ENCLOSURE 1

MFN 05-153

GE Responses to NRC Request for Additional Information

Letter No. 1 Related to ESBWR Design Certification

Application – Chapters 11 and 12 – Radiation Protection

11.2.3-1 The listed decontamination factors are not consistent with NUREG-0016 guidance. *The decontamination factors (DF) listed in Table 11.2-3 are not consistent with NUREG-0016. No DF value is given for tritium. See related RAI No. 12.2.2.3-1. Without this information, the staff cannot independently confirm the annual doses reported in Table 12.2-20.*

GE Response:
The DF for tritium is one, which is consistent with Section 1.5.2.8.2 of NUREG-0016. A revised version of Table 11.2-3 will be included in DCD Revision 01 to be issued January 31st, 2006. A pdf file of the DRAFT DCD Revision 01, page 11.2-12 is included in Enclosure 2. The revised Table 11.2-3 follows:

Subsystems*	**Filter**	**Reverse Osmosis**	**Ion-Exchanger**	**Total DF**
Equipment (low conductivity)				
Drain Subsystem:				
Halogens	1	-	100 (10)**	1,000
Cs, Rb	1	-	10 (10)**	100
Other nuclides	1	-	100 (10)**	1,000
Floor (high conductivity)				
Drain Subsystem:				
Halogens	1	10	100 (10)**	10,000
Cs, Rb	1	10	2 (10)**	200
Other nuclides	1	10	100 (10)**	10,000
A DF of 1 is used for tritium.				
Chemical Drain Subsystem:				
Chemical drain is processed in Floor Drain Subsystem.				
Detergent Drain Subsystem:				
A DF of 1 is used for the detergent drain filter for all radionuclides.				

* From NUREG-0016 Revision 1, Table 1-5.
** For two ion exchangers in series, the DF for the second unit is given in parenthesis

11.2.3-2 The text does not state which sets of decontamination factors were used to assess doses from liquid releases.

The text does not state which sets of decontamination factors were used to assess doses from liquid releases. The text states that the values listed in Table 11.2-3 are conservative and consistent with NUREG-0016, but does not specify whether the "Total DF" values were used given that (i) the use of a second ion-exchanger in series is optional by NUREG-0016, (ii) if the use of a second ion changer was applied in calculating doses, and (iii) whether an aggregate DF (weighted by liquid waste volume estimates from Table 11.2-4) was derived and applied in calculating doses. See related RAI No. 12.2.2.3-1. Without this information, the staff cannot independently confirm the annual doses reported in Table 12.2-20.

GE Response:

The Total DF factors used are based on two in-series ion exchangers, as stated in revised Table 11.2-3 (GE response to RAI 11.2.3-1 above) and weighted by liquid waste volume and activity for obtaining primary coolant activity (PCA) values (used as input to NUREG-0016 BWR-GALE code calculation).

It should be noted that the liquid annual release and concentration values in Table 12.2-19 will change as a result of the revised liquid effluent analysis. The current (DCD Revision 00) analysis estimated the liquid releases based on SBWR data. The liquid effluent source term analysis will be revised to reflect the current ESBWR design. The revised tables will be included in Revision 01 of the DCD to be issued by January 31st, 2006.

11.2.5-1 The text describing instrumentation used to monitor liquid effluent releases is inconsistent with that of Section 11.5.3.2.6.

The text describing instrumentation used to monitor liquid effluent releases is inconsistent with that of Section 11.5.3.2.6. It does not refer to the use of a continuous radiation monitoring system. Update the text accordingly.

GE Response:

The text for Section 11.2.5 will be changed to indicate "continuous" radiation monitoring of the liquid radwaste effluent. (It should be realized that, since the liquid effluents are processed and discharged on a batch basis, the radiation monitor is probably not "on" at all times since there isn't any flow through the discharge line to the environs at all times. Flow should only exist during a discharge, at which time the radiation monitor is "on" and "continuous".) A pdf file of the DRAFT DCD Revision 01, page 11.2-7 is included in Enclosure 2.

11.2.5-2 The presence of the continuous liquid effluent radiation monitor is not discussed in the text, nor shown in Figure 11.2-1

The presence of the continuous liquid effluent radiation monitor is not discussed in the text, nor shown in Figure 11.2-1. Provide an updated figure showing the placement of the liquid effluent radiation monitor.

GE Response:

Figure 11.2-1 will be updated in DCD Chapter 11, Revision 01 to depict the liquid radwaste effluent radiation monitor. DCD Revision 01 will be issued January 31st, 2006

11.5.3-1 The operational ranges of radiation monitoring systems listed in Tables 11-5.1 and 11.5-2 are inconsistent.

