HITACHI

GE Hitachi Nuclear Energy

Richard E. Kingston
Vice President, ESBWR Licensing

PO Box 780 M/C A-65
Wilmington, NC 28402-0780
USA

T 910 819 6192
F 910 362 6192
rick.kingston@ge.com

MFN 09-759 Supplement 1 Docket No. 52-010

January 15, 2010

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

Subject: **Response to NRC Request for Additional Information Letter No. 404 Related to ESBWR Design Certification Application – Engineered Safety Systems – RAI Number 6.4-22 S01**

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 Number 6.4-22 S01 is addressed in Enclosure 1.

Enclosure 2 contains markups to DCD Tier 2 Section 6.4 and Chapter 16 as noted in the Enclosure 1 response.

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

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 10-001, Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request for Additional Information Letter No. 404 Related to ESBWR Design Certification Application,* December 29, 2009

Enclosures:

1. MFN 09-759 Supplement 1 - Response to NRC Request for Additional Information Letter No. 404 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-22 S01
2. MFN 09-759 Supplement 1 - Response to NRC Request for Additional Information Letter No. 404 Related to ESBWR Design Certification Application – Engineered Safety Features – RAI Number 6.4-22 S01 – Markups to ESBWR DCD Tier 2 Section 6.4 and Chapter 16

cc: AE Cubbage USNRC (with enclosures)
JG Head GEH (with enclosures)
DH Hinds GEH (with enclosures)
SC Moen GEH (with enclosures)
eDRF Section 0000-0101-5514 Rev 1

Enclosure 1

MFN 09-759 Supplement 1

Response to NRC Request for

Additional Information Letter No. 404

Related to ESBWR Design Certification Application

Engineered Safety Features

RAI Number 6.4-22 S01

NRC RAI 6.4-22

In letter MFN 09-551, dated August 17, 2009, GEH provided a detailed discussion in response to Control Room Habitability Area (CRHA) Meeting Open Topic #6 (see ML091760538 for the meeting summary). The GEH response provided justification as to why, as a result of the existence of the CRHA vestibules, a COL applicant could justify the establishment of a near zero limit for CRHA inleakage attributed to CRHA access/egress.

The assumption of such a low value, to be considered as an allowed departure from the 10 cfm infiltration value provided for such leakage by SRP 6.4, requires further justification in the DCD.

In consideration for this, include a discussion in the DCD Tier 2, Section 6.4 or in DCD Chapter 16, Technical Specification Section 5.5.12, that more explicitly states the unique ESBWR requirement for determining the unfiltered air in leakage past the CHRHA boundary; in that the ESBWR design assumes a zero or near zero value for CRHA access and egress leakage limit. Clarify in the DCD that a COL applicant must justify this limit in the leakage program manual, in view of SRP 6.4 section III.3.Eiii Note 4.

GEH Response

In letter MFN 09-551, dated August 17, 2009, GEH provided a detailed discussion in response to Control Room Habitability Area (CRHA) Meeting Open Topic #6 (see ML091760538 for the meeting summary). The GEH response provided justification as to why, as a result of the existence of the CRHA vestibules, a COL applicant could justify the establishment of a near zero limit for CRHA inleakage attributed to CRHA access/egress.

The assumption of such a low value, to be considered as an allowed departure from the 10 cfm infiltration value provided for such leakage by SRP 6.4, requires further justification in the DCD.

As discussed in Topic #6, the “near zero” ingress and egress inleakage due to vestibule doors is NOT a departure from the SRP requirements as discussed below. The insights associated with the infiltration value as elaborated upon in Topic #6 and related RAIs will be incorporated into the DCD.

In consideration for this, include a discussion in the DCD Tier 2, Section 6.4 or in DCD Chapter 16, Technical Specification Section 5.5.12, that more explicitly states the unique ESBWR requirement for determining the unfiltered air in leakage past the CHRHA boundary; in that the ESBWR CRHA design assumes a zero or near zero value for CRHA access and egress leakage limit. Clarify in the

DCD that a COL applicant must justify this limit in the leakage program manual, in view of SRP 6.4 section III.3.Eiii Note 4.

As discussed in Topic #6, the "near zero" ingress and egress inleakage due to vestibule doors is NOT a departure and as such requires no further justification.

