OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT
CALCULATION COVER SHEET

1. QA: QA
Page: 1 Of: 31

2. Calculation Title

Source Terms for HLW Glass Canisters

MOL.20000823.0004

3. Document Identifier (including Revision Number)

CAL-MGR-NU-000002 REV 01

4. Total Attachments

8

5. Attachment Numbers – Number of pages in each

I-3, II-3, III-4, IV-4, V-7, VI-7, VII-2, VIII-compact disk

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9. Remarks

Revision History

10. Revision No.	11. Description of Revision
00	Initial issue.
01	Revisions have been made regarding the following three items: <ol style="list-style-type: none">1. For the Savannah River Site, the radionuclide inventory of the design-basis glass is used to represent the inventory for the site.2. The quantities of uranium and thorium for the Hanford Site, Savannah River Site, and West Vally are revised.3. The starting year for the thermal output and radiation sources is moved from 2015 to 2010. Changes in the text are marked by change bars on the left margin.

CONTENTS

	Page
1. PURPOSE	4
2. METHOD	4
3. ASSUMPTIONS	5
4. USE OF COMPUTER SOFTWARE AND MODELS	6
4.1 SOFTWARE	6
4.2 SOFTWARE ROUTINES	7
4.3 MODELS	7
5. CALCULATION	7
5.1 HLW OF HANFORD SITE	8
5.2 HLW OF SAVANNAH RIVER SITE	12
5.3 HLW OF WEST VALLEY DEMONSTRATION PROJECT	13
5.4 HLW OF IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY	15
5.5 PHYSICAL PARAMETERS OF HLW GLASS	18
5.6 HLW GLASS WITH IMMOBILIZED PLUTONIUM	19
6. RESULTS	20
6.1 RADIONUCLIDE INVENTORY	21
6.2 RADIATION PRODUCTION RATES	25
6.3 DECAY HEAT GENERATION	26
7. REFERENCES	27
8. ATTACHMENTS	30

TABLES

	Page
5-1. Chemical Compositions in wt% of HLW Canisters	8
5-2. Chemical Compositions by Mass (kg) of HLW Canisters	9
5-3. Elemental Compositions by Mass (kg) of HLW Canisters	10
5-4. Radionuclide Inventory of Hanford HLW Glass	11
5-5. Radionuclide Inventory of SRS HLW Glass	12
5-6. Radionuclide Inventory of WVDP HLW Glass	13
5-7. Physical Characteristics of HLW at INEEL	16
5-8. Radionuclide Inventory of INTEC HLW Glass	16
5-9. Radionuclide Inventory of ANL-W HLW Ceramic Matrix	17
5-10. Radionuclide Inventory of ANL-W HLW Metal Matrix	17
5-11. Physical Parameters of HLW Glass Canisters	18
5-12. Average Total Radioactivity of Immobilized Waste in a CIC Canister at 2010	19
5-13. Average Total Radionuclide Inventory of Waste Forms in a CIC Canister at 2010	19
6-1. Average Radionuclide Inventory (Ci) per Short Canister at 2040	21
6-2. Average Radionuclide Inventory per Long Canister at 2040	23
6-3. Average Radionuclide Inventory per CIC Canister at 2040	24
6-4. Calendar Years of the 181 Time Steps for Radiation Sources and Decay Heat	25
8-1. List of Attachments	30
8-2. ORIGEN-S Output Files	30

1. PURPOSE

This calculation is prepared by the Monitored Geologic Repository (MGR) Waste Package Design Section. The objective of this calculation is to determine the source terms that include radionuclide inventory, decay heat, and radiation sources due to gamma rays and neutrons for the high-level radioactive waste (HLW) from the West Valley Demonstration Project (WVDP), Savannah River Site (SRS), Hanford Site (HS), and Idaho National Engineering and Environmental Laboratory (INEEL). This calculation also determines the source terms of the canister containing the SRS HLW glass and immobilized plutonium. The scope of this calculation is limited to source terms for a time period out to one million years.

The results of this calculation may be used to carry out performance assessment of the potential repository and to evaluate radiation environments surrounding the waste packages (WPs). This calculation was performed in accordance with the Development Plan *Source Terms for HLW Glass Canisters* (Ref. 7.24). AP-3.12Q, Revision 0, ICN 2, *Calculations*, was used to perform the calculation and develop the document (Ref. 7.21).

2. METHOD

HLW is the highly radioactive material resulting from the reprocessing of spent nuclear fuel. The U.S. Department of Energy (DOE) stores its HLW at the HS, SRS, and INEEL. The commercially generated HLW is stored at the WVDP in New York state. The HLWs from all four sites are destined for disposal in the potential MGR at Yucca Mountain. Before being shipped to Yucca Mountain, the HLW at the HS, SRS, and WVDP will be vitrified into borosilicate glass contained in stainless steel canisters, whereas the HLW at the INEEL will be processed into glass, ceramic matrix, and metal matrix and placed in stainless steel canisters. For the surplus plutonium from the defense program, the plutonium will be immobilized in a ceramic and stored in a SRS HLW glass canister. Therefore, this calculation evaluates a total of seven waste forms, including four borosilicate glass forms, a ceramic matrix, a metal matrix, and immobilized plutonium in borosilicate glass.

The source terms of the HLW are calculated using the ORIGEN-S program of the SCALE 4.3 computer code system (Ref. 7.3). For each HLW form, the initial isotopic concentration and the chemical composition are input and decayed out to one million years in an ORIGEN-S calculation. The source terms computed by ORIGEN-S include the isotopic concentrations, the gamma and neutron production rates, and the decay heat (thermal energy) generated by the radioactive material. The time period for which the source terms are calculated extends from the year 2,010 to approximately the year 1,000,000.

All electronic codes and data will be stored on unrewritable compact disk(s), and the management of the data will be controlled in accordance with AP-3.12Q, Revision 0, ICN 2, *Calculations* (Ref. 7.21), AP-6.1Q, *Controlled Documents* (Ref. 7.22), and AP-17.1Q, *Record Source Responsibilities*

for *Inclusionary Records* (Ref. 7.25). These work processes and procedures have been evaluated and found to satisfy the requirements of AP-SV.1Q, *Control of the Electronic Management of Data* (Ref. 7.23); the evaluation is provided in Ref. 7.20.

3. ASSUMPTIONS

- 3.1 For each HLW form in the canister, the ORIGEN-S decay calculation is carried out by blending the radionuclide activities in curies with the total mass of the HLW. It is assumed that the extra mass due to the radionuclides is part of the HLW and not subtracted from the mixture. The basis for this assumption is that the actual mass of the HLW has no effect on the radioactivity of the waste form as it decays. However, the extra mass will lead to higher (more conservative) neutron production rates from alpha particles reacting with light elements such as boron, oxygen, silicon, fluorine, etc. (Ref. 7.4, pp. F7.2.22-26). This assumption is used in Section 5.
- 3.2 The HLW chemical compositions for the HS, SRS, and WVDP have an item, identified as "other," to include components of generally less than 0.1 weight percent (wt%). It is assumed that these items are negligible and the compositions of each individual HLW are renormalized to 100%. The basis for this assumption is the same as that in the previous assumption. This assumption is used in Section 5.
- 3.3 It is assumed that the HLW at the HS includes the strontium and cesium capsules currently stored in water basins and the liquid high-level radioactive waste stored in underground carbon-steel tanks, and that the two wastes would be blended and vitrified into borosilicate glass. The basis for this assumption is that only these two wastes have been declared to be the candidate HLW at the HS (Ref. 7.8, Table RL-1, p. 6). This assumption is used in Section 5.1.
- 3.4 It is assumed that for each HLW form, the average radionuclide inventory of a canister is equal to the total inventory of the waste form divided by the projected number of canisters. The basis for this assumption is that the average inventory provides a representative pour canister for each HLW form. This assumption is used in Section 5.
- 3.5 The radionuclide inventory for the SRS HLW glass canister is based on the SRS design-basis HLW glass. It is assumed that the time of production of the HLW glass is the year 2010. The basis for this assumption is that the SRS HLW glass canisters must be produced and available for storage in the potential repository by 2010. For the SRS HLW glass canisters that are produced before this year, the inventory at year 2010 represents the bounding value. This assumption is used in Section 5.2.
- 3.6 For the canister containing SRS HLW glass and immobilized plutonium, it is assumed that the immobilized plutonium does not displace any HLW glass in the SRS HLW glass canister, and that the immobilized plutonium is homogeneously mixed with the HLW glass constituents. The basis for this assumption is that conservative (higher) decay heat rates are

obtained because the homogenization process increases the (α, n) reaction rates in the light elements of the HLW glass. Also, similar to Assumption 3.1, the extra HLW glass mass will further increase these reaction rates. This assumption is used in Section 5.6.

- 3.7 For the canister containing SRS HLW glass and immobilized plutonium, the isotopic concentrations for Th-232 and U-234 are given as less than certain values. In this calculation, the concentrations of these two isotopes are assumed to be their respective maximum values. The basis for this assumption is that this will yield higher (more conservative) radionuclide inventory for the canister. This assumption is used in Section 5.6.
- 3.8 For the chemical compositions of the SRS HLW glass canister and the WVDP HLW glass canister, manganese dioxide (MnO_2) is assumed for manganese oxide (MnO). The basis for this assumption is that the actual mass of the HLW has no effect on the radioactivity of the waste form as it decays. However, the extra oxygen atom will lead to higher (more conservative) neutron production rates from alpha particles reacting with light elements. This assumption is used in Section 5.
- 3.9 The masses of the HLW in the Argonne National Laboratory-West (ANL-W) ceramic and metal canisters are assumed to be 1,500 and 4,850 kg, respectively. The basis of this assumption is the same as that of Assumption 3.1. This assumption is used in Sections 5.4 and 5.5.
- 3.10 The chemical compositions for the HS, SRS, and WVDP HLW glass canisters contain uranium and thorium elements (Table 5-3). It is assumed that these two elements do not exist in the chemical composition of the HLW glass canisters. The basis of this assumption is that uranium and thorium are reported in the radionuclide inventory. Since the ORIGEN-S input for this calculation combines the radionuclide inventory and chemical composition of the glass (Assumption 3.1), including these two elements in the chemical composition would doubly define their quantities. This assumption is use in Section 5.

4. USE OF COMPUTER SOFTWARE AND MODELS

4.1 SOFTWARE

The ORIGEN-S program of the SCALE 4.3 computer code system is used to decay the isotopic concentrations of the individual waste forms in both the total quantity and in a single canister.

- Program Name: SCALE
- Version/Revision number: 4.3 Hewlett Packard (HP) 9000 Version
- Computer Software Configuration Item (CSCI) Number: 30011 V4.3 (Ref. 7.3)
- Computer Type: HP 9000/700 Series workstation
- This software was previously obtained from Software Control Management (SCM) in accordance with appropriate procedures
- Computer Processing Unit Name and Civilian Radioactive Waste Management System

(CRWMS) Management and Operating (M&O) Contractor Tag Number: 'Bloom,' CRWMS-M&O Tag 700887.

The SCALE 4.3 computer code system performs criticality, shielding, and nuclear fuel depletion and decay calculations. The software qualification of the SCALE 4.3 software, including benchmark problems related to generation of the isotopic content of spent nuclear fuel (SNF), is summarized in the Software Qualification Report for the SCALE Modular Code System Version 4.3 (Ref. 7.3). The software is used within the range of validation as described in the qualification document.

The ORIGEN-S program may be used in an independent mode to perform nuclear fuel depletion and decay calculations. The validation test cases for the ORIGEN-S code include isotopic calculation for pressurized water reactor SNFs that contain isotopic compositions encompassing those in HLW. Since this calculation is concerned with the decay of the isotopic concentration in HLW, ORIGEN-S is an appropriate tool for this task.

The input file for each computer calculation is echoed in the output file of the calculation. The output files are described in Section 7.

4.2 SOFTWARE ROUTINES

Microsoft Excel 97, loaded on Personal Computer using INTEL processor, has been employed. Simple numeric calculations, as documented in Section 5, and data reduction and calculations of ORIGEN-S outputs were performed electronically with this spreadsheet software package. The user-defined formulas, input, and results are documented in sufficient detail in Sections 5 and 6 to allow independent repetition of the calculations.

4.3 MODELS

No models are used in this calculation.

5. CALCULATION

Source terms for HLW canisters have previously been determined (Ref. 7.6 and Ref. 7.7). The previous calculations used the chemical composition of the SRS HLW glass to represent those of the other sites. This calculation uses the chemical compositions and the radionuclide inventories of the individual HLW forms from two data sources. The sources are (1) the responses to repository Environmental Impact Statement (EIS) data call for HLW provided to DOE by the individual sites (Ref. 7.8 to Ref. 7.18), and (2) the latest revision of the Integrated Data Base (Ref. 7.2). The following subsections present the detailed description of the characteristics of each HLW form.

Each ORIGEN-S decay calculation was carried out by blending the radionuclides (curies) with the total mass of the HLW, resulting in a mixture with extra mass due to the radionuclides. As discussed in Assumption 3.1, the actual mass of the HLW has no effect on the decay of the radionuclides. However, the extra mass will result in higher (more conservative) neutron production rates from

alpha particles.

The number of digits in the values cited herein may be the result of a calculation or may reflect the input from another source; consequently, the number of digits should not be interpreted as an indication of accuracy.

5.1 HLW OF HANFORD SITE

The HLW at the HS consists of the liquid high-level radioactive waste stored in underground carbon-steel tanks and the strontium and cesium capsules stored in water basins. As indicated in Assumption 3.3, the two wastes would be vitrified into borosilicate glass. The estimate volume of borosilicate glass will be 15,700 cubic meters, and the corresponding estimated mass will be 44,000 metric tons. This volume of glass would require 14,500 canisters, nominally 4.5 meters (15 feet) long with a 0.61-meter (2-foot) diameter (Ref. 7.1, p. A-36). The estimated mass of the HLW in each canister is 3,040 kg (Ref. 7.1, p. A-45). Tables 5-1 and 5-2 provide the chemical compositions, respectively in terms of wt% and masses of the individual compounds, of the HLW in a Hanford canister and in canisters of other HLW forms. Table 5-3 gives the corresponding masses of the elements. The uranium and thorium elements in Table 5-3 are part of the radionuclide inventory, and, hence, in the ORIGEN-S input they are accounted for in the radionuclide input and excluded from the HLW glass mass input (Assumption 3.10). Finally, Table 5-4 presents the radionuclide inventory of the Hanford HLW glass canister.

