1-2.*

(5) *See Reference 2.0-9 for the definition of normal winter precipitation and extreme winter precipitation events. The maximum ground snow load for extreme winter precipitation event includes the contribution from the normal winter precipitation event. See also Table 3G.1-2.*

(6) *Zero percent exceedance values are based on conservative estimates of historical high and low values for potential sites. Consistent with Reference 2.0-4, they represent historical limits excluding peaks of less than two hours. One and two percent annual exceedance values were selected in order to bound the values presented in Reference 2.0-4 and available Early Site Permit applications.*

(7) *At the foundation level of Seismic Category I structures. The static bearing pressure is the average pressure. The dynamic bearing pressure is the toe pressure. ~~To compare with the maximum bearing demand, the allowable bearing pressure is developed from the site-specific bearing capacity divided by a factor of safety appropriate for the design load combination.~~ The maximum static bearing demand is multiplied by a factor of safety appropriate for the design load combination and is compared with the site-specific allowable static bearing pressure. The maximum dynamic bearing demand~~,~~ is multiplied by a factor of safety appropriate for the design load combination~~,~~ and is ~~to be~~ compared with the site-specific allowable dynamic bearing pressure. When a site-specific shear wave velocity is between soft soil and medium soil the larger of the soft or medium maximum dynamic bearing demand will be used. When a site-specific shear wave velocity is between medium soil and hard soil the larger of the medium or hard maximum dynamic bearing demand will be used. Alternatively, for soils with a site-specific shear wave velocity a linearly interpolated dynamic bearing demand between soft and medium soil or between medium and hard soil can be used ~~is the larger value or a linearly interpolated value of the applicable range of shear wave velocities at the foundation level~~. The shear wave velocities of soft, medium and hard soils are 300 m/sec (1000 ft/sec), 800 m/sec (2600 ft/sec) and greater than or equal to 1700 m/sec (5600 ft/sec), respectively.*

(8) *This is the minimum shear wave velocity of the supporting foundation material and material surrounding the embedded walls associated with seismic strains for lower bound soil properties at minus one sigma from the mean. The ratio of the largest to the smallest shear wave velocity over the mat foundation width of the supporting foundation material does not exceed 1.7.*

(9) *Safe Shutdown Earthquake (SSE) design ground response spectra of 5% damping, also termed Certified Seismic Design Response Spectra (CSDRS), are defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Reactor/Fuel and Control Building structures. For the Firewater Service Complex, which is essentially a surface founded structure, the CSDRS is 1.35 times the values shown in Figures 2.0-1 and 2.0-2 and is defined as free-field outcrop spectra at the foundation level (bottom of the base slab) of the Firewater Service Complex structure.*

(10) *Values reported here are actually design criteria rather than site design parameters. They are included here because they do not appear elsewhere in the DCD.*

(11) *If a selected site has a X/Q value that exceeds the ESBWR reference site value, the COL Applicant will address how the radiological consequences associated with the controlling design basis accident continue to meet the dose reference values provided in 10 CFR 52.79(a)(1)(vi) and control room operator dose limits provided in General Design Criterion 19 using site-specific X/Q values.*

(12) *If a selected site has X/Q values that exceed the ESBWR reference site values, the release concentrations in Table 12.2-17 would be adjusted proportionate to the change in X/Q values using the stack release information in Table 12.2-16. In addition, for a site selected that exceeds the bounding X/Q or D/Q values, the COL Applicant will address how the resulting annual average doses (Table 12.2-18b) continue to meet the dose reference values provided in 10 CFR 50 Appendix I using site-specific X/Q and D/Q values.*

(13) *Value was selected to comply with expected requirements of southeastern coastal locations.*

(14) *Localized liquefaction potential under other than Seismic Category I structures is addressed per SRP 2.5.4 in Table 2.0-2.*

(15) *Settlement values are long-term (post-construction) values except for differential settlement within the foundation mat. The design of the foundation mat accommodates immediate and long-term (post-construction) differential settlements after the installation of the basemat.*

(16) *For sites not meeting the soil property requirements, a site-specific analysis is required to demonstrate the adequacy of the standard plant design.*

(17) *The High Humidity Diurnal Swing is defined in Appendix 3H Subsection 3H.3.2.1*]*

Text sections and table that are bracketed and italicized with an asterisk following the brackets are designated as Tier 2. Prior NRC approval is required to change.

