REVISED RESPONSE TO REQUEST FOR ADDITIONAL INFORMATION

APR1400 Design Certification

Korea Electric Power Corporation / Korea Hydro & Nuclear Power Co., LTD

Docket No. 52-046

RAI No.:	**171-8143**
SRP Section:	**11.03 – Gaseous Waste Management System**
Application Section:	**11.03 – Gaseous Waste Management System**
Date of RAI Issue:	**08/25/2015**

Question No. 11.03-3

In SRP 11.3, BTP 11-5 describes acceptable methods to evaluate doses associated with the postulated releases of radioactive gases resulting from the failure of a gas decay tank or bed or a leak from a GWMS component.

The BTP presents guidelines for selecting the type of failure and model assumptions that provide reasonable assurance that the radiological consequences of a single failure of an active component will not result in doses exceeding a small fraction (10 percent) of the 10 CFR Part 100 dose limits for the whole body to any offsite individuals for the postulated event of systems designed to withstand explosions and earthquakes, or 1 mSv (0.1 rem) for systems not designed to withstand explosions and earthquakes. The analysis assumes that the waste gas system fails to meet its design bases, as required by 10 CFR 50.34a and GDC 60 and 61. The analysis relies on methods described in BTP 11-5 and the use of the PWR-GALE or BWR GALE code (NUREG-0016 or NUREG-0017) and Regulatory Guide 1.112.

The staff reviewed DCD section 11.3.3.2 and Table 11.3-9 that show the applicants Gaseous Waste Management System Failure Doses. These doses appear to be in within BTP 11-5 guidelines, however the staff requests a calculation package to verify the results provided in Table 11.3-9, specifically:.

1. BTP 11-5 describes the use of Regulatory Guide 1.109's Table B-1 for use in calculating the results of the BTP 11-5 analysis. Please verify the use of these values in Table B-1.

2. Results of NRC staff review of an equation on page 11.3-27 suggests that KHNP used FGR 12, applying the RADTRAD Computer Code, as the source for dose conversion factors. Please verify the source of the dose conversion factors.

3. The calculation package should include a description of all parameters used in the analysis to determine the results of Table 11.3-9. Please provide a detailed list of all parameters utilized to determine Table 11.3-9 results.

4. The calculation package should include a list all equations used to calculate the results of Table 11.3-9. Please provide all equations utilized for Table 11.3-9 calculations.

5. Please provide an equation or DCD reference section for all parameters found on page 11.3-27.

6. Please provide clarification to section 11.3.3.2 to describe the source of data for parameters R(i)n, R(i)a, and MF(i) and also provide the equations used to calculate the discussed variables.

Please address the items above and provide a mark-up on the proposed DCD changes.

Response - (Rev. 1)

1. Waste gas system failure dose analysis for the APR1400 was performed using the RADTRAD code which is based on RG 1.183. The external dose coefficients used in the RADTRAD analysis are obtained from Table III.1 of Federal Guidance Report (FGR) 12, “External Exposure to Radionuclides in Air, Water, and Soil”. Justification of using FGR 12 dose coefficients is provided in the response to Item No. 2 below.

2. As indicated by the NRC staff, the current BTP 11-5 (Rev.3, March 2007) Section B.2.B.ii requires the use of the total body dose factor listed as DFB_i in Table B-1 of RG 1.109. The acceptance criterion for this event is set to the total body dose of 1 mSv at the EAB for the system not designed to withstand explosions and earthquakes. This BTP states that the criterion is established to limit the exposure below a small fraction of the 10 CFR 100 limit of 25 rem, for whole body dose to any offsite individual.

   However, the corresponding requirement in 10 CFR 100 was revised to apply TEDE criterion for construction permit applicants on January 10, 1997. This TEDE dose limit is specified in 10 CFR 50.34(a)(1)(ii) and all the postulated accident consequence analyses are required to evaluate the TEDE as indicated in RG 1.183. In order to estimate the TEDE value, it is necessary to use the external effective dose equivalent dose coefficients in USEPA FGR 12, not the total body dose coefficients in RG 1.109. Therefore, the APR1400 waste gas system failure dose analysis used the dose coefficients of FGR 12.

   KHNP believes that this approach is consistent with the recent NRC position, since the Draft Revision of the BTP 11-5 (August 2014) incorporates the change of dose criterion from total body dose to TEDE and the use of FGR 12 dose coefficients, instead of those of RG 1.109.

3. The methods to calculate the waste gas tank failure dose are described in DCD Subsection 11.3.3.2. This response provides the parameter values used in the analysis.

   a. Source terms

While the activity released from a waste gas system failure should be estimated based on 1% fuel failure in accordance with BTP 11-5, the annual gaseous effluent releases calculated by the PWR-GALE code are based on the expected primary coolant concentrations. Therefore, these releases are adjusted to incorporate 1% fuel failure. In order to adjust the expected annual releases to the design basis 1% fuel failure releases, the multiplication factor (MF(i)) is applied. The multiplication factor for a specific radionuclide is defined as follows:

$$MF(i)=\frac{RCS_{i,1\%\ Failed\ Fuel}}{RCS_{i,GALE}}$$

where,

- $RCS_{i,1\%\ Failed\ Fuel}$: RCS specific activity of nuclide i based on 1% fuel failure (μCi/g), which are provided in DCD Table 11.1-2
- $RCS_{i,GALE}$: RCS specific activity of nuclide i calculated by PWR-GALE code (μCi/g), which are presented in the output of the PWR-GALE code run

Table 1 provides the calculated MF(i) values for each noble gas nuclide. Using the MF(i) values and the $R(i)_n$ and $R(I)_a$ values the total source term is calculated as shown in Table 2.

