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MFN 09-712 Docket No. 52-010

December 12, 2009

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

Subject: **Submittal of Response to Portion of NRC Request for Additional Information Letter No. 388 Related to ESBWR Design Certification Application - RAI Number 12.4-19 S05**

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 NRC letter No. 388, dated November 2, 2009 (Reference 1).

Enclosure 1 provides the GEH response to the subject RAI as requested in Reference 1.

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

Sincerely,

Richard E. Kingston
Vice President, ESBWR Licensing

Reference:

1. MFN 09-689 - Letter from U.S. Nuclear Regulatory Commission to Jerald G. Head, *Request For Additional Information Letter No. 388 Related To ESBWR Design Certification Application*, dated November 2, 2009

Enclosure:

1. MFN 09-712 – Response to Portion of NRC Request for Additional Information Letter No. 388 Related to ESBWR Design Certification Application - RAI Number 12.4-19 S05

cc:

AE Cubbage	USNRC (with enclosure)
JG Head	GEH/Wilmington (with enclosure)
DH Hinds	GEH/Wilmington (with enclosure)
DF Taylor	GEH/Wilmington (with enclosure)
TL Enfinger	GEH/Wilmington (with enclosure)
eDRF Section	0000-0105-3191, Rev.1

Enclosure 1

MFN 09-712

Response to Portion of NRC Request for Additional Information Letter No. 388 Related to ESBWR Design Certification Application

RAI Number 12.4-19 S05

NRC RAI 12.4-19 S05

There appear to be several inconsistencies in your response to RAI 12.4-19 S04. Please modify your response to address the following issues:

a. Item b) 1) of the staff's RAI requests that GEH provide its reasons for changing the radius of the steel tube. In your response you state that the steel tube radius was changed "for the purpose of the shielding evaluation" (you also state that cost factors and seismic requirements were other reasons for changing the tube radius). Provide a more thorough description of what role the shielding evaluation had in the decision to reduce the radius of the steel tube from 15" to 12" (such a reduction in the tube radius would decrease the thickness of the water shielding between the fuel assembly and the steel tube and therefore increase the dose rate from the fuel assembly).

b. In your response to item 8 a) of RAI 12.4-19 S03 (requesting a list of modified shielding assumptions), you stated that the thickness (1.27 cm) of the transfer tube did not change. If the transfer tube thickness did not change, explain why, in your response to RAI 12.4-19 S04, you provide a comparison of the thickness of the IFTT wall thickness with the BWR-6 wall thickness in item b)1) of your response.

c. GEH response to item b) 2) of RAI 12.4-19 S04 states that the "radius of the guard tube was changed to accommodate the larger steel tube..." However, in your response to b) 1), you state that the IFTT steel tube was reduced in radius, not increased in radius. Modify your response to this item to reflect that fact that the IFTT steel tube was made smaller (in diameter), not larger. Since the IFTT steel tube was made smaller in diameter, not larger, provide the justification for increasing the radius of the guard tube from 16 to 18 inches.

d. It is unclear from your response whether lead shielding will be used to provide additional shielding around the IFTT when it passes through the interior of a room. GEH response to item b) 4) of RAI 12.4-19 S04 states that "The previously reported dose rates did not credit 10 or 15 cm of lead when the transfer tube passes through the interior of a room. Letter MFN 06-499 Supplement 2 was misleading as it indicated lead shielding had been credited in the calculation of the dose rate around the IFTT." However, note 7 for DCD Figure 12.3-10 states that the wall thickness between Room 1401 and the trapezoidal room must be 200 cm of concrete shielding, "equivalent to 150 cm of concrete plus 10 cm of lead." Specify if lead shielding will be used to provide additional shielding for the IFTT. If not, provide your justification for describing this shielding in the notes to some of the DCD layout drawings.

e. In response to item c of RAI 12.4-19 S02, GEH provided a list of physical controls, interlocks, and an annunciator that will serve to prevent access to any area adjacent to the IFTT which has a radiation class classification higher than "A". Include a listing of these controls and interlocks in the appropriate section of the Chapter 12 DCD.

On October 2, 2009, the staff held a telecom with GEH to discuss the following additional instances where either GEH's responses to portions of RAI 12.4-19 were unclear or where GEH did not address the reasons for changes to dose rates in the vicinity of the IFTT.

