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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

Docket No. 52-010

December 16, 2009

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

Subject: **Response to NRC Request for Additional Information Letter No. 397 Related to ESBWR Design Certification Application – Engineered Safety Systems – RAI Numbers 6.4-24 and 6.4-25**

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 the Reference 1 NRC letter. GEH response to RAI Numbers 6.4-24 and 6.4-25 is addressed 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 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.

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

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

Sincerely,

Lee F. Dougherty for

Richard E. Kingston
Vice President, ESBWR Licensing

D068
NRO

Reference:

1. MFN 09-746, Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request for Additional Information Letter No. 397 Related to ESBWR Design Certification Application,* November 25, 2009

Enclosures:

1. MFN 09-776 - Response to NRC Request for Additional Information Letter No. 397 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Numbers 6.4-24 and 6.4-25 – GEH Proprietary Information
2. MFN 09-776 - Response to NRC Request for Additional Information Letter No. 397 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Numbers 6.4-24 and 6.4-25 - Public Version
3. MFN 09-776 - Response to NRC Request for Additional Information Letter No. 397 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Numbers 6.4-24 and 6.4-25 – Markups to ESBWR DCD Tier 1 and Tier 2
4. MFN 09-776 - Response to NRC Request for Additional Information Letter No. 397 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Numbers 6.4-24 and 6.4-25 –Affidavit

cc:	AE Cubbage	USNRC (with enclosures)
	JG Head	GEH (with enclosures)
	DH Hinds	GEH (with enclosures)
	SC Moen	GEH (w/o enclosures)
	eDRFsection	0000-0110-7092

Enclosure 2

MFN 09-776

Response to NRC Request for

Additional Information Letter No. 397

Related to ESBWR Design Certification Application

Engineered Safety Systems

RAI Numbers 6.4-24 and 6.4-25

Public Version

NRC RAI 6.4-24

Demonstrate that the passive cooling CRHA design will meet the proposed human performance acceptance criteria of <86°F Wet Bulb Globe Temperature (WBGT) Index for the worst case coincident dry bulb and wet bulb within the proposed ESBWR Standard Plant Site Parameter Envelope.

The staff is concerned that the environmental condition input assumption proposed Design Basis Heat up Calculation is non conservative with respect to the proposed human performance acceptance criteria of <86°F Wet Bulb Globe Temperature Index. The current DB calc addresses only the 0% exceedance values of 117°F dry bulb coincident with 80°F wet bulb as listed in DCD Tier 2, Chapter 2 Table 2.01. Although potentially conservative with respect to maximum control room temperature criteria, this environmental input value may not be conservative with respect to the proposed human performance acceptance criteria.

The staff has reviewed your previous responses on this topic in RAI 9.4-29 S03 Item A and in RAI 6.4-21 S01 item 1. Additional information is needed.

In order to address this concern, the staff requests GEH provide the following information:

1. In the response to RAI 9.4-29 S03 Item A, GEH describes the use of the Wet-bulb Globe Temperature (WBGT) index as being more effective than a previously described effective temperature index. GEH then states that the psychometric wet bulb temperature may be an approximate index for measuring heat stress and strain, where radiant temperatures and air velocity are not large factors and where increased humidity exists.

The staff is unclear what index is proposed to assess operator performance in the ESBWR CRHA. (i.e., Is WBGT to be used or just wet bulb?). If wet bulb temperature is proposed, and since low humidity coincident with high dry bulb temperatures can also be expected, please fully justify why wet bulb alone would be more appropriate than the use of WBGT index that uses a combination of calculated CRHA dry bulb and wet bulb and globe temperatures.

2. Demonstrate there are no environmental dry bulb/humidity combinations within the ESBWR standard plant parameter envelope that would result in greater than 86°F Wet Bulb or Wet Bulb Globe Temperature Index in the CRHA anytime during the 72 hour period of passive cooling. This can be done by providing the input assumptions and results of sensitivity studies using various outside air humidity ranges and diurnal temperature swings, and the same methodology as that proposed for the design basis CRHA heat up calculation.

3. In the response to #1 above, address the 0 percent exceedance 88°F wet bulb (non-coincident) ambient design temperature value listed in DCD chapter 2 Table 2.01. The proposed ESBWR standard plant site parameter envelope outside air environmental conditions of 88°F wet bulb could result in control room conditions exceeding a heat stress index that uses 86°F wet bulb. Coincident dry bulb temperatures for this wet bulb temperature from 88 degrees to below 117°F are within the proposed ESBWR site parameter envelope. The corresponding relative humidity for this temperature range would be 100 percent to 30 percent. Since the EFUs are designed to exchange the CRHA air 7 to 9 times per day, the staff believes that over time the CRHA relative humidity would trend toward that of the incoming air. Therefore outside air of high temperature and high humidity, when cooled by passive heat sinks in the CHRA could result in increasing humidity in the CRHA at the end of the 72 hour period. Unless moisture is removed, the resultant CHRA heat stress index could be exceeded.

4. In addition to the moisture contained in incoming air, some moisture would be added by the evaporation of perspiration from the 11 CRHA occupants. In your response to No. 1 above, quantify and justify the quantity of moisture added per person per hour from perspiration and breath.

5. During the November 17, 2009, ACRS meeting, GEH mentioned that moisture was shown to be removed from CHRA air on some analyses you performed. Please provide details on what heat sinks are performing this function and if there is need of design features to direct and remove the condensed moisture.

__GEH Response__

1. In the response to RAI 9.4-29 S03 Item A, GEH describes the use of the Wet-bulb Globe Temperature (WBGT) index as being more effective than a previously described effective temperature index. GEH then states that the psychometric wet bulb temperature may be an approximate index for measuring heat stress and strain, where radiant temperatures and air velocity are not large factors and where increased humidity exists.