Table 1 Multiplication Factors

Isotope	Maximum RCS Specific Activity [1] (μCi/cc) (A)	Expected RCS Specific Activity [2] (μCi/cc) (B)	MF(i) (C) = A / B
Kr-85m	1.12E+00	1.64E-02	6.85E+01
Kr-85	4.80E+00	1.19E+00	4.02E+00
Kr-87	8.80E-01	1.74E-02	5.06E+01
Kr-88	2.44E+00	1.84E-02	1.32E+02
Xe-131m	4.80E+00	9.00E-01	5.33E+00
Xe-133m	2.92E-01	7.47E-02	3.91E+00
Xe-133	3.12E+02	3.26E-02	9.59E+03
Xe-135m	6.40E-01	1.33E-01	4.82E+00
Xe-135	6.40E+00	6.90E-02	9.28E+01
Xe-138	5.60E-01	6.24E-02	8.98E+00

1) Calculated using DAMSAM code. The maximum RCS specific activity is based on 0.25% fuel failue multiplied by a factor of 4. The 0.25% fuel failure RCS specific activities are provided in DCD Table 12.2-5.
2) Calculated using PWR-GALE code based on ANSI/ANS18.1-1999. These values are obtained from the PWR-GALE code output.

Table 2 Activity Released from Waste Gas System Failure

Isotope	Multiplication Factor (A)	Normal GWMS Release [1] (μCi/yr) (B)	Accident Release from GWMS [2] (μCi/yr) (C)	Total Release from GWMS (μCi/yr) (D) = B + C	2-hour Release due to GWMS Failure (μCi) (E) =(D*A)/8760*2
Kr-85m	6.85E+01	0.00E+00	2.50E+07	2.50E+07	3.91E+05
Kr-85	4.02E+00	1.80E+09	1.80E+09	3.60E+09	3.31E+06
Kr-87	5.06E+01	0.00E+00	2.50E+07	2.50E+07	2.89E+05
Kr-88	1.32E+02	0.00E+00	2.80E+07	2.80E+07	8.47E+05
Xe-131m	5.33E+00	9.80E+07	1.38E+09	1.48E+09	1.80E+06
Xe-133m	3.91E+00	0.00E+00	1.15E+08	1.15E+08	1.03E+05
Xe-133	9.59E+03	0.00E+00	5.00E+07	5.00E+07	1.10E+08
Xe-135m	4.82E+00	0.00E+00	1.71E+08	1.71E+08	1.88E+05
Xe-135	9.28E+01	0.00E+00	1.05E+08	1.05E+08	2.22E+06
Xe-138	8.98E+00	0.00E+00	7.80E+07	7.80E+07	1.60E+05

1) Normal GWMS Release is obtained from the PWR-GALE output. Gaseous releases from gas stripping are only considered for this analysis.
2) Accident Release from GWMS is obtained from the PWR-GALE output without credit of charcoal delay beds. Gaseous releases from gas stripping are only considered for this analysis.

The source term data provided in Table 2 are different from those used in calculating the dose values in DCD Table 11.3-9. KHNP revised the source term data to only include the release from GWMS. Therefore, DCD Table 11.3-9 will be updated to incorporate this change of the source term. Previous calculation used the total source terms from PWR-GALE Code output which is the sum of the GWMS release and the building ventilation releases. However, since this analysis only needs to consider release from the failure of waste gas system, the releases from other vents are not required to be included.

The schematic diagram of APR1400 GWMS is provided in Attachment 2 of the response.

b. Atmospheric dispersion factors and Dose Coefficients

Atmospheric dispersion factors and the breathing rates used in the calculation are provided in Table 3. The external dose coefficients are provided in Table 4. These values are consistent with those used in other radiological consequence analyses in Chapter 15.

Table 3 Atmospheric Dispersion Factors and Breathing Rates

Parameter	Value
EAB Atmospheric Dispersion Factor (χ/Q, sec/m^3)	1.00E-03
EAB Breathing Rate	3.50E-04
LPZ Atmospheric Dispersion Factors (χ/Qs)	
Time (Hr)	χ/Q (sec/m^3)
0 – 8	2.20E-04
8 – 24	1.60E-04
24 – 96	1.00E-04
96 - 720	8.00E-05
LPZ Breathing Rates	
Time (Hr)	BR (m^3/sec)
0 – 8	3.50E-04
8 – 24	1.80E-04
24 - 720	2.30E-04

Table 4 External Dose Coefficients

Nuclide	Effective Dose Equivalent Dose Coefficient (Sv·m^3/Bq·sec)
Xe-131m	3.89E-16
Xe-133m	1.37E-15
Xe-133	1.56E-15
Xe-135m	2.04E-14
Xe-135	1.19E-14
Xe-138	5.77E-14
Kr-85	1.19E-16
Kr-85m	7.48E-15
Kr-87	4.12E-14
Kr-88	1.02E-13

4. Equations used to calculate the results of DCD Table 11.3-9 are presented in DCD Section 11.3.3.2 and no additional equations were used in the analysis.

5. All parameters used in DCD page 11.3-27 are described in the response to Items No. 2 and No. 3 above.

6. Details of the explanation and the parameter values for $R(i)_n$, $R(i)_a$, MF(i) and equations are provided in the response to Item No. 3 above.

Impact on DCD

DCD Table 11.3-9 will be updated as indicated in the Attachment 1.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

d. For isotopes whose design basis RCS equilibrium concentration, calculated using the DAMSAM Code, is less than the expected concentration, the expected concentration is used for conservatism.

e. Particulates and iodines are assumed to be removed by pretreatment equipment. Therefore, only the total effective dose equivalent (TEDE) from external exposure to noble gases is calculated in this analysis.