- Reactor Building outside containment

The region inside the RB surrounding the containment encloses penetrations through the containment. The Control Room Habitability Area (CRHA) includes the main control room and areas adjacent to the control room containing operator facilities. Also located in the CB are safety-related Distributed Control and Information System (DCIS) rooms, located at elevation -7400 mm. Major equipment zones are shown on the RB arrangement drawing (Figures 1.2-1 to 1.2-9).

3H.3 ENVIRONMENTAL CONDITIONS

Table 3H-1 contains a cross listing of the environmental data tables arranged by location and by type of condition.

3H.3.1 Plant Normal Operating Conditions

Tables 3H-2 through 3H-4 define the thermodynamic conditions (pressure, temperature and humidity) for normal operating conditions for areas containing safety-related equipment. Figures showing equipment location and system configurations are referenced in each table. Section 12.3 defines the radiation conditions for the Reactor Building and Control Building for normal operating conditions. Table 3H-5 specifies the radiation environmental conditions inside the containment vessel for normal operating conditions. Specific radiation environment conditions for equipment are determined through the equipment qualification program based on actual location. Section 9.4 defines the Fuel Building thermodynamic conditions for normal operating conditions.

3H.3.2 Accident Conditions

Thermodynamic conditions for safety-related equipment in the containment vessel, CB and RB are presented in Tables 3H-8 through 3H-10 for accident conditions. Heat loads for the evaluated post accident periods are specified in Table 3H-12. In general, the most severe environmental conditions result from a postulated reactor coolant line break inside the containment, Loss-Of-Coolant-Accident (LOCA) (bounding case) plus Loss Of Offsite Power (LOOP), see Chapter 6 for detailed information. However, accident conditions were also considered for ruptures occurring in the steam tunnel and breaks in the RWCU/SDC System outside the containment, High Energy Line Break (HELB) plus LOOP, see Chapter 6 for detailed information. Tables 3H-6 and 3H-7 list typical radiation environmental qualification conditions inside the RB and the CB. Table 3H-11 specifies the radiation environment conditions inside the containment vessel. The EQ program confirms explicit radiation and thermodynamic conditions during accidents. The limiting thermodynamic conditions in the Fuel Building results from the boiling of the spent fuel pool. The thermodynamic conditions during an accident when the spent fuel pool boils is a limiting temperature of 104°C (219°F), with 100% relative humidity and a pressure of 14 kPaG (2.0 psig).

3H.3.2.1 Transient Room Temperature Analysis

The performance evaluation for environmental qualification show conformance to the requirements identified in Section 3.11. The maximum temperature Control Building and Reactor Building Environmental Temperature Analysis for ESBWR is presented in Reference

3H.4-8 and is summarized below. Reference 3H.4-8 is designated as Tier 2*. Prior NRC approval is required to change Tier 2* information. The Control Room Habitability Area Minimum Temperature Analysis and high humidity analysis is also summarized below.

Acceptance Criteria

The design meets the following Acceptance Criteria:

- **Environmental Qualification Maximum Temperatures** – The maximum temperature limit for which the safety-related equipment is qualified is not exceeded. The maximum temperature limit is specified in Tables 3H-9 and 3H-10.
- **Control Room Habitability Area Temperature** – The maximum bulk average temperature meets the acceptance criteria stated in Subsection 69.4.1. The minimum bulk average air temperature remains at or above 13°C (55°F) for 72 hours after an accident.

Analysis Assumptions

The analysis event assumptions are summarized below. Initial conditions and assumptions can be found in Table 3H-14. Heat loads used in the analysis are found in Table 3H-12.