The staff is unclear what index is proposed to assess operator performance in the ESBWR CRHA. (i.e., Is WBGT to be used or just wet bulb?). If wet bulb temperature is proposed, and since low humidity coincident with high dry bulb temperatures can also be expected, please fully justify why wet bulb alone would be more appropriate than the use of WBGT index that uses a combination of calculated CRHA dry bulb and wet bulb and globe temperatures.

The ESBWR CRHA threshold limit for heat stress and human performance is 30°C (86°F) wet bulb temperature. As described in DCD Tier 2 subsection 6.4.4, "The psychrometric wet bulb temperature is an appropriate index for assessing heat stress and predicting heat strain under conditions where radiant temperatures and air velocity are not large factors and where increased humidity exists. National Institute for Occupational Safety and Health (NIOSH) 86-113 provides a wet bulb temperature limit of about 30°C (86°F) for unimpaired performance on sedentary tasks (moderate levels of physical work) for normally clothed individuals at low airflows."

Measuring psychrometric wet bulb temperature does not require special equipment or software programs to determine WBGT or the Effective Temperature Index. The assumptions and conditions required to utilize wet bulb temperature to assess operator performance related to heat stress are applicable to the ESBWR CRHA conditions following a design basis accident:

- Radiant heat (radiant heat transmission) is negligible inside the CRHA (enclosed subterranean structure) considering that the heat flow in most cases is from ambient air to the concrete structure.
- During passive cooling of the CRHA, minimal circulation (minimal air velocity) is developed by diffusion and convective air currents as described in DCD Tier 2 subsection 6.4.2. While moving air promotes sweat evaporation when relative humidity is less than 80%, the effect on wet bulb globe temperature is minor. If the air temperature is higher than the skin temperature (36°C), then evaporation is counterbalanced by convective heating of the body.
- The CRHA will have an increased humidity for conditions where heat stress is an issue. For the design 0% exceedance condition, CRHA humidity exceeds 45% and CRHA air temperature is below skin temperature during the 72 hours following the DBA (passive heat removal).
- CRHA occupants will be engaged in moderate level of physical work. 2005 ASHRAE Fundamentals Handbook (Chapter 30) provides representative latent heat rates for adult males for standing, doing light work, and walking. Seated, very light work activity results in 80% of the heat rates listed.

Using wet bulb temperature as the heat stress limit is appropriate for high humidity conditions. When conditions exist where there is low humidity coincident with high dry bulb temperatures, limiting the dry bulb temperature to 93°F ensures that heat stress limits are not reached. This means that when there are high dry bulb temperatures, there will be lower humidity and heat stress will not be a concern considering either the wet bulb temperature or wet bulb globe temperature.

National Institute for Occupational Safety and Health (NIOSH) 86-113 provides a wet bulb temperature limit of about 30°C (86°F) for unimpaired performance on sedentary tasks (moderate levels of physical work) for normally clothed individuals at low airflows."

The CRHA will have an increased humidity and lower temperature for conditions where heat stress may be an issue.

Sensitivity analysis has been performed varying the outside air ambient conditions [(DB 88°F) (RH 100%) and (Range 20°F)]. For high humidity conditions, the CRHA wet bulb temperature remains below the 30°C (86°F) limit. Because the limiting condition occurs at high humidity where the wet bulb temperature is applicable, and because low humidity/high temperature conditions do not violate the 86°F limit, wet bulb temperature is appropriate as a heat stress limit.

2. Demonstrate there are no environmental dry bulb/humidity combinations within the ESBWR standard plant parameter envelope that would result in greater than 86°F Wet Bulb or Wet Bulb Globe Temperature Index in the CRHA anytime during the 72 hour period of passive cooling. This can be done by providing the input assumptions and results of sensitivity studies using various outside air humidity ranges and diurnal temperature swings, and the same methodology as that proposed for the design basis CRHA heat up calculation.

During the 72 hour DBA passive cooling period, the ESBWR CRHA does not exceed the 86°F wet bulb temperature limit. Appendix A provides a sensitivity study for the input files submitted with the transmittal of RAI 9.4-33 S01 (MFN Letter 08-064 Supp 1 dated June 9, 2008) to evaluate a 100% humidity condition.

The analysis is similar to the DCD analysis and methodology with the following exceptions:

(1) CRHA initial temperature of 78°F is used rather than 74°F,

(2) Internal heat load of 7630 Watts is used rather than 9630 Watts,

(3) A diurnal swing of 20°F is used rather than 27°F,

(4) Outdoor temperature is 88°F dry bulb and 100% humidity, rather than 117°F dry bulb and 20% humidity,

(5) 5 people are assumed, rather than 11,

(6) A 200 L/s EFU flow rate is used rather than 240 L/s, and

(7) Once simulation starts, no heat transfer is allowed to or from the surface in contact with the ground.

(8) There is no simulated "abnormal function" of the CB HVAC subsystem where CRHA air temperature held constant at 85°F for eight hours before the SBO event.

As shown in Table 3 of Attachment A, outdoor conditions (88°F dry bulb temperature with 100% relative humidity) yield a wet bulb temperature below 86°F. As mentioned above, Attachment A is a sensitivity study using the assumptions submitted previously in response to RAI 9.4-33 S01. The study was performed using a higher initial CRHA temperature (with respect to the DCD analysis), overshadowing the effect of having smaller internal heat loads and fewer people. In the latest analysis assumptions described by the DCD, a lower CRHA initial temperature was used in conjunction with higher heat loads and more people. The DCD analysis adds conservatism with a higher EFU flow rate and more people. The ITAAC requirements that have been added to Tier 1 Table 2.16.2-4 of the DCD ensures that the CRHA will meet acceptance criterion for temperature and heat stress using as-built conditions, including the number of people, flow rate and heat loads.