The operational ranges of radiation monitoring systems listed in Tables 11-5.1 and 11.5-2 are inconsistently presented in terms of expected activity levels or dynamic ranges. For example, the dynamic response ranges of stack vent instrumentation of the Radwaste, Turbine, and Spent Fuel ventilation systems given in Table 11.5-1 are different than shown in Table 11.5-2. Also, the reported activity levels given in Table 11.5-2 for the Plant Stack are beyond the dynamic detection range, i.e., the expected activity levels are lower than the lowest dynamic range by 3 to 5 orders of magnitude. Confirm whether the stated dynamic range of the instrumentation is correct as indicated.

GE Response:

In DCD Chapter 11.5, the "Turbine Building HVAC Vent" will have the displayed channel ranges (3 channels) changed to be the same as the "Radwaste Building Ventilation Exhaust" (3 channels); i.e., all should be "MBq/m3". It's envisioned that the skids are the same, therefore the ranges will be the same. Radwaste Building stack/path, Turbine Building Stack/path and Fuel Building Stack/path, should have the same displayed ranges.

With regard to Table 11.5-2, the dynamic detection ranges of the Radwaste Building stack/path and the Spent Fuel Building stack/path should be the same. The dynamic ranges of the "Plant Stack" is higher than the expected activity, primarily because the expected activity is anticipated to be very low and is usually diluted in the stack by a large flow. Sometimes the expected amount released is far lower than the capability of a commercial grade radiation detector to "see" the activity. In theory, an amount released could even be "zero"; one would not expect a radiation monitor to detect "zero". As long as the radiation detector can detect the lower limits as stipulated in 10CFR20, then the monitored path is compliant.

11.5.3-2 The radiological units of the Turbine Building Vent Exhaust (Normal Vent and Area Exhausts) and Turbine Building HVAC Vent monitoring systems are inconsistently given between Table 11-5.1 and Table 11.5-2.

The radiological units of the Turbine Building Vent Exhaust (Normal Vent and Area Exhausts) and Turbine Building HVAC Vent monitoring systems given in Table 11-5.1 are expressed in "mSv/h" but listed as "MBq/m^3" in Table 11.5-2. Provide tables with updated information

GE Response:

The entry for this item in Table 11.5-2 will be changed in DCD Chapter 11, revision 01 to be the same range as Table 11.5-1, although it will now be expressed in terms of "Co-60" and not Xe-133 or Kr-85. A pdf file of the DRAFT DCD Revision 01, page 11.5-19 is included in Enclosure 2.

11.5.3-3 The designation of radiation monitoring systems and their respective ID codes are inconsistently presented in Table 11.5.3 and Figure 11.5-1

This section refers to Table 11.5-3 and Fig. 11.5-1 for information about the designation and ID codes of radiation monitoring systems. A review of instrumentation ID codes indicates that the numbering system is inconsistent for ID No. 21, 22 and 23. The system identified as No. 21 on Fig. 11.5-1 is not listed in Table 11.5-3 and its designation ("#21, COPS") and function are not described in the Section. As a result, ID codes No. 21 and 22 presented in Table 11.5-3 are not consistent with those shown in Fig. 11.5-1. Also, instrument ID code No. 23 is missing in Table 11.5-3, but is included in Fig. 11.5-1. Provide figures and tables (and text as needed) with updated information

GE Response:

DCD Chapter 11, revision 01 will correct Figure 11.5-1 so that COPS is not shown & the numbers adjusted, so that reference to COPS is eliminated. A pdf file of the DRAFT DCD Revision 01, Figure 11.5-1, page 11.5-29 is included in Enclosure 2.

12.2.2-1 The section refers to information on atmospheric dispersion parameters presented in Table 12.2-15, but the text does not provide any supporting details.

The evaluation of doses associated with airborne effluent releases is based on assumed atmospheric dispersion parameters given in Table 12.2-15. The text does not present any discussion about the assumptions used in developing the dispersion parameters at the stated distance of 800 m. A review of Section 2.3.5 (Long-Term Diffusion Estimates) of the Design Control Document indicates that the parameters were derived using NRC guidance (NUREG-0800 and NUREG-0324), but no details are provided on the assumptions used. It should noted that NUREG-0324 (Sept. 1977) has been superseded by NUREG/CR-2919 (Sept. 1982). Without this information, the staff cannot independently confirm the adequacy of the values given for the dispersion parameters and resulting annual doses reported in Table 12.2-18.

