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MFN 08-222

Docket No. 52-010

March 22, 2008

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

Subject: **Response to Portion of RAI Letter 150 Related to the ESBWR Design Certification – Radiation Protection – RAI Number 12.2-9 S03**

The purpose of this letter is to submit the GE Hitachi Nuclear Energy (GEH) response to the U.S. Nuclear Regulatory Commission (NRC) Request for Additional Information (RAI) sent by NRC letter dated February 7, 2008 (Reference 1). GEH response to RAI Number 12.2-9 S03 is addressed in Enclosure 1. DCD Markups related to this response 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

Reference:

1. MFN 08-117, Letter from U.S. Nuclear Regulatory Commission to Robert E. Brown, GEH, *Request For Additional Information Letter No. 150 Related To ESBWR Design Certification Application*, dated February 7, 2008.

Enclosures:

1. Response to Portion of NRC Request for Additional Information Letter No. 150 Related to ESBWR Design Certification Application – Radiation Protection – RAI Number 12.2-9 S03
2. DCD Markups

cc:	AE Cubbage	USNRC (with enclosures)
	GB Stramback	GEH/San Jose (with enclosures)
	RE Brown	GEH/Wilmington (with enclosures)
	DE Hinds	GEH/Wilmington (with enclosures)
	eDRF	0000-0081-5895

Enclosure 1

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Response to Portion of NRC Request for Additional Information Letter No. 150 Related to ESBWR Design Certification Application

Radiation Protection

RAI Number 12.2-9 S03

NRC RAI 12.2-9 S03:

An evaluation of the response to NRC RAI 12.2-9 S02, contained in MFN 08-019, indicates that the staff could not independently confirm some of the revised results presented in that response. Specifically:

a. Offgas Ar-41 source term: the staff calculates 1960 MBq/yr, while the response indicates 1400 MBq/yr.

b. Offgas Kr-85 source term: the staff calculates 5.2E+06 MBq/yr, while the response indicates 4.3E+06 MBq/yr.

c. Drywell noble gases: staff results are higher by a factor of two for all nuclides as compared to the response.

d. Reactor Bldg K-85m source term: no explanation is given for the increase from 69,000 to 90,000 MBq/yr, while the source terms for all other nuclides are essentially the same.

Accordingly, provide supporting information and technical details for the staff to understand and resolve these differences.

GEH Response:

a. The Ar-41 release rate was assumed to be 40 µCi/sec into the offgas system. The calculation was then performed through each of the tanks. Tank 1 (guard tank) has a charcoal mass of 7500 kg, flow rate of 54 m^3/hr, K_d of 6.4 cm^3/g, which yields a holdup time of 0.89 hours. The flow is then split equally into two parallel banks of four additional tanks (Tanks 2-5). Each of these tanks has a charcoal mass of 27,750 kg with a flow rate of 27 m^3/hr through each bank and a K_d of 6.4 cm^3/g, which yields a holdup time of 6.58 hours for each tank. Decay of the initial Ar-41 flow rate of 40 µCi/sec is split equally through each tank using a simple decay of $e^{-\lambda t}$:

   After Tank 1, the total activity flow rate through both banks is 28.2 µCi/sec
   After Tank 2, the total activity flow rate through both banks is 2.34 µCi/sec
   After Tank 3, the total activity flow rate through both banks is 1.94E-01 µCi/sec
   After Tank 4, the total activity flow rate through both banks is 1.60E-02 µCi/sec
   After Tank 5, the total activity flow rate through both banks is 1.33E-03 µCi/sec – this is converted to an annual release of 3.85E-02 Ci/year (assuming a 0.92 availability), which is 1.4E+03 MBq/year.

   The 2 charcoal bank hold-up time is assessed as follows:

   The flow rate of 54 m^3/hr is split between the two banks with 27 m^3/hr flowing through each bank. In calculating the holdup time for the first tank in each bank, the following data is utilized: flow rate (27 m^3/hr), K_d for Ar-41 (6.4 cm^3/g), and the charcoal mass of the tank (27,750 kg). This calculation yields a holdup time of 6.58 hours. Therefore, the holdup time in each tank (regardless of which bank) is 6.58 hours. Even though the flow (and activity rate) is split between the two banks, the

activity through each bank will receive a holdup time of 6.58 hours for each of those tanks. Thus, the 6.58 hour holdup time can be applied to the entire stream of activity.