In order to ensure that the as-built CRHA meets the wet bulb temperature limit, ITAAC Table 2.16.2-4 Item iii has been added to the DCD Tier 1 as shown in the attached markup. The ITAAC requires that the analysis from Item 4i be performed using the limiting 0% exceedance wet bulb design temperature with the as-built features (initial temperatures, heat load, people, and EFU flow rate). Additionally, a change was made to DCD Tier 2 Table 3H-14 to define the limiting high humidity design conditions for outside wet bulb air temperature and diurnal wet bulb temperature range used in the wet bulb temperature evaluation.

3. In the response to #1 above, address the 0 percent exceedance 88°F wet bulb (non-coincident) ambient design temperature value listed in DCD chapter 2 Table 2.01. The proposed ESBWR standard plant site parameter envelope outside air environmental conditions of 88°F wet bulb could result in control room conditions exceeding a heat stress index that uses 86°F wet bulb. Coincident dry bulb temperatures for this wet bulb temperature from 88 degrees to below 117°F are within the proposed ESBWR site parameter envelope. The corresponding relative humidity for this temperature range would be 100 percent to 30 percent. Since the EFUs are designed to exchange the CRHA air 7 to 9 times per day, the staff believes that over time the CRHA relative humidity would trend toward that of the incoming air. Therefore outside air of high temperature and high humidity, when cooled by passive heat sinks in the CHRA could result in increasing humidity in the CRHA at the end of the 72 hour period. Unless moisture is removed, the resultant CHRA heat stress index could be exceeded.

As mentioned in response to Question 2, 100% outdoor air humidity (continuous throughout the analysis) and outside temperature of 88°F dry bulb and coincident 88°F wet bulb have been set as inputs to a CRHA temperature analysis. The results in Attachment A show that the wet bulb temperature in the CRHA does not exceed 86°F.

4. In addition to the moisture contained in incoming air, some moisture would be added by the evaporation of perspiration from the 11 CRHA occupants. In your response to No. 1 above, quantify and justify the quantity of moisture added per person per hour from perspiration and breath.

A latent heat load of 55 W (188 Btu/hr) per person was chosen as per recommendation of the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) handbook, Chapter 30, Table 1, "Standing, light work; walking."

Water vapor is added to the CRHA atmosphere at a specified flow rate based on the latent heat load divided by latent heat of vaporization. This gives a moisture addition of 0.245 grams per second from the perspiration and breath of 11 people. The moisture is added at a temperature of 35°C (95°F), which is a reasonable approximation of body temperature. This moisture input and the resulting heat load has been taken into account in the analysis.

5. During the November 17, 2009, ACRS meeting, GEH mentioned that moisture was shown to be removed from CRHA air on some analyses you performed. Please provide details on what heat sinks are performing this function and if there is need of design features to direct and remove the condensed moisture.

The concrete walls, floor, and ceiling that make up the CRHA heat sink perform the function of removing moisture from the air by condensing the moisture in the air onto the cooler surfaces.

As shown in Table 3 of Attachment A the limiting humidity calculation yields [[ ]] of condensation on the CRHA heat sinks over the three days of passive cooling following a design basis accident. As designed, the CRHA floor lies [[ ]] below the occupied zone. This would allow some condensed water to accumulate without presenting a concern to the CRHA occupants or equipment based on the calculated [[ ]] accumulation.

The amount of water anticipated due to moisture condensing on walls is minimal. Given a 443 m^2 (4768 ft^2) control room area and twice the estimated moisture from above, the uniform water level from the condensation is on the order of [[ ]]. This does not represent a threat to the cabling used for any safety related functions on the CRHA floor. Following industry standard data center practices, the power and fiber optic circuits that feed to the consoles from the subfloor area will be routed through conduits or trays, and will not be directly in contact with the floor. These structures will provide more than enough elevation to avoid a small layer of water collected on the floor of the CRHA from affecting the safety related cabling.

DCD Impact

DCD Tier #1, Table 2.16.2-4 and DCD Tier #2, Table 3H-14 will be revised as noted in the attached markups.

NRC RAI 6.4-25

Provide additional justification for the 27°F diurnal temperature swing used in the CRHA Design Basis Heat up Calculation.

In the response to RAI 9.4-33 S01, GEH mentions that the 27°F diurnal temperature swing was per the ASHRAE fundamentals handbook for the prospective ESBWR site at Clinton. The staff is concerned that this diurnal swing is not conservative with respect to other potential locations within the ESBWR site parameter envelope. Since sensitivity studies have shown little margin in the final CRHA temperature with respect to the acceptance criteria, and a diurnal swing could be used as a method of removing moisture from the incoming air, affecting the resultant heat index in the CHRA, more information is required to justify this input assumption.

1. A review of ASHRE Fundamentals handbook, Chapter 14, climatic design information tables did not reveal this value among the tables of annual cooling design conditions for various sites. The closest location that could be found was Decatur, IL which shows the hottest month dry bulb range to be 20°F. Clarify how the 27°F diurnal temperature range was obtained from the ASHRAE Fundamentals Handbook.

2. How is this chosen site temperature swing conservative with respect to other potential locations? Justify why there could be no other locations within the ESBWR site parameter envelope with a more moderate swing, which could result in higher heat load or moisture content for the incoming air.

GEH Response

1. A review of ASHRAE Fundamentals handbook, Chapter 14, climatic design information tables did not reveal this value among the tables of annual cooling design conditions for various sites. The closest location that could be found was Decatur, IL which shows the hottest month dry bulb range to be 20°F. Clarify how the 27°F diurnal temperature range was obtained from the ASHRAE Fundamentals Handbook.

A trend was observed in the ASHRAE data across weather locations. As areas experience higher maximum temperatures, there can be higher monthly average diurnal swings. For example, the weather station in Nellis AFB, NV experiences an annual maximum temperature of 113.5°F and has a high temperature range of 27.4°F in June.

A value of 27°F was chosen to be a conservative representative of a diurnal swing when temperatures are abnormally high. As can be seen, the maximum temperature of 117°F is higher than the annual maximum temperature in Nellis AFB, NV that has a diurnal swing of 27.4°F.