In RAI 12.4-19 S02, the staff notified GEH that the applicant had used an incorrect shielding code input parameter when calculating the dose rates from the IFTT. The use of this incorrect input parameter by GEH resulted in estimated dose rates from the IFTT (during the transfer of a spent fuel assembly in the IFTT) that were smaller by a factor of approximately ten than the dose rates calculated by the staff's contractor. In supplemental 2 to this RAI, the staff asked GEH to correct the erroneous shielding code input parameter and describe the effects of this change on the calculated dose rates in various rooms/areas surrounding the IFTT. In GEH's response to this supplement 2 RAI, GEH provided a table (Table 2) listing, for each of the rooms adjacent to the IFTT, the concrete shielding thickness of the room wall adjacent to the IFTT and the resulting dose rate and radiation zone designation in each room. In reviewing this table, the staff noted that there was no clear indication of what table parameters had changed (e.g., dose rates, shield wall thickness) as a result of GEH's correction of the erroneous shield code input parameter. As part of the staff's supplement 3 RAI, the staff asked GEH to describe "how these dose rates compare with the calculated dose rates provided in response to the initial RAI 12.4-19." In GEH's response to this supplement 3 RAI, GEH stated "Because there are significant differences with respect to the first response, no detailed comparison is performed but the differences in the results obtained are considered to be justified." This response is unacceptable since it does not address the staff's concern with respect to what parameters had changed (e.g., dose rates, shield wall thickness) as a result of GEH's correction of the erroneous shield code input parameter.

f. The staff compared the radiation zone designations listed in Table 2 with the dose rate designations for the same rooms depicted in an earlier version of plant layout Figure 12.3-10. On the basis of this comparison, it appears that GEH's correction of the erroneous shield code input parameter did not result in an increase in the dose rate designations for any of the rooms adjacent to the IFTT. For each of the rooms listed in Table 2, provide a justification as to why the radiation zone designation in Table 2 did not increase as a result of GEH's correction of the erroneous shield code input parameter.

g. Although Table 2 lists concrete shielding thicknesses for each of the rooms adjacent to the IFTT, it is unclear which, if any, of these concrete shielding thicknesses listed in Table 2 were increased (in order to prevent the associated room dose rates from increasing) as a result of GEH's correction of the erroneous shield code input parameter. For each of the rooms listed in Table 2, provide a listing of what changes were made in the thickness of the adjoining concrete walls as a result of GEH's correction of the erroneous shield code input parameter.

h. Note 1 to Figure 12.3-10 in Rev. 6 of the DCD states that the dose rate in rooms 1702 and the trapezoidal room is classified as radiation zone J (> 5 Sv/hr) during fuel transfer. In an earlier revision (Rev. 3) of the DCD, Note 1 to Figure 12.3-10 states that these same areas are classified as being a lower radiation zone, zone I (<5 Sv/hr), during fuel transfer. By increasing the dose rate for these areas to zone J during spent fuel transfer, these areas become classified as Very High Radiation Areas, per the definition in 10 CFR 20.1602. Describe what plant modification was made that resulted in the increase in the zone designation from zone I to zone J during spent fuel transfer for the areas identified by Note 1 to DCD Figure 12.3-10.

GEH Response

All previous responses and supporting shielding evaluations were reviewed prior to developing this response to RAI 12.4-19 S05. That review identified some prior inconsistencies, which are explained in this response.

For this response, the Inclined Fuel Transfer System (IFTS) shielding evaluation that was generated for RAI 12.4-19 (MFN 06-499 issued on 12/22/06) will be referred to as the "original IFTS shielding evaluation", and the IFTS shielding evaluation performed for RAI 12.4-19 S01 and S02 (MFN 06-499 S1 issued on 4/15/08) will be referred to as the "revised IFTS shielding evaluation". The review of the prior responses and supporting shielding evaluations showed that the revised IFTS shielding evaluation differed from the original IFTS shielding evaluation in three distinct ways:

1. The original IFTS shielding evaluation included the error identified by the NRC in RAI 12.4-19 S02, and that error was corrected in the revised IFTS shielding evaluation.
2. The original IFTS shielding evaluation made assumptions for the inputs of the sizes and thicknesses of the transfer tube and guard tube, and the revised IFTS shielding evaluation used actual dimensions from a GEH BWR/6 IFTS design that had been reviewed for use in the ESBWR. That design had been reviewed to determine its suitability for use in the ESBWR design, and to develop appropriate geometry inputs for use in the revised IFTS shielding evaluation.
3. The original IFTS shielding evaluation assumed the thicknesses of concrete shielding based on the ESBWR DCD General Arrangement drawings, and the revised IFTS shielding evaluation assumed the thicknesses of concrete shielding such that the radiation zones would not increase. The revised evaluation provided the concrete shielding thicknesses without lead in Table 2 of RAI 12.4-19 S01 and S02 (MFN 06-499 S1 issued on 4/15/08). The revised IFTS shielding evaluation did evaluate some cases where concrete thicknesses had been reduced by adding various thicknesses of lead. However, it was inappropriate to include any reference to lead in the response to item 8a of RAI 12.4-19 S03 (MFN 06-499 S2 issued on 1/27/09) because none of the results reported in Table 2 of that response credited lead shielding.

The dimensions of the IFTS transfer tube and guard tube that were used as inputs to both the original and revised IFTS shielding evaluations are shown below.

IFTS Transfer Tube and Guard Tube Dimensions Used in IFTS Shielding Analyses

IFTS Component dimension	Revised IFTS Shielding Evaluation (inches)	Original IFTS Shielding Evaluation (inches)
IFTS transfer tube outer-radius	12	16[2]
IFTS transfer tube thickness	0.5	1.0
IFTS guard tube outer-radius	18	17[2]
IFTS guard tube thickness	0.75[1]	1.0

Note 1 The IFTS guard tube thickness credited in the revised IFTS shielding evaluation was incorrectly reported to be 0.5 inches in the response to RAI 12.4-19 S02 (MFN 06-499 S1 issued on 4/15/08) and in response to RAI 12.4-19 S03 (MFN 06-499 S2 issued on 1/27/09). The IFTS guard tube thickness credited in the revised IFTS shielding evaluation is 0.75 inches.

Note 2 These values were reported in terms of outer diameter in the response to the initial RAI 12.4-19 (MFN 06-499 issued on 12/22/06), but are reported here in terms of outer radius for the purpose of providing a direct comparison.

The results from the revised IFTS shielding evaluation (which used current IFTS component dimensions) are those reported in Table 2 of RAI 12.4-19 S02 (MFN 06-499 S1 issued on 4/15/08). The errors identified in this response concern the reporting of the details of the revised IFTS shielding evaluation in RAI responses. No errors in the revised IFTS shielding evaluation have been identified and the results remain valid (reproduced below).

Table 2 of RAI response 12.4-19 S2 (MFN 06-499 S1 issued on 4/15/08)
Dose rate and radiation zoning designations during IFTS operation

Room		Concrete shielding cm.	mSv/hr	Radiation Zone
1401	RB CRD B Panel Room.	200[1]	9.52E-04	A
1501	Reactor Building. Electrical Equipment Room B	200	6.48E-04[5]	A
1600	Wetwell access / Fan room. Hallway between quadrants.	200	6.48E-04[5]	A[2]
1703	Standby Liquid control Pump room.	200	9.52E-04	A[2]
1702	Incline fuel transfer tube room.	N/A: Inside	8.16E+06	J
-	Trapezoidal room.	N/A: Inside	8.16E+06	J
2IP1	Incline fuel transfer pit.	N/A: Inside	8.16E+06	J
2190	FB Commodity chase.	200	9.52E-04	A[3]
2400	FB Rail car bay (at Elevations 4650, and 13570)	125[4]	1.86E+00	F

Note 1 The wall of the Trapezoidal Room to room 1401 is designed up to a minimum 200 cm concrete shielding equivalent, keeping the room 1401 as a radiation zone “A” during IFTT operation.

Note 2 The normal Operation Radiation Zone Classification is “B”.

Note 3 The normal Operation Radiation Zone Classification is “D”.

Note 4 The wall of the trapezoidal room to room 2400, at Elevation 4650, is designed up to a minimum 125 cm concrete shielding equivalent, keeping the room 2400 at this area as a radiation zone “F” or lower during IFTT operation.