GE Response:

Since the ESBWR is designed for a generic site, the determination of the annual average dilution factors (X/Q and D/Q) has been made considering multiple sites. Data used come from the ABWR program for 27 US sites and one fictitious site, assuming an 800 meter exclusion area boundary (site boundary). The value for the X/Q was determined using the NRC Computer Code XOQDOQ (NUREG/CR-2919) for the above sites and the dispersion coefficient for the worst sector chosen. The D/Q value was taken from a table of annual average meteorological coefficients prepared by the GE REFAE computer code. The mean value is selected.

Average Annual Dispersion Coefficient (X/Q): 2.0E-06 s/m^3
Average Annual Deposition Coefficient (D/Q): 1.8E-09 m^{-2}

These values are representative of 27 US sites and are obtained following the methodology of NUREG-0800.

This information will be included in Revision 01 of the DCD to be issued January 31st, 2006.

12.2.2-2 Table 12.2-16 presents anomalous radioactivity release inventories.

Table 12.2-16 presents anomalous radioactivity release inventories for Kr-87 and Xe-135 from the Offgas System. In both instances, the listed annual releases appear to be unrealistically low by orders of magnitude. Without a clarification, the staff cannot independently confirm the annual doses reported in Table 12.2-18.

GE Response:

The fission product release inventories were calculated using very preliminary draft offgas system parameter values.

It should be noted that the annual release and concentration values in Table 12.2-18 will change as a result of the revised gaseous effluent analysis. The current (DCD Revision 00) analysis estimated the gaseous releases based on preliminary data. The gaseous effluent source term analysis will be revised to reflect the current ESBWR design. The revised radioactivity release inventories will be included in Revision 01 of the DCD to be issued January 31st, 2006.

12.2.2-3 The evaluation of doses associated with airborne effluent releases is stated as being based on methods described in NRC guidance, but the text does not provide any supporting details.

The evaluation of doses associated with airborne effluent releases is stated as being based on the methodology presented in NUREG-0016 and NUREG/CR-4653. The text does not present any discussion of the assumptions used in describing offsite dose receptor locations, rationale for the exposure pathways listed in Table 12.2-18, and a listing of all model parameters used in calculating doses. Without this information, the staff cannot independently confirm the annual doses reported in Table 12.2-18.

GE Response:

The bases for the airborne release offsite dose calculation are summarized in the table below. This will be placed before Table 12.2-18. What was originally called Table 12.2-18 (ESBWR Annual Average Doses from Airborne Releases) will be Table 12.2-18b; the newly generated table below will be designated as Table 12.2-18a. This table will be included in Revision 01 of the DCD to be issued January 31st, 2006.

Table 12.2-18a
Airborne Offsite Dose Calculation Bases

Meteorology χ/Q	Table 12.2-15
Meteorology D/Q	Table 12.2-15
Meteorology Boundary	Table 12.2-15
Airborne Release Source Term	Table 12.2-16
Calculation Methodology	Regulatory Guide 1.109
Computer Code Utilized	GASPAR II (NUREG/CR-4653)
Individual Consumption Rates	Table E-5 of Reg. Guide 1.109
Misc. Calculation Inputs:	
Fraction of year that dairy cows, goats, and beef cattle graze on pasture (f_p)	0.5
Fraction of daily feed that is pasture grass when dairy cows, goats, and beef cattle graze on pasture (f_s)	1.0
Annual Average Doses from Airborne Releases	Table 12.2-18b

12.2.2-4 The estimates of liquid effluent annual radionuclide activity estimates listed in Table 12.2-19 cannot be confirmed using the information presented here and in Section 11.2.3 of the Design Control Document.

The text does not state which sets of decontamination factors were used to assess doses from liquid radioactive releases. The text states that the values listed in Table 12.2-19 are bounding and consistent with NUREG-0016, but does not specify which decontamination factors (DF) listed in Table 11.2-3 were used in deriving the annual activity inventories of Table 12.2-19. A cursory check of the information presented in Table 12.2-19 indicates that a DF of 100 was used in estimating liquid effluent concentrations of I-131, Co-60, Cs-137, Ba-140, and Np-239. Also, it was noted that a DF of 100 was used for tritium, which is contrary to the DF (value of 1) prescribed in NUREG-0016. Note that the application of a DF of 1 for tritium is expected to result in liquid effluent discharge concentrations that are about twice the limit of App. B (Table 2, Col. 2) of Part 20. See related RAI No. 11.2.3-1.