Table 5-1. Chemical Compositions in wt% of HLW Canisters

Compound	Hanford ^a	SRS ^b	WVDP ^c	INTEC ^d	Ceramic ^e
Al ₂ O ₃	9.31	3.97	6	7.35	1.7
B ₂ O ₃	7.02	7.98	12.89	11.30	4.75
BaSO ₄	0.00	0.27	0.16	--	--
Bi ₂ O ₃	1.15	--	--	--	--
CaF ₂	--	--	--	7.99	--
CaO	0.83	0.96	0.48	0.23	--
CaSO ₄	--	0.08	--	--	--
Ce ₂ O ₃	1.13	--	0.31	--	--
Cr ₂ O ₃	0.36	0.12	0.14	--	--
Cs ₂ O	--	0.12	--	0.02	--
CuO	--	0.44	--	--	--
Fe ₂ O ₃	4.49	10.37	12.02	0.05	--
K ₂ O	0.17	3.85	5	--	0.1
La ₂ O ₃	0.11	--	--	--	--
Li ₂ O	2.01	4.38	3.71	--	--
MgO	--	1.35	0.89	--	--
MnO ₂	1.17	2.02	0.82	--	--
NaF	0.63	--	--	--	--
Na ₂ O	11.79	8.7	8	13.92	1.8
Na ₂ SO ₄	0.10	0.1	--	--	--
NaCl	--	0.19	--	--	0.6825
NiO	1.08	0.88	0.25	--	--
P ₂ O ₅	1.56	--	1.2	0.06	--
PbO ₂	0.14	--	--	--	--
SiO ₂	46.11	50.01	40.98	56.68	16.65
SrO	0.18	--	0.02	--	--

Compound	Hanford ^a	SRS ^b	WVDP ^c	INTEC ^d	Ceramic ^e
ThO ₂	0.01	0.19	3.56	--	--
TiO ₂	--	0.89	0.8	--	--
UO ₃	6.69	--	0.63	--	--
U ₃ O ₈	--	2.13	--	0.96	--
ZrO ₂	3.79	--	1.32	--	--
Nd ₂ O ₃	--	--	0.14	--	--
RuO ₂	--	--	0.08	--	--
ZnO	--	--	0.02	--	--
AMP ^f	--	--	--	1.44	--
LiCl-KCl	--	--	--	--	9.645
RbCl	--	--	--	--	0.015
SrCl ₂	--	--	--	--	0.0485
CsCl	--	--	--	--	0.1135
BaCl ₂	--	--	--	--	0.051
LaCl ₃	--	--	--	--	0.055
CeCl ₃	--	--	--	--	0.1025
PrCl ₃	--	--	--	--	0.051
NdCl ₃	--	--	--	--	0.171
SmCl ₃	--	--	--	--	0.0275
YCl ₃	--	--	--	--	0.0305
Zeolite ^g	--	--	--	--	64
Other	0.17	1	0.58	--	0.007
Total	100.00	100.00	100.00	100.00	100.00

^a Ref. 7.8, p. 7^b Based on the Design-Basis glass (Blend) in Table 1 (Ref. 7.12)^c Ref. 7.13, WQR-1.1, p. 7^d Idaho Nuclear Technology and Engineering Center (Ref. 7.8, p. 12; Ref. 7.16)^e Ref. 7.14, pp. 6-7^f AMP = ammoniummolybdophosphate, (NH₄)₃(PMo₁₂O₄₀)^g The chemical formula for Zeolite is: Na₁₂[(AlO₂)₁₂(SiO₂)₁₂]

Table 5-2. Chemical Compositions by Mass (kg) of HLW Canisters

Compound	Hanford	SRS	WVDP	INTEC	Ceramic
Al ₂ O ₃	283.02	79.4	120	114.67	25.5
B ₂ O ₃	213.41	159.6	257.8	176.26	71.25
BaSO ₄	0.00	5.4	3.2	--	--
Bi ₂ O ₃	34.96	--	--	--	--
CaF ₂	--	--	--	124.72	--
CaO	25.23	19.2	9.6	3.54	--
CaSO ₄	--	1.6	--	--	--
Ce ₂ O ₃	34.35	--	6.2	--	--
Cr ₂ O ₃	10.94	2.4	2.8	--	--
Cs ₂ O	--	2.4	--	0.24	--
CuO	--	8.8	--	--	--
Fe ₂ O ₃	136.50	207.4	240.4	0.72	--
K ₂ O	5.17	77	100	--	1.5
La ₂ O ₃	3.34	--	--	--	--
Li ₂ O	61.10	87.6	74.2	--	--
MgO	--	27	17.8	--	--
MnO ₂	35.57	40.4	16.4	--	--
NaF	19.15	--	--	--	--
Na ₂ O	358.42	174	160	217.19	27
Na ₂ SO ₄	3.04	2	--	--	--
NaCl	--	3.8	--	--	10.2375

Compound	Hanford	SRS	WVDP	INTEC	Ceramic
NiO	32.83	17.6	5	--	--
P ₂ O ₅	47.42	--	24	0.88	--
PbO ₂	4.26	--	--	--	--
SiO ₂	1401.74	1000.2	819.6	884.21	249.75
SrO	5.47	--	0.4	--	--
ThO ₂	0.30	3.8	71.2	--	--
TiO ₂	--	17.8	16	--	--
UO ₃	203.38	--	12.6	--	--
U ₃ O ₈	--	42.6	--	15.04	--
ZrO ₂	115.22	--	26.4	--	--
Nd ₂ O ₃	--	--	2.8	--	--
RuO ₂	--	--	1.6	--	--
ZnO	--	--	0.4	--	--
AMP	--	--	--	22.52	--
LiCl-KCl	--	--	--	--	144.675
RbCl	--	--	--	--	0.225
SrCl ₂	--	--	--	--	0.7275
CsCl	--	--	--	--	1.7025
BaCl ₂	--	--	--	--	0.765
LaCl ₃	--	--	--	--	0.825
CeCl ₃	--	--	--	--	1.5375
PrCl ₃	--	--	--	--	0.765
NdCl ₃	--	--	--	--	2.565
SmCl ₃	--	--	--	--	0.4125
YCl ₃	--	--	--	--	0.4575
Zeolite	--	--	--	--	960
Other	5.17	20	11.6	--	0.105
Total	3040.00	2000.00	2000.00	1560.00	1500

Table 5-3. Elemental Compositions by Mass (kg) of HLW Canisters

Element	Hanford	SRS	WVDP	INTEC	Ceramic	Metal
O	1329.784	911.1312	903.7293	715.7972	633.8986	--
Al	150.0457	42.44698	63.88059	60.68814	195.8501	--
B	66.38692	50.06458	80.5271	54.73893	22.12831	--
Ba	--	3.209565	2.882811	--	0.504547	--
Bi	31.41219	--	--	--	--	--
Ca	18.06404	14.33668	6.901156	66.55235	--	--
Ce	29.37866	--	5.324256	--	0.874109	--
Cl	--	2.32847	--	--	97.80555	--
Cr	7.500658	1.658672	1.926942	--	--	857.5143
Cs	--	2.286609	--	0.227541	1.344081	--
Cu	--	7.101018	--	--	--	--
F	8.680469	--	--	60.69595	--	--
Fe	95.63239	146.5277	169.1246	0.506188	--	2345.554
K	4.297509	64.56705	83.49907	--	49.61786	--
La	2.856218	--	--	--	0.467271	--
Li	28.43542	41.1074	34.67219	--	8.587429	--
Mg	--	16.44643	10.79666	--	--	--
Mn	22.51477	25.78786	10.42412	--	--	100.884
Na	277.8363	132.551	119.3897	161.1269	179.4341	--
Ni	25.84385	13.97007	3.952003	--	--	605.3042
P	20.73206	--	10.5352	0.757704	--	2.017681
Pb	3.692932	--	--	--	--	--
S	0.687344	1.585873	--	--	--	1.513261

Element	Hanford	SRS	WVDP	INTEC	Ceramic	Metal
Si	656.3399	472.2509	385.3447	413.3127	306.5644	50.44202
Sr	4.634973	--	0.340211	--	0.40213	--
Th ^a	0.267613	3.373208	62.93626	--	--	--
Ti	--	10.77904	9.648093	--	--	--
U ^a	169.5357	36.48976	10.54677	--	--	--
Zr	85.4407	--	19.65818	11.13211	--	756.6303
Nd	--	--	2.414588	--	1.476468	--
Ru	--	--	1.222341	--	--	--
Zn	--	--	0.323234	--	--	--
H	--	--	--	0.145133	--	--
N	--	--	--	0.504226	--	--
Mo	--	--	--	13.81495	--	126.105
Pr	--	--	--	--	0.435974	--
Rb	--	--	--	--	0.159043	--
Sm	--	--	--	--	0.241644	--
Y	--	--	--	--	0.208319	--
C	--	--	--	--	--	4.035361
Total	3040	2000	2000	1560	1500	4850

^aUranium and thorium are already included in the radionuclide inventory and, hence, are excluded from the HLW glass compositions (Assumption 3.10)

Table 5-4. Radionuclide Inventory of Hanford HLW Glass

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	Total Activity ^a (Ci)	Average Activity per Canister ^b (Ci)
C-14	60140	5730	9.62E-02 ^d	6.63E-06
Co-60	270600	5.3	1.23E+04	8.48E-01
Ni-59	280590	7.60E+04	9.34E+02	6.44E-02
Ni-63	280630	100	9.20E+04	6.34E+00
Se-79	340790	6.50E+04	7.73E+02	5.33E-02
Sr-90	380900	29.1	9.73E+07 ^d	6.71E+03
Zr-93	400930	1.50E+06	3.63E+03	2.50E-01
Nb-93m	410931	16.1	2.69E+03	1.86E-01
Tc-99	430990	2.10E+05	3.26E+04	2.25E+00
Ru-106	441060	1.02	1.04E+05	7.17E+00
Cd-113m	481131	14.1	1.69E+04	1.17E+00
Sn-126	501260	1.00E+05	1.19E+03	8.21E-02
Sb-125	511250	2.8	2.08E+05	1.43E+01
I-129	531290	1.60E+07	3.20E+01 ^e	2.21E-03
Cs-134	551340	2.1	8.89E+04	6.13E+00
Cs-137	551370	30.2	1.12E+08 ^d	7.72E+03
Sm-151	621510	90	2.75E+06	1.90E+02
Eu-152	631520	13.5	1.48E+03	1.02E-01
Eu-154	631540	8.6	1.47E+05	1.01E+01
Eu-155	631550	4.7	1.36E+05	9.38E+00
Ra-226	882260	1.60E+03	6.31E-02	4.35E-06
Ra-228	882280	5.8	7.71E+01	5.32E-03
Ac-227	892270	21.8	8.76E+01	6.04E-03
Th-229	902290	7.30E+03	1.81E+00	1.25E-04
Th-232	902320	1.40E+10	2.11E+00	1.46E-04
Pa-231	912310	3.30E+04	1.56E+02	1.08E-02
U-232	922320	70	1.23E+02	8.48E-03
U-233	922330	1.60E+05	4.76E+02	3.28E-02
U-234	922340	2.50E+05	3.46E+02	2.39E-02

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	Total Activity ^a (Ci)	Average Activity per Canister ^b (Ci)
U-235	922350	7.00E+08	1.45E+01	1.00E-03
U-236	922360	2.30E+07	9.57E+00	6.60E-04
U-238	922380	4.50E+09	3.22E+02	2.22E-02
Np-237	932370	2.10E+06	1.41E+02	9.72E-03
Pu-238	942380	87.7	2.77E+03	1.91E-01
Pu-239	942390	2.40E+04	3.91E+04	2.70E+00
Pu-240	942400	6.60E+03	8.93E+03	6.16E-01
Pu-241	942410	14.4	2.29E+05	1.58E+01
Pu-242	942420	3.80E+05	1.16E+00	8.00E-05
Am-241	952410	432.7	6.99E+04	4.82E+00
Am-243	952430	7.40E+03	9.34E+00	6.44E-04
Cm-242	962420	0.45	7.70E+01	5.31E-03
Cm-243	962430	29.1	1.00E+01	6.90E-04
Cm-244	962440	18.1	2.42E+02	1.67E-02
Total	--	--	2.13E+08	1.47E+04

^a As of January 1, 1994 (Ref. 7.1, p. A-38; Ref. 7.18, pp. 8-10)

^b Total activity divided by 14,500, the number of canisters (Ref. 7.1, p. A-36)

^c Ref. 7.5

^d Ref. 7.8, p. 6

^e Ref. 7.9, p. 3

5.2 HLW OF SAVANNAH RIVER SITE

The SRS HLW consists of wastes generated from the treatment of irradiated nuclear fuels. The Defense Waste Processing Facility at SRS mixes the HLW with glass-forming materials, converts it to a durable borosilicate glass waste form, and pours it into stainless steel canisters. An estimated 5,978 HLW glass canisters (Ref. 7.1, p. A-38) would be generated at SRS. Each canister has a nominal outside diameter of 0.61 meter (2 feet) and a nominal height of 3 meters (10 feet). The estimated total HLW glass volume and mass are 4,240 cubic meters and 11,600 metric tons, respectively (Ref. 7.1, p. A-36). The estimated mass of each HLW glass canister is 2,000 kg (Ref. 7.11; Ref. 7.1, p. A-45). The chemical composition and the corresponding elemental mass of the SRS HLW glass canister are presented in Tables 5-1 through 5-3. The radionuclide inventory of the design-basis SRS HLW glass canister (Ref. 7.10, Appendix 4, p. 4) was assumed to be produced at year 2010 (Assumption 3.5). The radionuclide inventory is presented in Table 5-5 and is used in this calculation.

Table 5-5. Radionuclide Inventory of SRS HLW Glass

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	Total Activity ^b (Ci)	Activity per Canister ^a (Ci)
Co-60	270600	5.3	1.02E+06	1.70E+02
Ni-59	280590	7.60E+04	1.43E+02	2.39E-02
Ni-63	280630	100	1.78E+04	2.97E+00
Se-79	340790	6.50E+04	1.02E+03	1.70E-01
Sr-90	380900	29.1	2.88E+08	4.82E+04
Y-90	390900	2.67 days	2.85E+08	4.77E+04
Zr-93	400930	1.50E+06	6.70E+03	1.12E+00
Tc-99	430990	2.10E+05	1.84E+04	3.07E+00
Ru-106	441060	1.02	1.34E+07	2.24E+03

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	Total Activity ^b (Ci)	Activity per Canister ^a (Ci)
Rh-106	451060	2.18 hours	1.35E+07	2.25E+03
Pd-107	461070	6.50E+06	8.79E+01	1.47E-02
Sn-126	501260	1.00E+05	2.62E+03	4.38E-01
Sb-125	511250	2.8	5.14E+06	8.60E+02
Cs-134	551340	2.1	2.01E+06	3.36E+02
Cs-135	551350	2.30E+06	5.93E+02	9.92E-02
Cs-137	551370	30.2	2.59E+08	4.33E+04
Ba-137m	561371	2.55 minutes	2.47E+08	4.14E+04
Ce-144	581440	284.6 days	5.88E+07	9.84E+03
Pr-144	591440	17.3 minutes	5.89E+07	9.85E+03
Pm-147	611470	2.6	1.44E+08	2.41E+04
Sm-151	621510	90	1.43E+06	2.39E+02
Eu-154	631540	8.6	3.71E+06	6.20E+02
Eu-155	631550	4.7	2.94E+06	4.91E+02
Np-237	932370	2.10E+06	5.30E+01	8.86E-03
U-234	922340	2.50E+05	2.04E+02	3.42E-02
U-238	922380	4.50E+09	6.28E+01	1.05E-02
Pu-238	942380	87.7	8.85E+06	1.48E+03
Pu-239	942390	2.40E+04	7.71E+04	1.29E+01
Pu-240	942400	6.60E+03	5.18E+04	8.67E+00
Pu-241	942410	14.4	9.92E+06	1.66E+03
Pu-242	942420	3.80E+05	7.29E+01	1.22E-02
Am-241	952410	432.7	6.58E+04	1.10E+01
Am-243	952440	7.40E+03	3.46E+01	5.79E-03
Cm-244	962440	18.1	6.40E+05	1.07E+02
Total	--	--	1.40E+09	2.35E+05

^a Design-basis glass at year of production 2,010 (Ref. 7.10, Appendix 4, p. 4)

^b Total number of canisters is 5,978 (Ref. 7.1, p. A-38)

^c Ref. 7.5

5.3 HLW OF WEST VALLEY DEMONSTRATION PROJECT

The HLW that is produced at the WVDP comes from the commercial spent nuclear fuel reprocessing plant operated by Nuclear Fuel Services. The HLW that has been converted into borosilicate glass is stored in the converted Chemical Process Cell in the Process Building. A total number between 260 and 300 HLW glass canisters will be generated at WVDP. Each canister has a nominal outside diameter of 0.61 meter (2 feet) and a nominal height of 3 meters (10 feet). The estimated total HLW glass volume is 200 cubic meters, and the estimated total mass is between 540 and 630 metric tons (Ref. 7.1, p. A-37 ; Ref. 7.17, p. 3). The estimated mass of HLW glass in each canister is 2,000 kg (Ref. 7.1, p. A-45). The radionuclide inventory of the WVDP HLW glass is presented in Table 5-6, and the chemical composition is given in Table 5-3.

