GE Energy

David H. Hinds
Manager, ESBWR

PO Box 780 M/C L60
Wilmington, NC 28402-0780
USA

T 910 675 6363
F 910 362 6363
david.hinds@ge.com

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Subject: **Response to Portion of NRC Request for Additional Information Letter No. 60 – Radiation Protection – RAI Numbers 12.3-4, 12.3-5, 12.4-9, 12.4-13, 12.4-18, 12.4-20, 12.4-32 and 12.4-33**

Enclosure 1 contains GE's response to the subject NRC RAIs transmitted via the Reference 1 letter.

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

Sincerely,

Kathy Sedney for

David H. Hinds
Manager, ESBWR

D068

Reference:

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

Enclosure:

1. MFN 06-477 – Response to Portion of NRC Request for Additional Information Letter No. 60 – Radiation Protection – RAI Numbers 12.3-4, 12.3-5, 12.4-9, 12.4-13, 12.4-18, 12.4-20, 12.4-22, 12.4-32, and 12.4-33

cc: AE Cubbage USNRC (with enclosures)
GB Stramback GE/San Jose (with enclosures)
eDRF 0053-9734

Enclosure 1

MFN 06-477

Partial Response to RAI Letter No. 60

Related to ESBWR Design Certification Application

Radiation Protection-

RAI Numbers: 12.3-4, 12.3-5, 12.4-9, 12.4-13, 12.4-18, 12.4-20, 12.4-22, 12.4-32, and 12.4-33

RAI 12.3-04:

DCD Tier 2, Section 12.2.1.2.1, states that "the HEPA train is capable of removing all large particulate releases and up to 70% of the small particulate releases. As such, no significant radioactive contamination of the HEPA train is expected." Clarify this statement, as HEPA filters are high efficiency, generally removing 99.97% of the most penetrating sized particles. Provide the maximum source strength for the filtering media, and any adsorption media (such as activated charcoal) used to determine the need for shielding (or whether the system design allows media change out without unnecessary radiation exposure) for each HVAC system that services contaminated or potentially contaminated areas of the plant.

GE Response:

The HEPA filters of the ventilation streams into the Reactor Building are bypassed during normal plant operation since the presence of radioactive aerosols is not expected. Each of three waste streams (Reactor Building, Turbine Building and Radwaste Building) has HEPA filters capable of retaining particles with an efficiency of 99.97%. Noble gases and tritium are not retained in the filters. The efficiency factor considered for halogens is also 99.97%. In order to evaluate the maximum quantity of radiation that can be stored in the filters, the very high HEPA filter efficiency is conservatively used. The minimum efficiency for HEPA filters required by ASHRAE Standard 52 is 80-85%.

The attached markup to Subsection 12.2.1.2.1, Radioactive Sources in HVAC, will be provided in DCD Tier 2, Revision 3.

The maximum accumulated radiation source has been calculated to provide flexibility if the design does not include remote devices for changing the filtration elements.

Table 12.3-04(1) shows the accumulated radioactivity in each HEPA filter considered, with the corresponding intensity strength into each HEPA filter for the HVAC systems shown in Table 12.3-04(2).

Table 12.3-04(3) lists the isotopes considered in the calculation with the corresponding inventory stored in the different charcoal vessels of the stream of the off-gas system, with the corresponding intensity of the source shown on Table 12.3-04(4).

DCD Subsection 12.2.1.2.1 will be revised in DCD Tier 2, Revision 3 as shown on the attached markup.

Table12.3-04(1)