No changes to the DCD will be made as a result of this response; however, DCD Tier 2, Table 12.2-15 shows the K_d for Ar-41 as 6 cm^3/g. This value will be revised to 6.4 cm^3/g in the table, as this was the value used in the current and previous analyses. Additionally, the K_d for krypton in DCD Tier 2, Table 12.2-15 will be changed to 18.5 as used in the analysis from the rounded value of 19.

b. The previous revision of the offgas gaseous effluent release analysis (supporting the response to RAI 12.2-9 S02) assumed a design basis Kr-85 concentration (at 30 minutes decay) of 20 µCi/sec, which was inconsistent with the 24 µCi/sec value provided in DCD Tier2, Table 11.1-2a. The revised analysis utilized the concentration for Kr-85 (and for all the other noble gases) from DCD Tier 2, Table 11.1-2a as input for the revised evaluation. The revised values are reflected in the "Offgas System" column of DCD Tier 2, Table 12.2-16, which is included with this RAI response.

c. GEH's response to item (g) of RAI 12.2-9 S02 (MFN 08-019, dated January 17, 2008) stated that the value A_T represents the total design basis noble gas steam activity. Item (g) of the response also indicated that the contribution of Kr-90 and Xe-139 activities represented a negligible contribution to the annual noble gas release from the plant. It was resolved in item (g) of the response to delete the two isotopes from DCD Tier 2, Tables 12.2-16 and 12.2-17. While the two isotopes were deleted from the DCD tables, the two isotope activities were still included in the calculation of the value A_T. For the revised analysis supporting this RAI response, the Kr-90 and Xe-139 isotope activities were eliminated in the calculation of the value A_T. The contribution of these two isotopes was approximately 50% of the total value of A_T. This decreased the total value of A_T, subsequently increasing the ratio of A_i / A_T, as defined in the response to item (g) of RAI 12.2-9 S02 (MFN 08-019, dated January 17, 2008). The revised drywell noble gas release values are provided in DCD Tier 2, Table 12.2-16, which is included with this RAI response.

d. In the response to RAI 12.2-9 S01 (MFN06-212 Supplement 2, dated May 22, 2007), GEH stated that the Reactor Building noble gas and particulate releases were calculated by the sum of the Containment Building and Auxiliary Building values from NUREG-0016, Table 2-12 and multiplying them by the appropriate adjustment factors. When GEH was performing its analysis to support the response to RAI 12.2-9 S02 (MFN 08-019, dated January 17, 2008), GEH discovered that it had not incorporated the NUREG-0016 Table 2-12 Containment Building Kr-85m release of 1 Ci/yr in its previous evaluations. The analysis supporting the response to RAI 12.2-9 S02 (MFN 08-019, dated January 17, 2008) remedied this issue, thus increasing the Kr-85m release from the Reactor Building. No DCD changes will be made as a result of this response.

DCD Impact:

DCD Tier 2, Tables 12.2-15, 12.2-16, and 12.2-17 will be revised as noted on the attached markup. It should be noted that some of the identified changes to Tables 12.2-16 and 12.2-17 are attributed to the response to RAI 12.2-9 S02 submitted via MFN 08-019 dated January 14, 2008.

Enclosure 2

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DCD Markups

Table 12.2-15

Airborne Sources Calculation

Calculation Bases	
Methodology	Appendix 12B
Noble Gas Source at t=30 min	740 MBq/sec (20,000 μCi/sec)
I^{131} Release Rate	3.7 MBq/sec (100 μCi/sec)
Meteorology χ/Q	2.0E-06 s/m^3
Meteorology D/Q	4.0E-09 m^{-2}
~~Meteorology Boundary~~	~~800 m~~
Plant Availability Factor	0.92
Offgas System:	
Offgas stream temperature	100°F
Flow rate at 100°F	54 m^3/hr
K_d (Kr)	~~19~~ 18.5 cm^3/g
K_d (Xe)	330 cm^3/g
K_d (Ar)	6.4 cm^3/g
Guard tank charcoal mass	7,500 kg (single tank)
Adsorber tank charcoal mass	27,750 kg (each)
Adsorber tank arrangement	2 parallel trains of 4 tanks each
Turbine Gland Sealing System Exhaust:	
I-131 release	0.81 Ci/yr per μCi/g of I-131 in coolant
I-133 release	0.22 Ci/yr per μCi/g of I-131 in coolant