Table 5-6. Radionuclide Inventory of WVDP HLW Glass

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	Total Activity ^a (Ci)	Activity Per Can ^b (Ci)
H-3	10030	12.3	5.87E+01	2.26E-01
C-14	60140	5730	1.37E+02	5.27E-01
Fe-55	260550	2.7	1.42E+02	5.46E-01
Co-60	270600	5.3	3.49E+02	1.34E+00

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	Total Activity ^a (Ci)	Activity Per Can ^b (Ci)
Ni-59	280590	7.60E+04	1.06E+02	4.08E-01
Ni-63	280630	100	8.17E+03	3.14E+01
Se-79	340790	6.50E+04	6.02E+01	2.32E-01
Sr-90	380900	29.1	5.81E+06	2.23E+04
Y-90	390900	2.67 days	5.81E+06	2.23E+04
Zr-93	400930	1.50E+06	2.72E+02	1.05E+00
Nb-93m	410931	16.1	2.07E+02	7.96E-01
Tc-99	430990	2.10E+05	1.70E+03	6.54E+00
Ru-106	441060	1.02	2.31E-01	8.88E-04
Rh-106	451060	2.18 hours	2.31E-01	8.88E-04
Pd-107	461070	6.50E+06	1.10E+01	4.23E-02
Cd-113m	481131	14.1	1.60E+03	6.15E+00
Sn-121m	501211	55	1.61E+01	6.19E-02
Sn-126	501260	1.00E+05	1.04E+02	4.00E-01
Sb-125	511250	2.8	1.62E+03	6.23E+00
Sb-126	511260	12.4 days	1.46E+01	5.62E-02
Sb-126m	511261	11 seconds	1.04E+02	4.00E-01
Te-125m	521251	58 days	3.97E+02	1.53E+00
I-129	531290	1.60E+07	2.10E-01	8.08E-04
Cs-134	551340	2.1	6.87E+02	2.64E+00
Cs-135	551350	2.30E+06	1.61E+02	6.19E-01
Cs-137	551370	30.2	6.29E+06	2.42E+04
Ba-137m	561371	2.55 minutes	5.95E+06	2.29E+04
Ce-144	581440	284.6 days	3.11E-03	1.20E-05
Pr-144	591440	17.3 minutes	3.11E-03	1.20E-05
Pm-146	611460	5.53	5.11E+00	1.97E-02
Pm-147	611470	2.6	1.80E+04	6.92E+01
Sm-151	621510	90	8.05E+04	3.10E+02
Eu-152	631520	13.5	2.69E+02	1.03E+00
Eu-154	631540	8.6	5.91E+04	2.27E+02
Eu-155	631550	4.7	1.03E+04	3.96E+01
Tl-207	812070	4.77 minutes	9.40E+00	3.62E-02
Tl-208	812080	3.05 minutes	3.09E+00	1.19E-02
Pb-211	822110	36.1 minutes	9.43E+00	3.63E-02
Pb-212	822120	10.64 hours	8.62E+00	3.32E-02
Bi-211	832110	2.14 minutes	9.43E+00	3.63E-02
Bi-212	832120	1.01 hours	8.62E+00	3.32E-02
Po-212	842120	45 seconds	5.52E+00	2.12E-02
Po-215	842150	1.78 milli-seconds	9.43E+00	3.63E-02
Po-216	842160	0.15 seconds	8.62E+00	3.32E-02
Rn-219	862190	3.96 seconds	9.43E+00	3.63E-02
Rn-220	862200	3.82 days	8.62E+00	3.32E-02
Fr-223	872230	21.8 minutes	1.30E-01	5.00E-04
Ra-223	882230	11.44 days	9.43E+00	3.63E-02
Ra-224	882240	3.44 days	8.62E+00	3.32E-02
Ra-228	882280	5.8	1.58E+00	6.08E-03
Ac-227	892270	21.8	9.43E+00	3.63E-02
Ac-228	892280	6.15 hours	1.58E+00	6.08E-03
Th-227	902270	18.72 days	9.30E+00	3.58E-02
Th-228	902280	1.9	8.62E+00	3.32E-02
Th-229	902290	7.30E+03	2.15E-01	8.27E-04
Th-230	902300	7.50E+04	5.87E-02	2.26E-04
Th-232	902320	1.40E+10	1.64E+00	6.31E-03
Pa-231	912310	3.30E+04	1.52E+01	5.85E-02
U-232	922320	70	6.87E+00	2.64E-02

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	Total Activity ^a (Ci)	Activity Per Can ^b (Ci)
U-233	922330	1.60E+05	9.53E+00	3.67E-02
U-234	922340	2.50E+05	4.61E+00	1.77E-02
U-235	922350	7.00E+08	1.01E-01	3.88E-04
U-236	922360	2.30E+07	2.96E-01	1.14E-03
U-238	922380	4.50E+09	8.54E-01	3.28E-03
Np-236	932360	1.60E+05	9.47E+00	3.64E-02
Np-237	932370	2.10E+06	2.35E+01	9.04E-02
Np-239	932390	2.36 days	3.47E+02	1.33E+00
Pu-236	942360	2.9	8.43E-01	3.24E-03
Pu-238	942380	87.7	8.04E+03	3.09E+01
Pu-239	942390	2.40E+04	1.65E+03	6.35E+00
Pu-240	942400	6.60E+03	1.22E+03	4.69E+00
Pu-241	942410	14.4	6.13E+04	2.36E+02
Pu-242	942420	3.80E+05	1.65E+00	6.35E-03
Am-241	952410	432.7	5.35E+04	2.06E+02
Am-242	952420	16.02 hours	2.87E+02	1.10E+00
Am-242m	952421	141	2.89E+02	1.11E+00
Am-243	952430	7.40E+03	3.47E+02	1.33E+00
Cm-242	962420	162.8 days	2.38E+02	9.15E-01
Cm-243	962430	29.1	1.16E+02	4.46E-01
Cm-244	962440	18.1	6.07E+03	2.33E+01
Cm-245	962450	8.50E+03	8.81E-01	3.39E-03
Cm-246	962460	4.76E+03	1.01E-01	3.88E-04
Total	--	--	2.42E+07	9.30E+04

^a Indexed to year 1996 (Ref. 7.13, WQR-1.2, p. AP-2-3)

^b Total number of canisters is 260 (Ref. 7.1, p. A-40)

^c Ref. 7.5

5.4 HLW OF IDAHO NATIONAL ENGINEERING AND ENVIRONMENTAL LABORATORY

INEEL has proposed three different HLW stream matrices for disposal—glass, ceramic, and metal. The glass matrix waste stream would come from the Idaho Nuclear Technology and Engineering Center (INTEC). The Argonne National Laboratory-West (ANL-W) would generate both the ceramic and the metallic HLW matrices. Table 5-7 lists the volumes, masses, estimated number of canisters, and mass per canister for the three HLW streams. The canisters have a nominal outside diameter of 0.61 meter (2 feet) and a nominal height of 3 meters (10 feet) (Ref. 7.1, p. A-37 and p. A-45).

Tables 5-1, 5-2, and 5-3 provide the chemical compositions for the three INEEL HLW streams. Tables 5-8, 5-9, and 5-10 contain the radionuclide inventories for the three INEEL HLW streams. For the INTEC HLW glass, the inventories are given for the year 2,035. For the ANL-W waste matrices, the inventories are presented for the year 2,000. For each waste stream, the total radionuclide inventory is provided, as is the worst-case value for activities in curies per canister.

Table 5-7. Physical Characteristics of HLW at INEEL^a

Physical Quantities	INTEC HLW Glass	ANL-W Ceramic	ANL-W Metal
Total Volume (m ³)	743.0	60.0	1.2
Total Mass (kg)	1,860,000	144,000 ^b	9,000
Number of Canisters	1,190	96 [80-125]	6 [2-10]
Mass per Canister (kg)	1,560	960-1,500	1,500-4,850

^a Ref. 7.1, p. A-37 and p. A-45^b Ref. 7.15

Table 5-8. Radionuclide Inventory of INTEC HLW Glass

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^d	Total Activity ^a (Ci)	Average Activity per Can ^b (Ci)	Bounding Activity per Can ^{a,c} (Ci)
H-3	10030	12.3	3.56E+03	2.99E+00	4.30E+00
C-14	60140	5730	2.78E-02	2.34E-05	8.26E-05
Co-60	270600	5.3	3.21E+01	2.70E-02	0.0
Sr-90	380900	29.1	7.04E+06	5.92E+03	1.16E+04
Y-90	390900	2.67 days	7.04E+06	5.92E+03	1.16E+04
Nb-93m	410931	16.1	4.74E+02	3.98E-01	1.43E+00
Nb-94	410940	2.00E+04	5.36E-03	4.50E-06	1.60E-05
Tc-99	430990	2.10E+05	3.41E+03	2.87E+00	9.92E+00
Rh-102	451020	2.9	1.99E-05	1.67E-08	7.71E-10
Sn-126	501260	1.00E+05	8.91E+01	7.49E-02	2.59E-01
Sb-125	511250	2.8	1.03E+00	8.66E-04	2.48E-05
I-129	531290	1.60E+07	5.64E+00	4.74E-03	1.65E-02
Cs-134	551340	2.1	3.28E-02	2.76E-05	1.71E-07
Cs-135	551350	2.30E+06	1.63E+02	1.37E-01	2.53E-01
Cs-137	551370	30.2	5.95E+06	5.00E+03	1.21E+04
Ba-137m	561371	2.55 minutes	5.60E+06	4.71E+03	1.16E+04
Pm-147	611470	2.6	2.67E+01	2.24E-02	4.68E-04
Eu-154	631540	8.6	5.98E+03	5.03E+00	1.93E+00
Eu-155	631550	4.7	7.55E+00	6.34E-03	3.75E-02
Ra-226	882260	1.60E+03	9.69E-03	8.14E-06	7.16E-05
Th-230	902300	7.50E+04	3.95E-01	3.32E-04	2.75E-03
Th-232	902320	1.40E+10	9.89E-08	8.31E-11	4.96E-10
U-232	922320	70	4.63E-03	3.89E-06	3.09E-06
U-233	922330	1.60E+05	1.33E-03	1.12E-06	6.06E-06
U-234	922340	2.50E+05	9.95E+01	8.36E-02	8.26E-02
U-235	922350	7.00E+08	5.90E-01	4.96E-04	5.51E-04
U-236	922360	2.30E+07	1.54E+00	1.29E-03	1.32E-03
U-238	922380	4.50E+09	2.94E-02	2.47E-05	3.20E-05
Np-237	932370	2.10E+06	6.26E+00	5.26E-03	2.75E-02
Pu-238	942380	87.7	8.98E+04	7.55E+01	8.81E+00
Pu-239	942390	2.40E+04	1.81E+03	1.52E+00	1.32E+00
Pu-240	942400	6.60E+03	1.57E+03	1.32E+00	5.29E-01
Pu-241	942410	14.4	1.93E+04	1.62E+01	1.87E+00
Pu-242	942420	3.80E+05	3.42E+00	2.87E-03	3.97E-05
Am-241	952410	432.7	1.27E+04	1.07E+01	2.97E+00
Am-243	952430	7.40E+03	1.39E-02	1.17E-05	1.05E-04
Cm-243	962430	29.1	4.70E-04	3.95E-07	3.36E-06
Cm-244	962440	18.1	1.03E-02	8.66E-06	7.71E-05
Total	--	--	2.58E+07	2.17E+04	4.69E+04

^a As of year 2,035 (Ref. 7.17, p. 9)^b The total activity divided by the number of canisters, 1,190^c This is the most active (worst-case) canister^d Ref. 7.5

Table 5-9. Radionuclide Inventory of ANL-W HLW Ceramic Matrix

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^d	Total Activity ^a (Ci)	Average Activity per Can ^b (Ci)	Bounding Activity per Can ^{a,c} (Ci)
Sr-90	380900	29.1	7.13E+05	7.43E+03	4.69E+04
I-129	531290	1.60E+07	3.38E-01	3.52E-03	1.75E-02
Cs-134	551340	2.1	7.90E+03	8.23E+01	5.06E+02
Cs-135	551350	2.30E+06	1.59E+01	1.66E-01	8.75E-01
Cs-137	551370	30.2	8.49E+05	8.84E+03	5.31E+04
Ce-144	581440	0.78	4.94E+04	5.15E+02	3.25E+03
Pm-147	611470	2.6	4.48E+05	4.67E+03	3.00E+04
Eu-154	631540	8.6	2.07E+03	2.16E+01	1.19E+02
Eu-155	631550	4.7	1.93E+04	2.01E+02	1.19E+03
Ra-226	882260	1.60E+03	2.99E-05	3.11E-07	2.06E-06
Th-230	902300	7.54E+04	4.65E-03	4.84E-05	8.89E-04
Th-232	902320	1.40E+10	2.31E-09	2.41E-11	1.31E-10
U-232	922320	70	2.63E-03	2.74E-05	1.75E-04
U-233	922330	1.60E+05	1.98E-04	2.06E-06	1.38E-05
U-234	922340	2.50E+05	2.76E+00	2.88E-02	1.94E-01
U-235	922350	7.00E+08	8.77E-02	9.14E-04	5.94E-03
U-236	922360	2.30E+07	6.34E-02	6.60E-04	4.19E-03
U-238	922380	4.50E+09	2.76E-01	2.88E-03	4.94E-03
Np-237	932370	2.10E+06	1.33E+00	1.39E-02	5.75E-02
Pu-238	942380	87.7	3.58E+02	3.73E+00	2.94E+01
Pu-239	942390	2.40E+04	1.68E+04	1.75E+02	8.13E+02
Pu-240	942400	6.60E+03	1.50E+03	1.56E+01	6.88E+01
Pu-241	942410	14.4	1.08E+04	1.13E+02	1.31E+03
Pu-242	942420	3.80E+05	1.23E-01	1.28E-03	2.31E-02
Am-241	952410	432.7	1.62E+03	1.69E+01	3.44E+01
Am-243	952430	7.40E+03	2.77E-01	2.89E-03	1.88E-02
Cm-243	962430	29.1	1.60E-01	1.67E-03	3.06E-03
Cm-244	962440	18.1	1.90E+00	1.98E-02	1.31E-01
Total	--	--	2.12E+06	2.21E+04	1.37E+05