GE Response:

As was addressed in the response to RAI 11.2.3-1, a DF value of 1 was used for tritium. As discussed in the response to RAI 11.2.3-2, the total DF factors used are based on two in-series ion exchangers, and weighted by liquid waste volume and activity for obtaining primary coolant activity (PCA) values (used as input to NUREG-0016 BWR-GALE code calculation).

It should be noted that the annual release and concentration values in Table 12.2-19 will change as a result of the revised liquid effluent analysis. The current (DCD Revision 00) analysis estimated the liquid releases based on SBWR data. The liquid effluent source term analysis will be revised to reflect the current ESBWR design. The revised tables will be included in Revision 01 of the DCD to be issued January 31st, 2006.

12.2.2-5 The text notes the use of a liquid waste dilution factor of 10 prior to releases to the point of closest exposure to the public without providing any basis for the value.
The text cites the use of a liquid waste dilution factor of 10 prior to the point of release that is closest to the public, but no rationale is given for this value. The discussion does not state if a dilution factor was applied beyond the point of release in assessing doses to hypothetical receptors listed in Table 12.2-20. Provide the rationale for the dilution factor of 10 and address whether additional dilution factors were used to calculate doses to the hypothetical receptors listed in Table 12.2-20.

GE Response:
Since the ESBWR is not site-specific, a reference BWR is considered to establish the dilution factor for the liquid dose assessment. Using ABWR as a reference, it is assumed that a factor of ten exists between the discharge canal and the subsequent consumption or recreational activity involving liquid effluents. The assumptions are considered very conservative and are expected bound conditions found at actual sites. No additional dilution factors were used to calculate doses to the hypothetical receptors listed in Table 12.2-20.

12.2.2-6 Table 12.2-19 presents liquid effluent concentration limits based on prior version of App. B to 10 CFR Part 20, rather than using the limits of the current edition.

Table 12.2-19 presents estimated liquid effluent concentrations for comparison against the limits of App. B to Part 20. A review of the listed limits indicates that they are based on the 1993 edition of Part 20 instead of the current Part 20. It should be noted that compliance with liquid effluent limits of the current Part 20 is required. For comparison note that the effluent limits listed in Table 12.2-17 are based on the current Part 20 App. B criteria. Provide an updated version of Table 12.2-19 listing liquid effluent concentration limits based on current NRC criteria.

GE Response:

Table 12.2-19 will be revised in Revision 01 of the DCD to include the current 10 CFR 20 Appendix B liquid effluent concentration limits. The revised table is provided below:

Table 12.2-19
Average Annual Liquid Releases

	Annual Release	Concentration	10 CFR 20 MPC
Nuclide	**MBq/yr**	**Bq/ml**	**Bq/ml**
I-131	8.90E+01	2.98E-05	3.70E-02
I-132	9.30E+01	3.11E-05	3.70E+00
I-133	2.88E+02	9.66E-05	2.59E-01
I-134	7.25E+01	2.43E-05	1.48E+01
I-135	2.38E+02	7.96E-05	1.11E+00
H-3	2.20E+06	7.37E-01	3.70E+01
C-14	5.90E+00	1.98E-06	1.11E+00
Na-24	1.12E+02	3.74E-05	1.85E+00
P-32	6.72E+00	2.25E-06	3.33E-01
Cr-51	6.96E+02	2.33E-04	1.85E+01
Mn-54	2.42E+02	8.11E-05	1.11E+00
Mn-56	4.84E+02	1.62E-04	2.59E+00
Co-56	3.09E+02	1.03E-04	2.22E-01
Co-57	4.39E+00	1.47E-06	2.22E+00
Co-58	8.18E+00	2.74E-06	7.40E-01
Co-60	8.66E+02	2.90E-04	1.11E-01
Fe-55	1.06E+03	3.54E-04	3.70E+00
Fe-59	1.84E+01	6.16E-06	3.70E-01
Ni-63	2.62E+01	8.76E-06	3.70E+00
Cu-64	1.59E+02	5.34E-05	7.40E+00
Zn-65	8.18E+01	2.74E-05	1.85E-01
Rb-89	2.31E+00	7.72E-07	3.33E+01
Sr-89	3.09E+00	1.04E-06	2.96E-01
Sr-90	1.01E+00	3.37E-07	1.85E-02
Y-90	8.51E-02	2.85E-08	2.59E-01
Sr-91	2.97E+01	9.96E-06	7.40E-01
Y-91	3.12E+00	1.05E-06	2.96E-01
Sr-92	3.26E+01	1.09E-05	1.48E+00
Y-92	2.32E+01	7.75E-06	1.48E+00