The equation used to calculate the dose consequences for failures in the GRS, which is consistent with BTP 11-5 (Reference 16), is as follows:

$$D = \sum_{i} K(i) \cdot Q(i) \cdot \chi/Q$$

Where:

D = total effective dose equivalent, mSv

K(i) = dose conversion factor given in U.S. Environmental Protection Agency (EPA) Federal Guidance Report No. 12 (Reference 32) for the ith isotope, $mSv \cdot m^3/Bq \cdot sec$

χ/Q = short-term accident atmospheric dispersion factor for 2 hours at EAB, sec/m^3

from DCD Table 2.3-1

Q(i) = noble gas release rate of the ith isotope for 2 hours calculated using the following equation, Bq

$$Q(i) = [R(i)_n + R(i)_a] \cdot MF(i)$$

$R(i)_n$ = gaseous effluent release rate due to normal operation for 2 hours, Bq

$R(i)_a$ = gaseous effluent release rate due to GRS failure for 2 hours, Bq

Dose consequence is calculated using the RADTRAD Code (Reference 33). As presented in Table 11.3-9, the calculated TEDE at the EAB is 0.0316 mSv, which is less than the acceptance criterion of 1 mSv specified in the Standard Review Plan, Section 11.3 (Reference 1).

MF(i) = Multiplication factor used to adjust PWR-GALE code output to incorporate 1% fuel failure

Replace this table with "A" in the next page

Table 11.3-9

Gaseous Radwaste System Failure Doses

Radioactivity Release Path	Dose (mSv)	
	EAB	LPZ
Tank Release to Environment	~~3.16~~E-02	~~6.950~~E-03
Allowable Dose Limit	1.00E+00	1.00E+00

1.16

2.55

A

Table 11.3-9

Gaseous Radwaste System Failure Activity release and Doses

1. Radioactivity Released due to GWMS Failure

Nuclide	Multiplication Factor (A)	Normal GWMS Release(1) (μCi /yr) (B)	Accident Release from GWMS(2) (μCi /yr) (C)	Total Release from GWMS(3) (μCi /yr) (D)	2-hour Release due to GWMS Failure(4) (μCi) (E)
Kr-85m	6.85E+01	0.00E+00	2.50E+07	2.50E+07	3.91E+05
Kr-85	4.02E+00	1.80E+09	1.80E+09	3.60E+09	3.31E+06
Kr-87	5.06E+01	0.00E+00	2.50E+07	2.50E+07	2.89E+05
Kr-88	1.32E+02	0.00E+00	2.80E+07	2.80E+07	8.47E+05
Xe-131m	5.33E+00	9.80E+07	1.38E+09	1.48E+09	1.80E+06
Xe-133m	3.91E+00	0.00E+00	1.15E+08	1.15E+08	1.03E+05
Xe-133	9.59E+03	0.00E+00	5.00E+07	5.00E+07	1.10E+08
Xe-135m	4.82E+00	0.00E+00	1.71E+08	1.71E+08	1.88E+05
Xe-135	9.28E+01	0.00E+00	1.05E+08	1.05E+08	2.22E+06
Xe-138	8.98E+00	0.00E+00	7.80E+07	7.80E+07	1.60E+05

(1) Normal GWMS Release is obtained from PWR-GALE output. Gaseous releases from gas stripping are only considered for this analysis.

(2) Accident Release from GWMS is obtained from PWR-GALE output without credit of charcoal delay beds. Gaseous releases from gas stripping are only considered for this analysis.

(3) (D) = (B)+(C)

(4) (E) = (D)×(A) ×2/8,760

2. Offsite Doses due to GWMS Failure

Radioactivity Release Path	Dose (mrem)	
	EAB	LPZ
Tank Release to Environment	1.16E+00	2.55E-01
Allowable Dose Limit	1.00E+02	1.00E+02