^a As of year 2,000 (Ref. 7.14, pp. 3-5)^b The total activity divided by the number of canisters, 96^c This is the most active (worst-case) canister^d Ref. 7.5

Table 5-10. Radionuclide Inventory of ANL-W HLW Metal Matrix

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^d	Total Activity ^a (Ci)	Average Activity per Can ^b (Ci)	Bounding Activity per Can ^{a,c} (Ci)
C-14	60140	5730	4.29E+00	7.15E-01	4.29E+00
Co-60	270600	5.3	3.16E+03	5.27E+02	3.16E+03
Ni-59	280590	7.60E+04	1.07E+01	1.78E+00	1.07E+01
Ni-63	280630	100	4.12E+02	6.87E+01	3.94E+02
Nb-93m	410931	16.1	2.93E+01	4.88E+00	2.93E+01
Nb-94	410940	2.00E+04	2.73E+00	4.55E-01	2.73E+00

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^d	Total Activity ^a (Ci)	Average Activity per Can ^b (Ci)	Bounding Activity per Can ^{a,c} (Ci)
Tc-99	430990	2.10E+05	1.27E+02	2.12E+01	1.27E+02
Ru-106	441060	1.02	2.13E+04	3.55E+03	2.13E+04
Sn-126	501260	1.00E+05	2.81E+00	4.68E-01	2.13E+00
Sb-125	511250	2.8	1.38E+04	2.30E+03	1.38E+04
U-232	922320	70	1.21E-04	2.02E-05	1.19E-04
U-233	922330	1.60E+05	5.83E-05	9.72E-06	5.83E-05
U-234	922340	2.50E+05	7.68E-01	1.28E-01	7.68E-01
U-235	922350	7.00E+08	2.53E-02	4.22E-03	2.53E-02
U-236	922360	2.30E+07	1.82E-02	3.03E-03	1.82E-02
U-238	922380	4.50E+09	9.71E-02	1.62E-02	8.75E-02
Np-237	932370	2.10E+06	2.40E-05	4.00E-06	2.25E-05
Pu-238	942380	87.7	6.64E-03	1.11E-03	6.64E-03
Pu-239	942390	2.40E+04	3.32E-01	5.53E-02	3.22E-01
Pu-240	942400	6.60E+03	2.92E-02	4.87E-03	2.92E-02
Pu-241	942410	14.4	1.93E-01	3.22E-02	1.93E-01
Pu-242	942420	3.80E+05	2.02E-06	3.37E-07	2.02E-06
Am-241	952410	432.7	3.05E-02	5.08E-03	2.06E-02
Am-243	952430	7.40E+03	4.79E-06	7.98E-07	4.79E-06
Cm-243	962430	29.1	3.04E-06	5.07E-07	2.13E-06
Cm-244	962440	18.1	3.13E-05	5.22E-06	3.13E-05
Total	--	--	3.89E+04	6.48E+03	3.88E+04

^a As of year 2,000 (Ref. 7.14, pp. 3-5)^b The total activity divided by the number of canisters, 6^c This is the most active (worst-case) canister^d Ref. 7.5

5.5 PHYSICAL PARAMETERS OF HLW GLASS

Table 5-11 summarizes the estimated mass of HLW borosilicate glass and the number of HLW canisters for each site. The table also includes the mass of HLW per canister for each waste form. It is noted that the HS canister is 15 feet long, whereas the canisters from other sites are 10 feet long.

Table 5-11. Physical Parameters of HLW Glass Canisters^a

Site	Mass of HLW Glass		Number of Canisters		Mass/Canister (kg)
	Metric Tons	Percent	Number	Percent	
Hanford	44,000	75.545559	14,500	65.819337	3,040
SRS	11,600	19.916556	5,978	27.135724	2,000
WVDP	630	1.0816751	260	1.1802088	2,000
INEEL	2,013	3.4562093	1,292	5.8647299	1,560; 1,500; 4,850 ^b
Total	58,243	100	22,030	100	--

^a Ref. 7.1, pp. A-36-A-40; Table A-36^b These are mass/canister for INTEC HLW glass, ANL-W ceramic, and ANL-W metal, respectively

5.6 HLW GLASS WITH IMMOBILIZED PLUTONIUM

There are about 50 metric tons of plutonium in the surplus fissile material. Approximately 32 metric tons of this material are suitable for commercial reactor fuel as mixed oxide (MOX). The remaining 18.2 metric tons have been designated for direct disposal by immobilizing the plutonium in ceramic disks contained in steel cans that in turn are encapsulated in a SRS HLW glass canister. This is the can-in-canister (CIC) concept (Ref. 7.1, p. A-52). Each CIC canister will contain 28 plutonium-containing cans. The cans are held in seven columns by magazine assemblies, which, in turn, are held in place in the canister by a locking rack assembly. The total SRS HLW glass volume displaced by the cans, magazines, and rack is 12.1% (Ref. 7.19, p. 3; Ref. 7.1, p. A-53).

Table 5-12 presents the average total activity of the immobilized waste form in a CIC canister for the year 2,010. The total radioactivity of a CIC canister is calculated by subtracting 12.1% from the radioactivity of the SRS HLW canister and adding the radioactivity from Table 5-12 to the remaining SRS HLW canister.

Table 5-13 presents the radioactivity of all waste forms in a CIC canister. In the ORIGEN-S decay calculation for the CIC canister, the blending option was employed to mix the total radionuclide inventory given in Table 5-13 with the full SRS HLW glass (Assumption 3.6) to calculate the radiation and thermal source terms for the desired time steps.

Table 5-12. Average Total Radioactivity of Immobilized Waste in a CIC Canister at 2010^a

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^b	18.2-Ton Case (Ci)	50-Ton Case (Ci)
Pu-238	942380	87.7	115	56
Pu-239	942390	2.40E+04	1517	1555
Pu-240	942400	6.60E+03	517	404
Pu-241	942410	14.4	4452	2680
Pu-242	942420	3.80E+05	9.20E-02	4.30E-02
Am-241	952410	432.7	675	406
U-234	922340	2.50E+05	< 1.00E-05	< 5.00E-06
U-235	922350	7.00E+08	2.20E-03	1.00E-03
U-238	922380	4.50E+09	1.80E-02	1.80E-02
Th-232	902320	1.40E+10	< 3.00E-05	< 3.0E-05

^aRef. 7.19, p. 19

^bRef. 7.5

Table 5-13. Average Total Radionuclide Inventory of Waste Forms in a CIC Canister at 2010

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	SRS HLW (Ci) ^a	Immobilized Waste (Ci) ^b	Total (Ci)
Co-60	270600	5.3	1.49E+02	--	1.49E+02
Ni-59	280590	7.60E+04	2.10E-02	--	2.10E-02
Ni-63	280630	100	2.61E+00	--	2.61E+00
Se-79	340790	6.50E+04	1.49E-01	--	1.49E-01
Sr-90	380900	29.1	4.24E+04	--	4.24E+04
Y-90	390900	2.67 days	4.19E+04	--	4.19E+04
Zr-93	400930	1.50E+06	9.84E-01	--	9.84E-01
Tc-99	430990	2.10E+05	2.70E+00	--	2.70E+00

Radionuclide	ORIGEN-S ID No.	Half-Life (yr) ^c	SRS HLW (Ci) ^a	Immobilized Waste (Ci) ^b	Total (Ci)
Ru-106	441060	1.02	1.97E+03	--	1.97E+03
Rh-106	451060	2.18 hours	1.98E+03	--	1.98E+03
Pd-107	461070	6.50E+06	1.29E-02	--	1.29E-02
Sn-126	501260	1.00E+05	3.85E-01	--	3.85E-01
Sb-125	511250	2.8	7.56E+02	--	7.56E+02
Cs-134	551340	2.1	2.95E+02	--	2.95E+02
Cs-135	551350	2.30E+06	8.72E-02	--	8.72E-02
Cs-137	551370	30.2	3.81E+04	--	3.81E+04
Ba-137m	561371	2.55 minutes	3.64E+04	--	3.64E+04
Ce-144	581440	284.6 days	8.65E+03	--	8.65E+03
Pr-144	591440	17.3 minutes	8.66E+03	--	8.66E+03
Pm-147	611470	2.6	2.12E+04	--	2.12E+04
Sm-151	621510	90	2.10E+02	--	2.10E+02
Eu-154	631540	8.6	5.45E+02	--	5.45E+02
Eu-155	631550	4.7	4.32E+02	--	4.32E+02
Np-237	932370	2.10E+06	7.79E-03	--	7.79E-03
U-234	922340	2.50E+05	3.01E-02	1.00E-05	3.01E-02
U-238	922380	4.50E+09	9.23E-03	1.80E-02	2.72E-02
Pu-238	942380	87.7	1.30E+03	1.15E+02	1.42E+03
Pu-239	942390	2.40E+04	1.13E+01	1.52E+03	1.53E+03
Pu-240	942400	6.60E+03	7.62E+00	5.17E+02	5.25E+02
Pu-241	942410	14.4	1.46E+03	4.45E+03	5.91E+03
Pu-242	942420	3.80E+05	1.07E-02	9.20E-02	1.03E-01
Am-241	952410	432.7	9.67E+00	6.75E+02	6.85E+02
Am-243	952440	7.40E+03	5.09E-03	--	5.09E-03
Cm-244	962440	18.1	9.41E+01	--	9.41E+01
Th-232	902320	1.40E+10	--	3.00E-05	3.00E-05
U-235	922350	7.00E+08	--	2.20E-03	2.20E-03
Total	Total	--	2.06E+05	7.28E+03	2.14E+05

^a 87.9% of the average activity per canister of SRS HLW glass in Table 5-5

^b Obtained from the 18.2-ton case in Table 5-12

^c Ref. 7.5

6. RESULTS

This document may be affected by technical product input information that requires confirmation. Any changes to the document that may occur as a result of completing the confirmation activities will be reflected in subsequent revisions. The status of the input information quality may be confirmed by review of the Document Input Reference System database.

The source terms of the HLW have been calculated using the ORIGEN-S program of the SCALE 4.3 computer code system (Ref. 7.3). For each of the six HLW canisters from the four sites, the radionuclide inventory, the gamma and neutron production rates, and the decay heat were calculated. The total radionuclide inventory for each HLW form, as well as for the grand total, has been determined. The time period for which the source terms were determined extends from the year 2,010 to approximately the year 1,000,000. The results of the radionuclide inventory, the gamma and neutron production rates, and the decay heat are presented separately in the following subsections.

6.1 RADIONUCLIDE INVENTORY

The grand total radionuclide inventory from all four sites and the average inventory per canister for each waste form were calculated.

The average radionuclide inventory per canister for each of the six HLW forms and for the CIC immobilized plutonium waste were determined for the year 2,040. Table 6-1 presents the average inventory per canister for each of the five "short" (10-foot) HLW canisters, which are from the SRS, WVDP, and INEEL. Also given in the table are the average inventories per "short" HLW canister from all three sites and the bounding inventory per canister for each nuclide. The average inventory per "short" HLW canister was determined by dividing the sum of the total inventories from the SRS, WVDP, and INEEL by 7,530, which is the total number of "short" canisters (Table 5-11). Table 6-2 provides the average inventory for the "long" (15-foot) HLW canister. The 15-foot HLW canister is from the HS. Table 6-3 gives the average total radionuclide inventory of a CIC canister at 2,040.

The grand total radionuclide inventories of HLW from all four sites at calendar years 2,130; 2,230; 2,330; 2,430; 2,530; 3,030; 4,030; 5,030; 7,030; 10,030; 12,030; 22,030; 32,030; 102,030; 302,030; and 1,002,030 are presented in Attachment I. The total radionuclide inventories of HLW from SRS at the same calendar years are given in Attachment II. The SRS will produce the most concentrated average HLW canisters.

Table 6-1. Average Radionuclide Inventory (Ci) per Short Canister at 2040

Nuclide	SRS	WVDP	INEEL			Average (per Can)
			INTEC	Ceramic	Metal	
Ac-225	1.53E-09	9.66E-04	5.17E-10	1.15E-08	3.41E-08	3.34E-05
Ac-227	3.08E-11	5.30E-02	3.96E-09	3.37E-07	1.55E-06	1.83E-03
Ac-228	3.42E-15	6.31E-03	3.77E-11	2.50E-11	4.75E-12	2.18E-04
Am-241	5.14E+01	1.99E+02	1.07E+01	1.89E+01	5.64E-03	4.96E+01
Am-242	0.00E+00	8.90E-01	0.00E+00	0.00E+00	0.00E+00	3.07E-02
Am-242m	0.00E+00	8.94E-01	0.00E+00	0.00E+00	0.00E+00	3.09E-02
Am-243	5.77E-03	1.32E+00	1.17E-05	2.88E-03	7.95E-07	5.02E-02
At-217	1.53E-09	9.66E-04	5.17E-10	1.15E-08	3.41E-08	3.34E-05
Ba-137m	2.04E+04	8.27E+03	4.21E+03	3.31E+03	0.00E+00	1.72E+04
Bi-210	2.92E-08	1.97E-06	1.22E-06	6.04E-07	1.27E-07	2.92E-07
Bi-211	3.08E-11	5.30E-02	3.96E-09	3.37E-07	1.55E-06	1.83E-03
Bi-212	3.42E-15	2.50E-02	3.15E-06	1.89E-05	1.40E-05	8.64E-04
Bi-213	1.53E-09	9.65E-04	5.17E-10	1.15E-08	3.41E-08	3.33E-05
Bi-214	1.31E-07	4.34E-06	8.84E-06	1.23E-06	4.05E-07	1.67E-06
C-14	0.00E+00	5.24E-01	2.34E-05	0.00E+00	7.12E-01	1.87E-02
Cd-113m	0.00E+00	7.07E-01	0.00E+00	0.00E+00	0.00E+00	2.44E-02
Ce-142	0.00E+00	1.43E-05	0.00E+00	2.35E-06	0.00E+00	5.24E-07
Ce-144	2.61E-08	0.00E+00	0.00E+00	1.89E-13	0.00E+00	2.07E-08
Cm-242	0.00E+00	7.36E-01	0.00E+00	0.00E+00	0.00E+00	2.54E-02
Cm-243	0.00E+00	1.53E-01	3.50E-07	6.31E-04	1.92E-07	5.29E-03
Cm-244	3.39E+01	4.32E+00	7.15E-06	4.28E-03	1.13E-06	2.71E+01
Cm-245	0.00E+00	3.38E-03	0.00E+00	0.00E+00	0.00E+00	1.17E-04
Cm-246	0.00E+00	3.86E-04	0.00E+00	0.00E+00	0.00E+00	1.33E-05
Co-60	3.29E+00	4.11E-03	1.40E-02	0.00E+00	2.73E+00	2.62E+00
Cs-134	1.40E-02	9.94E-07	5.14E-06	1.19E-04	0.00E+00	1.11E-02
Cs-135	9.92E-02	6.19E-01	1.37E-01	1.66E-01	0.00E+00	1.24E-01