Activity Accumulated in the HEPA Filters of the Ventilation System, MBq

Isotope	Reactor	Turbine	Radwaste	Isotope	Reactor	Turbine	Radwaste
I-131	7.427E+05	7.449E+05	3.594E+04	Zr-95	4.906E+03	8.276E+0	1.689E+04
I-132	3.806E+03	5.769E+04	3.762E+03	Nb-95	2.669E+04	6.928E+0	4.527E+01
I-133	9.122E+04	3.891E+05	2.511E+04	Mo-99	1.404E+04	1.776E+0	2.645E+00
I-134	2.069E+03	4.042E+04	2.646E+03	Tc-99m	7.269E-01	0	0
I-135	1.796E+04	1.698E+05	1.120E+04	Ru-103	1.257E+04	6.248E+0	1.250E+01
Na-24	4.434E+01	0	0	Rh-103m	4.208E+02	0	0
P-32	2.445E+02	0	0	Ru-106	3.377E+01	0	0
Cr-51	6.405E+03	7,586E+03	5,960E+03	Rh-106	6.360E-05	0	0
Mn-54	1.887E+04	3.389E+04	2.214E+05	Ag-110m	2.974E+01	0	0
Mn-56	1.555E+00	0	0	Sb-124	2.255E+02	1.874E+0	1.327E+03
Fe-55	1.375E+04	0	0	Te-129m	7.035E+01	0	0
Fe-59	1.440E+03	1,373E+03	4,207E+03	Te-131m	9.055E-01	0	0
Co-58	2.004E+03	2.189E+04	4.470E+03	Te-132	5.992E-01	0	0
Co-60	9.308E+04	7.493E+04	5.308E+05	Cs-134	7.527E+04	1.367E+0	1.670E+05
Ni-63	1.560E+01	0	0	Cs-136	5.043E+02	4.110E+0	0
Cu-64	4.848E+00	0	0	Cs-137	1.200E+05	7.906E+0	3.228E+05
Zn-65	6.955E+04	3.117E+05	1.517E+04	Cs-138	2.503E-02	0	0
Rb-89	2.781E-03	0	0	Ba-140	2.210E+04	4.043E+0	1.651E+01
Sr-89	4.884E+02	1.019E+05	0	La-140	2.190E+02	0	0
Sr-90	2.987E+02	1.613E+03	0	Ce-141	2.319E+03	1.028E+0	7.281E+01
Y-90	1.159E+00	0	0	Ce-144	2.869E+01	0	0
Sr-91	3.486E+00	0	0	Pr-144	2.055E-03	0	0
Sr-92	6.841E-01	0	0	W-187	1.705E+00	0	0
Y-91	1.295E+02	0	0	Np-239	2.543E+02	0	0
Y-92	7.168E-01	0	0				
Y-93	4.030E+00	0	0	**Total,**	**1.343E+06**	**2.199E+0**	**1.369E+06**

Table12.3-04(2)

Source Strength in the HEPA Filters of the Ventilation System

HEPA	**Source Strength, MeV/s**					
Energy	**0.8 MeV**	**1.3 MeV**	**1.7 MeV**	**2.5 MeV**	**4.0 MeV**	**5.0 MeV**
Reactor	4.49E+11	2.50E+11	2.15E+10	8.00E+08	2.89E+06	9.08E-01
Turbine	7.81E+11	4.76E+11	1.15E+11	8.51E+09	4.54E+06	0
Radwaste	7.59E+11	1.16E+12	6.68E+10	6.35E+08	2.97E+05	0

Table12.3-04(3) (1/3)

Activity Accumulated in the Charcoal Beds of the Off-Gas System

Inventory in MBq

Isotope	Guard bed	Beds 1& 5	Beds 2& 6	Beds 3& 7	Beds 4 & 8
^{83m}Kr	7.29E+05	1.32E+05	9.96E+01	0	0
^{85m}Kr	1.91E+06	1.24E+06	6.26E+04	3.17E+03	1.60E+02
^{85}Kr	1.14E+04	3.09E+04	3.09E+04	3.09E+04	3.09E+04
^{87}Kr	2.86E+06	2.38E+05	6.20E+00	0	0
^{88}Kr	5.29E+06	1.86E+06	1.57E+04	1.33E+02	0
^{89}Kr	1.60E+02	0	0	0	0
^{131m}Xe	1.54E+05	2.64E+05	1.15E+05	5.03E+04	2.19E+04
^{133m}Xe	1.71E+06	6.63E+05	7.69E+03	9.02E+01	0
^{133}Xe	5.98E+07	6.12E+07	9.35E+06	1.43E+06	2.18E+05
^{135m}Xe	2.02E+05	0	0	0	0
^{135}Xe	3.77E+07	1.58E+05	0	0	0
^{137}Xe	1.21E+03	0	0	0	0
^{138}Xe	5.56E+05	0	0	0	0
^{131}I	3.19E+00	0	0	0	0
^{132}I	3.34E-01	0	0	0	0
^{133}I	2.31E+00	0	0	0	0
^{134}I	2.14E-01	0	0	0	0
^{135}I	1.06E+00	0	0	0	0
^{89}Rb	4.15E-02	0	0	0	0
^{134}Cs	2.56E-02	0	0	0	0
^{137}Cs	1.62E-04	0	0	0	0
^{138}Cs	1.51E-06	0	0	0	0
^{137m}Ba	1.01E-06	0	0	0	0
^{3}H	1.02E-02	0	0	0	0
^{24}Na	4.87E-03	0	0	0	0
^{32}P	6.99E-01	0	0	0	0
^{51}Cr	9.18E-02	0	0	0	0
^{54}Mn	1.96E-02	0	0	0	0