The 27°F diurnal temperature range was arrived at after a review of ASHRAE Climatic Design Information of data across various weather locations, from the CD-ROM provided with the Fundamentals Handbook. The data will not be found on any specific station table since:

1. There is no one data sheet that corresponds to the 0% exceedance design condition for the ESBWR. The ESBWR 0% exceedance values are conservative estimates of various sites.
2. The 2005 ASHRAE Fundamental data sheets, while listing values under Monthly Mean Daily Temperature Ranges, do not list actual values for extreme conditions. The data are Mean values and would represent an average for the month. It is known that with the more extreme high and low temperature conditions (with 0% exceedance), there are larger range swings. The 2009 ASHRAE Fundamentals recognized this fact and expanded upon the single monthly value for the range by incorporating additional rows for 5% DB and WB temperature ranges. Per ASHRAE, these values represent the "Mean daily dry- and wet-bulb temperature ranges coincident with the 5% monthly design dry-bulb (and wet-bulb) temperature. Reviewing the 5% value versus the overall monthly value reveals a higher temperature swing. If the table was expanded further, to the 2% or 1% or 0.4% design temperatures, would show a further increased swing.

2. How is this chosen site temperature swing conservative with respect to other potential locations? Justify why there could be no other locations within the ESBWR site parameter envelope with a more moderate swing, which could result in higher heat load or moisture content for the incoming air.

Each site's meteorological data will be compared to the Envelope of ESBWR Standard Plant Site Parameters in DCD Tier 2 Table 2.0-1. A COL evaluation will be provided for sites that are not bounded by the temperature swings analyzed. COL Item 2.0-1-A provides that "A COL Applicant referencing ESBWR DCD demonstrates that site characteristics for a given site fall within the ESBWR DCD site parameter values."

Additionally, sensitivity analysis on a variation in the diurnal temperature swing shows little sensitivity with respect to CRHA temperatures. Keeping all other inputs the same, decreasing the diurnal swing from 15.0°C (27°F) to 11.1°C (20°F) yields an increase in maximum dry bulb CRHA temperature of only 0.28°C (0.5°F).

DCD Impact

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

APPENDIX A

IMPORTANT NOTICE REGARDING CONTENTS OF THIS REPORT

Please Read Carefully

The information contained in this document is furnished as reference to the NRC Staff for the purpose of obtaining NRC approval of the ESBWR Certification and implementation. The only undertakings of GE Hitachi Nuclear Energy (GEH) with respect to information in this document are contained in contracts between GEH and participating utilities, and nothing contained in this document shall be construed as changing those contracts. The use of this information by anyone other that for which it is intended is not authorized; and with respect to any unauthorized use, GEH makes no representation or warranty, and assumes no liability as to the completeness, accuracy, or usefulness of the information contained in this document.

Control Room Habitability Area Humidity Analysis for ESBWR

PURPOSE AND SCOPE

During emergency operation, the CRHA emergency habitability system passive heat sink is designed to limit the temperature rise inside the CRHA to allowable values. Similarly, the heat sink capacity of the CB structures is designed so that the environmental qualification temperatures of the safety-related components located inside the CB are not exceeded in case of accident.

Calculations consider moist air and latent heat inside the Control Room Habitability Area (CRHA). The calculations show the effects of the moisture content in the outside air on the maximum CRHA air temperature to ensure that the CRHA wet bulb air temperature remains below the threshold limit for assessing heat stress and predicting heat strain.

HEATUP CALCULATIONS INPUT AND ASSUMPTIONS

Accident Scenario

The event of Station Black Out (SBO) and accident conditions is considered.

In an SBO event, room active ventilation and cooling is lost for 72 hours (Ref-1). After that time, it is assumed that normal HVAC cooling returns.

In an SBO event, the nonsafety-related electronic and electrical loads, powered from the two hours nonsafety-related batteries, are active for two hours. Table 1 reflects the control room heat load interval.

Control Building Room Maximum Temperature

Safety-Related Qualification Temperatures

The maximum (target) temperature considered is shown in Table 2.

The maximum room air temperature must not exceed the temperature for which the safety-related equipment located inside the room is designed or qualified.

Control Room Habitability Area

The maximum (target) temperature considered inside the CRHA is 30.0°C (86°F) wet bulb temperature.

Safety-Related Equipment Location

The safety-related equipment location and their heat load considered in the heat up calculations are included in Table 6.

Room Initial Temperature

The initial temperatures in the CB rooms considered in the heat up calculations are included in Table 4. Table 4 includes the maximum initial temperature in the CB rooms. The maximum values have been used to set up the initial values for the summer condition (maximum temperature expected in accident conditions).

The summer time initial temperature in the calculations has been set up to be higher than the maximum room temperature in DCD. As a general rule, an initial temperature of 27°C (81°F) is considered in rooms inside the CB, which is 1.4°C (2.5°F) higher than the maximum room temperature defined in DCD Tier 2 Table 9.4.1 (Ref-2). One exception is the control room temperature of 25.6°C (78°F), a 2.3°C (4°F) increase on the maximum room temperature.

For walls that are in contact with the ground, an external surface temperature of 30°C (86°F) in summer has been considered, assuming that the ground will be at a constant temperature of 30°C (86°F). This fully conservative value has been obtained as follows:

- A mean ground temperature is estimated from the annual average air temperature in summer, i.e., 39.7°C (103.5°F), [47.2°C (117°F)-DR/2, where DR is the daily range in summer]
- A representative value for the "ground surface temperature amplitude" based on Fig-29.2 of Ref-12 is obtained: 10°C (21.2°F)
- According to Eq-29.36 of Ref-12, a mean ground surface temperature is obtained by subtracting 10°C (21.2°F) from 39.7°C (103.5°F), obtaining 29.7°C (85.5°F). Conservatively, it is considered that the soil in contact with the walls below grade will be at a temperature of 30°C (86°F). Once the simulation starts, no heat transfer is allowed to/from the surface in contact with the ground

The initial temperature of the CRHA and of the adjacent rooms shall determine the temperature, and therefore the heat absorption capacity of all the structural elements that comprise the different rooms. It will subsequently be a main factor in the maximum temperature reached.

