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Security Notice
This letter forwards Security-Related information in accordance with 10 CFR 2.390. Upon removal of Enclosure 3, the balance of this letter may be considered non-Security-Related.

MFN 09-070

Docket No. 52-010

March 3, 2009

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

Subject: **Response to Portion of NRC Request for Additional Information Letter No. 218 Related to ESBWR Design Certification Application – Radiation Protection – RAI Number 12.4-23 S02**

Enclosure 1 contains the GE Hitachi Nuclear Energy (GEH) response to the subject NRC RAI originally transmitted via the Reference 1 letter and supplemented by an NRC request for clarification and GEH responses addressed in References 2 through 4. Enclosure 2 contains DCD Tier 2 Markups that are not security-related.

Enclosure 3 contains Security-Related DCD Figures identified by the designation "{{{Security-Related Information - Withhold Under 10 CFR 2.390}}}. " GEH hereby requests this information be withheld from public disclosure in accordance with the provisions of 10 CFR 2.390. No public version of these security-related DCD Markups are provided in these RAI responses since they would be blank pages with only figure titles and figure numbers; however, DCD Tier 2, Revision 6 will contain public versions of these figures.

D068

If you have any questions about the information provided here, please contact me.

Sincerely,

Richard E. Kingston

Richard E. Kingston
Vice President, ESBWR Licensing

References:

1. MFN 08-561, *Letter from the U.S. Nuclear Regulatory Commission to Robert E. Brown, Request for Additional Information Letter No. 218, Related To ESBWR Design Certification Application*, dated July 1, 2008

2. MFN 06-342, *Letter from the U.S. Nuclear Regulatory Commission to David Hinds, Request for Additional Information Letter No. 60, Related To ESBWR Design Certification Application*, dated September 18, 2006

3. MFN 07-143, *Summary Report - RAI Resolutions Incorporated in ESBWR Design Control Document, Revision 3, and RAI Response Schedule*, dated March 12, 2007

4. MFN 08-429, *Response to NRC Request for Additional Information Letter No. 60 Related to the ESBWR Design Certification - Radiation Protection - RAI Number 12.4-23 S01*, dated May 2, 2008

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 218, Related to ESBWR Design Certification Application – Radiation Protection – RAI Number 12.4-23 S02

2. Response to Portion of NRC Request for Additional Information Letter No. 218, Related to ESBWR Design Certification Application – Radiation Protection – RAI Number 12.4-23 S02 - DCD Markups

3. Response to Portion of NRC Request for Additional Information Letter No. 218, Related to ESBWR Design Certification Application – Radiation Protection – RAI Number 12.4-23 S02 - Security-Related Information - Withhold Under 10 CFR 2.390

cc:

AE Cubbage	USNRC (with enclosures)
RE Brown	GEH/Wilmington (with enclosures)
DH Hinds	GEH/Wilmington (with enclosures)
eDRF	0000-0095-4894/R1

Enclosure 1

MFN 09-070

Response to Portion of NRC Request for

Additional Information Letter No. 218

Related to ESBWR Design Certification Application

Radiation Protection

RAI Number 12.4-23 S02

For historical purposes, the original text of RAIs 12.4-23 and 12.4-23 S01 the GE responses are included. These responses do not include any attachments or DCD mark-ups.

NRC RAI 12.4-23:

Describe maximum radiation source term in the filter or adsorption media for ventilation systems designed to operate during accident conditions.

List the ESBWR ventilation systems designed to operate during accident conditions. Indicate their location on plant layout drawings. Describe the maximum radiation source term in the filter or adsorption media, and give associated radiation dose rates in adjacent areas. Describe design features to ensure that the radiation exposures resulting from maintenance (filter change out) of these systems is ALARA.

GEH Response:

Sufficient detail to answer this RAI is described in Subsection 12.3.3.3 and related tables.