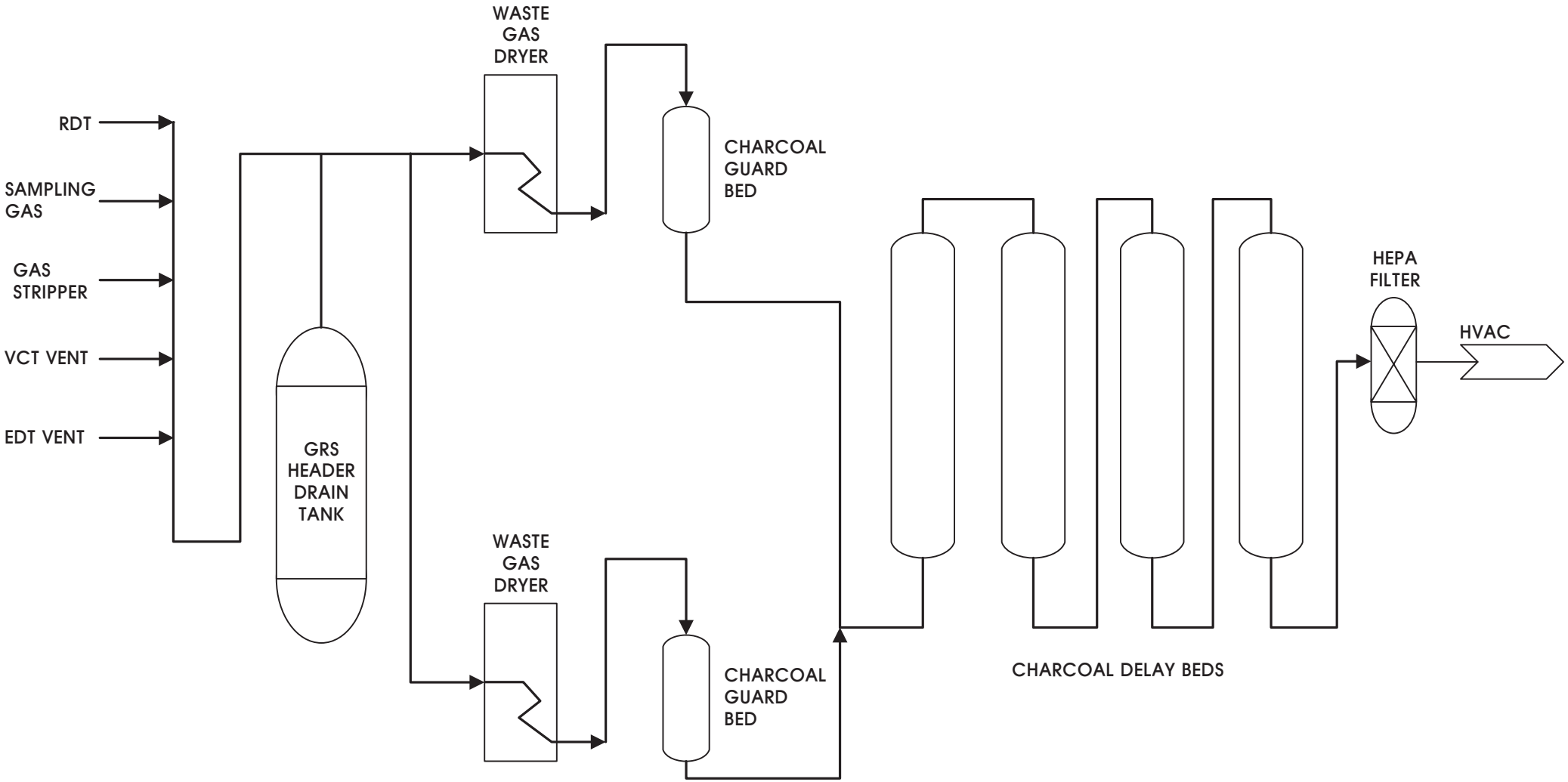

Figure 1. Schematic Diagram of GWMS

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Application Section:	**11.03 – Gaseous Waste Management System**
Date of RAI Issue:	**08/25/2015**

Question No. 11.03-4

The applicant follows the guidance provided in RG 1.143 to classify structures and components of the GWMS.

Staff was unable to confirm the results provided for the Rad Waste Classifications listed in Tables 11.3-11. Indications are that the A1 and A2 values for the following radionuclides were chosen as zero.

Table 11.3-11: Br-84, Kr-88, Xe-133m, Xe-135m, Xe-137, and Xe-138

In section 5.3 of Regulatory Guide 1.143, the use of 10 CFR 71 Appendix A is referenced for use in determining the classification of systems in an RW-IIa classification through the use of A1 and A2 values. 10 CFR 71, Appendix A, Table 1 contains the values for the A1 and A2 values. Missing from Table 1 are the values for the radionuclides listed above from Table 11.3-11. Appendix A to Part 71 states:

“II. a. For individual radionuclides whose identities are known, but which are not listed in Table A- 1, the A1 and A2 values contained in Table A-3 may be used. Otherwise, the licensee shall obtain prior Commission approval of the A1 and A2 values for radionuclides not listed in Table A-1, before shipping the material.”

The staff requests that the applicant provide the A1 and A2 values for all radionuclides in accordance with the regulations in determining the radwaste classifications provided in Table 11.3-11.

The staff also requests that all calculations are provided for the determinations made in the above two tables.

Please address the items above and provide a mark-up on the proposed DCD changes.

Response - (Rev. 1)

In accordance with the requirement in 10 CFR 71 Appendix A, II.a, the evaluation on radwaste safety classification for GWMS components were revised to add the A1 and A2 values from 10 CFR 71, Appendix A, Table A-3 for the following nuclides:

- Br-84, Kr-88, Xe-133m, Xe-135m, Xe-137, and Xe-138.

The calculations which were performed for the waste gas dryer skid, Charcoal guard bed, Charcoal delay beds and GRS head drain tank are provided in Tables 1 through 7 of this response for the staff's review.

Since most of the components have already been classified as RW-IIa, there is no impact on the existing classification by addition of the above nuclides except for Charcoal guard bed. Charcoal guard bed classification is raised to RW-IIa. Related DCD sections and Tables will be updated to modify the fraction values. The revised Table 11.3-11 provided in this response will replace the previous DCD Markup in Attachment 4 (69~70/85) of the response to RAI 110-7919 - Question 11.01-2.

While re-evaluating radwaste safety classifications, the waste gas dryer skid inventory was adjusted so that only the source region volume is used instead of using the entire volume of the component. The adjustment on the waste gas dryer skid has no impact on the radwaste classification.

Table 1. Radwaste Safety Classification for Waste Gas Dryer Skid

Nuclide	Activity (Ci)	A_1	Activity/A_1	A_2	Activity/A_2
H-3	8.436E-06	2.7E+00	3.12E-06	5.4E-01	1.56E-05
Br-84	1.500E-07	2.7E+00	5.55E-08	5.4E-01	2.78E-07
Kr-85m	4.728E-01	2.2E+02	2.15E-03	8.1E+01	5.84E-03
Kr-85	1.182E-02	2.7E+02	4.38E-05	2.7E+02	4.38E-05
Kr-87	4.634E-01	5.4E+00	8.58E-02	5.4E+00	8.58E-02
Kr-88	1.182E+00	2.7E+00	4.38E-01	5.4E-01	2.19E+00
Xe-131m	1.182E-01	1.1E+03	1.07E-04	1.1E+03	1.07E-04
Xe-133m	3.025E-02	2.7E-02	1.12E+00	2.4E-03	1.26E+01
Xe-133	1.515E+01	5.4E+02	2.81E-02	2.7E+02	5.61E-02
Xe-135m	3.640E-01	2.7E+00	1.35E-01	5.4E-01	6.74E-01
Xe-135	2.083E+00	8.1E+01	2.57E-02	5.4E+01	3.86E-02
Xe-137	9.008E-02	2.7E+00	3.34E-02	5.4E-01	1.67E-01
Xe-138	3.119E-01	2.7E+00	1.16E-01	5.4E-01	5.78E-01
I-131	1.906E-05	8.1E+01	2.35E-07	1.9E+01	1.00E-06
I-132	5.124E-06	1.1E+01	4.66E-07	1.1E+01	4.66E-07
I-133	2.718E-05	1.9E+01	1.43E-06	1.6E+01	1.70E-06
I-134	3.213E-06	8.1E+00	3.97E-07	8.1E+00	3.97E-07
I-135	1.500E-05	1.6E+01	9.37E-07	1.6E+01	9.37E-07
Sum			1.98E+00		1.64+01