Internal Heat Loads

Sensible Heat Load

The internal heat loads considered in the heat up calculation are included in Table 7.

A maximum internal heat load of 7630 W is considered during the 0-72h interval. The heat load distribution among equipment, emergency lighting, people and others is included in Table 7.

Latent Heat Load

The latent load in the CRHA due to people has been considered at a rate of 55 W per person. This is a typical value stated for "Standing, light work; walking" in Chapter 30 Table-1 of Ref-12.

External Heat Loads, Boundary Conditions

External Loads

External heat loads can be transmitted to a room through walls, floors and ceilings or partitions that separate it from another room or from the exterior.

No solar heat transmission is considered in CB areas below grade.

Ventilation Loads

The heat load due to 200 l/s (Ref-1) outside air intake is taken into account in the CRHA heat up calculations. The outside air dry bulb maximum temperature is 31.1°C (88°F), (Ref-2) and a typical daily temperature range of 11.0°C (20°F) is considered. Due to the 100% humidity condition, the outside air wet bulb maximum temperature is 31.1°C (88°F) as well.

The input design profile data is shown in Fig 1.

Concrete Characteristics

Concrete characteristics are defined in NEDE-33536P, Section 1.3.7.

Room, Floor, and Wall Dimensions

Model dimensional information is defined in NEDE-33536P, Section 1.3.8.

CALCULATION METHOD AND ASSUMPTIONS

Modeling of Building Rooms

The control building model is described in NEDE-33536P, Section 1.4.1.

Modeling Assumptions

The model assumptions used are described in NEDE-33536P, Section 1.4.2.

Methodology

The methodology implemented is described in NEDE-33536P, Section 1.4.3.

Code Description

The CONTAIN 2.0 Code is described in NEDE-33536P, Section 1.4.4.

CALCULATIONS, RESULTS, AND CONCLUSIONS

Heatup Calculations Performed (0-72H)

Case L-2 (see Table 7 for further information). Design outside air conditions: 31.1°C (88°F), 100% RH and daily range [11°C (20°F)].

The calculation has been considered to clarify the NRC concern about whether outside air at 0% exceedance non-coincident maximum wet bulb temperature and 100% relative humidity could lead to a 72 h CRHA wet bulb temperature greater than the heat stress limit, and whether the heat absorbed by the CRHA structures might be affected by the condensation.

In cases where humid air is considered, the effect of condensation when it happens (i.e., when the surface temperature of the CRHA structure reaches the dew point of the room air temperature) is taken into account in the overall heat transfer coefficient.

It should be noted that Case L-2 is not realistic, since, by definition, the 0% exceedance values represent extreme conditions rather than values repeated over several days.

CONTAIN has been used for this calculation.

Results of the Heatup Calculations

Table-2 shows the maximum allowable temperature (target), in accident conditions up to 72h in rooms and the temperature obtained in calculations. Table 3 shows the CRHA temperature obtained. The volume of condensation is also included. The relevant results are the following:

- The maximum room air temperature obtained in the calculations are below the maximum allowable values.
- L-2 results clarify that higher humidity ratios, and subsequently higher specific enthalpy, do not affect the maximum temperature reached

Conclusions

The main conclusions are:

- The maximum allowable temperature, or temperature rise at 72 h after the accident, is met in all CB rooms.
- The maximum allowable temperature in CRHA, i.e., 33.9°C (93°F) dry bulb and 30.0°C (86°F) wet bulb, is met when considering 31.1°C (88°F) dbt and coincident 31.1°C (88°F) wbt outdoor conditions (100% outdoor relative humidity).
- Condensation concerns
    - The main issue is that "when the dew point of air in the CRHA reaches the temperature of any surface structure inside the CRHA, condensation occurs," i.e. plotting dew point inside the CRHA vs. time, and the structure surface temperature vs. time will show the potential for condensation phenomena.
    - Outside air humidity and latent load inside the CRHA will increase condensation. Both issues have been taken into account:
        - Outside conditions close to saturation point have been considered
        - Moisture due to people breathing and perspiring is also considered (latent load)
    - The outside air conditions used are not realistic (overly conservative), but they are the most favorable conditions for condensation occurrence.
    - A detailed analysis of the humidity condensation inside the CRHA is included in Figure 3, which shows the air dew point inside the CRHA vs time and the CRHA structure surface temperature vs time.

It may be concluded that the cabinet internal temperature is higher than the temperature on the surface of the structures and therefore, no condensation can occur inside the cabinets.

REFERENCES

1) 26A6642AT. DCD Tier 2. Chapter 6, Engineered Safety Features. Section 6.4, Control Room Habitability System

2) 26A6642AY. DCD Tier 2, Chapter 9; Auxiliary System. Subsection 9.4.1 Control Building HVAC System

3) Not used

4) 105E4057 (Rev-0 & 1). Control Building Structure. Shimizu Drawings U73-2010-1 through 3

5) Not used

6) 105E3908 (Rev-3). ESBWR Nuclear Island. General Arrangement

7) Yilmaz T. P. & Paschal W. B. article: "An analytical approach to transient room temperature analysis"

8) Not used

9) CONTAIN 2.O Code: A Computer Code for Nuclear Reactor Containment Analysis. NUREG/CR-6533. SAND97-1735

10) SR3-1-ECA-00011 (Rev-1). EBAS Elimination. CRHVS Redesign

11) 26A6642AN (Rev-4). DCD Tier. Chapter 3, Design of Structures, Components, Equipment and Systems. Appendices 3G – 3L

12) ASHRAE Fundamentals 2005

13) Thermal Conductivity Of A Dispersed Porous Material. A. Denis, A. Soba. Dto. Combustibles Nucleares, Centro Atómico Constituyentes, CNEA.

