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Subject: **Response to NRC Request for Additional Information Letter No. 60 Related to the ESBWR Design Certification – Radiation Protection – RAI Number 12.4-23S01**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) responses to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated September 18, 2006 and supplemented by NRC open item letter dated July 27, 2007 (Reference 2). GEH response to RAI Number 12.4-23S01 is addressed in Enclosure 1. DCD Markups related to these responses are provided in Enclosure 2.

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

Sincerely,

James C. Kinsey

James C. Kinsey
Vice President, ESBWR Licensing

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NRO

References:

1. MFN 06-342, Letter from U.S. Nuclear Regulatory Commission to David H. Hinds, GEH, *Request For Additional Information Letter No. 60 Related To ESBWR Design Certification Application*, dated September 18, 2006.
2. MFN 07-433, Letter from Mohammed Shuaibi, U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Economic Simplified Boiling Water Reactor (ESBWR) Chapter 12 Open Items [Radiation Protection]*, dated July 27, 2007.

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 60 Related to ESBWR Design Certification Application – Radiation Protection – RAI Number 12.4-23S01
2. Response to Portion of NRC Request for Additional Information Letter No. 60 Related to ESBWR Design Certification Application – Radiation Protection – RAI Number 12.4-23S01 – DCD Markups

cc:

AE Cubbage	USNRC (with enclosures)
GB Stramback	GEH/San Jose (with enclosures)
RE Brown	GEH/Wilmington (with enclosures)
DH Hinds	GEH/Wilmington (with enclosures)
eDRF	0000-0084-6452R1

ENCLOSURE 1

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Response to Portion of NRC Request for Additional Information Letter No 60 Related to ESBWR Design Certification Application

Radiation Protection

RAI Number 12.4-23S01

NRC RAI 12.4-23S01:

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 change-out), 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.

ENCLOSURE 2

MFN 08-429

Response to Portion of NRC Request for Additional Information Letter No 60 Related to ESBWR Design Certification Application

Radiation Protection

RAI Number 12.4-23S01

DCD Markups

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 plant vent 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 plant vent stack. FBFPVS exhaust fans are used for smoke removal.

The common plant 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 units designed to operate during accident conditions ~~are~~ is~~the Reactor Building HVAC Filter Units and~~ the Control Building Emergency Filter Unit (EFU). The Reactor Building HVAC 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~~accident~~ dose assessment is the LOCA Inventory in Reactor Building obtained following the assumptions of Regulatory Guide 1.183 (Reference 12.3-16). The source term of the Control Building EFU for accident dose assessment is the LOCA inventory in the environment obtained following the assumptions of Regulatory Guide 1.183. The activity retained in the filters over 30 days 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 mSv/hr under normal operation.

For the Control Building EFU and the Reactor Building filters, the dose rates in the filter and adjacent rooms in accident conditions are shown in Tables 12.3-10a and 12.3-10b.

Table 12.3-9

Activity Accumulated in the HVAC Filters in Accident Conditions ~~After 30 Days~~

Isotope	Reactor Building-HVAC filter (3-30 d) (MBq)	Control Building EFU(0-30 d) (MBq)
Co-58	2.39E+05~~5.85E+03~~	5.90E+00~~1.99E+01~~
Co-60	3.13E+05~~7.08E+03~~	6.62E+00~~2.05E+01~~
Rb-86	4.32E+06~~1.38E+05~~	1.69E+02~~5.34E+02~~
Sr-89	3.29E+08~~8.36E+06~~	8.65E+03~~2.51E+04~~
Sr-90	5.02E+07~~1.13E+06~~	1.06E+03~~2.86E+03~~
Sr-91	1.82E+04~~6.41E+05~~	8.91E+02~~3.90E+03~~
Sr-92	1.58E-04~~1.31E+05~~	2.60E+02~~9.45E+02~~
Y-90	1.30E+07~~2.88E+05~~	2.40E+02~~4.14E+02~~
Y-91	5.59E+06~~1.36E+05~~	1.39E+02~~3.83E+02~~
Y-92	2.05E-01~~1.32E+05~~	1.65E+02~~5.91E+02~~
Y-93	3.56E+02~~8.45E+03~~	1.16E+01~~5.11E+01~~
Zr-95	6.51E+06~~1.61E+05~~	1.63E+02~~4.67E+02~~
Zr-97	8.18E+03~~1.59E+04~~	2.05E+01~~9.17E+01~~
Nb-95	7.39E+06~~1.77E+05~~	1.70E+02~~4.70E+02~~
Mo-99	4.87E+06~~5.21E+05~~	6.31E+02~~2.55E+03~~
Tc-99m	1.41E+06~~2.57E+05~~	2.81E+02~~9.42E+02~~
Ru-103	5.52E+07~~1.46E+06~~	1.54E+03~~4.56E+03~~
Ru-105	3.39E-01~~2.60E+04~~	4.37E+01~~1.75E+02~~
Ru-106	3.15E+07~~7.22E+05~~	6.84E+02~~1.87E+03~~
Rh-105	7.52E+05~~1.91E+05~~	2.35E+02~~9.99E+02~~
Sb-127	8.53E+06~~6.79E+05~~	8.16E+02~~3.18E+03~~
Sb-129	1.37E+00~~1.58E+05~~	2.67E+02~~1.06E+03~~
Te-127	4.28E+06~~4.33E+05~~	4.71E+02~~1.53E+03~~
Te-127m	1.49E+07~~3.51E+05~~	3.44E+02~~9.49E+02~~
Te-129	4.43E+05~~1.30E+05~~	1.80E+02~~5.42E+02~~
Te-129m	3.12E+07~~8.48E+05~~	9.15E+02~~2.74E+03~~
Te-131m	1.28E+06~~4.70E+05~~	5.89E+02~~2.57E+03~~
Te-132	9.36E+07~~8.53E+06~~	1.03E+04~~4.08E+04~~
I-131	1.19E+09~~6.20E+07~~	7.95E+04~~2.81E+05~~
I-132	1.18E+07~~4.66E+06~~	6.73E+03~~2.34E+04~~
I-133	3.34E+07~~3.16E+07~~	3.97E+04~~1.79E+05~~
I-134	0.00E+00~~4.46E+05~~	1.31E+03~~3.35E+03~~
I-135	1.57E+04~~1.01E+07~~	1.51E+04~~6.51E+04~~
Cs-134	1.03E+09~~2.30E+07~~	2.28E+04~~6.15E+04~~