Table 2 Radwaste Safety Classification for Charcoal Guard Bed

Nuclide	Activity (Ci)	A_1	Activity/A_1	A_2	Activity/A_2
Br-84	1.092E-05	2.7E+00	4.04E-06	5.4E-01	2.02E-05
Kr-85m	6.324E-01	2.2E+02	2.87E-03	8.1E+01	7.81E-03
Kr-85	1.578E-02	2.7E+02	5.85E-05	2.7E+02	5.85E-05
Kr-87	6.189E-01	5.4E+00	1.15E-01	5.4E+00	1.15E-01
Kr-88	1.578E+00	2.7E+00	5.85E-01	5.4E-01	2.92E+00
Xe-131m	1.578E-01	1.1E+03	1.43E-04	1.1E+03	1.43E-04
Xe-133m	4.054E-02	2.7E-02	1.50E+00	2.4E-03	1.69E+01
Xe-133	2.022E+01	5.4E+02	3.74E-02	2.7E+02	7.49E-02
Xe-135m	4.865E-01	2.7E+00	1.80E-01	5.4E-01	9.01E-01
Xe-135	2.784E+00	8.1E+01	3.44E-02	5.4E+01	5.16E-02
Xe-137	1.200E-01	2.7E+00	4.44E-02	5.4E-01	2.22E-01
Xe-138	4.162E-01	2.7E+00	1.54E-01	5.4E-01	7.71E-01
I-131	5.054E-01	8.1E+01	6.24E-03	1.9E+01	2.66E-02
I-132	1.619E-03	1.1E+01	1.47E-04	1.1E+01	1.47E-04
I-133	7.757E-02	1.9E+01	4.08E-03	1.6E+01	4.85E-03
I-134	3.865E-04	8.1E+00	4.77E-05	8.1E+00	4.77E-05
I-135	1.359E-02	1.6E+01	8.50E-04	1.6E+01	8.50E-04
Sum			2.67E+00		2.20E+01

Table 3 Radwaste Safety Classification for First Charcoal Delay Bed

Nuclide	Activity (Ci)	A1	Activity/A1	A2	Activity/A2
Kr-85m	2.81E+02	2.2E+02	1.3E+00	8.1E+01	3.5E+00
Kr-85	2.36E+01	2.7E+02	8.8E-02	2.7E+02	8.8E-02
Kr-87	8.11E+01	5.4E+00	1.5E+01	5.4E+00	1.5E+01
Kr-88	4.59E+02	2.7E+00	1.7E+02	5.4E-01	8.5E+02
Xe-131m	2.23E+03	1.1E+03	2.0E+00	1.1E+03	2.0E+00
Xe-133m	2.12E+02	2.7E-02	7.9E+03	2.4E-03	8.9E+04
Xe-133	2.03E+05	5.4E+02	3.8E+02	2.7E+02	7.5E+02
Xe-135m	1.28E+01	2.7E+00	4.7E+00	5.4E-01	2.4E+01
Xe-135	2.60E+03	8.1E+01	3.2E+01	5.4E+01	4.8E+01
Xe-137	7.89E-01	2.7E+00	2.9E-01	5.4E-01	1.5E+00
Xe-138	1.01E+01	2.7E+00	3.8E+00	5.4E-01	1.9E+01
Sum			8.47E+03		2.20E+01

Table 4 Radwaste Safety Classification for Second Charcoal Delay

Nuclide	Activity (Ci)	A_1	Activity/A_1	A_2	Activity/A_2
Kr-85m	1.09E+01	2.2E+02	4.9E-02	8.1E+01	1.3E-01
Kr-85	2.36E+01	2.7E+02	8.8E-02	2.7E+02	8.8E-02
Kr-87	8.65E-04	5.4E+00	1.6E-04	5.4E+00	1.6E-04
Kr-88	2.73E+00	2.7E+00	1.0E+00	5.4E-01	5.1E+00
Xe-131m	1.16E+03	1.1E+03	1.1E+00	1.1E+03	1.1E+00
Xe-133m	6.03E+00	2.7E-02	2.2E+02	2.4E-03	2.5E+03
Xe-133	4.59E+04	5.4E+02	8.5E+01	2.7E+02	1.7E+02
Xe-135m	0.00E+00	2.7E+00	-	5.4E-01	-
Xe-135	2.97E-06	8.1E+01	3.7E-08	5.4E+01	5.5E-08
Xe-137	0.00E+00	2.7E+00	-	5.4E-01	-
Xe-138	0.00E+00	2.7E+00	-	5.4E-01	-
Sum			3.11E+02		2.69E+03

Table 5 Radwaste Safety Classification for Third Charcoal Delay Bed

Nuclide	Activity (Ci)	A_1	Activity/A_1	A_2	Activity/A_2
Kr-85m	4.22E-01	2.2E+02	1.9E-03	8.1E+01	5.2E-03
Kr-85	2.36E+01	2.7E+02	8.8E-02	2.7E+02	8.8E-02
Kr-87	9.24E-09	5.4E+00	1.7E-09	5.4E+00	1.7E-09
Kr-88	1.61E-02	2.7E+00	6.0E-03	5.4E-01	3.0E-02
Xe-131m	6.03E+02	1.1E+03	5.5E-01	1.1E+03	5.5E-01
Xe-133m	1.71E-01	2.7E-02	6.3E+00	2.4E-03	7.1E+01
Xe-133	1.04E+04	5.4E+02	1.9E+01	2.7E+02	3.8E+01
Xe-135m	0.00E+00	2.7E+00	-	5.4E-01	-
Xe-135	3.38E-15	8.1E+01	4.2E-17	5.4E+01	6.3E-17
Xe-137	0.00E+00	2.7E+00	-	5.4E-01	-
Xe-138	0.00E+00	2.7E+00	-	5.4E-01	-
Sum			2.62E+01		1.10E+02