Table12.3-04(3) (2/3)

Activity Accumulated in the Charcoal Beds of the Off-Gas System
Inventory in MBq

Isotope	Guard bed	Beds 1& 5	Beds 2& 6	Beds 3& 7	Beds 4 & 8
^{55}Fe	8.26E+00	0	0	0	0
^{59}Fe	1.13E-02	0	0	0	0
^{58}Co	6.00E-02	0	0	0	0
^{60}Co	3.21E+00	0	0	0	0
^{63}Ni	3.07E-01	0	0	0	0
^{64}Cu	1.29E-02	0	0	0	0
^{65}Zn	2.04E+00	0	0	0	0
^{89}Sr	4.26E-02	0	0	0	0
^{90}Sr	6.18E-01	0	0	0	0
^{90}Y	1.56E-04	0	0	0	0
^{91}Sr	1.29E-02	0	0	0	0
^{92}Sr	8.19E-03	0	0	0	0
^{91}Y	1.96E-02	0	0	0	0
^{92}Y	6.65E-03	0	0	0	0
^{93}Y	1.35E-02	0	0	0	0
^{95}Zr	4.38E-03	0	0	0	0
^{95}Nb	2.35E-03	0	0	0	0
^{99}Mo	4.60E-02	0	0	0	0
^{99m}Tc	4.06E-03	0	0	0	0
^{103}Ru	6.64E-03	0	0	0	0
^{103m}Rh	3.67E-12	0	0	0	0
^{106}Ru	9.24E-03	0	0	0	0
^{106}Rh	1.27E-15	0	0	0	0
^{110m}Ag	2.12E-03	0	0	0	0
^{129m}Te	1.14E-02	0	0	0	0
^{131m}Te	1.03E-03	0	0	0	0
^{132}Te	2.70E-04	0	0	0	0
^{140}Ba	4.28E-02	0	0	0	0

Table12.3-04(3) (3/3)

Activity Accumulated in the Charcoal Beds of the Off-Gas System
Inventory in MBq

Isotope	Guard bed	Beds 1& 5	Beds 2& 6	Beds 3& 7	Beds 4 & 8
^{140}La	5.59E-03	0	0	0	0
^{141}Ce	8.15E-03	0	0	0	0
^{144}Ce	7.14E-03	0	0	0	0
^{144}Pr	1.91E-07	0	0	0	0
^{187}W	2.45E-03	0	0	0	0
^{239}Np	1.56E-01	0	0	0	0
Total	1.11E+08	6.58E+07	9.58E+06	1.51E+06	2.71E+05

Table12.3-04(4)

Source Strength in the Charcoal Beds of the Off-Gas System

Charcoal	**Source Strength, MeV/s**					
Energy	0.8 MeV	1.3 MeV	1.7 MeV	2.5 MeV	4.0 MeV	5.0 MeV
Guard bed	5.19E+12	9.00E+11	2.92E+12	7.08E+12	7.03E+10	1.98E+06
Beds 1 & 5	6.40E+11	2.92E+11	9.68E+11	2.21E+12	6.49E+09	0
Beds 2 & 6	3.95E+10	2.40E+09	8.03E+09	1.79E+10	6.84E+06	0
Beds 3 & 7	7.68E+09	2.03E+09	6.78E+09	1.52E+10	5.65E+06	0
Beds 4 & 8	8.81E+08	0	0	0	0	0

Radioactive Sources in the HVAC System

The HVAC System is described in Section 9.4 and employs a bypass HEPA filter train for use in the event of airborne contamination of the RB or controlled purge of the RB containment. The HEPA train is capable of removing all large particulate releases and up to 70% of small particulate releases. ~~As such, no significant radioactive contamination of the HEPA train is expected.~~