Nuclide	SRS	WVDP	INEEL			Average (per Can)
			INTEC	Ceramic	Metal	
Cs-137	2.16E+04	8.76E+03	4.45E+03	3.51E+03	0.00E+00	1.82E+04
Eu-152	0.00E+00	1.04E-01	0.00E+00	0.00E+00	0.00E+00	3.59E-03
Eu-154	5.51E+01	6.52E+00	3.36E+00	8.56E-01	0.00E+00	4.45E+01
Eu-155	5.77E+00	5.85E-02	3.02E-03	5.37E-01	0.00E+00	4.59E+00
Fe-55	0.00E+00	7.67E-06	0.00E+00	0.00E+00	0.00E+00	2.65E-07
Fr-221	1.53E-09	9.66E-04	5.17E-10	1.15E-08	3.41E-08	3.34E-05
Fr-223	4.25E-13	7.31E-04	5.47E-11	4.65E-09	2.14E-08	2.52E-05
Gd-152	0.00E+00	3.19E-14	0.00E+00	0.00E+00	0.00E+00	1.10E-15
H-3	0.00E+00	1.90E-02	2.26E+00	0.00E+00	0.00E+00	3.58E-01
I-129	0.00E+00	8.08E-04	4.74E-03	3.52E-03	0.00E+00	8.22E-04
K-40	5.54E-05	7.17E-05	0.00E+00	4.26E-05	0.00E+00	4.70E-05
La-138	0.00E+00	0.00E+00	0.00E+00	1.02E-08	0.00E+00	1.30E-10
Nb-93m	8.11E-01	1.01E+00	3.21E-01	0.00E+00	8.75E-01	7.30E-01
Nb-94	0.00E+00	0.00E+00	4.50E-06	0.00E+00	4.54E-01	3.62E-04
Nd-144	3.67E-12	6.81E-10	0.00E+00	4.16E-10	0.00E+00	3.17E-11
Ni-59	2.39E-02	4.08E-01	0.00E+00	0.00E+00	1.78E+00	3.45E-02
Ni-63	2.41E+00	2.32E+01	0.00E+00	0.00E+00	5.21E+01	2.76E+00
Np-236	0.00E+00	3.64E-02	0.00E+00	0.00E+00	0.00E+00	1.26E-03
Np-237	9.21E-03	9.33E-02	5.28E-03	1.41E-02	4.07E-06	1.15E-02
Np-238	0.00E+00	4.02E-03	0.00E+00	0.00E+00	0.00E+00	1.39E-04
Np-239	5.77E-03	1.32E+00	1.17E-05	2.88E-03	7.95E-07	5.02E-02
Pa-231	1.21E-10	5.84E-02	5.25E-08	7.76E-07	3.57E-06	2.02E-03
Pa-233	9.21E-03	9.33E-02	5.28E-03	1.41E-02	4.07E-06	1.15E-02
Pa-234	1.37E-05	4.26E-06	3.21E-08	3.74E-06	2.11E-05	1.11E-05
Pa-234m	1.05E-02	3.28E-03	2.47E-05	2.88E-03	1.62E-02	8.50E-03
Pb-209	1.53E-09	9.65E-04	5.17E-10	1.15E-08	3.41E-08	3.33E-05
Pb-210	2.92E-08	1.97E-06	1.22E-06	6.04E-07	1.27E-07	2.92E-07
Pb-211	3.08E-11	5.30E-02	3.96E-09	3.37E-07	1.55E-06	1.83E-03
Pb-212	3.42E-15	2.50E-02	3.15E-06	1.89E-05	1.40E-05	8.64E-04
Pb-214	1.31E-07	4.34E-06	8.84E-06	1.23E-06	4.05E-07	1.67E-06
Pd-107	1.47E-02	4.23E-02	0.00E+00	0.00E+00	0.00E+00	1.31E-02
Pm-146	0.00E+00	7.92E-05	0.00E+00	0.00E+00	0.00E+00	2.73E-06
Pm-147	8.70E+00	6.18E-04	5.98E-03	1.20E-01	0.00E+00	6.91E+00
Po-210	2.92E-08	1.97E-06	1.22E-06	6.04E-07	1.27E-07	2.92E-07
Po-211	8.48E-14	1.46E-04	1.09E-11	9.27E-10	4.27E-09	5.04E-06
Po-212	2.19E-15	1.60E-02	2.02E-06	1.21E-05	8.94E-06	5.53E-04
Po-213	1.50E-09	9.45E-04	5.06E-10	1.13E-08	3.34E-08	3.26E-05
Po-214	1.31E-07	4.34E-06	8.84E-06	1.23E-06	4.05E-07	1.67E-06
Po-215	3.08E-11	5.30E-02	3.96E-09	3.37E-07	1.55E-06	1.83E-03
Po-216	3.42E-15	2.50E-02	3.15E-06	1.89E-05	1.40E-05	8.64E-04
Po-218	1.31E-07	4.34E-06	8.85E-06	1.23E-06	4.06E-07	1.67E-06
Pr-144	2.61E-08	0.00E+00	0.00E+00	1.89E-13	0.00E+00	2.07E-08
Pr-144m	3.65E-10	0.00E+00	0.00E+00	2.65E-15	0.00E+00	2.90E-10
Pu-236	0.00E+00	3.24E-03	0.00E+00	0.00E+00	0.00E+00	1.12E-04
Pu-238	1.17E+03	2.21E+01	7.26E+01	2.72E+00	8.09E-04	9.41E+02
Pu-239	1.29E+01	6.34E+00	1.52E+00	1.75E+02	5.52E-02	1.29E+01
Pu-240	8.84E+00	4.72E+00	1.32E+00	1.55E+01	4.85E-03	7.59E+00
Pu-241	3.90E+02	2.82E+01	1.27E+01	1.64E+01	4.66E-03	3.13E+02
Pu-242	1.22E-02	6.36E-03	2.87E-03	1.28E-03	3.37E-07	1.04E-02
Ra-223	3.08E-11	5.30E-02	3.96E-09	3.37E-07	1.55E-06	1.83E-03
Ra-224	3.42E-15	2.50E-02	3.15E-06	1.89E-05	1.40E-05	8.64E-04
Ra-225	1.53E-09	9.66E-04	5.17E-10	1.15E-08	3.41E-08	3.34E-05
Ra-226	1.31E-07	4.34E-06	8.84E-06	1.23E-06	4.06E-07	1.67E-06
Ra-228	3.42E-15	6.31E-03	3.77E-11	2.50E-11	4.75E-12	2.18E-04

Nuclide	SRS	WVDP	INEEL			Average (per Can)
			INTEC	Ceramic	Metal	
Rb-87	0.00E+00	0.00E+00	0.00E+00	3.85E-06	0.00E+00	4.91E-08
Rh-102	0.00E+00	0.00E+00	5.05E-09	0.00E+00	0.00E+00	7.98E-10
Rh-106	2.98E-06	0.00E+00	0.00E+00	0.00E+00	5.19E-09	2.37E-06
Rn-219	3.08E-11	5.30E-02	3.96E-09	3.37E-07	1.55E-06	1.83E-03
Rn-220	3.42E-15	2.50E-02	3.15E-06	1.89E-05	1.40E-05	8.64E-04
Rn-222	1.31E-07	4.34E-06	8.85E-06	1.23E-06	4.06E-07	1.67E-06
Ru-106	2.98E-06	0.00E+00	0.00E+00	0.00E+00	5.19E-09	2.37E-06
Sb-125	4.23E-01	8.75E-05	2.43E-04	0.00E+00	8.92E-02	3.36E-01
Sb-126	6.13E-02	5.60E-02	1.05E-02	0.00E+00	6.55E-02	5.23E-02
Sb-126m	4.38E-01	4.00E-01	7.49E-02	0.00E+00	4.68E-01	3.74E-01
Se-79	1.70E-01	2.32E-01	0.00E+00	0.00E+00	0.00E+00	1.43E-01
Sm-146	0.00E+00	3.57E-10	0.00E+00	0.00E+00	0.00E+00	1.23E-11
Sm-147	5.96E-07	1.71E-09	4.06E-13	9.34E-07	0.00E+00	4.85E-07
Sm-148	0.00E+00	0.00E+00	0.00E+00	8.19E-12	0.00E+00	1.04E-13
Sm-149	0.00E+00	0.00E+00	0.00E+00	7.99E-12	0.00E+00	1.02E-13
Sm-151	1.90E+02	2.21E+02	0.00E+00	0.00E+00	0.00E+00	1.58E+02
Sn-121	0.00E+00	2.76E-02	0.00E+00	0.00E+00	0.00E+00	9.53E-04
Sn-121m	0.00E+00	3.56E-02	0.00E+00	0.00E+00	0.00E+00	1.23E-03
Sn-126	4.38E-01	4.00E-01	7.49E-02	0.00E+00	4.68E-01	3.74E-01
Sr-90	2.30E+04	7.55E+03	5.23E+03	2.77E+03	0.00E+00	1.94E+04
Tc-99	3.07E+00	6.54E+00	2.87E+00	0.00E+00	2.12E+01	3.13E+00
Te-125m	1.03E-01	2.14E-05	5.94E-05	0.00E+00	2.18E-02	8.18E-02
Th-227	3.04E-11	5.23E-02	3.91E-09	3.32E-07	1.53E-06	1.81E-03
Th-228	3.42E-15	2.50E-02	3.15E-06	1.89E-05	1.40E-05	8.64E-04
Th-229	1.53E-09	9.66E-04	5.17E-10	1.15E-08	3.41E-08	3.34E-05
Th-230	2.54E-05	2.34E-04	3.36E-04	5.90E-05	4.71E-05	8.21E-05
Th-231	3.81E-07	3.88E-04	4.96E-04	9.21E-04	4.22E-03	1.07E-04
Th-232	5.75E-15	6.31E-03	8.34E-11	2.54E-11	5.98E-12	2.18E-04
Th-234	1.05E-02	3.28E-03	2.47E-05	2.88E-03	1.62E-02	8.50E-03
Ti-206	3.85E-14	2.60E-12	1.61E-12	7.97E-13	1.67E-13	3.85E-13
Ti-207	3.07E-11	5.29E-02	3.95E-09	3.36E-07	1.55E-06	1.83E-03
Ti-208	1.23E-15	8.98E-03	1.13E-06	6.81E-06	5.02E-06	3.10E-04
Ti-209	3.22E-11	2.03E-05	1.09E-11	2.41E-10	7.17E-10	7.01E-07
U-232	0.00E+00	1.82E-02	3.70E-06	1.84E-05	1.36E-05	6.29E-04
U-233	1.17E-06	3.67E-02	1.23E-06	4.49E-06	9.72E-06	1.27E-03
U-234	1.46E-01	2.10E-02	8.46E-02	2.92E-02	1.28E-01	1.30E-01
U-235	3.81E-07	3.88E-04	4.96E-04	9.21E-04	4.22E-03	1.07E-04
U-236	7.79E-06	1.15E-03	1.29E-03	6.78E-04	3.03E-03	2.61E-04
U-237	9.32E-03	6.74E-04	3.04E-04	3.92E-04	1.12E-07	7.48E-03
U-238	1.05E-02	3.28E-03	2.47E-05	2.88E-03	1.62E-02	8.50E-03
Y-90	2.30E+04	7.55E+03	5.24E+03	2.78E+03	0.00E+00	1.94E+04
Zr-93	1.12E+00	1.05E+00	0.00E+00	0.00E+00	0.00E+00	9.25E-01
Total	8.88E+04	3.27E+04	1.92E+04	1.26E+04	8.12E+01	7.48E+04

Table 6-2. Average Radionuclide Inventory per Long Canister at 2040

Nuclide	Ci	Nuclide	Ci	Nuclide	Ci
Ac-225	2.57E-04	Np-237	9.79E-03	Rn-222	4.36E-06
Ac-227	9.70E-03	Np-239	6.41E-04	Ru-106	1.76E-13
Ac-228	1.66E-04	Pa-231	1.08E-02	Sb-125	1.21E-04
Am-241	4.92E+00	Pa-233	9.79E-03	Sb-126	1.15E-02
Am-243	6.41E-04	Pa-234	2.89E-05	Sb-126m	8.21E-02
At-217	2.57E-04	Pa-234m	2.22E-02	Se-79	5.33E-02

Nuclide	Ci	Nuclide	Ci	Nuclide	Ci
Ba-137m	2.52E+03	Pb-209	2.57E-04	Sm-151	1.33E+02
Bi-210	3.30E-06	Pb-210	3.30E-06	Sn-126	8.21E-02
Bi-211	9.70E-03	Pb-211	9.70E-03	Sr-90	2.16E+03
Bi-212	5.69E-03	Pb-212	5.69E-03	Tc-99	2.25E+00
Bi-213	2.57E-04	Pb-214	4.36E-06	Te-125m	2.95E-05
Bi-214	4.36E-06	Po-210	3.30E-06	Th-227	9.56E-03
C-14	6.59E-06	Po-211	2.67E-05	Th-228	5.69E-03
Cd-113m	1.22E-01	Po-212	3.64E-03	Th-229	2.57E-04
Ce-142	7.91E-05	Po-213	2.52E-04	Th-230	1.01E-05
cm243	2.25E-04	Po-214	4.36E-06	Th-231	1.00E-03
cm244	2.87E-03	Po-215	9.70E-03	Th-232	1.46E-04
Co-60	2.00E-03	Po-216	5.69E-03	Th-234	2.22E-02
Cs-134	1.18E-06	Po-218	4.36E-06	Ti-206	4.36E-12
Cs-137	2.67E+03	Pu-238	1.33E-01	Ti-207	9.67E-03
Eu-152	9.32E-03	Pu-239	2.70E+00	Ti-208	2.04E-03
Eu-154	2.47E-01	Pu-240	6.13E-01	Ti-209	5.40E-06
Eu-155	1.03E-02	Pu-241	1.71E+00	U-232	5.37E-03
Fr-221	2.57E-04	Pu-242	8.00E-05	U-233	3.28E-02
Fr-223	1.34E-04	Ra-223	9.70E-03	U-234	2.39E-02
Gd-152	3.19E-15	Ra-224	5.69E-03	U-235	1.00E-03
I-129	2.21E-03	Ra-225	2.57E-04	U-236	6.61E-04
K-40	3.69E-06	Ra-226	4.36E-06	U-237	4.10E-05
La-138	6.23E-08	Ra-228	1.66E-04	U-238	2.22E-02
Nb-93m	2.41E-01	Rh-106	1.76E-13	Y-90	2.16E+03
Ni-59	6.44E-02	Rn-219	9.70E-03	Zr-93	2.50E-01
Ni-63	4.61E+00	Rn-220	5.69E-03	Total	9.66E+03