Table 12.2-16

Annual Airborne Releases for Offsite Dose Evaluations (MBq)

Nuclide	Reactor Building	Turbine Building	Radwaste Building	Mechanical Vacuum Pump	Turbine Seal	Offgas System	Drywell
Kr-83m						1.4E-04	8.5E+01 ~~3.7E+01~~
Kr-85m	9.0E+04 ~~6.9E+04~~	5.6E+05 ~~5.7E+05~~				6.6E+03 ~~6.8E+03~~	3.4E+02 ~~1.5E+02~~
Kr-85						5.2E+06 ~~4.3E+06~~	7.5E+01 ~~3.3E+01~~
Kr-87	4.5E+04 ~~4.6E+04~~	1.4E+06				8.5E-10 ~~8.6E-10~~	3.1E+02 ~~1.4E+02~~
Kr-88	9.0E+04 ~~9.2E+04~~	2.0E+06 ~~2.1E+06~~				1.4E+01 ~~1.5E+01~~	6.9E+02 ~~3.0E+02~~
Kr-89	4.5E+04 ~~4.6E+04~~	1.3E+07	6.5E+05 ~~6.7E+05~~				8.3E+01 ~~3.7E+01~~
~~Kr-90~~							~~1.3E+01~~
Xe-131m						1.5E+05 ~~1.1E+05~~	4.1E+01 ~~1.8E+01~~
Xe-133m						8.1E-01	1.9E+02 ~~8.5E+01~~
Xe-133	2.5E+06	3.4E+06	5.0E+06 ~~5.1E+06~~	2.9E+07 ~~1.9E+07~~		8.5E+05 ~~8.3E+05~~	1.1E+04 ~~5.0E+03~~
Xe-135m	1.4E+06	9.0E+06 ~~9.2E+06~~	1.2E+07				8.5E+01 ~~3.7E+01~~
Xe-135	2.9E+06	7.4E+06 ~~7.6E+06~~	6.3E+06 ~~6.4E+06~~	1.1E+07 ~~7.4E+06~~		4.4E-37 ~~4.3E-37~~	2.6E+03 ~~1.2E+03~~
Xe-137	4.1E+06	2.3E+07	1.9E+06				1.2E+02 ~~5.5E+01~~
Xe-138	1.8E+05	2.3E+07	4.5E+04 ~~4.6E+04~~				2.7E+02 ~~1.2E+02~~
~~Xe-139~~							~~1.6E+01~~
I-131	9.4E+02	5.2E+03	3.4E+02	1.8E+03	4.7E+01		6.8E+01 ~~6.8E+03~~
I-132	8.5E+03	4.6E+04	3.0E+03				9.9E+00 ~~9.9E+02~~
I-133	6.2E+03	3.4E+04	2.2E+03		8.4E+01		6.5E+01 ~~6.5E+03~~
I-134	1.5E+04	8.4E+04	5.5E+03				6.9E+00 ~~6.9E+02~~

Table 12.2-16

Annual Airborne Releases for Offsite Dose Evaluations (MBq)

Nuclide	Reactor Building	Turbine Building	Radwaste Building	Mechanical Vacuum Pump	Turbine Seal	Offgas System	Drywell
I-135	8.6E+03	4.7E+04	3.1E+03				2.9E+01 ~~2.9E+03~~
H-3	1.2E+06 ~~1.3E+06~~	1.2E+06 ~~1.3E+06~~					2.6E+05
C-14						5.3E+05 ~~3.5E+05~~	
Na-24							5.4E+00 ~~5.4E-01~~
P-32							1.3E+00 ~~1.3E-01~~
Ar-41						1.4E+03 ~~2.9E+02~~	
Cr-51	2.6E+01 ~~2.7E+01~~	2.2E+01	1.7E+01				1.1E+02 ~~1.1E+01~~
Mn-54	3.3E+01 ~~3.4E+01~~	1.4E+01 ~~1.5E+01~~	9.6E+01 ~~9.8E+01~~				1.7E+00 ~~1.7E-01~~
Mn-56							1.1E+01 ~~1.1E+00~~
Fe-55							4.7E+01 ~~4.7E+00~~
Fe-59	9.3E+00 ~~9.5E+00~~	2.4E+00	7.2E+00 ~~7.3E+00~~				1.2E+00 ~~1.2E-01~~
Co-58	7.2E+00 ~~7.3E+00~~	2.4E+01	4.8E+00 ~~4.9E+00~~				4.4E+00 ~~4.4E-01~~
Co-60	1.2E+02	2.4E+01	1.7E+02				9.4E+00 ~~9.4E-01~~
Ni-63							4.7E-02 ~~4.7E-03~~
Cu-64							6.9E+00 ~~6.9E-01~~
Zn-65	1.2E+02	1.4E+02 ~~1.5E+02~~	7.2E+00 ~~7.3E+00~~				4.6E+01 ~~4.6E+00~~
Rb-89							2.0E-01 ~~2.0E-02~~
Sr-89	1.2E+00	1.4E+02 ~~1.5E+02~~					4.3E+00 ~~4.3E-01~~
Sr-90	2.4E-01	4.8E-01 ~~4.9E-01~~					3.3E-01 ~~3.3E-02~~