- The event presented is the most limiting between LOCA or HELB with each concurrent with LOOP.
- Normal Heating, Ventilation and Air Conditioning (HVAC) heating and/or cooling is lost for the first 72 hours of the accident.
- After 72 hours the safety-related equipment heat loads are no longer accounted for because the safety-related equipment needed to maintain safe shutdown no longer requires power to perform their safety-related functions. Normal HVAC mitigates the safety-related equipment heat loads when power is available.
- During the first 2 hours of the event the nonsafety-related heat loads in the RB and in the CB outside of the CRHA powered by the nonsafety-related batteries are considered in the analysis.
- Safety-related heat loads are considered throughout the duration of the event when power is available.
- The CRHA calculation considers safety-related heat loads and additional heat loads for some nonsafety-related equipment. Select nonsafety-related equipment deenergizes if active cooling is not available.
- Room to room interactions are considered in all calculations.
- Outside air intake from the emergency filter unit (EFU) is considered for the CRHA calculation during maximum and minimum temperature conditions.

Analysis Results

As shown in Table 3H-15, the environmental qualification temperatures for safety-related equipment is not exceeded during the limiting event based on the presented detailed Control Building and Reactor Building Environmental Temperature Analysis for ESBWR thermo-hydraulic analyses performed with CONTAIN 2.0. The CRHA minimum bulk average air temperature acceptance criteria is met based on the detailed Control Room Habitability Area Minimum Temperature Analysis performed, which is benched marked against the Control Building CONTAIN maximum temperature analysis in Reference 3H.4-8. The CRHA Wet Bulb Globe Temperture (WBGT) index acceptance criteria are met. When rooms are located on the same level and have similar dimensions and internal heat loads, the most unfavorable room is taken to be the representative room for that group of rooms. Solar heat loads were applied to rooms located above grade. Table 3H-15 summarizes the representative room temperatures and locations of the room groups.

During the transient event concurrent with LOOP and loss of normal HVAC the heat generated in the rooms is absorbed by the surrounding walls, floor and ceiling. The building concrete acts as a heat sink for passive heat removal. The room temperature rises quickly because the heat absorption capacity of air is very low. The heat transfer to the walls, floor and ceiling maintain the environmental temperatures below the qualification temperature.

During wintertime conditions the RB and CB are isolated and equipment room cool down is insignificant. The case for the CRHA post 72 hours presented in Table 3H-15 which accounts for heat loads from people and minimal lighting only, demonstrates that the cool down for the RB and CB are inconsequential. The injection of ambient air at wintertime conditions when safety-related heat loads are not present provides a faster cool down rate than the other rooms located in the RB and CB. For the winter conditions the Control Room Habitability Area Minimum Temperature Analysis considers the 0% exceedance minimum dry bulb ambient outside air temperature (-40°C/°F) ~~was considered~~. For the summer conditions the 0% exceedance coincident maximum dry bulb and wet bulb ambient outside air temperature [47.2°C (117°F) DBt and 26.7°C (80°F) WBt] was considered. The daily temperature range applied was Δ 15°C (27°F). For high humidity conditions the 0% exceedance non-coincident maximum wet bulb temperature [31.1°C (88°F) WBt] and High Humidity Diurnal Swing [Δ 4.4°C (8°F) DBt] are applied to the methodology for the analysis presented in Reference 3H.4-8. The High Humidity Diurnal Swing is defined as the dry bulb temperature swing determined by:

> The maximum and the minimum wet bulb temperatures for the worst 3-day period over which the 0% exceedance wet bulb temperature occurs. The coincident dry bulb temperature (33.3°C/92°F) for the maximum wet bulb temperature (31.1°C/88°F) is taken as the maximum dry bulb and wet bulb temperatures for 3 days. The coincident dry bulb temperature (28.9°C/84°F) for the highest overnight low wet bulb temperature (27.2°C/81°F) over the 3-day period is taken as the minimum dry bulb temperature. The difference between the coincident maximum dry bulb temperature (33.3°C/92°F) and the highest overnight low dry bulb temperature (28.9°C/84°F) is used as the diurnal swing. The simplified diurnal swing encompassing the highest wet bulb high and highest wet bulb low is 33.3°C (92°F) dry bulb/31.1°C (88°F) wet bulb and 28.9°C (84°F) dry bulb/27.2°C (81°F) wet bulb.