Table 1. Control Room Heat Load Interval

	Time interval, after SBO starts	
	0-2h	2-72h
Loads from Electric & Electronic *nonsafety –related* equipment	Active	Inactive
Loads from Electric & Electronic *safety–related* equipment	Active	Active

Table 2. Thermodynamic Environment Conditions inside Control Building for Accident Conditions

Rooms & Equipment	Max. Allowable Temp. After 72 h
Division I, II, III and IV electrical rooms Q-DCIS panels Rooms No 3110, 3120, 3130 and 3140	45°C (113°F)
Control Room Habitability Area. Main control room panels Rooms No 3270, 3272, 3271, 3201, 3202, 3273, 3206, 3205, 3204, 3275, 3207, 3208	30.0°C (86°F)[1,2]
Electrical chases Rooms 3250, 3261	110°C (230°F)
Safety Portions of CRHAVS Rooms 3406, 3407	50°C (122°F)

1. Maximum allowable dry bulb temperature inside the CRHA 33.9 °C (93°F). (Ref-1)
2. Wet bulb temperature used to set maximum allowable CRHA temperature.

Table 3. Thermodynamic Environment Conditions inside Control Room Habitability Area for Accident Conditions

	Max Dry Bulb 0-72h	Max Wet Bulb 0-72h	Total Max. Condensate
Case L-2	[[		]]
Maximum Temperature Allowable (Ref-1)	**33.9 °C** **(93 °F)**	**30.0 °C** **(86 °F)**	--

Table 4. Initial Room Temperature T

Rooms & Equipment	Initial Temperature to be Considered in summer Heatup Calculation	Maximum temperature considered by analysis for normal Plant operation defined in Table 9.4-1
Division I, II, III and IV electrical rooms Q-DCIS panels Rooms No 3110, 3120, 3130 and 3140	27°C (81°F)	25.6°C (78°F)
Corridors Rooms No 3100, 3101	27°C (81°F)	25.6°C (78°F)
Control Room Habitability Area. Main control room panels Rooms No 3270, 3272, 3271, 3201, 3202, 3273, 3206, 3205, 3204, 3275, 3207, 3208	25.6°C (78°F)	25.6°C (78°F)
Corridor Rooms 3200,3203, 3277, 3274	27°C (81°F)	25.6°C (78°F)
Electrical chases Rooms 3250, 3261	27°C (81°F)	25.6°C (78°F)
HVAC chases Rooms 3251, 3260	27°C (81°F)	25.6°C (78°F)
N-DCIS Rooms 3301, 3302, 3303, 3300	30°C (86°F)	25.6°C (78°F)
HVAC equipment Rooms 3401, 3402, 3403, 3404	40°C (104°F)	40°C (104°F)
Safety Portions of CRHAVS Rooms 3406, 3407	40 °C (104°F)	40 °C (104°F)

Table 5. Not used

Table 6. Internal Head Loads and Safety Related Equipment Location for L-2 Analysis

Floor El.	Rooms	Equipment and Description	Safety-related Eq.	Heat Load 0h-2h	Heat Load 2h-24h	Heat Load 24h-72h
-7400	3110, 3120, 3130, 3140	Div I, II, III and IV Q-DCIS	Yes	5720 W (0h-2h) (19517 Btu/h)	4675 W (2h-24h) (15952 Btu/h)	3080 W (24h-72h) (10509 Btu/h)
	3100, 3101	Corridors [1]	No	--	--	--
-2000	3270, 3272, 3271, 3201, 3202, 3273, 3206, 3205, 3204, 3275, 3207, 3208	Main Control Room (MCR) and associated support areas (CRHA)	Yes	7630 W (26035 Btu/h)	7630 W (26035 Btu/h)	7630 W (26035 Btu/h)
	3200,3203, 3277, 3274	Corridor [1]	No	--	--	--
	3250, 3261	Electrical chases	Yes	500 W (1706 Btu/h)	500 W (1706 Btu/h)	500 W (1706 Btu/h)
	3251, 3260	HVAC chases [1]	No	--	--	--
+4650	3301, 3302, 3303, 3300	N-DCIS	No	54000 W (184420 Btu/h)	--	--
+9060	3401, 3402, 3403, 3404	HVAC equipment [1]	No	--	--	--
	3406, 3407	Safety Portions of CRHAVS subsystem. [2]	Yes	500 W (1706 Btu/h)	500 W (1706 Btu/h)	500 W (1706 Btu/h)

1. No heat loads during a 0 - 72 hour period (heat sink)
2. The CRHAVS EFU for SBO operation are located in these rooms

Table 7. CRHA Heatup Case

CASE L-2	0-24H				24-72H			
OUTSIDE AIR CONDITIONS	Maximum at 3:00 pm		Minimum at 5:00 am		Maximum at 3:00 pm		Minimum at 5:00 am	
Dry bulb Temp	31.1 °C	88 °F	20.1 °C	68 °F	31.1 °C	88 °F	20.1 °C	68 °F
Coincident wet bulb Temp.	31.1 °C	88 °F	20.1 °C	68 °F	31.1 °C	88 °F	20.1 °C	68 °F
Coincident Relative humidity	100 %		100 %		100 %		100 %	
Humidity ratio kg_w/kg_{da}	[[ ]]		[[ ]]		[[ ]]		[[ ]]	
DAILY RANGE	11.0 °C	20 °F			11.0 °C	20 °F		
Total (Sensible)	7630 W				7630 W			
a. Equipment (W)	5000 W				5000 W			
b. Lighting (W)	200 W				200 W			
c. Miscelaneous (W)	200 W				200 W			
d. EFU fan (W)	746x1.15= 860 W [4]				746x1.15= 860 W [4]			
e. People. 5 p (W)	5x75 [1] = 375 W				5x75 [1] = 375 W			
f. Margin (W)	995 W				995 W			
Total (Latent)	275 W				275 W			
a. People. 5 p (W)	5x55 [1] = 275				5x55 [1] = 275			
HVAC Air	--				--			
Ventilation Air	200 l/s [3]				200 l/s [3]			