Radioactive Sources in the Main Steam and Feedwater Lines

All radioactive material in the main steam system result from radioactive sources carried over from the reactor core during plant operations. In most components carrying live steam, N16 is the dominant source of radioactivity (Section 11.1). Otherwise, under conditions where sufficient decay time has removed the N16 source, noble radiogases become the dominant source term (Section 11.1). Flow in the feedwater lines is dominated by corrosion and fission products and is the result of the residual activity of reactor steam after treatment in the condenser filterdemineralizer system.

Post-Accident Radioactive Sources

The ESBWR design limits potential radiation exposure from accidents both to plant personnel and to the public by the use of passive safety features, containment and treatment of potential accident sources. The following describes those features of the ESBWR germane to postaccident radiation sources in the RB containment and the RB.The RB containment is an inert steel-lined pressure boundary capable of containing all accident sources with minimal leakage to the environment or other plant areas. The containment is provided with redundant passive cooling systems (Subsections 5.4.6 and 6.2.2) to insure within a reasonable probability that this primary boundary does not exceed design criteria. Drywell spray provides additional capability to control pressure. Therefore, for all but the most improbable accident scenarios requiring massive failures of all major systems including passive systems, radioactive sources from the pressure vessel are adequately contained in the RB containment.

Surrounding the containment on all sides, the ESBWR employs a RB that provides a secondary holdup volume (Subsection 6.2.3) to trap containment penetration and valve leakage except direct bypass leakage via such lines as the main steam lines and feedwater lines. All major connections from the containment, except the isolation condenser steam lines and condensate lines and the main steam lines and feedwater lines requiring isolation valves, terminate with the second isolation valve in the RB. The RWCU/SDC is the only high energy line in the containment and RB that could produce potential releases in the containment or RB. High energy line rupture releases in the containment are isolated by the HVAC system for holdup and treatment, except potential high energy breaks, which are then routed to the turbine building for release via the plant stack. High energy line rupture releases in the RB are routed to the refueling floor where a rupture disk relieves the overpressure. See Section 15.4 for discussions of line break releases.

Estimates on sources and location for limiting design basis events are found in Section 15.4.

RAI 12.3-05:

Describe the basis for the N-16 source strength in the steam and condensate systems used for plant shielding design. Discuss how the operational experience of current BWRs with hydrogen water chemistry and noble metal injection was factored into this estimated source term. Provide an estimate of the contribution to the N-16 skyshine to an individual at a typical site boundary distance from N-16 skyshine.

GE Response:

The coolant activation product of primary importance in BWRs is ^{16}N. ANSI-18.1 specifies a concentration of 1.85 MBq/g in steam leaving the reactor vessel. This is treated independent of reactor design because both the production rate of ^{16}N, and the steam flow rate from the vessel are assumed to vary in direct proportion to reactor thermal power. The design basis ^{16}N concentration in steam for the ESBWR is designated to be 1.85 MBq/g, and has been used as the design basis concentration for GE BWRs since the early 1970's. Operating experience confirms that a ^{16}N concentration of 1.85 MBq/g is conservative.

It should be noted that a portion of the source term traditionally identified as "^{16}N " actually represents C-15, which is typically present in concentrations less than 0.555MBq/g. Historically, gross gamma dose rate measurements, used to confirm the magnitude of the ^{16}N concentration, have included responses to gamma rays from ^{15}C. Use of the combined "^{16}N" source term in the shielding design introduces additional conservatism because the ^{15}C component has a 2.45-s half-life, and decays more rapidly with transport time through the system than does ^{16}N, which has a 7.1-s half-life.

The design basis ^{16}N concentrations in steam and reactor water are shown in Table 11.1-6 of the DCD/Tier 2. The reactor water concentration at the recirculation system nozzle is 2.2 MBq/g. Since the ESBWR does not have an external recirculation loop, the reactor water concentration has been decay-corrected to the reactor core exit to obtain an estimated value of 7.03 MBq/g.

It has been observed that during operation with intentional introduction of hydrogen to the feedwater for the purpose of controlling feedwater oxygen concentrations (i.e., with hydrogen water chemistry), the ^{16}N concentration in the steam is significantly elevated.