DCD Impact:

None

NRC RAI 12.4-23 S01:

Response Letter MFN-07-143 dated March 12, 2007, which addressed RAI resolutions incorporated in ESBWR DCD, Revision 3. RAI 12.4-23 asked GE to list the ESBWR ventilation systems designed to operate during accident conditions and to indicate their location on plant layout drawings. GE was also asked to describe the maximum radiation source term in the filter or adsorption media, and give associated radiation dose rates in adjacent areas. Finally, they were to describe design features to ensure that the radiation exposures resulting from maintenance (filter change out) of these systems is ALARA. The information contained in the modifications made to Revision 3 of the DCD (Section 12.3.3.3 and Table 12.3-10) to address RAI 12.4-23 do not adequately respond to the staff's concerns.

Please address the following issues:

a. *On the plant layout drawings, indicate the location of the reactor building HVAC filter units.*

b. *Include a table in the DCD similar to Table 12.3-10 which shows the dose rates*

c. *In Section 12.3.3.3 of the DCD, GE states that the shielding wall thickness between the RB HVAC filter cubicles is sized so that the dose contribution in any cubicle from the filter in the adjacent one does not exceed 250 mSv/hr. Describe what maintenance (such as filter changeout), if any, would be required on the RB HVAC filter units under accident conditions.*

   If these units would have to be accessed following an accident to aid in the mitigation of or recovery from an accident, show that an operator would be able to perform the necessary operations on these units without exceeding the dose criteria of 50 mSv (5 rem) whole body, or its equivalent to any part of the body for the duration of the accident (per 10 CFR Part 50 and GDC 19, Control Room).

d *Modify Figure 12.3-47 to show the post-accident radiation zones in the vicinity of the control building emergency filter units on level 9060 of the control building.*

GEH Response:

a. The Reactor Building HVAC filter units are located at the North end of Elevation 13570, at locations R2-R3 / RA-RB and R1-R2 / RB-RC, inside Room 1600.

b. Revision 5 to DCD Tier 2 will include the revised source term for the HVAC filters. Table 12.3-9, 12.3-10a and a new Table 12.3-10b show activities and the dose rates in the adjacent areas to the reactor building HVAC filter unit rooms.

c. During normal operation, the filter activity is negligible and the dose contribution in any cubicle from the filter in the adjacent area or room will be lower than 250 mSv/hr. No maintenance is expected on these filters for the duration of the accident.

d. The post-accident radiation zones in the vicinity of the control building emergency filter units on level 9060 have been modified and the revised figure will be included in the response to RAI 12.4-31.

DCD Impact:

DCD Tier 2 Section 12.3 will be revised to include the revised Subsection 12.3.3.3, Tables 12.3-9, 12.3-10a, and the new Table 12.3-11 as noted on the attached markups.

NRC RAI 12.4-23 S02:

1. *The response to RAI 12.4-23 S01 a) specifies the location of the Reactor Building HVAC units to be on elevation 13570 of the RB in room 1600 in the northwest corner of the building. State why Fig. 12.3-6 does not show the filters in the locations described.*

2. *In response to RAI 12.4-23 S01 b), there appears to be several discrepancies in the revised Table 12.3-10a:*

-- *The rooms listed in the fifth and sixth rows of Table 12.3-10a appear to be in error since room 3403 is listed twice in the table, each time with a different estimated dose rate, and room 3401 is not even listed. Correct this apparent room designation error.*

-- *Justify why the estimated dose rates in the corridor and outside the Control Building were deleted from the revised table.*

-- *The first line of Table 12.3-10a lists the dose rate for room 3406 and room 3407 is listed in parenthesis. Specify why both rooms are not listed.*

3. *In response to RAI 12.4-23 S01 b), Table 12.3-10b lists the rooms (and corresponding dose rates) which are adjacent to the Reactor Building HVAC filters. However, the rooms listed as being above (room 1740) and below (room 1503) these filters are in the northwest corner of the RB (location R2-R3 and RE-RG) while the Reactor Building HVAC filters are located at the northeast corner of the RB (location R2-R3 and RA-RB and at R1-R2 and RB-RC), based on GEH response to RAI 12.4-23a. Therefore, rooms 1740 and 1503 are not located above and below the Reactor Building HVAC filters, as is indicated in Table 12.3-10b. Correct this apparent discrepancy in room location/dose rates.*