The ESBWR CRHA design meets SRP 6.4 III.3.A.i, Zone Isolation with filtered incoming air and positive pressure. The EFUs include deep bed charcoal filter units and the CRHA boundary has automatic isolation with immediate automatic pressurization. The CRHA positive differential pressure with respect to adjacent areas is continuously maintained. The CRHAVS doesn't have "recirculated" air nor is any portion of ductwork under any negative pressure outside the CRHA boundary. As such, SRP 6.4 Note 4 does not specifically apply but the basis for reduced or zero inleakage values associated with double door vestibules is applicable to the ESBWR CRHA.

The CRHA ingress and egress through the double door vestibules will be finalized during preparation of the CRHA Inleakage Test Procedure under COL applicant item 6.4-1-A, CRHA Procedures and Training. The CRHA ingress and egress leakage criteria must support the total 12 cfm leakage criteria assumed in the LOCA dose analysis and test requirements as described in Generic letter 2003-01.

GEH agrees that the insights gained during Topic #6 evaluation should be captured and incorporated into DCD Tier 2. DCD Tier 2 will be updated to include a discussion on how the specific design features of the plant allow one to arrive at the low inleakage value cited.

DCD Impact

DCD Tier # 2, Section 6.4.7, Testing and Inspection, Inservice Testing, will be revised as noted in the attached markup stating:

The Control Room EFU supplies air with a design flow rate of 220 l/s (466 cfm), and it is designed to maintain the control room envelope at a positive pressure with respect to adjacent compartments during normal operation and radiological events. An intake filter efficiency of 99% is assumed for particulate, elemental, and organic iodine species. The system does not include filtered recirculation and the design incorporates leak tightness design requirements (Section 6.4.3). Although the control room is maintained at a positive pressure, the dose analysis assumes a 5.66 l/s (12.0 cfm) unfiltered inleakage. Based on the ESBWR CRHA design and ventilation system operation the acceptance criteria for inleakage associated with CRHA access and egress will be near zero during development of the CRHA Unfiltered Inleakage Test.

DCD Tier #2, Section 6.4.9 will add reference back to subsection 6.4.7.

NRC RAI 6.4-22 S01

In letter MFN 09-759, dated December 5, 2009, GEH responded to staff RAI 6.4-22, which requested GEH clarify the DCD to state that the value of CRHA ingress/egress leakage would be provided and justified by a COL applicant.

The staff has reviewed the response and the proposed DCD revisions and the following additional information is needed:

In accordance with SRP 6.4 and Regulatory Guide 1.197 guidance, the acceptance criteria for CRHA unfiltered in leakage will be no greater than the amount of unfiltered leakage assumed in the Dose Consequence Analysis minus the amount of unfiltered inleakage allocated for CRHA access and egress. This allocation may be specified and justified either within the standard design or by a COL applicant.

Update DCD subsection 6.4.4, Inservice Testing, to include the value assumed for access/ egress for CRHA unfiltered inleakage and provide a basis for the number assumed, or alternatively, clarify the DCD to indicate that this number must be specified by the COL applicant that references the ESBWR design.

GEH Response

GEH will update DCD Tier 2, subsection 6.4.7 to reflect the limiting unfiltered CRHA inleakage value attributable to CRHA ingress/egress. Historically, NRC staff has not approved a value for unfiltered leakage attributable to CRHA ingress/egress of less than 5 cfm. GEH will provide an effective CRHA inleakage value of 2.36 l/s (5 cfm) applied to ESBWR CRHA ingress/egress. This inleakage estimate value is conservative. Supporting justification for this effective inleakage includes the following:

- The Staff has approved values of 2.36 l/s (5 cfm) CRHA inleakage attributable to CRHA ingress/egress, for control room designs, including advanced LWR designs with double door vestibules. The ESBWR CRHA includes advanced design, low leakage, interlocked double-vestibule type doors designed to minimize inleakage during CRHA ingress/egress.
- ESBWR CRHA pressure integrity of double door vestibules is ensured by measurement of the CRHA pressure relative to the area outside of the double door vestibule during the normal pressurized mode of operation with the results trended and used as part of the 24 month assessment of the CRHA boundary (ref: DCD Chapter 16 section 5.5.12, Programs and Manuals).
- A local CRHA inleakage value of 2.36 l/s (5 cfm) attributed to CRHA ingress/egress through the double door vestibules would result in an “effective” inleakage value of less than 2.36 l/s (5 cfm) contributing to the total CRHA

unfiltered inleakage analysis assumption. The ESBWR control room dose analysis unfiltered inleakage term considers leakage into the CRHA from louvers located in the control building nearest to the receptor (point source). The CRHA double door vestibules are located inside corridors distant from the assumed inleakage introduction location. Therefore, mixing and diffusion of inleakage will occur prior to reaching the outside door of the CRHA double door vestibule.