Note 5 Value was reported incorrectly in Table 2 of RAI 12.4-19 S02 (MFN 06-499 S1 issued on 4/15/08) and corrected in item 6 of RAI 12.4-19 S03 (MFN 06-499 S2 issued on 1/27/09)

It should be noted that the revised IFTS shielding evaluation dose rates reported in RAI 12.4-19 S01 and S02 (MFN 06-499 S1 issued on 4/15/08) did not credit the guard tube in any of the rooms the IFTS transits.

Item a:

Provide a more thorough description of what role the shielding evaluation had in the decision to reduce the radius of the steel tube from 15" to 12" (such a reduction in the tube radius would decrease the thickness of the water shielding between the fuel assembly and the steel tube and therefore increase the dose rate from the fuel assembly).

GEH Response to item a:

The revised IFTS shielding evaluation did not play any role in determining the IFTS guard tube and transfer tube size or wall thicknesses. The sizes and thicknesses of the IFTS guard tube and transfer tube were changed in the revised IFTS shielding evaluation to be consistent with a GEH IFTS design that was developed for use in a BWR/6 and evaluated for use in the ESBWR. Note that the outer radius of the IFTS transfer tube decreased from 16 inches in the original IFTS shielding evaluation to 12 inches in the revised IFTS shielding evaluation.

Item b:

In your response to item 8 a) of RAI 12.4-19 S03 (requesting a list of modified shielding assumptions), you stated that the thickness (1.27 cm) of the transfer tube did not change. If the transfer tube thickness did not change, explain why, in your response to RAI 12.4-19 S04, you provide a comparison of the thickness of the IFTT wall thickness with the BWR-6 wall thickness in item b)1) of your response.

GEH Response to item b:

The thickness of the transfer tube was assumed to be 1 inch in the original IFTS shielding evaluation and was reduced to 0.5 inches in the revised IFTS shielding evaluation. Item 8a of RAI 12.4-19 S03 (MFN 06-499 S2 issued on 1/27/09) is not correct.

Comparisons to the BWR/6 discussed in RAI 12.4-19 S04 (MFN 09-538 issued on 8/10/2009) were added to that response in order to report the design judgments (justifications) outlined in the actual design notes from the IFTS design review.

Item c:

GEH response to item b) 2) of RAI 12.4-19 S04 states that the "radius of the guard tube was changed to accommodate the larger steel tube..." However, in your response to b) 1), you state that the IFTT steel tube was reduced in radius, not increased in radius. Modify your response to this item to reflect that fact that the IFTT steel tube was made smaller (in diameter), not larger. Since the IFTT steel tube was made smaller in diameter, not larger, provide the justification for increasing the radius of the guard tube from 16 to 18 inches.

GEH Response to item c:

The IFTS transfer tube size decreased from the original IFTS shielding evaluation to the revised IFTS shielding evaluation. The original IFTS shielding evaluation assumed a guard tube with a 16-inch inner radius and a wall thickness of 1 inch (giving an outer radius of 17 inches). The revised IFTS shielding evaluation assumed a guard tube with an outer radius of 18 inches.
The assertion that the IFTS guard tube had been changed to accommodate a larger transfer tube that was made in item b (2) of RAI 12.4-19 S04 is not correct (MFN 09-538 issued on 8/10/09).

Item d:

Specify if lead shielding will be used to provide additional shielding for the IFTT. If not, provide your justification for describing this shielding in the notes to some of the DCD layout drawings.

GEH Response to item d:

There is no requirement (stated or implied) to use lead shielding for any room adjacent to the IFTS. Note 7 on DCD Rev. 6 Figure 12.3-10 is accurate, however. To accommodate detail design and possible interferences, the provision to trade off concrete shielding against lead is provided. For example, the wall between the Trapezoidal Room and room 1401 must be a minimum of 200 cm concrete shielding equivalent, thus maintaining room 1401 as a radiation zone “A” during IFTS operation. 200 cm of concrete shielding is equivalent to 150 cm of concrete plus 10 cm of lead as described in Note 7 of DCD Rev. 6 Figure 12.3-10. This allows for alternate shielding configurations that will maintain the assigned radiation zone.