Table 6 Radwaste Safety Classification for Fourth Charcoal Delay Bed

Nuclide	Activity (Ci)	A_1	Activity/A_1	A_2	Activity/A_2
Kr-85m	1.64E-02	2.2E+02	7.4E-05	8.1E+01	2.0E-04
Kr-85	2.36E+01	2.7E+02	8.8E-02	2.7E+02	8.8E-02
Kr-87	9.89E-14	5.4E+00	1.8E-14	5.4E+00	1.8E-14
Kr-88	9.57E-05	2.7E+00	3.5E-05	5.4E-01	1.8E-04
Xe-131m	3.14E+02	1.1E+03	2.9E-01	1.1E+03	2.9E-01
Xe-133m	4.86E-03	2.7E-02	1.8E-01	2.4E-03	2.0E+00
Xe-133	2.34E+03	5.4E+02	4.3E+00	2.7E+02	8.7E+00
Xe-135m	0.00E+00	2.7E+00	-	5.4E-01	-
Xe-135	3.86E-24	8.1E+01	4.8E-26	5.4E+01	7.2E-26
Xe-137	0.00E+00	2.7E+00	-	5.4E-01	-
Xe-138	0.00E+00	2.7E+00	-	5.4E-01	-
Sum			4.89E+00		1.11E+01

Table 7 Radwaste Safety Classification for GWMS Head Drain Tank

Nuclide	Activity (Ci)	A_1	Activity/A_1	A_2	Activity/A_2
H-3	2.48E-04	2.7E+00	9.2E-05	5.4E-01	4.6E-04
Br-84	4.41E-06	2.7E+00	1.6E-06	5.4E-01	8.2E-06
Kr-85m	1.39E+01	2.2E+02	6.3E-02	8.1E+01	1.7E-01
Kr-85	3.49E-01	2.7E+02	1.3E-03	2.7E+02	1.3E-03
Kr-87	1.36E+01	5.4E+00	2.5E+00	5.4E+00	2.5E+00
Kr-88	3.49E+01	2.7E+00	1.3E+01	5.4E-01	6.5E+01
Xe-131m	3.49E+00	1.1E+03	3.2E-03	1.1E+03	3.2E-03
Xe-133m	8.89E-01	2.7E-02	3.3E+01	2.4E-03	3.7E+02
Xe-133	4.46E+02	5.4E+02	8.3E-01	2.7E+02	1.7E+00
Xe-135m	1.07E+01	2.7E+00	4.0E+00	5.4E-01	2.0E+01
Xe-135	6.11E+01	8.1E+01	7.5E-01	5.4E+01	1.1E+00
Xe-137	2.64E+00	2.7E+00	9.8E-01	5.4E-01	4.9E+00
Xe-138	9.19E+00	2.7E+00	3.4E+00	5.4E-01	1.7E+01
I-131	5.59E-04	8.1E+01	6.9E-06	1.9E+01	2.9E-05
I-132	1.51E-04	1.1E+01	1.4E-05	1.1E+01	1.4E-05
I-133	7.97E-04	1.9E+01	4.2E-05	1.6E+01	5.0E-05
I-134	9.43E-05	8.1E+00	1.2E-05	8.1E+00	1.2E-05
I-135	4.41E-04	1.6E+01	2.8E-05	1.6E+01	2.8E-05
Sum			5.84E+01		4.82E+02

Impact on DCD

DCD Tier1 Section 2.7.6.2.1, Table 2.7.6.2-3, Table 2.7.6.2-4 and DCD Tier 2 Table 11.3-4 and Table 11.3-11 will be updated as indicated in the Attachment.

Impact on PRA

There is no impact on the PRA.

Impact on Technical Specifications

There is no impact on the Technical Specifications.

Impact on Technical/Topical/Environmental Reports

There is no impact on any Technical, Topical or Environmental Report.

3. The GRS discharge valve is closed automatically upon detection of a high radiation signal from the radiation monitor at the gaseous waste discharge. The discharge valve is also automatically closed when there is insufficient or no ventilation flow.

4. An alarm from the gaseous waste discharge radiation monitor is provided in the MCR and the radwaste control room.

5. The nitrogen injection valve is opened automatically upon receipt of a high oxygen concentration signal above the pre-determined setpoint.

6. The GRS components are classified as RW-IIa ~~and RW-IIe~~ in accordance with NRC RG 1.143 and designed to the corresponding requirements in order to maintain structural integrity under the design basis loads. Component Radiation Safety Classification is summarized in Table 2.7.6.2-3.

2.7.6.2.2 Inspections, Tests, Analysis, and Acceptance Criteria

The inspections, tests, and analyses, and associated acceptance criteria for the gaseous radwaste system is specified in Table 2.7.6.2-4 except for containment penetration isolation valves and piping.

The inspection, tests, analyses, and associated acceptance criteria for the containment penetration isolation valves and piping of GRS are specified in Table 2.11.3-2.