Table 6-3. Average Radionuclide Inventory per CIC Canister at 2040

Nuclide	Ci	Nuclide	Ci	Nuclide	Ci
Ac-225	1.74E-09	Pa-234m	2.72E-02	Ru-106	2.62E-06
Ac-227	5.00E-07	Pb-209	1.74E-09	Sb-125	3.72E-01
Ac-228	2.92E-05	Pb-210	2.68E-08	Sb-126	5.39E-02
Am-241	7.99E+02	Pb-211	5.00E-07	Sb-126m	3.85E-01
Am-243	5.08E-03	Pb-212	2.92E-05	Se-79	1.49E-01
At-217	1.74E-09	Pb-214	1.21E-07	Sm-147	5.25E-07
Ba-137m	1.80E+04	Pd-107	1.29E-02	Sm-151	1.67E+02
Bi-210	2.68E-08	Pm-147	7.65E+00	Sn-126	3.85E-01
Bi-211	5.00E-07	Po-210	2.68E-08	Sr-90	2.03E+04
Bi-212	2.92E-05	Po-211	1.38E-09	Tc-99	2.70E+00
Bi-213	1.74E-09	Po-212	1.87E-05	Te-125m	9.08E-02
Bi-214	1.21E-07	Po-213	1.71E-09	Th-227	4.94E-07
Ce-144	2.29E-08	Po-214	1.21E-07	Th-228	2.92E-05
Cm-244	2.98E+01	Po-215	5.00E-07	Th-229	1.74E-09
Co-60	2.88E+00	Po-216	2.92E-05	Th-230	2.36E-05
Cs-134	1.23E-02	Po-218	1.21E-07	Th-231	2.25E-03
Cs-135	8.72E-02	Pr-144	2.29E-08	Th-232	3.00E-05

Nuclide	Ci		Nuclide	Ci		Nuclide	Ci
Cs-137	1.90E+04		Pr-144m	3.21E-10		Th-234	2.72E-02
Eu-154	4.84E+01		Pu-238	1.12E+03		Ti-206	3.53E-14
Eu-155	5.08E+00		Pu-239	1.53E+03		Ti-207	4.99E-07
Fr-221	1.74E-09		Pu-240	5.24E+02		Ti-208	1.05E-05
Fr-223	6.91E-09		Pu-241	1.39E+03		Ti-209	3.66E-11
K-40	5.54E-05		Pu-242	1.03E-01		U-233	1.48E-06
Nb-93m	7.13E-01		Ra-223	5.00E-07		U-234	1.37E-01
Nd-144	3.23E-12		Ra-224	2.92E-05		U-235	2.25E-03
Ni-59	2.10E-02		Ra-225	1.74E-09		U-236	4.66E-04
Ni-63	2.12E+00		Ra-226	1.21E-07		U-237	3.32E-02
Np-237	1.52E-02		Ra-228	2.92E-05		U-238	2.72E-02
Np-239	5.08E-03		Rh-106	2.62E-06		Y-90	2.03E+04
Pa-231	1.41E-06		Rn-219	5.00E-07		Zr-93	9.84E-01
Pa-233	1.52E-02		Rn-220	2.92E-05		Total	8.32E+04
Pa-234	3.54E-05		Rn-222	1.21E-07		--	--

6.2 RADIATION PRODUCTION RATES

Gamma and neutron production rates from each of the six HLW canisters and for the CIC canister were calculated for the time period extending from the year 2,010 to 1,002,010. There are a total of 181 time steps for the one-million-year time period. Since the first 300 years takes up 113 time steps, the emphasis is on the preclosure period of the repository. Table 6-4 provides the calendar years corresponding to the 181 time steps for which the radiation sources were calculated.

The energy spectra and intensities of gamma and neutron production rates for each of the seven canisters for ten selected time steps covering the entire one-million-year time period are presented in Attachments V and VI, respectively. The calendar years that correspond to the ten time steps are: 2,010; 2,015; 2,020; 2,060; 2,110; 2,510; 3,010; 12,010; 102,010; and 1,002,010.

Table 6-4. Calendar Years of the 181 Time Steps for Radiation Sources and Decay Heat

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
2020	2021	2022	2023	2024	2025	2026	2027	2028	2029
2030	2031	2032	2033	2034	2035	2036	2037	2038	2039
2040	2041	2042	2043	2044	2045	2046	2047	2048	2049
2050	2051	2052	2053	2054	2055	2056	2057	2058	2059
2060	2061	2062	2063	2064	2065	2066	2067	2068	2069
2070	2071	2072	2073	2074	2075	2076	2077	2078	2079
2080	2081	2082	2083	2084	2085	2086	2087	2088	2089
2090	2091	2092	2093	2094	2095	2096	2097	2098	2099
2100	2101	2102	2103	2104	2105	2106	2107	2108	2109
2110	2120	2130	2140	2150	2160	2170	2180	2190	2200
2210	2260	2310	2360	2410	2460	2510	2560	2610	2660
2710	2760	2810	2860	2910	2960	3010	3510	4010	4510
5010	5510	6010	6510	7010	7510	8010	8510	9010	9510
10010	10510	11010	11510	12010	17010	22010	27010	32010	37010
42010	47010	52010	57010	62010	67010	72010	77010	82010	87010

92010	97010	102010	152010	202010	252010	302010	352010	402010	452010
502010	552010	602010	652010	702010	752010	802010	852010	902010	952010
1002010									

6.3 DECAY HEAT GENERATION

Similar to the radiation production rates, the decay heat produced by the radionuclides in each of the seven canisters was calculated for the time period extending from the year 2,010 to the year 1,002,010. The same 181 time steps given in Table 6-4 were used for the decay heat results. The decay heat of the individual canisters for the 181 time steps are presented in Attachment III and plotted in Attachment IV.

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8. ATTACHMENTS

The list of attachments is presented in Table 8-1. Electronic output files are provided on a compact disk that is Attachment VIII of this calculation. The files' attributes are listed in Table 8-2. Each file is identified by its name, size (in bytes), and the date and time. It should be noted that for files transferred from the HP to the personal computer, the date and time will reflect the time of transfer. The actual date and time of each run completion can be found in its corresponding file.

Table 8-1. List of Attachments

Description	Attachment Number	No. of Pages
Grand Total HLW Radionuclide Inventory from All Sites by Calendar Year	I	3
Total HLW Radionuclide Inventory from SRS by Calendar Year	II	3
Thermal Output per Canister by Calendar Year	III	4
Plots of Thermal Output per Canister by Calendar Year	IV	4
Gamma Source Spectra and Intensities of Individual Canisters by Calendar Year	V	7
Neutron Source Spectra and Intensities of Individual Canisters by Calendar Year	VI	7
Sample ORIGEN-S Input Listing	VII	2
Electronic ORIGEN-S Output files	VIII	Compact Disk

Table 8-2. ORIGEN-S Output Files

File Name	Description	Size (bytes)	Date	Time
abs2-hf.out	Radionuclide inventory of HS HLW Canister at 2040	141,039	4/25/2000	9:09 a.m.
abs2-srs.out	Radionuclide inventory of SRS HLW Canister at 2040	128,281	4/25/2000	9:11 a.m.
abs2-wvdp.out	Radionuclide inventory of WVDP HLW Canister at 2040	154,527	4/25/2000	9:12 a.m.
abs2-intec.out	Radionuclide inventory of INTEC HLW Canister at 2040	127,121	4/25/2000	9:13 a.m.
abs2-ceramic.out	Radionuclide inventory of Ceramic HLW Canister at 2040	126,961	4/25/2000	9:13 a.m.
abs2-metal.out	Radionuclide inventory of Metal HLW Canister at 2040	118,931	4/25/2000	9:14 a.m.
abs2-cic.out	Radionuclide inventory of CIC HLW Canister at 2040	131,953	4/25/2000	9:14 a.m.
hf2-can.out	Thermal and Radiation Sources of HS HLW Canister, 181 Time Steps	2,416,986	4/25/2000	9:16 a.m.
hf2-can10.out	Thermal and Radiation Sources of HS HLW Canister, 10 Time Steps	217,663	4/25/2000	4:04 p.m.
srp2-can.out	Thermal and Radiation Sources of SRS HLW Canister, 181 Time Steps	2,267,538	4/25/2000	9:21 a.m.
srp2-can10.out	Thermal and Radiation Sources of SRS HLW Canister, 10 Time Steps	189,287	4/25/2000	9:22 a.m.
wvdp2-can.out	Thermal and Radiation Sources of WVDP HLW Canister, 181 Time Steps	2,673,552	4/25/2000	9:22 a.m.
wvdp2-can10.out	Thermal and Radiation Sources of WVDP HLW Canister, 10 Time Steps	240,592	4/25/2000	9:23 a.m.
intec-can.out	Thermal and Radiation Sources of INTEC HLW Canister, 181 Time Steps	2,018,909	4/25/2000	9:23 a.m.
intec-can10.out	Thermal and Radiation Sources of INTEC HLW Canister, 10 Time Steps	191,689	4/25/2000	9:23 a.m.
ceramic2-can.out	Thermal and Radiation Sources of Ceramic HLW	2,268,485	4/25/2000	9:24 a.m.

File Name	Description	Size (bytes)	Date	Time
	Canister, 181 Time Steps			
ceramic2-can10.out	Thermal and Radiation Sources of Ceramic HLW Canister, 10 Time Steps	197,773	4/25/2000	9:24 a.m.
metal2-can.out	Thermal and Radiation Sources of Metal HLW Canister, 181 Time Steps	2,134,218	4/25/2000	9:25 a.m.
metal2-can10.out	Thermal and Radiation Sources of Metal HLW Canister, 10 Time Steps	184,736	4/25/2000	9:25 a.m.
cic2-can.out	Thermal and Radiation Sources of CIC HLW Canister, 181 Time Steps	2,349,824	4/25/2000	9:26 a.m.
cic2-can10.out	Thermal and Radiation Sources of CIC HLW Canister, 10 Time Steps	197,409	4/25/2000	9:26 a.m.
total-2000.out	Total Radionuclide inventory of HLW from All Sites	243,621	4/25/2000	9:27 a.m.
srs-2000.out	Total Radionuclide inventory of HLW from SRS	212,725	4/25/2000	9:28 a.m.

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment I

Page I-1

Grand Total HLW Radionuclide Inventory (Ci) from All Sites by Calendar Year

Nuclide	2130	2230	2330	2430	2530	3030	4030	5030	7030	10030	12030	22030	32030	102030	302030	1002030
Ac-225	7.76E+00	1.19E+01	1.61E+01	2.02E+01	2.43E+01	4.41E+01	8.11E+01	1.15E+02	1.74E+02	2.45E+02	2.83E+02	3.95E+02	4.38E+02	4.35E+02	3.71E+02	2.64E+02
Ac-227	1.70E+02	1.72E+02	1.71E+02	1.71E+02	1.71E+02	1.69E+02	1.66E+02	1.63E+02	1.57E+02	1.48E+02	1.43E+02	1.19E+02	9.94E+01	3.75E+01	2.02E+01	1.99E+01
Ac-228	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00
Am-241	4.55E+05	3.89E+05	3.31E+05	2.82E+05	2.40E+05	1.08E+05	2.17E+04	4.37E+03	1.78E+02	1.93E+00	4.65E-01	1.72E-01	7.61E-02	2.52E-04	2.19E-11	0.00E+00
Am-242	1.49E+02	9.07E+01	5.55E+01	3.39E+01	2.08E+01	1.78E+00	1.30E-02	9.55E-05	5.13E-09	2.02E-15	1.08E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-242m	1.49E+02	9.11E+01	5.57E+01	3.41E+01	2.09E+01	1.79E+00	1.31E-02	9.59E-05	5.15E-09	2.03E-15	1.09E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Am-243	3.84E+02	3.80E+02	3.77E+02	3.73E+02	3.70E+02	3.53E+02	3.21E+02	2.92E+02	2.42E+02	1.83E+02	1.51E+02	5.91E+01	2.31E+01	3.19E-02	2.16E-10	0.00E+00
At-217	7.76E+00	1.19E+01	1.61E+01	2.02E+01	2.43E+01	4.41E+01	8.11E+01	1.15E+02	1.74E+02	2.45E+02	2.83E+02	3.95E+02	4.38E+02	4.35E+02	3.71E+02	2.64E+02
Ba-137m	2.07E+07	2.06E+06	2.04E+05	2.03E+04	2.01E+03	1.93E-02	1.78E-12	1.64E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi-210	1.07E-01	2.29E-01	4.66E-01	8.27E-01	1.32E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.19E+03	6.83E+02
Bi-211	1.70E+02	1.72E+02	1.71E+02	1.71E+02	1.71E+02	1.69E+02	1.66E+02	1.63E+02	1.57E+02	1.48E+02	1.43E+02	1.19E+02	9.94E+01	3.75E+01	2.02E+01	1.99E+01
Bi-212	3.91E+01	1.73E+01	9.32E+00	6.35E+00	5.24E+00	4.60E+00	4.59E+00	4.59E+00	4.58E+00	4.56E+00	4.55E+00	4.51E+00	4.46E+00	4.22E+00	3.90E+00	3.76E+00
Bi-213	7.76E+00	1.19E+01	1.61E+01	2.02E+01	2.43E+01	4.40E+01	8.11E+01	1.15E+02	1.74E+02	2.45E+02	2.83E+02	3.95E+02	4.38E+02	4.35E+02	3.71E+02	2.64E+02
Bi-214	1.31E-01	2.86E-01	5.62E-01	9.65E-01	1.50E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.19E+03	6.83E+02
C-14	1.39E+02	1.37E+02	1.36E+02	1.34E+02	1.32E+02	1.25E+02	1.10E+02	9.79E+01	7.68E+01	5.34E+01	4.20E+01	1.25E+01	3.73E+00	7.83E-04	2.42E-14	0.00E+00
Cd-113m	2.34E+01	1.71E-01	1.26E-03	9.21E-06	6.75E-08	1.43E-18	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
Ce-142	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00	1.15E+00
Cm-242	1.23E+02	7.50E+01	4.59E+01	2.81E+01	1.72E+01	1.47E+00	1.08E-02	7.90E-05	4.25E-09	1.67E-15	9.00E-20	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-243	4.82E+00	4.23E-01	3.72E-02	3.27E-03	2.87E-04	1.50E-09	4.10E-20	1.12E-30	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Cm-244	6.49E+03	1.41E+02	3.06E+00	6.64E-02	1.44E-03	6.96E-12	1.62E-28	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
Cm-245	8.71E-01	8.64E-01	8.57E-01	8.50E-01	8.43E-01	8.09E-01	7.46E-01	6.88E-01	5.84E-01	4.57E-01	3.88E-01	1.72E-01	7.60E-02	2.52E-04	2.07E-11	0.00E+00
Cm-246	9.88E-02	9.74E-02	9.59E-02	9.46E-02	9.32E-02	8.66E-02	7.48E-02	6.46E-02	4.82E-02	3.10E-02	2.32E-02	5.35E-03	1.24E-03	4.34E-08	8.15E-21	0.00E+00
Co-60	1.42E-01	2.75E-07	5.33E-13	1.03E-18	2.00E-24	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	0.00E+00
Cs-135	9.33E+02	9.33E+02	9.33E+02	9.33E+02	9.33E+02	9.33E+02	9.32E+02	9.32E+02	9.32E+02	9.31E+02	9.30E+02	9.27E+02	9.25E+02	9.05E+02	8.52E+02	6.90E+02
Cs-137	2.20E+07	2.18E+06	2.16E+05	2.15E+04	2.13E+03	2.04E-02	1.88E-12	1.74E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-152	1.50E+00	8.27E-03	4.55E-05	2.51E-07	1.38E-09	7.03E-21	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
Eu-154	2.37E+02	7.42E-02	2.32E-05	7.27E-09	2.27E-12	6.85E-30	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
Eu-155	5.64E-02	2.08E-08	7.70E-15	2.85E-21	1.05E-27	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	0.00E+00
Fr-221	7.76E+00	1.19E+01	1.61E+01	2.02E+01	2.43E+01	4.41E+01	8.11E+01	1.15E+02	1.74E+02	2.45E+02	2.83E+02	3.95E+02	4.38E+02	4.35E+02	3.71E+02	2.64E+02
Fr-223	2.35E+00	2.37E+00	2.37E+00	2.36E+00	2.36E+00	2.33E+00	2.29E+00	2.25E+00	2.16E+00	2.04E+00	1.97E+00	1.64E+00	1.37E+00	5.18E-01	2.79E-01	2.75E-01
Gd-152	6.01E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11	6.02E-11
H-3	1.70E+01	6.15E-02	2.22E-04	8.04E-07	2.91E-09	1.80E-21	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-129	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.82E+01	3.81E+01	3.80E+01	3.77E+01	3.66E+01
K-40	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01	4.07E-01
La-138	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04	9.04E-04
Nb-93m	1.05E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.05E+04	1.05E+04	1.01E+04	9.25E+03	6.74E+03
Nb-94	2.72E+00	2.71E+00	2.70E+00	2.69E+00	2.68E+00	2.64E+00	2.55E+00	2.46E+00	2.30E+00	2.08E+00	1.94E+00	1.38E+00	9.80E-01	8.97E-02	9.70E-05	4.03E-15
Nd-144	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07	2.39E-07
Ni-59	1.19E+03	1.19E+03	1.19E+03	1.19E+03	1.19E+03	1.18E+03	1.17E+03	1.16E+03	1.14E+03	1.11E+03	1.09E+03	9.90E+02	9.03E+02	4.73E+02	7.44E+01	1.15E-01
Ni-63	4.69E+04	2.35E+04	1.17E+04	5.87E+03	2.94E+03	9.21E+01	9.06E-02	8.90E-05	8.60E-11	8.17E-20	7.89E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-236	9.46E+00	9.45E+00	9.45E+00	9.44E+00	9.44E+00	9.41E+00	9.35E+00	9.30E+00	9.18E+00	9.02E+00	8.91E+00	8.39E+00	7.90E+00	5.18E+00	1.55E+00	2.28E-02
Np-237	2.43E+02	2.57E+02	2.68E+02	2.78E+02	2.87E+02	3.13E+02	3.31E+02	3.34E+02	3.35E+02	3.34E+02	3.34E+02	3.33E+02	3.32E+02	3.25E+02	3.04E+02	2.42E+02