Table 12.2-16

Annual Airborne Releases for Offsite Dose Evaluations (MBq)

Nuclide	Reactor Building	Turbine Building	Radwaste Building	Mechanical Vacuum Pump	Turbine Seal	Offgas System	Drywell
Y-90							8.1E-02 ~~3.3E-02~~
Sr-91							6.7E+00 ~~6.7E-01~~
Sr-92							4.6E+00 ~~4.6E-01~~
Y-91							1.7E+00 ~~1.7E-01~~
Y-92							3.7E+00 ~~3.7E-01~~
Y-93							7.2E+00 ~~7.2E-01~~
Zr-95	2.4E+01	9.6E-01 ~~9.8E-01~~	1.9E+01 ~~2.0E+01~~				3.5E-01 ~~3.5E-02~~
Nb-95	2.4E+02	1.4E-01 ~~1.5E-01~~	9.6E-02 ~~9.8E-02~~				3.3E-01 ~~3.3E-02~~
Mo-99	1.6E+03	4.8E+01 ~~4.9E+01~~	7.2E-02 ~~7.3E-02~~				2.4E+01 ~~2.4E+00~~
Tc-99m							2.2E+00 ~~2.2E-01~~
Ru-103	1.0E+02	1.2E+00	2.4E-02				8.2E-01 ~~8.2E-02~~
Rh-103m							3.5E-03 ~~8.2E-02~~
Ru-106							1.4E-01 ~~1.4E-02~~
Rh-106							4.5E-06 ~~1.4E-02~~
Ag-110m	5.7E-02 ~~5.9E-02~~						4.6E-02 ~~1.3E-07~~
Sb-124	1.2E+00	2.4E+00	1.7E+00				
Te-129m							1.6E+00 ~~1.6E-01~~
Te-131m							5.5E-01 ~~5.5E-02~~
Te-132							1.4E-01 ~~1.4E-02~~
Cs-134	1.1E+02	4.8E+00 ~~4.9E+00~~	5.7E+01 ~~5.9E+01~~				1.3E+00 ~~1.3E-01~~
Cs-136	1.2E+01	2.4E+00					5.8E-01

Table 12.2-16

Annual Airborne Releases for Offsite Dose Evaluations (MBq)

Nuclide	Reactor Building	Turbine Building	Radwaste Building	Mechanical Vacuum Pump	Turbine Seal	Offgas System	Drywell
							~~5.8E-02~~
Cs-137	1.4E+02 ~~1.5E+02~~	2.4E+01	9.6E+01 ~~9.8E+01~~				3.4E+00 ~~3.4E-01~~
Cs-138							8.5E-01 ~~8.5E-02~~
Ba-140	5.3E+02 ~~5.4E+02~~	2.4E+02	9.6E-02 ~~9.8E-02~~				1.3E+01 ~~1.3E+00~~
La-140							1.3E+01 ~~1.3E+00~~
Ce-141	2.2E+01	2.4E+02	1.7E-01				1.2E+00 ~~1.2E-01~~
Ce-144							1.3E-01 ~~1.3E-02~~
Pr-144							1.6E-04 ~~1.3E-02~~
W-187							1.3E+00 ~~1.3E-01~~
Np-239							8.3E+01 ~~8.3E+00~~