Under these circumstances, conditions for production of volatile nitrogen chemical species are more favorable, resulting in a greater portion of the ^{16}N produced carried with the steam. The ^{15}C concentration remains approximately the same. For operation with hydrogen water chemistry, the recommended design basis ^{16}N concentration in steam is five times (9.25 MBq/g) the value for natural water chemistry.

The transport and partitioning of ^{16}N throughout the steam and condensate systems is a complex process. Several guidelines are useful in the determination of the component inventories:

(1) The total ^{16}N inventory in the turbine system is equal to the ^{16}N vessel nozzle release rate integrated over infinite time;

(2) The inventories in components for which measurements are available are consistent with the measurements;

(3) The ^{16}N is partitioned on the basis of equal activity per unit mass of vapor or liquid at each point in the system; and

(4) The ^{16}N inventory in each equipment item reflects the appropriate transit time decay.

The contribution to the dose around the plant has been estimated as a consequence of the skyshine produced by a large equipment item such as the steam turbine located in the turbine building, and considering real thickness of all the structures.

The turbines with their covers, are surrounded by a concrete structure (steel structure at the two fronts) with a thickness of 90 cm, with no concrete or steel slab over the turbine.

The total ^{16}N inventory considered in the equipment is as follows:

- $1.62 \cdot 10^{12}$ MeV/s in the High-Pressure Turbine (HPT)
- $7.95 \cdot 10^{9}$ MeV/s in the Low-Pressure Turbine (LPT)
- $3.89 \cdot 10^{12}$ MeV/s in the main steam piping that feed the turbines

The SKYIII.PC and QAD-CGGP computer programs were used for this calculation.

The obtained results are 5.93×10^{-4} mrem/yr at a typical site boundary distance of 800m and 1.66×10^{-4} mrem/yr at 1000m, both well below the 10CFR20.1301 and 10CFR20 1302 limits.

A new Table 12.2-21 including the N16 Skyshine annual dose results will be provided in Revision 3 of DCD Tier 2, Section 12.2, as shown on the attached markup.

12.2.1.3 Turbine Building Source Terms

This section provides a summation of the significant radioactive source terms found in the ESBWR turbine building. These source terms consist of those elements which are found to contain significant quantities of radioactive materials but do not include sources due to incidental contamination such as sources in valves due to deposition of corrosion or fission products species on the surfaces of the components.

Normal Operating Sources

N^{16} in the steam flow from the pressure vessel. is the primary turbine building source of radioactivity. The N^{16} source results in significant gamma shine from the main steam lines and steam bearing components on the order of 0.2-0.5 Gy/hr (20-50 rad/hr) contact. Other major sources of radiation in the turbine building are the Offgas System (Section 11.3) and the Condenser and Feedwater System. The Offgas System consists of the steam jet air ejector, recombiner, offgas condenser, and offgas charcoal tanks. Table 12.2-10 provides the sources for the Offgas System. The sources for the turbine condenser and feedwater filter/demineralizer system are given in Tables 12.2-11 and 12.2-12.

N16-skyshine offsite dose contribution

The N-16 skyshine contribution to offsite dose is provided in Table 12.2-21

Post-Accident Radioactive Sources

The turbine building contains no major sources of releasable radioactivity (discounting N^{16} because of the 7.7 second half-life) and potential releases are limited to liquid releases of low activity water from the feedwater and condenser systems. Two other sources exist which contain radioactive species but in a form not amenable for release. The potential for accident releases from these two sources, the offgas system, and the condenser demineralizers, is reduced due to heavy shielding and compartmentalizing of the components.

12.2.1.4 Radwaste Building Source Terms

This section provides a summation of the significant radioactive source terms found in the ESBWR radwaste building. These source terms consist of those elements which are found to contain significant quantities of radioactive materials but do not include sources due to incidental contamination such as sources in valves due to deposition of corrosion or fission products species on the surfaces of the components.

Normal Operating Sources

Tables 12.2-13a through 12.2-13g and 12.2-14a through 12.2-14b provide source inventories for the major radwaste components for operation. These sources are based upon the stream concentrations given in Section 11.1 and represent sources for shielding calculations. These inventories should not be construed to represent sources for offsite release. A complete description of the ESBWR radwaste system is given in Sections 11.2 through 11.4.