Item e:

In response to item c of RAI 12.4-19 S02, GEH provided a list of physical controls, interlocks, and an annunciator that will serve to prevent access to any area adjacent to the IFTT which has a radiation class classification higher than "A". Include a listing of these controls and interlocks in the appropriate section of the Chapter 12 DCD.

GEH Response to item e:

The controls listed in item c of the response to RAI 12.4-19 S02 (MFN 06-499 S1 issued on 4/15/08) were taken from DCD Section 12.3.1.4.4. Those items were added to the DCD at the request of the NRC as described in the response to RAI 12.4-20 S01 (MFN 07-143 issued on 3/12/07).

Item f:

For each of the rooms listed in Table 2, provide a justification as to why the radiation zone designation in Table 2 did not increase as a result of GEH's correction of the erroneous shield code input parameter.

GEH Response to item f:

The radiation zone designations in Table 2 of RAI 12.4-19 S02 (MFN 06-499 S1 issued on 4/15/08) did not change because the amount of shielding credited in the shielding evaluation was increased to ensure the zones stayed the same. The shielding thickness credited in the original and revised IFTS shielding evaluations are listed for the response to item g (below).

Item g:

For each of the rooms listed in Table 2, provide a listing of what changes were made in the thickness of the adjoining concrete walls as a result of GEH's correction of the erroneous shield code input parameter.

GEH Response to item g:

The original IFTS shielding supporting the response to initial RAI 12.4-19 (MFN 06-499 issued on 12/22/06) not only included the error identified by the NRC staff, but also assumed a different geometry of the IFTS from the revised IFTS shielding evaluation. For that reason, the changes in dose rates between the two evaluations cannot be attributed to the error corrected or the revised geometry inputs. Therefore, no conclusions should be made based on a comparison of the two IFTS shielding evaluations.

However, for the purpose of this response the table below provides a comparison between the results of the two evaluations and the concrete wall thicknesses credited. Further, note that radiation zone designations were not reported in the response to RAI 12.4-19 (MFN 06-499 issued on 12/22/06) but the corresponding radiation zones based on the ESBWR DCD Rev. 6 Section 12.3.1.3 criteria were added to this summary table here.

Previously determined dose rate and radiation zoning designations during IFTS operation

Room		Response to RAI 12.4-19 S01 & S02			Original Response to RAI 12.4-19		
		Concrete shielding cm.	mSv/hr	Radiation Zone	Concrete shielding cm.	mSv/hr	Radiation Zone
1401	RB CRD B Panel Room.	200	9.52E-04	A	150	1.20E-03	A
1501	Reactor Building. Electrical Equipment Room B	200	6.48E-04	A	200	8.00E-06[1]	A
1600	Wetwell access / Fan room. Hallway between quadrants.	200	6.48E-04	A	Not Evaluated		
1703	Standby Liquid control Pump room.	200	9.52E-04	A	200	8.00E-06	A
1702	Incline fuel transfer tube room.	N/A: Inside	8.16E+06	J	Not Evaluated		
-	Trapezoidal room.	N/A: Inside	8.16E+06	J	Not Evaluated		
2IP1	Incline fuel transfer pit.	N/A: Inside	8.16E+06	J	Not Evaluated		
2190	FB Commodity chase.	200	9.52E-04	A	200	8.00E-06	A
2400	FB Rail car bay (at Elevations 4650, and 13570)	125	1.86E+00	F	50	3.60E+01	G

Note 1 Value was not reported in MFN 06-499 on 12/22/06. The value was taken directly from the original IFTS shielding evaluation supporting MFN 06-499 on 12/22/06 for the purpose of this comparison.

Item h:

Describe what plant modification was made that resulted in the increase in the zone designation from zone I to zone J during spent fuel transfer for the areas identified by Note 1 to DCD Figure 12.3-10.

GEH Response to item h:

There was no plant modification that resulted in the radiation zones increasing. The zone associated with Note 1 to Figure 12.3-10 was added in DCD Revision 5 after the submittal of RAI 12.4-19 S01 and S02 (MFN 06-499 S1 issued on 4/15/08) to reflect the dose rates in those areas. Those areas were determined to be a Zone J during fuel movements as reported in Table 2 of RAI 12.4-19 S02 (MFN 06-499 S1 issued on 4/15/08).

DCD Impact

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