1. Chapter 30, Table-1 Ref-12
2. [Not used]
3. Ref-1
4. Ref-10

Case L-2. 100% of RH during the whole day

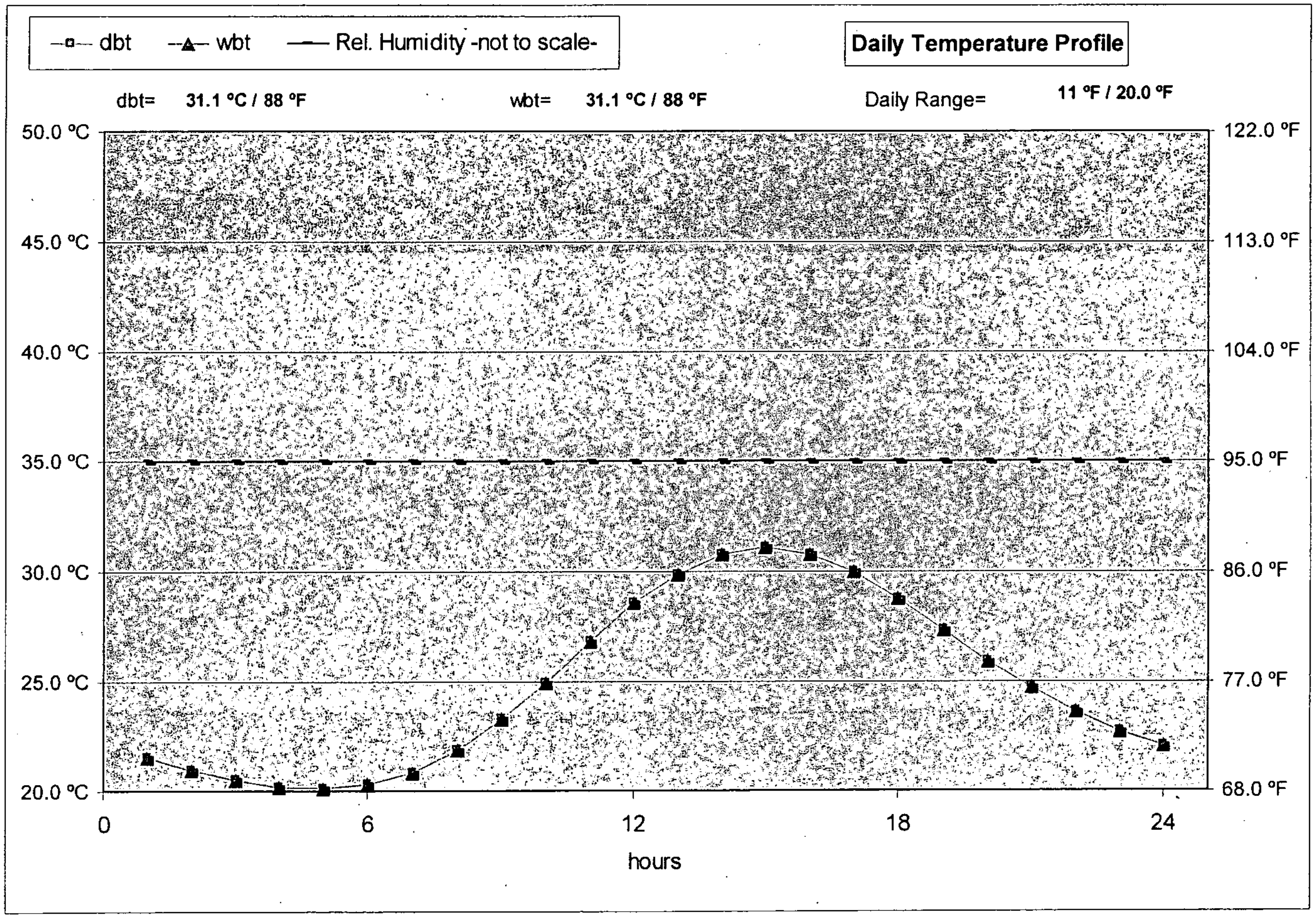

Figure 1. Case L-2 daily profile

[[ ]]

Figure 2. CRHA Case L-2

[[ ]]

Figure 3. Case L-2. Condensation on structures in CRHA

Enclosure 3

MFN 09-776

Response to NRC Request for

Additional Information Letter No. 397

Related to ESBWR Design Certification Application

Engineered Safety Systems

RAI Numbers 6.4-24 and 6.4-25

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
1. The functional arrangement of the CRHAVS is as described in the Design Description of this Subsection 2.16.2.2 and as shown in Figure 2.16.2-4.	Inspections of the CRHAVS configuration will be conducted.	The as-built CRHAVS conforms to the design description in this Subsection 2.16.2.2 and is as shown in Figure 2.16.2-4.
2. The CRHA isolation dampers automatically close upon receipt of any of the following signals: • high radiation in the CRHAVS intake; • high radiation downstream of an Emergency Filter Unit (EFU) during emergency operation; • low airflow through an EFU during emergency operation; • loss of AC power.	Testing of the CRHA isolation dampers will be performed using simulated signals to close the CRHA isolation dampers.	The as-built CRHA isolation dampers automatically close upon receipt of any of the following simulated signals: • high radiation in the CRHAVS intake; • a high radiation downstream of an Emergency Filter Unit (EFU) during emergency operation; • low airflow through an EFU during emergency operation; • a loss of AC power signal
3. The equipment identified in Table 2.16.2-3 as Seismic Category I can withstand Seismic Category I loads without loss of safety function.	i. Inspection will be performed to verify that the Seismic Category I equipment identified in Table 2.16.2-3 are located in a Seismic Category I structure.	i. The equipment identified as Seismic Category I in Table 2.16.2-3 is located in a Seismic Category I structure.