4. *In Table 12.3-10b, specify the difference between the listings of "wall (lid)" and "wall (lateral)" and state why two different wall thicknesses are listed for each of these listings.*

5. *In GEH response to RAI 12.4-23 S01 c) GEH stated that, during normal operations, the filter activity is negligible. GEH also stated (in the fourth paragraph of proposed DCD Tier 2 modifications attached to the RAI response, Section 12.3.3.3 (Rev. 5) that the "shielding wall thickness between RB HVAC filter cubicles is sized so that the dose contribution in any cubicle from the filter in the adjacent one does not exceed 250 mSv/hr under normal conditions". Clarify the apparent inconsistency between GEH statement that the filter activity during normal operations is negligible and that the dose rate from the filters does not exceed 250 mSv/hr under normal conditions.*

GEH Response:

1. The exact location of the Reactor Building HVAC units will be determined during detailed design, but the location will be in the Northeast quadrant, at elevation 13570, at locations R2-R3/RA-RB and R1-R2/RB-RC.

2. Item 1 - The designations are valid. There is no symmetry across plot line C3 (see DCD Figure 1.2-5 and the attached Figure 1, in Enclosure 3): Room 3406 has two walls in common with Room 3403, one in the north direction and another in the east direction; however, Room 3407 has only one common wall with Room 3404 (in the east direction) and one common wall with Room 3402 (in the south direction).

   Room 3403 is listed twice, one for the common wall with Room 3406 in the north direction and the other for the common wall with the same room 3406 in the east direction.

   Room 3401 is not listed because this room has no common walls with rooms 3406 or 3407. Room 3403, placed between Room 3406 and 3401, gives additional shielding and therefore dose rates are not calculated for Room 3401 since this room is not adjacent to the filter room.

   Table 12.3-10a has been revised to clarify the rooms and associated dose rates.

   Item 2 - The corridor considered in the dose analysis for DCD revisions 3 and 4 was deleted in the arrangement in DCD revision 5. See attached Figure 2, in Enclosure 3.

   Item 3 - The accumulated activity in the CB EFU is the same for the unit in Room 3406 and in Room 3407: Dose rates are presented for EFU in Room 3406 and in parenthesis for EFU in Room 3407. Table 12.3-10a has been revised to clarify the rooms and associated dose rates.

3. The room numbers have been corrected, as shown in the attached mark-ups for Table 12.3-10b. The DCD figures that show these rooms are: Figure 1.2-5, Figure 1.2-6 and Figure 1.2-7.

4. "Lid" has been used to differentiate removable walls from the lateral walls of the HVAC rooms. The "lid" walls are removable in order to facilitate the removal of the filters. Two different wall thicknesses are listed because both the lids and lateral wall thicknesses are not defined and two options have been analyzed.

5. This is a misprint; instead of 250 mSv/hr it should read 250 μSv/hr. The statement in DCD Tier 2 Section 12.3.3.3 has been corrected as shown in the attached mark-up.

Because of design refinements and improvements in the ESBWR source term, the accumulated activity in the Reactor Building and Control Building HVAC Filters and the associated dose rates have been recalculated. The design refinements included increasing the Control Building EFU intake flow rate and decreasing the containment leakage rate and Reactor Building mixing volume. The source term was refined to more accurately reflect the radionuclide inventory based on fuel bundle parameters specific to the ESBWR.

The timeframe for filter loading was standardized to have both the Control Room and Reactor Building filters accumulating radioactivity over the entire 720-hour period. Radioactive decay had not been included in previous DCD revisions but was incorporated with this new calculation to credit decay from the individual time steps to the end of the 720 hours to provide a more accurate inventory in the filters and the associated radiation fields.