Table 2.7.6.2-3

Radwaste Safety Classification of Gaseous Radwaste System

Component Name	Item No.(1)	Quantity	Location	Radwaste Safety Class
Header Drain Tank	GW-TK01	1	Compound Building	RW-IIa
Waste Gas Dryer	GW-CH71/72	2	Compound Building	RW-IIa
Charcoal Guard Bed	GW-PV71/72	2	Compound Building	~~RW-IIc~~
Charcoal Delay Bed	GW-PV73/74/75/76	4	Compound Building	RW-IIa
HEPA Filter	GW-FT01	1	Compound Building	RW-IIa

(1) The column "Item No." is information only (not part of certified design)

RW-IIa

Table 2.7.6.2-4 (2 of 2)

Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5. The nitrogen injection valve is opened automatically upon receipt of a high oxygen concentration signal above the pre-determined setpoint.	5. Tests will be conducted for the GRS nitrogen injection valve using simulated test signal.	5. Upon receipt of a simulated high oxygen concentration test signal, the as-built nitrogen injection valve is opened automatically.
6. The GRS components are classified as RW-IIa ~~and RW-IIc~~ in accordance with NRC RG 1.143 and designed to the corresponding requirements in order to maintain structural integrity under the design basis loads. Component Radiation Safety Classification is summarized in Table 2.7.6.2-3.	6. Inspection will be performed for the as-built equipment per design specifications to verify that as-built equipment construction (thicknesses and supports) and anchor bolt sizes meet design specifications and Owner Engineer approved fabrication drawings.	6. A report concludes that the equipment classified as RW-IIa ~~and RW-IIc~~ in Table 2.7.6.2-3 maintains structural integrity under the design basis loads.

Table 11.3-4 (1 of 2)

GRS Major Equipment Design Information

Tanks	
Equipment name	Header drain tank
Quantity (each)	1
Design capacity, L (ft^3)	566 (20)
Design pressure, kg/cm^2 (psig)	10.5 (150)
Design temperature, °C (°F)	93.3 (200)
[[Material]]	Stainless steel
Radwaste safety class	RW-IIa
Equipment name	Charcoal guard bed (GRS package)
Quantity (each)	2
Total mass of charcoal, kg (lbm)	272 (600)
Design flow, L/min (scfm)	623 (22)
Design pressure, kg/cm^2 (psig)	10.5 (150)
Design temperature, °C (°F)	93.3 (200)
[[Material]]	Stainless steel
Radwaste safety class	RW-~~IIe~~ IIa
Equipment name	Charcoal delay bed (GRS package)
Quantity (each)	4
Total mass of charcoal, kg (lbm)	9,525 (21,000)
Design flow, L/min (scfm)	57 (2)
Design pressure, kg/cm^2 (psig)	10.5 (150)
Design temperature, °C (°F)	93.3 (200)
[[Material]]	Carbon steel
Radwaste safety class	RW-IIa

Replace with "A" (next page)

Table 11.3-11 (1 of 2)

Design Basis Radioactive Source Terms for GRS Components (1 % Fuel Defect)

Nuclide	At Inlet (Bq/cm^3)	Buildup Activity on Charcoal Bed (Bq)					At Outlet (Bq/cm^3)	Header Drain Tank (Bq)	Waste Gas Dryer (Bq)
		Guard Bed	1st Delay Bed	2nd Delay Bed	3rd Delay Bed	4th Delay Bed			
Kr-85m	9.08E+05	2.34E+10	1.04E+13	4.02E+11	1.56E+10	6.06E+08	2.06E+00	5.14E+11	4.69E+12
Kr-85	2.27E+04	5.84E+08	8.75E+11	8.75E+11	8.75E+11	8.75E+11	2.27E+04	1.29E+10	1.17E+11
Kr-87	8.90E+05	2.29E+10	3.00E+12	3.20E+07	3.42E+02	3.66E-03	1.16E-14	5.04E+11	4.59E+12
Kr-88	2.27E+06	5.84E+10	1.70E+13	1.01E+11	5.97E+08	3.54E+06	2.81E-03	1.29E+12	1.17E+13
Xe-131m	2.27E+05	5.84E+09	8.25E+13	4.29E+13	2.23E+13	1.16E+13	1.65E+04	1.29E+11	1.17E+12
Xe-133m	5.81E+04	1.50E+09	7.86E+12	2.23E+11	6.34E+09	1.80E+08	3.79E-02	3.29E+10	3.00E+11
Xe-133	2.91E+07	7.48E+11	7.50E+15	1.70E+15	3.83E+14	8.67E+13	7.60E+04	1.65E+13	1.50E+14
Xe-135m	6.99E+05	1.80E+10	4.72E+11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.96E+11	3.61E+12
Xe-135	4.00E+06	1.03E+11	9.62E+13	1.10E+05	1.25E-04	1.43E-13	6.78E-30	2.26E+12	2.06E+13
Xe-137	1.73E+05	4.44E+09	2.92E+10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	9.77E+10	8.93E+11
Xe-138	5.99E+05	1.54E+10	3.75E+11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.40E+11	3.09E+12
Br-84	2.88E-01	4.04E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.63E+05	1.49E+06
I-131	3.66E+01	1.87E+10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.07E+07	1.89E+08
I-132	9.84E+00	5.99E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	5.58E+06	5.08E+07
I-133	5.22E+01	2.87E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	2.95E+07	2.69E+08
I-134	6.17E+00	1.43E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.49E+06	3.18E+07
I-135	2.88E+01	5.03E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	1.63E+07	1.49E+08

Replace with "A" (next page)

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Table 11.3-11 (2 of 2)

Nuclide	At Inlet (Bq/cm^3)	Buildup Activity on Charcoal Bed (Bq)					At Outlet (Bq/cm^3)	Header Drain Tank (Bq)	Waste Gas Dryer (Bq)
		Guard Bed	1st Delay Bed	2nd Delay Bed	3rd Delay Bed	4th Delay Bed			
Sum of Fractions									
$\sum A_i/A_{1i}$	-	2.01E-01	4.26E+02	8.63E+01	1.98E+01	4.17E+00	-	4.17E+00	3.80E+01
$\sum A_i/A_{2i}$	-	2.82E-01	8.19E+02	1.71E+02	3.90E+01	9.05E+00	-	5.48E+00	5.00e+01
Radwaste Classification									
	-	RW-IIc	RW-IIa	RW-IIa	RW-IIa	RW-IIa	-	RW-IIa	RW-IIa

"A" (Replace a new Table 11.3-11) (1 of 2)

Table 11.3-11 (1 of 2)

Design Basis Radioactive Source Terms for GRS Components (1 % Fuel Defect)