The overnight low wet bulb temperature in the high humidity CONTAIN analysis is 28.9°C (84°F), which is conservative relative to the 27.2°C (81°F) wet bulb temperature in the High Humidity Diurnal Swing.

The temperature in the CRHA remains below the temperature acceptance criteria outlined in Subsection 6~~9~~.4.~~1~~. The temperature and humidity profiles for the 0% exceedance coincident maximum temperature case is presented in Figures 3H-2 and 3H-3 respectively. Cases were

Table 3H-14

Input Parameters, Initial Conditions and Assumptions used in Reactor Building and Control Building Heat up Analyses

Parameter	Analytical Value	Design Value
Initial Ground Temperature °C (°F)[1]	30 (86)	15.5 (60)
HELB Temperatures	See Section 6.2 Analysis	See Section 6.2
LOCA Temperatures	See Section 6.2 Analysis	See Section 6.2
Heat Sink Initial Temperature[2]	Table 3H-15	Table 3H-15
CRHA Day and Night Temperature Profile for 0% Exceedance Dry Bulb Temperature Δ °C (°F)[3]	15 (27)	15 (27)
CRHA Day and Night High Humidity Diurnal Swing ~~Temperature Profile~~ for 0% Exceedance Wet Bulb Temperature ΔDBt °C (°F)[5]	~~11~~ 4.4 (2~~0~~8)	~~11~~ 4.4 (2~~0~~8)
EFU Outside Air Supply into CRHA l/s (cfm)	240(509) Maximum	See Table 9.4-1 Minimum
Concrete Thermal Conductivity for RB and CB W/m°C (Btu·in/h·ft^2·°F)[4]	0.865 (6.00)	1.63 (11.3)
Concrete Specific Heat J/kg·°C (Btu/lb°F)[4]	653.1 (0.156)	879.2 (0.210)
Concrete Density kg/m^3 (lb/ft^3)[4]	1922.2 (120.00)	2394.8 (149.50)
CRHA Heat Sink Perimeter m (ft)	103 (338)	103 (338)
CRHA Heat Sink Perimeter Wall Thickness in Contact with the Ground m (ft)	0.90 (2.95)	0.90 (2.95)
CRHA Heat Sink Perimeter Wall Thickness in Contact with the Corridor m (ft)	0.50 (1.64)	0.50 (1.64)
CRHA Heat Sink Thickness of Internal Walls and Walls not in contact with the Ground or Corridor m (ft)	0.30 (0.98)	0.30 (0.98)
CRHA Heat Sink Height m (ft)	6.15 (20.2)	6.15 (20.2)
CRHA Heat Sink Ceiling/Floor Area m^2 (ft^2)	443 (4769)	443 (4769)
CRHA Heat Sink Ceiling/Floor Thickness m (ft)	0.50 (1.64)	0.50 (1.64)
CRHA Room Volume m^3 (ft^3)	2724 (96197)	2724 (96197)

(1) During wintertime conditions the CB calculation uses 15.5°C (60°F) as the ground temperature. This temperature is used to set the initial temperature of the concrete heat sink.

(2) Initially a linear temperature distribution across the walls is used. The CRHA internal walls, floors and ceiling are exposed to an air temperature of 29.4°C (85°F) for an eight-hour period. The resulting concrete temperatures are used as the starting point for the CB analysis.

(3) During summertime conditions the maximum CB design temperature is used 47.2°C (117°F), during wintertime conditions the minimum CB design temperature is used – 40°C/°F.

(4) Combinations of thermal concrete properties were used for the RB calculation. The most limiting value is presented in the results.