- The actual ESBWR CRHA inleakage due to ingress/egress through the double door vestibules can be quantified during performance of the CRHA Inleakage Test Procedure developed under COL applicant item 6.4-1-A, CRHA Procedures and Training. Testing in accordance with ASTM E741, Standard Method for Determining Air Change in a Single Zone by Means of a Tracer Gas Dilution, will measure total inleakage while allowing CRHA ingress/egress as would exist following a design basis accident.

DCD Impact

DCD Tier # 2, Section 6.4.7, Testing and Inspection, Inservice Testing, will be revised as noted in the attached markup.

DCD Tier # 2, Chapter 16, Section 5.5.12, Control Room Habitability Area (CRHA) Boundary Program, will be revised as noted in the attached markup.

Enclosure 2

MFN 09-759 Supplement 1

Response to NRC Request for

Additional Information Letter No. 404

Related to ESBWR Design Certification Application

Engineered Safety Features

RAI Number 6.4-22 S01

Markups to ESBWR DCD Tier 2
Section 6.4 and Chapter 16

protection assumptions used in the generation of post-LOCA radiation source terms are described fully in Chapter 15.

Smoke protection is discussed in Subsection 9.4.1 and evaluated in Subsection 9.5.1. The use of noncombustible construction and heat and flame-resistant materials wherever possible throughout the plant minimizes the likelihood of fire and consequential fouling of the control room atmosphere with smoke or noxious vapor. In the smoke removal mode, a dedicated fan, intake, and exhaust path are utilized to purge the control room with a high volume of outside airflow.

A high radiation condition causes automatic changeover to the operating modes described in Subsection 6.4.4, Subsection 7.3.4.2, and in Subsection 9.4.1.2. The EFUs automatically start during a radiological event, independent of the loss of normal AC power. Through the use of redundant EFU components and dampers, one EFU and supply path to the CRHA would be available during a loss of normal AC power with failure of up to two divisions of safety-related power to provide CRHA breathing air and pressurization during a loss of AC concurrent with a radiological event. Local, audible alarms warn the operators to shut the self-closing doors, if for some reason they are open.

The EFUs are designed in accordance with Seismic Category I requirements. The failure of components (and supporting structures) of any system, equipment or structure, which is not Seismic Category I, does not result in loss of a required function of the EFUs.

Potential site-specific toxic or hazardous materials that may affect control room habitability will be identified by the COL Applicant. The COL Applicant will identify potential site specific toxic or hazardous materials that may affect control room habitability in order to meet the requirements of TMI Action Plan III.D.3.4 and GDC 19. The COL Applicant will determine the protective measures to be instituted to ensure adequate protection for control room operators as recommended under RG 1.78. These protective measures include features to (1) provide capability to detect releases of toxic or hazardous materials, (2) isolate the control room if there is a release, (3) make the control room sufficiently leak tight, and (4) provide equipment and procedures for ensuring the use of breathing apparatus by the control room operators (COL 6.4-2-A).

6.4.6 Life Support

In addition to the supply of vital air, food, water and sanitary facilities are provided.

6.4.7 Testing and Inspection

A program of preoperational and post-operational testing requirements is implemented to confirm initial and continued system capability. The CRHAVS is tested and inspected at appropriate intervals consistent with plant technical specifications. Emphasis is placed on tests and inspections of the safety-related portions of the habitability systems. Design changes to the CRHA will ensure key design assumptions are met such as:

- Heat sink / Heat source assumptions
- Air flow assumptions
- Heat transfer values

This will ensure that CRHA calculations and methodologies are maintained and updated throughout the life of the plant.

Preoperational Inspection and Testing

Preoperational testing of the CRHAVS is performed to verify that the minimum air flow rate of 220 l/s (466 cfm) is sufficient to maintain pressurization of the main control room envelope of at least 31 Pa (⅛ inch w.g.) with respect to the adjacent areas. The variable orifice relief device is set during this evolution to ensure an equal amount of air is exhausted from the CRHA. The positive pressure within the main control room is confirmed via the differential pressure transmitters within the control room. The installed flow meters are utilized to verify the system flow rates. The pressurization of the control room limits the ingress of radioactivity to maintain operator dose below regulatory limits. Air quality within the CRHA environment is confirmed to be within the guidelines of American Society of Heating, Refrigeration and Air Conditioning Engineers (ASHRAE) Standard 62 requirements for continued occupancy via meeting the fresh air supply requirement of 10.5 l/s (22 cfm) per person for the type of occupancy expected in the CRHA. The capacity of the safety-related battery is verified to ensure it can power an EFU fan for a minimum of 72 hours. Heat loads within the CRHA are verified to be less than the specified values. Preoperational testing of the CRHAVS isolation dampers is performed to verify the leaktightness of the dampers. Preoperational testing for CRHA inleakage during EFU operation is conducted in accordance with ASTM E741. Testing and inspection of the radiation monitors are discussed in Section 11.5. The other tests noted above are discussed in Chapter 14.