Nuclide	At Inlet		Buildup Activity on Charcoal Bed										At Outlet	
			Guard Bed		1st Delay Bed		2nd Delay Bed		3rd Delay Bed		4th Delay Bed			
	μCi//cm^3	Bq/cm^3	μCi	Bq	μCi	Bq	μCi	Bq	μCi	Bq	μCi	Bq	μCi//cm^3	Bq/cm^3
Kr-85m	2.46E+01	9.08E+05	6.31E+05	2.34E+10	2.80E+08	1.04E+13	1.09E+07	4.02E+11	4.22E+05	1.56E+10	1.64E+04	6.06E+08	5.58E-05	2.06E+00
Kr-85	6.14E-01	2.27E+04	1.58E+04	5.84E+08	2.36E+07	8.75E+11	2.36E+07	8.75E+11	2.36E+07	8.75E+11	2.36E+07	8.75E+11	6.13E-01	2.27E+04
Kr-87	2.41E+01	8.90E+05	6.19E+05	2.29E+10	8.10E+07	3.00E+12	8.66E+02	3.20E+07	9.25E-03	3.42E+02	9.89E-08	3.66E-03	3.14E-19	1.16E-14
Kr-88	6.14E+01	2.27E+06	1.58E+06	5.84E+10	4.59E+08	1.70E+13	2.72E+06	1.01E+11	1.61E+04	5.97E+08	9.57E+01	3.54E+06	7.60E-08	2.81E-03
Xe-131m	6.14E+00	2.27E+05	1.58E+05	5.84E+09	2.23E+09	8.25E+13	1.16E+09	4.29E+13	6.01E+08	2.23E+13	3.12E+08	1.16E+13	4.46E-01	1.65E+04
Xe-133m	1.57E+00	5.81E+04	4.04E+04	1.50E+09	2.12E+08	7.86E+12	6.03E+06	2.23E+11	1.71E+05	6.34E+09	4.87E+03	1.80E+08	1.02E-06	3.79E-02
Xe-133	7.86E+02	2.91E+07	2.02E+07	7.48E+11	2.03E+11	7.50E+15	4.58E+10	1.70E+15	1.04E+10	3.83E+14	2.34E+09	8.67E+13	2.05E+00	7.60E+04
Xe-135m	1.89E+01	6.99E+05	4.86E+05	1.80E+10	1.28E+07	4.72E+11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-135	1.08E+02	4.00E+06	2.78E+06	1.03E+11	2.60E+09	9.62E+13	2.97E+00	1.10E+05	3.39E-09	1.25E-04	3.86E-18	1.43E-13	1.83E-34	6.78E-30
Xe-137	4.66E+00	1.73E+05	1.20E+05	4.44E+09	7.88E+05	2.92E+10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Xe-138	1.62E+01	5.99E+05	4.17E+05	1.54E+10	1.01E+07	3.75E+11	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Br-84	7.77E-06	2.88E-01	1.09E+01	4.04E+05	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-131	9.89E-04	3.66E+01	5.05E+05	1.87E+10	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-132	2.66E-04	9.84E+00	1.62E+03	5.99E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-133	1.41E-03	5.22E+01	7.76E+04	2.87E+09	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-134	1.67E-04	6.17E+00	3.87E+02	1.43E+07	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
I-135	7.77E-04	2.88E+01	1.36E+04	5.03E+08	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sum of Fractions														
$\sum A_i/A_{1i}$	-		~~2.05E+01~~		~~8.94E+03~~		3.11E+02		2.62E+01		4.89E+00		-	
$\sum A_i/A_{2i}$	-		~~2.24E+02~~		~~9.55E+04~~		2.69E+03		1.10E+02		1.11E+01		-	
Radwaste Classification														
	-		RW-IIa		RW-IIa		RW-IIa		RW-IIa		RW-IIa		-	

2.67E+00

2.20E+01

8.47E+03

9.02E+04

"A" (Replace a new Table 11.3-11) (2 of 2)

Table 11.3-11 (2 of 2)

Nuclide	Header Drain Tank		Waste Gas Dryer	
	μCi	Bq	μCi	Bq
H-3	2.48E+02	9.18E+06	8.44E+00	3.12E+05
Kr-85m	1.39E+07	5.14E+11	4.73E+05	1.75E+10
Kr-85	3.48E+05	1.29E+10	1.18E+04	4.37E+08
Kr-87	1.36E+07	5.04E+11	4.63E+05	1.71E+10
Kr-88	3.48E+07	1.29E+12	1.18E+06	4.37E+10
Xe-131m	3.48E+06	1.29E+11	1.18E+05	4.37E+09
Xe-133m	8.90E+05	3.29E+10	3.03E+04	1.12E+09
Xe-133	4.45E+08	1.65E+13	1.52E+07	5.61E+11
Xe-135m	1.07E+07	3.96E+11	3.64E+05	1.35E+10
Xe-135	6.12E+07	2.26E+12	2.08E+06	7.71E+10
Xe-137	2.64E+06	9.77E+10	9.01E+04	3.33E+09
Xe-138	9.18E+06	3.40E+11	3.12E+05	1.15E+10
Br-84	4.40E+00	1.63E+05	1.50E-01	5.55E+03
I-131	5.60E+02	2.07E+07	1.91E+01	7.05E+05
I-132	1.51E+02	5.58E+06	5.12E+00	1.90E+05
I-133	7.99E+02	2.95E+07	2.72E+01	1.01E+06
I-134	9.44E+01	3.49E+06	3.21E+00	1.19E+05
I-135	4.40E+02	1.63E+07	1.50E+01	5.55E+05
Sum of Fractions				
$\sum A_i/A_{1i}$	~~4.51E+02~~		~~1.53E+01~~	
$\sum A_i/A_{2i}$	~~4.92E+03~~		~~1.67E+02~~	
Radwaste Classification				
	RW-IIa		RW-IIa	

1.98E+00

1.64E+01

5.84E+01

4.82E+02