Table 2.16.2-4

ITAAC For The Control Building Habitability HVAC Subsystem

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	ii. Type tests, analyses, or a combination of type tests and analyses, of equipment identified in Table 2.16.2-3 as Seismic Category I, will be performed using analytical assumptions, or will be performed under conditions which bound the Seismic Category I equipment design requirements. iii. Inspections and analyses will be performed to verify that the as-built equipment identified in Table 2.16.2-3, including anchorage, is bounded by the testing or analyzed conditions.	ii. The equipment identified in Table 2.16.2-3 as Seismic Category I can withstand Seismic Category I loads without loss of safety function. iii. The as-built equipment identified in Table 2.16.2-3 including anchorage, can withstand Seismic Category I loads without loss of safety function.
4. The CRHAVS heat sink passively maintains the temperature of the CRHA within an acceptable range for the first 72 hours following a design basis accident.	i. A Control Building and Reactor Building Environmental Temperature Analysis for ESBWR ~~thermal analysis~~ will be performed using the as-built heat sink dimensions, the as-built heat sink thermal properties, the as-built heat sink exposed surface area, the as-built thermal properties of materials covering parts of the heat sink, and the as-built heat loads ~~to confirm the results of the control room design basis heat up analysis~~.	i. The CRHA maximum bulk average air temperature ~~will not exceed~~is 33.9° C (93° 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

Table 2.16.2-4

ITAAC For The Control Building Habitability HVAC Subsystem

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	ii. A Control Room Habitability Area Minimum Temperature Analysis will be performed using as-built design inputs established by Table 2.16.2-4 Item 4i, in addition to minimum assumed heat loads, minimum assumed outside air conditions and minimum assumed normal operation concrete heat sink temperaturesA thermal analysis will be performed using the as-built heat sink dimensions, the as-built heat sink thermal properties, the as-built heat sink exposed surface area, the as-built thermal properties of materials covering parts of the heat sick, and the as-built heat loads to confirm the results of the control room winter design basis heat up analysis.	ii. The CRHA minimum bulk average air temperature will not be belowis 12.8° C (55° F) or above on a loss of normal heating for the first 72 hours following a design basis accident, given winter post design basis accident conditions and as reconciled to as-built features and assumed minimum temperatures.

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% exceedance wet bulb temperature and corresponding temperature 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 air temperature is 30.0° C (86° 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.
6. CRHA isolation damper and EFU operational status (Open/Closed) indication is provided in the MCR.	i. Inspection will be performed to verify CRHA isolation damper and EFU operational status indication is installed in the MCR.	i. The as-built CRHA isolation damper and EFU operational status indication is provided in the MCR.

Table 2.16.2-4

ITAAC For The Control Building Habitability HVAC Subsystem

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	ii. Testing will be performed to show that the operational status indication in the MCR accurately depicts the operational status of the CRHA isolation dampers and EFUs.	ii. The operational status indication accurately depicts the operational status of the as-built CRHA isolation dampers and EFUs.
7. The free air volume of the control room envelope is greater than or equal to the volume assumed in safety analyses.	Analyses to be performed based on the as-built control room envelope to determine the free air volume (total volume minus equipment and walls).	The free air volume of the control room envelop is ≥ 2,200 m^3 (78,000 ft^3).
8. Normal operation intake flow rate is greater than or equal to the flow rate assumed in the safety analyses.	Inspections will be performed to verify the normal operation intake flow rate.	The flow rate is ≥ 220 l/s (466 cfm).
9. (Deleted)		
10. CRHAVS Air Handling Units and Auxiliary Cooling Units support post-72 hour control room habitability cooling and cooling for post-accident monitoring heat loads.	Testing of the integrated system will be performed to demonstrate the air-flow capability of the CRHAVS to support post-72 hour cooling for CRHA and Q-DCIS heat loads.	The integrated system test demonstrates the air-flow capability to support post-72 hour cooling for CRHA and Q-DCIS heat loads.
11. The CRHA is provided with differential pressure indication for monitoring under normal and emergency operation.	Testing will be performed to verify that the CRHA MCR pressure indication operates as designed.	The as-built CRHA pressure indication is provided in the MCR.

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 Temperature Profile for 0% Exceedance Wet Bulb Temperature Δ °C (°F)	11 (20)	11 (20)
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·ft²·°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/m³ (lb/ft³)(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 m² (ft²)	443 (4769)	443 (4769)
CRHA Heat Sink Ceiling/Floor Thickness m (ft)	0.50 (1.64)	0.50 (1.64)
CRHA Room Volume m³ (ft³)	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.

Enclosure 4

MFN 09-776

Response to NRC Request for

Additional Information Letter No. 397

Related to ESBWR Design Certification Application

Engineered Safety Systems

RAI Numbers 6.4-24 and 6.4-25

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, Mr. Richard E. Kingston to U.S. Nuclear Energy Commission, entitled "*Response to NRC Request for Additional Information Letter No. 397 – Related to ESBWR Design Certification Application – Engineered Safety Systems – RAI Numbers 6.4-24 and 6.4-25,*" dated December 16, 2009. The proprietary information in enclosure 1, which is entitled "*MFN 09-776 – Response to NRC Request for Additional Information Letter No. 397 – Related to ESBWR Design Certification Application – Engineered Safety Systems – RAI Numbers 6.4-24 and 6.4-25 — 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 16th day of December 2009.

Larry J. Tucker
GE-Hitachi Nuclear Energy Americas, LLC