To ensure conservatism for the radioactivity build-up on the filters and the associated external radiation fields from the filters, a 20% increase in the radionuclide activity values was incorporated and a worst-case Reactor Building leakage rate was used. This required two different LOCA source inventories to be used. For the Reactor Building filters, a one cfm Reactor Building leak rate was assumed and for the Control Room filters, a 300 cfm Reactor Building leak rate was assumed, consistent with the revised LOCA dose analysis. The one cfm LOCA inventory for the Reactor Building was modified to maximize radionuclides that contributed to external radiation fields. Therefore, Cm-242 and Cm-244 were deleted from the LOCA inventory and Xe-131m and Xe-133m were added, as the external radiation fields from Cm-242 and Cm-244 are insignificant. This is the reason that the activity values for Cm-242 and Cm-244 in the Reactor Building in DCD Tier 2 Table 12.3-9 are listed as zero activity. The LOCA inventory values for Control Building did not include this adjustment.

The design refinements discussed above necessitated a revision to the LOCA dose analysis, which affected the values in Table 12.3-9, Table 12.3-10a and Table 12.3-10b and the response for this RAI.

DCD Impact:

DCD Tier 2 Section 12.3.3.3, Table 12.3-9, Table 12.3-10a and Table 12.3-10b will be revised in DCD Tier 2 Revision 6 as noted in the attached markups, in Enclosure 2.

Enclosure 2

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Response to Portion of NRC Request for

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Radiation Protection

RAI Number 12.4-23 S02

DCD Markups

FBGAVS serves the general area. The FBFPVS serves the refueling floor and pool areas. The FBVS operates during normal plant operation, plant startup, and plant shutdown.

The FBGAVS consists of two 100% capacity AHUs with two 100% capacity supply fans, two 100% capacity exhaust fans, recirculation AHUs, and unit heaters. The FBGAVS incorporates a common supply and return duct system that distributes conditioned air to the general area of the Fuel Building and exhaust air to the outside atmosphere. During normal operation, air travels through the AHU's stages where particulates are removed from the air by low and high efficiency filters; heat is transferred between the mixed air and the hot/chilled water coils; and the conditioned air is distributed to the clean areas by the supply fan. Exhaust air is ducted to the exhaust fan and exhausted to the outside atmosphere.

The FBFPVS consists of two 100% capacity AHUs with two 100% capacity supply fans, two 100% capacity exhaust fans, and redundant bubble-tight isolation dampers. The FBFPVS is a once-through ventilation system that distributes conditioned air to the refueling area of the reactor and spent fuel pool area of the Fuel Building. During normal operation, outside air travels through the AHU's stages where particulates are removed from the air by low and high efficiency filters; heat is transferred between the air and the hot/chilled water coils; and the conditioned air is distributed to the refueling area and spent fuel pool surfaces. Air is ducted to the exhaust fan and exhausted to the outside atmosphere through the RB/FB stack. The exhaust system has the manual capability to divert the exhaust for filtration by the purge exhaust filter unit, prior to discharge to the RB/FB stack. FBFPVS exhaust fans are used for smoke removal.

The RB/FB vent stack provides monitoring and discharging of FBGAVS and FBFPVS exhausts. See Subsection 9.4.2 for a detailed discussion of the FBVS.

12.3.3.3 Accident Conditions

The ventilation systems filter unit designed to operate during accident conditions is the Control Building Emergency Filter Unit (EFU). The Reactor Building HVAC Purge Exhaust Filter Units are required to operate if the post-accident recovery phase is pursued and are consequently classified as nonsafety-related.

To determine the radiation level in the HVAC filters in accident conditions, the LOCA (Loss-of-Coolant Accident) event is postulated.

The source term of the Reactor Building HVAC filter for the post accident recovery phase dose assessment is the LOCA Inventory in Reactor Building obtained following the assumptions of Regulatory Guide 1.183 (Reference 12.3-16). To ensure conservatism, a 1 cfm leak rate from the Reactor Building was used.