(5) The High Humidity Diurnal Swing determined for a maximum wet bulb temperature of 31.1°C (88°F) is a maximum temperature of 33.3°C (92°F) dry bulb/31.1°C (88°F) wet bulb and a minimum temperature of 28.9°C (84°F) dry bulb/27.2°C (81°F) wet bulb, which is a dry bulb temperature swing of 4.4°C (8°F).

Table 3H-15

Analytical Room Environment Temperatures

Rooms[5]	Temperature °C (°F)			
	Normal Operation (Analytical)[1]	72 hrs	168 hrs	Max Environment Temperature from Table 3H-9
Control Room Habitability Area Main control room panels Outlined area on Figure 3H-1 Summertime Conditions	23.3 (74)	33 (92)[4]	<33.9 (93)	33.9 (93) Average Bulk Max for 72 hrs
Control Room Habitability Area Main control room panels Outlined area on Figure 3H-1 Wintertime Conditions	22.78 (73)[2]	16 (61)[3]	13 (55)	Unspecified
Div 1, 2, 3 and 4 electrical rooms Safety-related DCIS panels Room Nos 3110, 3120, 3130 and 3140	25.6 (78)[2]	37 (99)	Safe Shutdown	45 (113)
Safety-related portions of CRHA Ventilation Subsystem Room Nos 3406, 3407	40 (104)[2]	43 (109)	Safe Shutdown	50 (122)
Electrical Chases Room Nos 3250, 3261	25.6 (78)[2]	35 (95)	Safe Shutdown	110 (230)

(1) All rooms in the RB and CB are evaluated at higher than expected normal operating temperatures unless otherwise shown in the table to be at normal operating temperatures. The HVAC equipment rooms start at a temperature of 40°C (104°F) as stated in Subsection 9.4.1.

(2) During winter conditions the CB room initial temperatures, with the exception of the CRHA, are set to 18.3°C (65°F).

(3) The CRHA heat loads considered during this period is 2821 Watts (9626 BTU/h).

(4) For high humidity conditions the CRHA has a maximum Wet Bulb Globe Temperature (WBGT) of 31.2°C (88.1°F). ~~The CRHA remains below a wet bulb temperature of 24°C (75°F).~~

(5) See Figures 1.2-1 to 1.2-8 for room locations.

Enclosure 4

MFN 09-776 Supplement 2

Response to Portion of NRC Request for

Additional Information Letter No. 405

Related to ESBWR Design Certification Application

Engineered Safety Features

RAI Number 6.4-24 S01 Parts 2, 3, and 4

Affidavit

GE-Hitachi Nuclear Energy Americas LLC

AFFIDAVIT

I, Larry J. Tucker, state as follows:

(1) I am the Manager, ESBWR Engineering, GE Hitachi Nuclear Energy ("GEH"), and have been delegated the function of reviewing the information described in paragraph (2) which is sought to be withheld, and have been authorized to apply for its withholding.

(2) The information sought to be withheld is contained in enclosure 1 of GEH's letter, MFN 09-776 Supplement 2, Mr. Richard E. Kingston to U.S. Nuclear Energy Commission, entitled "*Response to NRC Request for Additional Information Letter No. 405 – Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Numbers 6.4-24 S01 Parts 2, 3, and 4,*" dated January 31, 2010. The proprietary information in enclosure 1, which is entitled "*MFN 09-776 Supplement 2 – Response to NRC Request for Additional Information Letter No. 405 – Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-24 S01 Parts 2, 3, and 4 — GEH Proprietary Information,*" is indicated as the content contained between opening double brackets ([[) and closing double brackets (]]), and underlined. [[This sentence is an example.{3}]]. Figures and large equation objects are identified with double square brackets before and after the object. In each case, the superscript notation {3} refers to Paragraph (3) of this affidavit, which provides the basis for the proprietary determination.