Page I-2

Nuclide	2130	2230	2330	2430	2530	3030	4030	5030	7030	10030	12030	22030	32030	102030	302030	1002030
Np-238	6.73E-01	4.10E-01	2.51E-01	1.53E-01	9.39E-02	8.03E-03	5.89E-05	4.32E-07	2.32E-11	9.13E-18	4.90E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-239	3.84E+02	3.80E+02	3.77E+02	3.73E+02	3.70E+02	3.53E+02	3.21E+02	2.92E+02	2.42E+02	1.83E+02	1.51E+02	5.91E+01	2.31E+01	3.19E-02	2.16E-10	0.00E+00
Pa-231	1.72E+02	1.72E+02	1.71E+02	1.71E+02	1.71E+02	1.69E+02	1.66E+02	1.63E+02	1.57E+02	1.48E+02	1.43E+02	1.19E+02	9.93E+01	3.75E+01	2.02E+01	1.99E+01
Pa-233	2.43E+02	2.57E+02	2.68E+02	2.78E+02	2.87E+02	3.13E+02	3.31E+02	3.34E+02	3.35E+02	3.34E+02	3.34E+02	3.33E+02	3.32E+02	3.25E+02	3.04E+02	2.42E+02
Pa-234	5.03E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01	5.02E-01
Pa-234m	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02
Pb-209	7.76E+00	1.19E+01	1.61E+01	2.02E+01	2.43E+01	4.40E+01	8.11E+01	1.15E+02	1.74E+02	2.45E+02	2.83E+02	3.95E+02	4.38E+02	4.35E+02	3.71E+02	2.64E+00
Pb-210	1.07E-01	2.29E-01	4.66E-01	8.27E-01	1.32E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.19E+03	6.83E+02
Pb-211	1.70E+02	1.72E+02	1.71E+02	1.71E+02	1.71E+02	1.69E+02	1.66E+02	1.63E+02	1.57E+02	1.48E+02	1.43E+02	1.19E+02	9.94E+01	3.75E+01	2.02E+01	1.99E+01
Pb-212	3.91E+01	1.73E+01	9.32E+00	6.35E+00	5.24E+00	4.60E+00	4.59E+00	4.59E+00	4.58E+00	4.56E+00	4.55E+00	4.51E+00	4.46E+00	4.22E+00	3.90E+00	3.76E+00
Pb-214	1.31E-01	2.86E-01	5.62E-01	9.65E-01	1.50E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.19E+03	6.83E+02
Pd-107	9.89E+01	9.89E+01	9.89E+01	9.89E+01	9.89E+01	9.89E+01	9.89E+01	9.89E+01	9.88E+01	9.88E+01	9.88E+01	9.87E+01	9.86E+01	9.79E+01	9.58E+01	8.89E+01
Pm-146	2.59E-07	9.31E-13	3.35E-18	1.20E-23	4.32E-29	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	0.00E+00
Po-210	1.07E-01	2.29E-01	4.66E-01	8.27E-01	1.32E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.19E+03	6.83E+02
Po-211	4.69E-01	4.72E-01	4.72E-01	4.71E-01	4.70E-01	4.65E-01	4.56E-01	4.48E-01	4.31E-01	4.07E-01	3.92E-01	3.26E-01	2.73E-01	1.03E-01	5.56E-02	5.48E-02
Po-212	2.50E+01	1.11E+01	5.97E+00	4.07E+00	3.36E+00	2.94E+00	2.94E+00	2.94E+00	2.93E+00	2.92E+00	2.92E+00	2.89E+00	2.86E+00	2.70E+00	2.50E+00	2.41E+00
Po-213	7.61E+00	1.17E+01	1.57E+01	1.98E+01	2.37E+01	4.31E+01	7.94E+01	1.13E+02	1.71E+02	2.40E+02	2.77E+02	3.87E+02	4.29E+02	4.26E+02	3.63E+02	2.59E+02
Po-214	1.31E-01	2.86E-01	5.62E-01	9.64E-01	1.49E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.19E+03	6.83E+02
Po-215	1.70E+02	1.72E+02	1.71E+02	1.71E+02	1.71E+02	1.69E+02	1.66E+02	1.63E+02	1.57E+02	1.48E+02	1.43E+02	1.19E+02	9.94E+01	3.75E+01	2.02E+01	1.99E+01
Po-216	3.91E+01	1.73E+01	9.32E+00	6.35E+00	5.24E+00	4.60E+00	4.59E+00	4.59E+00	4.58E+00	4.56E+00	4.55E+00	4.51E+00	4.46E+00	4.22E+00	3.90E+00	3.76E+00
Po-218	1.31E-01	2.86E-01	5.62E-01	9.65E-01	1.50E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.20E+03	6.83E+02
Pu-236	8.42E-01	8.41E-01	8.41E-01	8.40E-01	8.40E-01	8.37E-01	8.32E-01	8.27E-01	8.17E-01	8.03E-01	7.93E-01	7.47E-01	7.03E-01	4.61E-01	1.38E-01	2.03E-03
Pu-238	3.47E+06	1.57E+06	7.14E+05	3.24E+05	1.47E+05	2.83E+03	1.06E+00	4.70E-04	1.14E-08	4.46E-15	2.39E-19	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-239	1.36E+05	1.36E+05	1.35E+05	1.35E+05	1.34E+05	1.33E+05	1.29E+05	1.25E+05	1.18E+05	1.08E+05	1.02E+05	7.68E+04	5.76E+04	7.70E+03	2.45E+01	4.44E-08
Pu-240	6.60E+04	6.53E+04	6.46E+04	6.40E+04	6.33E+04	6.00E+04	5.40E+04	4.86E+04	3.93E+04	2.87E+04	2.32E+04	8.07E+03	2.81E+03	1.73E+00	1.15E-09	0.00E+00
Pu-241	3.08E+04	2.47E+02	2.82E+00	8.67E-01	8.45E-01	8.11E-01	7.47E-01	6.89E-01	5.85E-01	4.58E-01	3.89E-01	1.72E-01	7.61E-02	2.52E-04	2.08E-11	0.00E+00
Pu-242	7.93E+01	7.93E+01	7.93E+01	7.93E+01	7.92E+01	7.92E+01	7.90E+01	7.89E+01	7.86E+01	7.82E+01	7.79E+01	7.64E+01	7.50E+01	6.59E+01	4.55E+01	1.24E+01
Ra-223	1.70E+02	1.72E+02	1.71E+02	1.71E+02	1.71E+02	1.69E+02	1.66E+02	1.63E+02	1.57E+02	1.48E+02	1.43E+02	1.19E+02	9.94E+01	3.75E+01	2.02E+01	1.99E+01
Ra-224	3.91E+01	1.73E+01	9.32E+00	6.35E+00	5.24E+00	4.60E+00	4.59E+00	4.59E+00	4.58E+00	4.56E+00	4.55E+00	4.51E+00	4.46E+00	4.22E+00	3.90E+00	3.76E+00
Ra-225	7.76E+00	1.19E+01	1.61E+01	2.02E+01	2.43E+01	4.41E+01	8.11E+01	1.15E+02	1.74E+02	2.45E+02	2.83E+02	3.95E+02	4.38E+02	4.35E+02	3.71E+02	2.64E+02
Ra-226	1.31E-01	2.86E-01	5.62E-01	9.65E-01	1.50E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.20E+03	6.83E+02
Ra-228	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00
Rb-87	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04	3.70E-04
Rn-219	1.70E+02	1.72E+02	1.71E+02	1.71E+02	1.71E+02	1.69E+02	1.66E+02	1.63E+02	1.57E+02	1.48E+02	1.43E+02	1.19E+02	9.94E+01	3.75E+01	2.02E+01	1.99E+01
Rn-220	3.91E+01	1.73E+01	9.32E+00	6.35E+00	5.24E+00	4.60E+00	4.59E+00	4.59E+00	4.58E+00	4.56E+00	4.55E+00	4.51E+00	4.46E+00	4.22E+00	3.90E+00	3.76E+00
Rn-222	1.31E-01	2.86E-01	5.62E-01	9.65E-01	1.50E+00	5.93E+00	2.19E+01	4.44E+01	1.00E+02	1.94E+02	2.58E+02	5.62E+02	8.32E+02	2.02E+03	2.20E+03	6.83E+02
Sb-126	5.61E+02	3.93E+02	3.93E+02	3.93E+02	3.92E+02	3.91E+02	3.88E+02	3.86E+02	3.80E+02	3.72E+02	3.67E+02	3.43E+02	3.20E+02	1.97E+02	4.92E+01	3.84E-01
Sb-126m	4.00E+03	2.81E+03	2.81E+03	2.80E+03	2.80E+03	2.79E+03	2.77E+03	2.75E+03	2.72E+03	2.66E+03	2.62E+03	2.45E+03	2.28E+03	1.41E+03	3.51E+02	2.75E+00
Se-79	1.85E+03	1.85E+03	1.85E+03	1.85E+03	1.85E+03	1.85E+03	1.84E+03	1.84E+03	1.83E+03	1.82E+03	1.81E+03	1.77E+03	1.74E+03	1.50E+03	9.85E+02	2.26E+02
Sm-146	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.33E-08	9.32E-08	9.31E-08	9.27E-08
Sm-147	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03	3.65E-03
Sm-148	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10	7.86E-10
Sm-149	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10	7.67E-10