Table 12.2-19
Average Annual Liquid Releases

	Annual Release	Concentration	10 CFR 20 MPC
Nuclide	**MBq/yr**	**Bq/ml**	**Bq/ml**
Y-93	2.94E+01	9.84E-06	7.40E-01
Zr-95	2.43E+01	8.12E-06	7.40E-01
Nb-95	2.89E+01	9.69E-06	1.11E+00
Mo-99	2.43E+01	8.13E-06	7.40E-01
Tc-99m	2.35E+01	7.87E-06	3.70E+01
Ru-103	5.04E+00	1.69E-06	1.11E+00
Rh-103m	2.48E-01	8.31E-08	2.22E+02
Ru-106	3.67E-02	1.23E-08	1.11E-01
Rh-106m	4.82E+00	1.61E-06	3.70E+00
Ag-110m	6.04E+01	2.02E-05	2.22E-01
Sb-124	2.11E+01	7.07E-06	2.59E-01
Te-129m	4.80E-01	1.61E-07	2.59E-01
Te-131m	1.07E+00	3.57E-07	2.96E-01
Te-132	1.18E-01	3.95E-08	3.33E-01
Cs-134	1.74E+02	5.83E-05	3.33E-02
Cs-136	9.17E+00	3.07E-06	2.22E-01
Cs-137	2.45E+02	8.22E-05	3.70E-02
Cs-138	9.73E+00	3.26E-06	1.48E+01
Ba-140	1.90E+01	6.37E-06	2.96E-01
La-140	4.79E+00	1.61E-06	3.33E-01
Ce-141	3.36E+00	1.13E-06	1.11E+00
Ce-144	5.35E+01	1.79E-05	1.11E-01
Pr-143	7.80E-02	2.61E-08	2.59E+00
W-187	1.88E+01	6.30E-06	1.11E+00
Np-239	8.54E+01	2.86E-05	7.40E-01

It should be noted that the annual release and concentration values in Table 12.2-19 will change as a result of the revised liquid effluent analysis. The current (DCD Revision 00) analysis estimated the liquid releases based on SBWR data. The liquid effluent source term analysis will be revised to reflect the current ESBWR design. The revised tables will be included in Revision 01 of the DCD to be issued January 31st, 2006.

12.2.2-7 The listing of a few radionuclides in Table 12.2-19 is inconsistent with that of Table 12.2-17.

The listing of radionuclides in Table 12.2-19 is inconsistent with that of Table 12.2-17. Table 12.2-19 includes Co-57 but Table 12.2-17 does not. Table 12.2-19 includes Pr-143 but Table 12.2-17 lists Pr-144 instead. Provide updated versions of Tables 12.2-19 and 12.2-17.

GE Response:

The liquid and gaseous analyses used slightly different radionuclides. The ESBWR radionuclides listed are similar to those listed for ABWR and other BWRs. Some radionuclide inventories are negligible either for liquid or gaseous streams.

It should be noted that the annual release, concentration, and dose values in Tables 12.2-16 through 12.2-20 will change as a result of the revised liquid and gaseous effluent analyses. The current (DCD Revision 00) analyses estimated the releases based on preliminary data. The effluent source term analyses will be revised to reflect the current ESBWR design. The revised tables will be included in Revision 01 of the DCD to be issued January 31st, 2006.

12.2.2-8 The evaluation of doses associated with liquid effluent releases is stated as being based on methods described in NRC guidance, but the text does not provide any supporting details.

The evaluation of doses associated with liquid effluent releases is stated as being based on the methodology presented in NUREG-0016 and NUREG/CR-4013. The text does not present any discussion of the assumptions used in describing offsite dose receptor locations, rationale for the exposure pathways listed in Table 12.2-20, and a listing of all model parameters used in calculating doses. Without this information, the staff cannot independently confirm the annual doses reported in Table 12.2-20.

GE Response:

The bases for the liquid effluent release offsite dose calculation are summarized in the table below. This will be placed before Table 12.2-20 in Revision 01 of the DCD. What was originally called Table 12.2-20 (Liquid Pathway Dose Analysis in mSv/year) will be Table 12.2-20b; the newly generated table below will be designated as Table 12.2-20a.

Table 12.2-20a

Liquid Pathway Offsite Dose Calculation Bases

Calculation Methodology	Regulatory Guide 1.109
Computer Code Utilized	LADTAP II (NUREG/CR-4013)
Individual Consumption Rates	Table E-5 of Reg. Guide 1.109
Site Water Type	Freshwater
Liquid Effluent Discharge Rate	0.095 m^3/s
Shore-Width Factor	0.2
Dilution Factor	10
Liquid Pathway Offsite Annual Doses	Table 12.2-20b