Table 12.2-17

Comparison of Airborne Concentrations with 10 CFR 20 Concentrations

	Airborne Release	Concentration	10 CFR 20
Nuclide	MBq/yr	Bq/m^3	Bq/m^3
Kr-83m	8.5E+01~~3.73E+01~~	5.4E-06 ~~2.36E-06~~	2.E+06
Kr-85m	6.6E+05~~6.50E+05~~	4.2E-02 ~~4.12E-02~~	4.E+03
Kr-85	5.2E+06~~4.29E+06~~	3.3E-01 ~~2.72E-01~~	3.E+04
Kr-87	1.4E+06~~1.45E+06~~	9.0E-02 ~~9.17E-02~~	7.E+02
Kr-88	2.1E+06~~2.18E+06~~	1.4E-01 ~~1.38E-01~~	3.E+02
Kr-89	1.4E+07~~1.40E+07~~	8.7E-01 ~~8.90E-01~~	4.E+01
~~Kr-90~~	~~1.25E+01~~	~~7.94E-07~~	~~4.E+01~~
Xe-131m	1.5E+05~~1.10E+05~~	9.3E-03 ~~6.97E-03~~	7.E+04
Xe-133m	1.9E+02~~8.59E+01~~	1.2E-05 ~~5.44E-06~~	2.E+04
Xe-133	4.1E+07~~3.11E+07~~	2.6E+00 ~~1.97E+00~~	2.E+04
Xe-135m	2.2E+07~~2.27E+07~~	1.4E+00 ~~1.44E+00~~	1.E+03
Xe-135	2.8E+07~~2.43E+07~~	1.8E+00 ~~1.54E+00~~	3.E+03
Xe-137	2.8E+07~~2.90E+07~~	1.8E+00 ~~1.84E+00~~	4.E+01
Xe-138	2.3E+07~~2.32E+07~~	1.4E+00 ~~1.47E+00~~	7.E+02
~~Xe-139~~	~~1.57E+01~~	~~9.93E-07~~	~~4.E+01~~
I-131	8.4E+03~~1.51E+04~~	5.3E-04 ~~9.57E-04~~	7.E+00
I-132	5.8E+04~~5.89E+04~~	3.7E-03 ~~3.74E-03~~	7.E+02
I-133	4.2E+04~~4.88E+04~~	2.7E-03 ~~3.09E-03~~	4.E+01
I-134	1.1E+05~~1.06E+05~~	6.7E-03 ~~6.72E-03~~	2.E+03
I-135	5.9E+04~~6.14E+04~~	3.7E-03 ~~3.89E-03~~	2.E+02
H-3	2.8E+06~~2.80E+06~~	1.7E-01 ~~1.78E-01~~	4.E+03
C-14	5.3E+05~~3.54E+05~~	3.4E-02 ~~2.24E-02~~	1.E+02
Na-24	5.4E+00~~5.42E-01~~	3.4E-07 ~~3.44E-08~~	3.E+02
P-32	1.3E+00~~1.34E-01~~	8.5E-08 ~~8.50E-09~~	2.E+01
Ar-41	1.4E+03~~2.85E+02~~	9.0E-05 ~~1.81E-05~~	4.E+02
Cr-51	1.8E+02~~7.73E+01~~	1.1E-05 ~~4.90E-06~~	1.E+03
Mn-54	1.5E+02~~1.47E+02~~	9.2E-06 ~~9.29E-06~~	4.E+01
Mn-56	1.1E+01~~1.07E+00~~	6.8E-07 ~~6.80E-08~~	7.E+02