Inservice Testing

Inservice testing of the CRHAVS includes operational testing of the EFU fans and filter unit combinations, EFU filter performance testing, automatic actuation testing of the CRHA isolation dampers and EFU fans, and unfiltered air inleakage testing of the CRHA envelope boundary. The CRHA boundary is Pressure Tested (PT) periodically to verify leak tightness on the envelope walls, doors, and boundaries. Testing to demonstrate the integrity of the CRHA envelope is performed in accordance with RG 1.197 and ASTM E741.

The Control Room EFU supplies air with a design flow rate of 220 l/s (466 cfm), and it is designed to maintain the control room envelope at a positive pressure with respect to adjacent compartments during normal operation and radiological events. An intake filter efficiency of 99% is assumed for particulate, elemental, and organic iodine species. The system does not include filtered recirculation and the design incorporates leak tightness design requirements (Section 6.4.3). Although the control room is maintained at a positive pressure, the dose analysis assumes a 5.66 l/s (12.0 cfm) unfiltered inleakage. Based on the ESBWR CRHA design and ventilation system operation the acceptance criteria for inleakage associated with the CRHA ~~access and egress~~ will be no greater than the amount of unfiltered leakage assumed in the Dose Consequence Analysis minus 2.36 l/s (5 cfm) which is the amount of unfiltered inleakage allocated for ingress and egress. This leakage estimate value is conservative~~near zero during development of the CRHA Unfiltered Inleakage Test~~.

Nuclear Air Filtration Unit Testing

The EFU filtration components are periodically tested in accordance with ASME AG-1, Code on Nuclear Air and Gas Treatment, to meet the requirements of RG 1.52.

5.5 Programs and Manuals

5.5.12 Control Room Habitability Area (CRHA) Boundary Program

A CRHA Boundary Program shall be established and implemented to ensure that CRHA habitability is maintained such that, with an OPERABLE CRHA Heating, Ventilation, and Air Conditioning (HVAC) Subsystem (CRHAVS), CRHA occupants can control the reactor safely under normal conditions and maintain it in a safe condition following a radiological event,[hazardous chemical release,] or a smoke challenge. The program shall ensure that adequate radiation protection is provided to permit access and occupancy of the CRHA under design basis accident (DBA) conditions without personnel receiving radiation exposures in excess of 0.05 Sv (5 rem) total effective dose equivalent (TEDE) for the duration of the accident. The program shall include the following elements:

COL 16.0-1-A 5.5.12-1

a. The definition of the CRHA and the CRHA boundary.

b. Requirements for maintaining the CRHA boundary in its design condition including configuration control and preventive maintenance.

c. Requirements for (i) determining the unfiltered air inleakage past the CRHA boundary into the CRHA in accordance with the testing methods and at the Frequencies specified in Sections C.1 and C.2 of Regulatory Guide 1.197, "Demonstrating Control Room Envelope Integrity at Nuclear Power Reactors," Revision 0, May 2003, and (ii) assessing CRHA habitability at the Frequencies specified in Sections C.1 and C.2 of Regulatory Guide 1.197, Revision 0.

d. Measurement, at designated locations, of the CRHA pressure relative to all external areas adjacent to the CRHA boundary during the pressurization mode of operation by one train of the CRHAVS, operating at the flow rate required by the VFTP, at a Frequency of 24 months on a STAGGERED TEST BASIS. The results shall be trended and used as part of the 24 month assessment of the CRHA boundary.

e. The quantitative limits on unfiltered air inleakage into the CRHA. These limits shall be stated in a manner to allow direct comparison to the unfiltered air inleakage measured by the testing described in paragraph c. The unfiltered air inleakage limit for radiological challenges is the inleakage flow rate assumed in the licensing basis analyses of DBA consequences less the amount designated for ingress and egress. [Unfiltered air inleakage limits for hazardous chemicals must ensure that exposure of CRHA occupants to these hazards will be within the assumptions in the licensing basis.]

COL 16.0-1-A 5.5.12-1