Table 12.3-9

Activity Accumulated in the HVAC Filters in Accident Conditions ~~After 30 Days~~

Isotope	Reactor Building-HVAC filter (3-30 d) (MBq)	Control Building EFU(0-30 d) (MBq)
Cs-136	9.16E+07~~3.42E+06~~	4.33E+03~~1.43E+04~~
Cs-137	6.87E+08~~1.52E+07~~	1.50E+04~~4.02E+04~~
Ba-139	0.00E+00~~5.37E+04~~	1.32E+02~~3.85E+02~~
Ba-140	2.15E+08~~8.20E+06~~	9.81E+03~~3.30E+04~~
La-140	1.11E+08~~3.29E+06~~	3.21E+03~~6.09E+03~~
La-141	5.71E-03~~2.91E+03~~	5.08E+00~~1.99E+01~~
La-142	0.00E+00~~5.84E+02~~	1.39E+00~~4.24E+00~~
Ce-141	1.11E+07~~3.04E+05~~	3.29E+02~~9.90E+02~~
Ce-143	1.86E+05~~5.55E+04~~	6.94E+01~~3.01E+02~~
Ce-144	1.62E+07~~3.72E+05~~	3.54E+02~~9.68E+02~~
Pr-143	2.52E+06~~8.68E+04~~	1.03E+02~~3.24E+02~~
Nd-147	7.00E+05~~2.88E+04~~	3.48E+01~~1.20E+02~~
Np-239	7.62E+06~~9.70E+05~~	1.18E+03~~4.85E+03~~
Pu-238	4.31E+04~~9.73E+02~~	9.07E-01~~2.45E+00~~
Pu-239	5.26E+03~~1.18E+02~~	1.10E-01~~2.97E-01~~
Pu-240	6.72E+03~~1.52E+02~~	1.41E-01~~3.82E-01~~
Pu-241	1.94E+06~~4.38E+04~~	4.09E+01~~1.11E+02~~
Am-241	1.09E+03~~2.35E+01~~	2.04E-02~~5.27E-02~~
Cm-242	1.79E+05~~4.17E+03~~	4.03E+00~~1.11E+01~~
Cm-244	9.95E+03~~2.25E+02~~	2.10E-01~~5.67E-01~~
Total	**4.07E+09~~1.90E+08~~**	**2.29E+05~~8.16E+05~~**

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)
Inside, 30 cm below EFU	3406 (or 3407)	-	~~7.87E+01~~3.92E+01
Lower Slab	3302	50	~~1.81E-01~~9.91E-02
Upper Slab	Roof	~~40~~70	~~1.40E-01~~1.67E-03
~~Lateral walls~~	~~Corridor~~	~~30~~	~~2.59E-01~~
	~~3404~~ 3403 (or ~~3403~~3402)	30	~~1.20E+00~~6.93E-02
	~~3407~~ 3403 (or ~~3406~~3404)	30	~~2.59E-01~~2.43E-01
	~~Outside~~	~~40~~	~~4.46E-02~~

Table 12.3-10b

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

Positions	Room	Thickness (cm)	Dose rate (mSv/hr)
Lower slab	1503	100	0.5
Wall (lid)	1600	60	69.1
		80	5.7
Upper slab	1740	100	0.4
Wall (lateral)	1600	60	56.4
		80	4.4