(3) In making this application for withholding of proprietary information of which it is the owner or licensee, GEH relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC Sec. 552(b)(4), and the Trade Secrets Act, 18 USC Sec. 1905, and NRC regulations 10 CFR 9.17(a)(4), and 2.390(a)(4) for "trade secrets" (Exemption 4). The material for which exemption from disclosure is here sought also qualify under the narrower definition of "trade secret", within the meanings assigned to those terms for purposes of FOIA Exemption 4 in, respectively, Critical Mass Energy Project v. Nuclear Regulatory Commission, 975F2d871 (DC Cir. 1992), and Public Citizen Health Research Group v. FDA, 704F2d1280 (DC Cir. 1983).

(4) Some examples of categories of information which fit into the definition of proprietary information are:

a. Information that discloses a process, method, or apparatus, including supporting data and analyses, where prevention of its use by GEH's competitors without license from GEH constitutes a competitive economic advantage over other companies;

b. Information which, if used by a competitor, would reduce his expenditure of resources or improve his competitive position in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product;

c. Information which reveals aspects of past, present, or future GEH customer-funded development plans and programs, resulting in potential products to GEH;

d. Information which discloses patentable subject matter for which it may be desirable to obtain patent protection.

The information sought to be withheld is considered to be proprietary for the reasons set forth in paragraphs (4)a. and (4)b. above.

(5) To address 10 CFR 2.390(b)(4), the information sought to be withheld is being submitted to NRC in confidence. The information is of a sort customarily held in confidence by GEH, and is in fact so held. The information sought to be withheld has, to the best of my knowledge and belief, consistently been held in confidence by GEH, no public disclosure has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or proprietary agreements which provide for maintenance of the information in confidence. Its initial designation as proprietary information, and the subsequent steps taken to prevent its unauthorized disclosure, are as set forth in paragraphs (6) and (7) following.

(6) Initial approval of proprietary treatment of a document is made by the manager of the originating component, the person most likely to be acquainted with the value and sensitivity of the information in relation to industry knowledge, or subject to the terms under which it was licensed to GEH. Access to such documents within GEH is limited on a "need to know" basis.

(7) The procedure for approval of external release of such a document typically requires review by the staff manager, project manager, principal scientist, or other equivalent authority for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside GEH are limited to regulatory bodies, customers, and potential customers, and their agents, suppliers, and licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or proprietary agreements.

(8) The information identified in paragraph (2) is classified as proprietary because it contains details of GEH's design and licensing methodology. The development of the methods used in these analyses, along with the testing, development and approval of the supporting methodology was achieved at a significant cost to GEH.

(9) Public disclosure of the information sought to be withheld is likely to cause substantial harm to GEH's competitive position and foreclose or reduce the availability of profit-making opportunities. The information is part of GEH's

comprehensive BWR safety and technology base, and its commercial value extends beyond the original development cost. The value of the technology base goes beyond the extensive physical database and analytical methodology and includes development of the expertise to determine and apply the appropriate evaluation process. In addition, the technology base includes the value derived from providing analyses done with NRC-approved methods.

The research, development, engineering, analytical and NRC review costs comprise a substantial investment of time and money by GEH.

The precise value of the expertise to devise an evaluation process and apply the correct analytical methodology is difficult to quantify, but it clearly is substantial.

GEH's competitive advantage will be lost if its competitors are able to use the results of the GEH experience to normalize or verify their own process or if they are able to claim an equivalent understanding by demonstrating that they can arrive at the same or similar conclusions.

The value of this information to GEH would be lost if the information were disclosed to the public. Making such information available to competitors without their having been required to undertake a similar expenditure of resources would unfairly provide competitors with a windfall, and deprive GEH of the opportunity to exercise its competitive advantage to seek an adequate return on its large investment in developing and obtaining these very valuable analytical tools.

I declare under penalty of perjury that the foregoing affidavit and the matters stated therein are true and correct to the best of my knowledge, information, and belief.

Executed on this 31st day of January 2010.

For Larry J. Tucker

Larry J. Tucker
GE-Hitachi Nuclear Energy Americas LLC