The source term of the Control Building EFU for accident dose assessment is the LOCA inventory at the EFU intakes obtained following the assumptions of Regulatory Guide 1.183. To ensure conservatism, a 300 cfm leak rate from the Reactor Building was used. The activity retained in the filters over 30 days corrected for radioactive decay is shown in Table 12.3-9.

In order to maintain the exposure from filter maintenance ALARA, the shielding wall thickness between RB HVAC filter cubicles is sized so that the dose contribution in any cubicle from the filter in the adjacent one does not exceed 250 ~~m~~μSv/hr under normal operation.

Table 12.3-9

Activity Accumulated in the HVAC Filters in Accident Conditions

Isotope	Reactor Building-HVAC filter* (MBq)	Control Building EFU*± (MBq)
Co-58	2.39E+053.95E+05	5.90E+001.54E+00
Co-60	3.13E+051.36E+06	6.62E+005.01E+00
Rb-86	4.32E+063.97E+06	1.69E+021.81E+01
Sr-89	3.29E+083.77E+08	8.65E+031.50E+03
Sr-90	5.02E+077.31E+07	1.06E+032.70E+02
Sr-91	1.82E+044.76E-16	8.91E+021.86E-20
Sr-92	1.58E-041.02E-73	2.60E+028.11E-78
Y-90	1.30E+071.08E+07	2.40E+021.69E+01
Y-91	5.59E+066.55E+06	1.39E+022.47E+01
Y-92	2.05E-011.74E-54	1.65E+027.40E-59
Y-93	3.56E+021.42E-16	1.16E+015.39E-21
Zr-95	6.51E+068.04E+06	1.63E+023.15E+01
Zr-97	8.18E+031.06E-07	2.05E+013.29E-12
Nb-95	7.39E+068.98E+06	1.70E+022.89E+01
Mo-99	4.87E+062.09E+04	6.31E+021.99E-01
Tc-99m	1.41E+061.21E+03	2.81E+021.89E-03
Ru-103	5.52E+076.61E+07	1.54E+032.69E+02
Ru-105	3.39E-013.02E-43	4.37E+011.59E-47
Ru-106	3.15E+074.68E+07	6.84E+021.74E+02
Rh-105	7.52E+051.15E+01	2.35E+021.46E-04
Sb-127	8.53E+062.60E+05	8.16E+022.08E+00
Sb-129	1.37E+007.86E-44	2.67E+024.18E-48
Te-127	4.28E+064.90E+05	4.71E+027.67E-01
Te-127m	1.49E+072.02E+07	3.44E+027.55E+01
Te-129	4.43E+051.02E+05	1.80E+021.60E-01
Te-129m	3.12E+073.63E+07	9.15E+021.50E+02
Te-131m	1.28E+062.12E+00	5.89E+023.00E-05
Te-132	9.36E+071.15E+06	1.03E+049.98E+00
I-131	1.19E+094.79E+08	7.95E+042.52E+03
I-132	1.18E+072.61E+04	6.73E+034.10E-02
I-133	3.34E+071.01E-01	3.97E+041.54E-06
I-134	0.00E+00	1.31E+030.00E+00
I-135	1.57E+049.59E-25	1.51E+044.15E-29
Cs-134	1.03E+091.56E+09	2.28E+045.81E+03