Table 12.2-17

Comparison of Airborne Concentrations with 10 CFR 20 Concentrations

	Airborne Release	Concentration	10 CFR 20
Nuclide	MBq/yr	Bq/m^3	Bq/m^3
Fe-55	4.7E+01~~4.72E+00~~	3.0E-06 ~~2.99E-07~~	1.E+02
Fe-59	2.0E+01~~1.94E+01~~	1.3E-06 ~~1.23E-06~~	2.E+01
Co-58	4.0E+01~~3.70E+01~~	2.6E-06 ~~2.35E-06~~	4.E+01
Co-60	3.2E+02~~3.18E+02~~	2.0E-05 ~~2.02E-05~~	2.E+00
Ni-63	4.7E-02~~4.74E-03~~	3.0E-09 ~~3.01E-10~~	4.E+01
Cu-64	6.9E+00~~6.93E-01~~	4.4E-07 ~~4.39E-08~~	1.E+03
Zn-65	3.2E+02~~2.80E+02~~	2.0E-05 ~~1.78E-05~~	1.E+01
Rb-89	2.0E-01~~2.01E-02~~	1.3E-08 ~~1.27E-09~~	7.E+03
Sr-89	1.5E+02~~1.48E+02~~	9.4E-06 ~~9.38E-06~~	7.E+00
Sr-90	1.0E+00~~7.65E-01~~	6.6E-08 ~~4.85E-08~~	2.E-01
Y-90	8.1E-02~~3.27E-02~~	5.1E-09 ~~2.07E-09~~	3.E+01
Sr-91	6.7E+00~~6.72E-01~~	4.3E-07 ~~4.26E-08~~	2.E+02
Sr-92	4.6E+00~~4.63E-01~~	2.9E-07 ~~2.93E-08~~	3.E+02
Y-91	1.7E+00~~1.74E-01~~	1.1E-07 ~~1.10E-08~~	7.E+00
Y-92	3.7E+00~~3.68E-01~~	2.3E-07 ~~2.33E-08~~	4.E+02
Y-93	7.2E+00~~7.23E-01~~	4.6E-07 ~~4.58E-08~~	1.E+02
Zr-95	4.4E+01~~4.49E+01~~	2.8E-06 ~~2.85E-06~~	1.E+01
Nb-95	2.4E+02~~2.44E+02~~	1.5E-05 ~~1.55E-05~~	7.E+01
Mo-99	1.7E+03~~1.66E+03~~	1.0E-04 ~~1.05E-04~~	7.E+01
Tc-99m	2.2E+00~~2.23E-01~~	1.4E-07 ~~1.41E-08~~	7.E+03
Ru-103	1.0E+02~~1.04E+02~~	6.5E-06 ~~6.58E-06~~	3.E+01
Rh-103m	3.5E-03~~8.24E-02~~	2.2E-10 ~~5.22E-09~~	7.E+04
Ru-106	1.4E-01~~1.35E-02~~	8.6E-09 ~~8.56E-10~~	7.E-01
Rh-106	4.5E-06~~1.35E-02~~	2.9E-13 ~~8.56E-10~~	4.E+01
Ag-110m	1.0E-01~~5.86E-02~~	6.6E-09 ~~3.71E-09~~	4.E+00
Sb-124	5.3E+00~~5.37E+00~~	3.3E-07 ~~3.40E-07~~	1.E+01
Te-129m	1.6E+00~~1.63E-01~~	1.0E-07 ~~1.03E-08~~	1.E+01
Te-131m	5.5E-01~~5.50E-02~~	3.5E-08 ~~3.49E-09~~	4.E+01
Te-132	1.4E-01~~1.41E-02~~	8.9E-09 ~~8.91E-10~~	3.E+01
Cs-134	1.8E+02~~1.78E+02~~	1.1E-05 ~~1.13E-05~~	7.E+00
Cs-136	1.5E+01~~1.47E+01~~	9.5E-07 ~~9.31E-07~~	3.E+01
Cs-137	2.7E+02~~2.69E+02~~	1.7E-05 ~~1.70E-05~~	7.E+00
Cs-138	8.5E-01~~8.50E-02~~	5.4E-08 ~~5.39E-09~~	3.E+03

Table 12.2-17

Comparison of Airborne Concentrations with 10 CFR 20 Concentrations

	Airborne Release	Concentration	10 CFR 20
Nuclide	MBq/yr	Bq/m^3	Bq/m^3
Ba-140	7.8E+02~~7.82E+02~~	4.9E-05 ~~4.96E-05~~	7.E+01
La-140	1.3E+01~~1.29E+00~~	8.2E-07 ~~8.19E-08~~	7.E+01
Ce-141	2.6E+02~~2.66E+02~~	1.7E-05 ~~1.69E-05~~	3.E+01
Ce-144	1.3E-01~~1.35E-02~~	8.5E-09 ~~8.53E-10~~	7.E-01
Pr-144	1.6E-04~~1.35E-02~~	9.9E-12 ~~8.53E-10~~	7.E+00
W-187	1.3E+00~~1.29E-01~~	8.2E-08 ~~8.21E-09~~	4.E+02
Np-239	8.3E+01~~8.28E+00~~	5.3E-06 ~~5.25E-07~~	1.E+02