Post-Accident Radioactive Sources

Potential releases in the radwaste building are contained by isolating the radwaste building atmosphere and sealing any water releases in the building. The radwaste building is seismically qualified and lined to prevent any potential water releases from high activity areas.

Table 12.2-21

N16 Skyshine annual dose at site boundary (mrem/yr)

Distance	Annual dose
800 m	$5.93 \cdot 10^{-4}$
1000 m	$1.66 \cdot 10^{-4}$

RAI 12.4-09:

DCD Tier 2, Figures 12.3-3, 12.3-4, and 12.3-5 indicate two equipment hatches (near RD/R1) that according to the associated foot notes are used for the transfer of "high activity components." Identify which components are referenced in the foot notes and discuss the anticipated frequency of such transfers.

GE Response:

No transfer of contaminated components will be performed through the two equipment hatches (near RD/R1) shown in DCD Tier 2, Figures 12.3-3, 12.3-4, and 12.3-5.

Note 2 in DCD Tier 2, Figure 12.3-3 and Note 1 in DCD Tier 2, Figures 12.3-4 and 12.3-5 will be deleted in Revision 3 of DCD Tier 2, Section 12.3.

RAI 12.4-13:

Room number 1713 on DCD Tier 2, Figure 12.3-7 contains the standby liquid control (SLC) tank A. What is the potential for this tank to become radiologically contaminated during the life of the plant? What dose rates from this tank were considered in the designed wall thicknesses for room 1713?

GE Response:

The Standby Liquid Control System (SLC) should not become contaminated during the entire life of the plant. SLC Tank A is located in Room 1713, SLC Tank B is located in Room 1723, and the SLC mixing pumps are located in Room 1703. These three rooms could be classified as Radiation Zone A, but are considered common to corridors 1720 and 1730 and classified as Radiation Zone B because they are inside a controlled area and they are accessed through said corridors.

The SLC tanks are isolated from contaminated systems by way of explosive and check valves. Potential contamination could only occur if there is leakage through isolation check valves after a LOCA or ATWS. Post accident access requirements and room doses are analyzed in DCD Tier 2, Subsection 12.3.6 and DCD Tier 2, Appendix 1B.

Inboard and outboard check valves on the SLCS injection lines provide the primary means for containment isolation to prevent radioactive material from entering the system outside primary containment. These valves are subject to periodic leakage testing to confirm their function. Additionally, the operating characteristics of the SLCS will prevent the introduction of radioactive material from the reactor into the system. During normal plant operation, the SLCS is in a standby condition filled with sodium pentaborate solution and maintained at a pressure greater than that of the reactor and is isolated from the reactor by the squib valves that provide a leak-proof barrier.

Following an accident in which the SLCS is actuated, the system will inject solution into the reactor until isolated by a low accumulator level signal. At this time, the system is still filled with sodium pentaborate at a pressure greater than the reactor. This prevents the back leakage of radioactive material from the reactor into the SLCS outside containment.

No shielding design requirements are considered for the walls of these rooms at normal and shutdown conditions, as the tanks and pumps should not become radiologically contaminated during the life of the plant. This position is also supported in GE's response to RAI 6.3-30 submitted on August 7, 2006 via MFN 06-245.

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

RAI 12.4-18:

DCD Tier 2, Figure 12.3-1 depicts a room (near RE/R7), with substantially shielded walls, containing two "sump pumps." Identify the system these sump pumps are associated with, and associated radiation source strength.

GE Response:

Room 2101 contains sump pumps for Fuel Building systems and equipment leaks and drains. The expected maximum radiation source in the pumps is the same as for the FAPCS and Spent Fuel Pool. The radiation sources in the spent fuel pool are given in DCD Tier 2, Table 12.2-3, Part B in units of MeV/sec-MWt. Water concentration is assumed to be 1% of normal reactor water concentration

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

<u>RAI 12.4-20</u>:

Identify all rooms or areas of the plant through which the inclined fuel transfer tube transits, unshielded, and any other room or area that is potentially accessible with radiation levels greater than 100 rads per hour. Provide a detailed description of the design features employed to ensure that no individual is able to gain unauthorized access to these areas. Specify if removable shielding is used to provide access to any of these areas.