Table 12.3-9

Activity Accumulated in the HVAC Filters in Accident Conditions

Isotope	Reactor Building-HVAC filter* (MBq)	Control Building EFU*~~*~~ (MBq)
Cs-136	~~9.16E+07~~6.74E+07	~~4.33E+03~~3.34E+02
Cs-137	~~6.87E+08~~1.02E+09	~~1.50E+04~~3.80E+03
Ba-139	~~0.00E+00~~0.00E+00	~~1.32E+02~~0.00E+00
Ba-140	~~2.15E+08~~1.46E+08	~~9.81E+03~~7.20E+02
La-140	~~1.11E+08~~2.54E+07	~~3.21E+03~~3.98E+01
La-141	~~5.71E-03~~1.19E-50	~~5.08E+00~~8.49E-55
La-142	0.00E+00	~~1.39E+00~~0.00E+00
Ce-141	~~1.11E+07~~1.23E+07	~~3.29E+02~~5.12E+01
Ce-143	~~1.86E+05~~1.09E+00	~~6.94E+01~~1.48E-05
Ce-144	~~1.62E+07~~2.14E+07	~~3.54E+02~~7.98E+01
Pr-143	~~2.52E+06~~1.79E+06	~~1.03E+02~~7.88E+00
Nd-147	~~7.00E+05~~3.99E+05	~~3.48E+01~~2.06E+00
Np-239	~~7.62E+06~~1.11E+04	~~1.18E+03~~1.14E-01
Pu-238	~~4.31E+04~~7.02E+04	~~9.07E-01~~2.59E-01
Pu-239	~~5.26E+03~~7.88E+03	~~1.10E-01~~2.89E-02
Pu-240	~~6.72E+03~~1.02E+04	~~1.41E-01~~3.74E-02
Pu-241	~~1.94E+06~~3.22E+06	~~4.09E+01~~1.19E+01
Am-241	~~1.09E+03~~1.94E+03	~~2.04E-02~~6.37E-03
Cm-242	~~1.79E+05~~0.00E+00**	~~4.03E+00~~1.17E+00
Cm-244	~~9.95E+03~~0.00E+00**	~~2.10E-01~~7.06E-02
Total	**~~4.07E+09~~4.03E+09**	**~~2.29E+05~~1.60E+04**

~~* The activity provided is calculated for 27 days (from 3 to 30 days) of accumulation. No radionuclide decay is conservatively assumed in the table activities.~~

~~*~~* The activity provided is calculated for 30 days accumulation and includes radioactive decay. ~~No radionuclide decay is conservatively assumed in the table activities.~~

** The source term used to generate the values was specifically designed to maximize radioactivity and external radiation fields in the Reactor Building. The activity values for these particular radionuclides are not included as they are insignificant contributors to the external radiation dose rates from the filters.

Table 12.3-10a

Dose Rates in the Control Building EFU and Adjacent Rooms in Accident Conditions

Position	Room	Thickness (cm)	Dose rate (mSv/hr)
	Room 3406 EFU		
Inside, 30 cm below EFU	3406 ~~(or 3407)~~	-	~~3.92E+01~~3.39E+00
Lower Slab	3302	50	~~9.91E-02~~2.24E-03
Upper Slab	Roof	70	~~1.67E-03~~2.42E-05
Behind wall in north direction	3403 ~~(or 3402)~~	30	~~6.93E-02~~2.54E-03
Behind wall in east direction	3403 ~~(or 3404)~~	30	~~2.43E-01~~8.82E-03
	Room 3407 EFU		
Inside, 30 cm below EFU	3407	-	3.39E+00
Lower Slab	3302	50	2.24E-03
Upper Slab	Roof	70	2.42E-05
Behind wall in south direction	3402	30	2.54E-03
Behind wall in east direction	3404	30	8.82E-03

Table 12.3-10b

Dose Rates in the Reactor Building HVAC Filter and Adjacent Rooms in Accident Conditions

Positions	Room	Thickness (cm)	Dose rate (mSv/hr)
Inside, 30 cm below filter	1600	-	1.67E+05
Lower slab	~~1503~~1500	100	~~0.5~~1.15E-01
Wall (lid)	1600	60	~~69.1~~2.51E+01
		80	~~5.7~~1.56E+00
Upper slab	~~1740~~1700, 1710, 1711, 1712, and 1713	100	~~0.49~~.07E-02
Wall (lateral)	1600	60	~~56.4~~1.92E+01
		80	~~4.4~~1.12E+00