<u>GE Response</u>:

The inclined fuel transfer tube transits, as shown on DCD Figure 9.1-2, through a shielded tube, 21P1, and rooms 18P2 and 1702, with no connection to any other room or area that could be potentially accessible during fuel transfer operations. Accessible areas and rooms adjacent to the inclined fuel transfer tube and rooms are shielded and with radiation levels lower than 100 rads per hour as shown on DCD Figures 12.3-1 through 12.3-4 and 12.3-5 through 12.3-8.

Means of providing for personnel access control to areas immediately adjacent to the IFTS are provided in response to RAI 12.2-19

Access from any area adjacent to the transfer tube is controlled through a system of physical controls, interlocks and an annunciator.

During IFTS operation or shutdown, personnel are prevented from (a) either reactivating the IFTS while personnel are in a controlled maintenance area, or (b) entering a controlled IFTS maintenance area while irradiated fuel or component are in any part of the IFTS.

Both an audible alarm and flashing red lights are provided inside and outside any IFTS maintenance area indicating IFTS operation.

Radiation monitors with alarms are provided both inside and outside any maintenance area.

A keylock system of a key lock in both the IFTS main operation panel and in the control room is provided to allow access to any IFTS maintenance area.

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

RAI 12.4-22:

Verify that the ventilation system is capable of reducing the airborne concentrations in areas accessible only for maintenance or in-service inspections to below the concentrations considered an airborne area as defined in 10 CFR 20.

GE Response

The HVAC systems for the buildings in the plant are discussed in DCD Section 9.4, including the design bases, system descriptions, and evaluations with regard to the heating, cooling, and ventilating capabilities of the systems.

The radiation control aspects of HVAC systems (design objectives, design description) are discussed in DCD Subsection 12.3.3.

The process leakage sources are described in DCD Subsection 11.1.1.5.

The nominal airborne concentrations of radionuclides in each building for normal power operations were conservatively (including areas accessible only for maintenance or in-service inspections) calculated for the Reactor Building, Fuel Building, Turbine Building and Radwaste Building.

A description of the methodology and airborne radionuclide concentrations will be provided in Revision 3 of the DCD, Tier 2 as shown on the attached markups in response to RAI 12.3-12.

RAI 12.4-32:

With the one exception noted above, DCD Tier 2, Figures 12.3-43 through 12.3-51 indicate that radiation dose rates in the vital area of the plant under design basis accident conditions are no higher than during normal operations as indicated by Figures 12.3-1 through 12.3-9. Justify this unexpected situation. Provide a complete description of the assumptions, input parameters, and models used to determine the radiation zones in ESBWR vital areas.

GE Response:

As described in DCD Subsection 12.3.6, Post-Accident Radiation Zone Maps, the post-accident radiation zone maps represent the maximum gamma dose rates that exist in these areas during the post-accident period, and these dose rates do not include the airborne contribution in the reactor building.

The shielding design of the rooms adjacent to vital areas precludes the dose rate due to the contaminated rooms from significantly affecting the post accident vital areas.

Assumptions and models used to determine the radiation zones in ESBWR vital areas are described in response to RAI 12.3-10.

The dose rates in vital areas will be provided in DCD Tier 2 Revision 3, Figures 12.2-43 through 12.3-51, as shown in the markups attached in response to RAI 12.4-31.

RAI 12.4-33:

DCD Tier 2, Section 12.3.6 states that the post accident zone maps "are design to reflect the criteria established in Subsection 3.1.2." Clarify this statement. Specify exactly which criteria are being referred to, and how they were used to establish the radiation zones in the vital areas of the plant.

GE Response:

The DCD Tier 2 Subsection 3.1.2 reference is being made to "Criterion 19 Control Room" (Subsection 3.1.2.10). GDC 19 refers to Control Room design requirements that requires: "Adequate radiation protection shall be provided to permit access and occupancy of the control room under accident conditions without personnel receiving radiation exposures in excess of 5 rem whole body, or its equivalent to any part of the body, for the duration of the accident".

ESBWR Control Rooms are designed in accordance with GDC 19 habitability requirements post-accident, such that radiation exposures will be less than 5 rem whole body. The Post Accident Zone maps are designed with consideration given to GDC 19 dose limits and expected personnel post-accident access time to each vital area.

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