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment I

Page I-3

Nuclide	2130	2230	2330	2430	2530	3030	4030	5030	7030	10030	12030	22030	32030	102030	302030	1002030
Sm-151	1.56E+06	7.22E+05	3.34E+05	1.55E+05	7.16E+04	1.52E+03	6.87E-01	3.10E-04	6.33E-11	5.83E-21	1.19E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-121	1.19E+03	6.51E-01	1.85E-01	5.24E-02	1.49E-02	2.73E-05	9.19E-11	3.09E-16	3.51E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-121m	2.96E+00	8.40E-01	2.38E-01	6.75E-02	1.92E-02	3.51E-05	1.18E-10	3.99E-16	4.52E-27	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-126	2.81E+03	2.81E+03	2.81E+03	2.80E+03	2.80E+03	2.79E+03	2.77E+03	2.75E+03	2.72E+03	2.66E+03	2.62E+03	2.45E+03	2.28E+03	1.41E+03	3.51E+02	2.75E+00
Sr-90	1.93E+07	1.64E+06	1.40E+05	1.19E+04	1.02E+03	4.57E-03	9.22E-14	1.86E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99	5.62E+04	5.62E+04	5.62E+04	5.61E+04	5.61E+04	5.60E+04	5.59E+04	5.57E+04	5.53E+04	5.48E+04	5.44E+04	5.26E+04	5.09E+04	4.05E+04	2.10E+04	2.11E+03
Th-227	1.69E+02	1.69E+02	1.69E+02	1.69E+02	1.68E+02	1.67E+02	1.64E+02	1.61E+02	1.55E+02	1.46E+02	1.41E+02	1.17E+02	9.80E+01	3.70E+01	1.99E+01	1.97E+01
Th-228	3.91E+01	1.73E+01	9.32E+00	6.35E+00	5.24E+00	4.60E+00	4.59E+00	4.59E+00	4.58E+00	4.56E+00	4.55E+00	4.51E+00	4.46E+00	4.22E+00	3.90E+00	3.76E+00
Th-229	7.76E+00	1.19E+01	1.61E+01	2.02E+01	2.43E+01	4.41E+01	8.11E+01	1.15E+02	1.74E+02	2.45E+02	2.83E+02	3.95E+02	4.38E+02	4.35E+02	3.71E+02	2.64E+02
Th-230	2.46E+00	5.21E+00	8.38E+00	1.17E+01	1.52E+01	3.27E+01	6.75E+01	1.02E+02	1.70E+02	2.68E+02	3.32E+02	6.28E+02	8.90E+02	2.01E+03	2.19E+03	6.83E+02
Th-231	1.53E+01	1.53E+01	1.53E+01	1.53E+01	1.54E+01	1.54E+01	1.55E+01	1.57E+01	1.59E+01	1.62E+01	1.65E+01	1.73E+01	1.80E+01	1.97E+01	2.00E+01	1.99E+01
Th-232	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00	3.76E+00
Th-234	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02
Ti-206	1.41E-07	3.03E-07	6.15E-07	1.09E-06	1.74E-06	7.82E-06	2.89E-05	5.86E-05	1.32E-04	2.56E-04	3.41E-04	7.41E-04	1.10E-03	2.66E-03	2.90E-03	9.01E-04
Ti-207	1.70E+02	1.71E+02	1.71E+02	1.71E+02	1.70E+02	1.69E+02	1.65E+02	1.62E+02	1.56E+02	1.48E+02	1.42E+02	1.18E+02	9.91E+01	3.74E+01	2.02E+01	1.99E+01
Ti-208	1.40E+01	6.23E+00	3.35E+00	2.28E+00	1.88E+00	1.65E+00	1.65E+00	1.65E+00	1.65E+00	1.64E+00	1.64E+00	1.62E+00	1.60E+00	1.52E+00	1.40E+00	1.35E+00
Ti-209	1.63E-01	2.51E-01	3.38E-01	4.24E-01	5.09E-01	9.25E-01	1.70E+00	2.41E+00	3.66E+00	5.15E+00	5.94E+00	8.30E+00	9.20E+00	9.14E+00	7.79E+00	5.55E+00
U-232	3.43E+01	1.32E+01	5.42E+00	2.53E+00	1.46E+00	8.35E-01	8.32E-01	8.27E-01	8.17E-01	8.03E-01	7.93E-01	7.47E-01	7.03E-01	4.61E-01	1.38E-01	2.03E-03
U-233	4.85E+02	4.85E+02	4.85E+02	4.85E+02	4.85E+02	4.84E+02	4.84E+02	4.83E+02	4.82E+02	4.80E+02	4.78E+02	4.72E+02	4.66E+02	4.30E+02	3.62E+02	2.64E+02
U-234	2.61E+03	3.29E+03	3.59E+03	3.73E+03	3.79E+03	3.84E+03	3.83E+03	3.82E+03	3.80E+03	3.77E+03	3.75E+03	3.66E+03	3.57E+03	3.00E+03	1.87E+03	5.92E+02
U-235	1.53E+01	1.53E+01	1.53E+01	1.53E+01	1.54E+01	1.54E+01	1.55E+01	1.57E+01	1.59E+01	1.62E+01	1.65E+01	1.73E+01	1.80E+01	1.97E+01	2.00E+01	1.99E+01
U-236	1.17E+01	1.19E+01	1.21E+01	1.23E+01	1.25E+01	1.34E+01	1.51E+01	1.66E+01	1.92E+01	2.22E+01	2.37E+01	2.79E+01	2.94E+01	3.01E+01	3.00E+01	2.94E+01
U-237	7.38E-01	5.90E-03	6.74E-05	2.07E-05	2.02E-05	1.94E-05	1.79E-05	1.65E-05	1.40E-05	1.09E-05	9.30E-06	4.11E-06	1.82E-06	6.03E-09	4.96E-16	0.00E+00
U-238	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02	3.86E+02
Y-90	1.93E+07	1.64E+06	1.40E+05	1.19E+04	1.02E+03	4.57E-03	9.22E-14	1.86E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Zr-93	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.06E+04	1.05E+04	1.05E+04	1.01E+04	9.25E+03	6.74E+03
Total	8.72E+07	1.05E+07	2.39E+06	1.13E+06	7.61E+05	4.02E+05	3.01E+05	2.75E+05	2.55E+05	2.34E+05	2.23E+05	1.84E+05	1.60E+05	1.04E+05	7.16E+04	2.84E+04

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment II

Page II-1

Total HLW Radionuclide Inventory (Ci) from SRS by Calendar Year

Nuclide	2130	2230	2330	2430	2530	3030	4030	5030	7030	10030	12030	22030	32030	102030	302030	1002030
Ac-225	1.55E-04	5.52E-04	1.23E-03	2.22E-03	3.55E-03	1.59E-02	7.18E-02	1.70E-01	4.82E-01	1.19E+00	1.79E+00	5.75E+00	1.05E+01	4.17E+01	9.24E+01	1.02E+02
Ac-227	7.05E-06	2.92E-05	6.74E-05	1.21E-04	1.91E-04	8.24E-04	3.18E-03	6.99E-03	1.87E-02	4.54E-02	6.87E-02	2.33E-01	4.49E-01	1.86E+00	2.63E+00	2.65E+00
Ac-228	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Am-241	3.34E+05	2.85E+05	2.43E+05	2.07E+05	1.76E+05	7.92E+04	1.59E+04	3.21E+03	1.30E+02	1.06E+00	4.31E-02	4.73E-09	5.18E-16	0.00E+00	0.00E+00	0.00E+00
Am-243	3.43E+01	3.40E+01	3.37E+01	3.33E+01	3.30E+01	3.15E+01	2.87E+01	2.61E+01	2.16E+01	1.63E+01	1.35E+01	5.28E+00	2.06E+00	2.85E-03	1.93E-11	0.00E+00
At-217	1.55E-04	5.52E-04	1.23E-03	2.22E-03	3.55E-03	1.59E-02	7.18E-02	1.70E-01	4.82E-01	1.19E+00	1.79E+00	5.75E+00	1.05E+01	4.17E+01	9.24E+01	1.02E+02
Ba-137m	1.52E+07	1.52E+06	1.51E+05	1.49E+04	1.48E+03	1.42E-02	1.31E-12	1.21E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Bi-210	1.55E-02	9.58E-02	2.73E-01	5.60E-01	9.60E-01	4.85E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Bi-211	7.05E-06	2.92E-05	6.74E-05	1.21E-04	1.91E-04	8.24E-04	3.18E-03	6.99E-03	1.87E-02	4.54E-02	6.87E-02	2.33E-01	4.49E-01	1.86E+00	2.63E+00	2.65E+00
Bi-212	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Bi-213	1.55E-04	5.52E-04	1.23E-03	2.22E-03	3.55E-03	1.59E-02	7.18E-02	1.70E-01	4.82E-01	1.19E+00	1.79E+00	5.75E+00	1.05E+01	4.16E+01	9.24E+01	1.02E+02
Bi-214	2.84E-02	1.36E-01	3.48E-01	6.71E-01	1.11E+00	4.85E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Cm-244	6.46E+03	1.40E+02	3.05E+00	6.61E-02	1.44E-03	6.93E-12	1.62E-28	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
Co-60	1.42E-01	2.75E-07	5.33E-13	1.03E-18	2.00E-24	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	0.00E+00
Cs-135	5.93E+02	5.93E+02	5.93E+02	5.93E+02	5.93E+02	5.93E+02	5.93E+02	5.92E+02	5.92E+02	5.92E+02	5.91E+02	5.89E+02	5.88E+02	5.75E+02	5.42E+02	4.39E+02
Cs-137	1.62E+07	1.61E+06	1.59E+05	1.58E+04	1.57E+03	1.51E-02	1.39E-12	1.28E-22	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Eu-154	2.31E+02	7.23E-02	2.26E-05	7.08E-09	2.22E-12	6.66E-30	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
Eu-155	5.61E-02	2.07E-08	7.66E-15	2.83E-21	1.05E-27	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	0.00E+00
Fr-221	1.55E-04	5.52E-04	1.23E-03	2.22E-03	3.55E-03	1.59E-02	7.18E-02	1.70E-01	4.82E-01	1.19E+00	1.79E+00	5.75E+00	1.05E+01	4.17E+01	9.24E+01	1.02E+02
Fr-223	9.74E-08	4.03E-07	9.30E-07	1.68E-06	2.64E-06	1.14E-05	4.39E-05	9.65E-05	2.58E-04	6.27E-04	9.47E-04	3.22E-03	6.19E-03	2.56E-02	3.63E-02	3.65E-02
K-40	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01	3.31E-01
Nb-93m	6.64E+03	6.70E+03	6.70E+03	6.70E+03	6.70E+03	6.70E+03	6.69E+03	6.69E+03	6.69E+03	6.68E+03	6.67E+03	6.64E+03	6.61E+03	6.40E+03	5.85E+03	4.26E+03
Nd-144	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08	2.19E-08
Ni-59	1.43E+02	1.43E+02	1.43E+02	1.43E+02	1.42E+02	1.42E+02	1.41E+02	1.39E+02	1.37E+02	1.33E+02	1.30E+02	1.19E+02	1.08E+02	5.68E+01	8.95E+00	1.39E-02
Ni-63	7.71E+03	3.86E+03	1.93E+03	9.66E+02	4.83E+02	1.51E+01	1.49E-02	1.46E-05	1.41E-11	1.34E-20	1.30E-26	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Np-237	6.52E+01	7.52E+01	8.38E+01	9.10E+01	9.72E+01	1.17E+02	1.30E+02	1.32E+02	1.33E+02	1.33E+02	1.33E+02	1.32E+02	1.32E+02	1.29E+02	1.21E+02	9.61E+01
Np-239	3.43E+01	3.40E+01	3.37E+01	3.33E+01	3.30E+01	3.15E+01	2.87E+01	2.61E+01	2.16E+01	1.63E+01	1.35E+01	5.28E+00	2.06E+00	2.85E-03	1.93E-11	0.00E+00
Pa-231	1.15E-05	3.87E-05	8.19E-05	1.41E-04	2.16E-04	8.24E-04	3.18E-03	6.99E-03	1.87E-02	4.54E-02	6.86E-02	2.33E-01	4.48E-01	1.86E+00	2.63E+00	2.65E+00
Pa-233	6.52E+01	7.52E+01	8.38E+01	9.10E+01	9.72E+01	1.17E+02	1.30E+02	1.32E+02	1.33E+02	1.33E+02	1.33E+02	1.32E+02	1.32E+02	1.29E+02	1.21E+02	9.61E+01
Pa-234	8.19E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02	8.16E-02
Pa-234m	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01
Pb-209	1.55E-04	5.52E-04	1.23E-03	2.22E-03	3.55E-03	1.59E-02	7.18E-02	1.70E-01	4.82E-01	1.19E+00	1.79E+00	5.75E+00	1.05E+01	4.16E+01	9.24E+01	1.02E+02
Pb-210	1.55E-02	9.58E-02	2.73E-01	5.60E-01	9.60E-01	4.85E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Pb-211	7.05E-06	2.92E-05	6.74E-05	1.21E-04	1.91E-04	8.24E-04	3.18E-03	6.99E-03	1.87E-02	4.54E-02	6.87E-02	2.33E-01	4.49E-01	1.86E+00	2.63E+00	2.65E+00
Pb-212	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Pb-214	2.84E-02	1.36E-01	3.48E-01	6.71E-01	1.11E+00	4.85E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Pd-107	8.79E+01	8.79E+01	8.79E+01	8.79E+01	8.79E+01	8.79E+01	8.79E+01	8.79E+01	8.79E+01	8.78E+01	8.78E+01	8.77E+01	8.76E+01	8.70E+01	8.51E+01	7.90E+01
Po-210	1.55E-02	9.58E-02	2.73E-01	5.60E-01	9.60E-01	4.85E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Po-211	1.94E-08	8.04E-08	1.85E-07	3.34E-07	5.26E-07	2.27E-06	8.74E-06	1.92E-05	5.14E-05	1.25E-04	1.89E-04	6.42E-04	1.23E-03	5.11E-03	7.24E-03	7.28E-03
Po-212	3.56E-10	1.20E-09	2.53E-09	4.34E-09	6.64E-09	2.51E-08	9.53E-08	2.06E-07	5.33E-07	1.24E-06	1.82E-06	5.55E-06	9.94E-06	4.31E-05	1.37E-04	4.63E-04
Po-213	1.51E-04	5.40E-04	1.21E-03	2.18E-03	3.48E-03	1.55E-02	7.03E-02	1.66E-01	4.71E-01	1.16E+00	1.75E+00	5.63E+00	1.03E+01	4.08E+01	9.04E+01	1.00E+02

Page II-2

Nuclide	2130	2230	2330	2430	2530	3030	4030	5030	7030	10030	12030	22030	32030	102030	302030	1002030
Po-214	2.84E-02	1.36E-01	3.48E-01	6.71E-01	1.11E+00	4.85E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Po-215	7.05E-06	2.92E-05	6.74E-05	1.21E-04	1.91E-04	8.24E-04	3.18E-03	6.99E-03	1.87E-02	4.54E-02	6.87E-02	2.33E-01	4.49E-01	1.86E+00	2.63E+00	2.65E+00
Po-216	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Po-218	2.84E-02	1.36E-01	3.48E-01	6.71E-01	1.11E+00	4.86E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Pu-238	3.43E+06	1.56E+06	7.06E+05	3.20E+05	1.45E+05	2.79E+03	1.03E+00	3.82E-04	5.21E-11	2.63E-21	3.60E-28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Pu-239	7.71E+04	7.69E+04	6.76E+04	7.64E+04	7.62E+04	7.51E+04	7.30E+04	7.09E+04	6.70E+04	6.14E+04	5.80E+04	4.35E+04	3.26E+04	4.36E+03	1.39E+01	2.52E-08
Pu-240	5.29E+04	5.24E+04	5.18E+04	5.13E+04	5.07E+04	4.81E+04	4.33E+04	3.90E+04	3.15E+04	2.30E+04	1.86E+04	6.47E+03	2.25E+03	1.38E+00	9.25E-10	0.00E+00
Pu-241	3.01E+04	2.40E+02	1.92E+00	1.53E-02	1.22E-04	3.94E-15	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
Pu-242	7.29E+01	7.29E+01	7.29E+01	7.29E+01	7.28E+01	7.28E+01	7.26E+01	7.25E+01	7.22E+01	7.18E+01	7.16E+01	7.03E+01	6.90E+01	6.06E+01	4.18E+01	1.14E+01
Ra-223	7.05E-06	2.92E-05	6.74E-05	1.21E-04	1.91E-04	8.24E-04	3.18E-03	6.99E-03	1.87E-02	4.54E-02	6.87E-02	2.33E-01	4.49E-01	1.86E+00	2.63E+00	2.65E+00
Ra-224	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Ra-225	1.55E-04	5.52E-04	1.23E-03	2.22E-03	3.55E-03	1.59E-02	7.18E-02	1.70E-01	4.82E-01	1.19E+00	1.79E+00	5.75E+00	1.05E+01	4.17E+01	9.24E+01	1.02E+02
Ra-226	2.84E-02	1.36E-01	3.48E-01	6.71E-01	1.11E+00	4.86E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Ra-228	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Rn-219	7.05E-06	2.92E-05	6.74E-05	1.21E-04	1.91E-04	8.24E-04	3.18E-03	6.99E-03	1.87E-02	4.54E-02	6.87E-02	2.33E-01	4.49E-01	1.86E+00	2.63E+00	2.65E+00
Rn-220	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Rn-222	2.84E-02	1.36E-01	3.48E-01	6.71E-01	1.11E+00	4.86E+00	1.86E+01	3.82E+01	8.68E+01	1.69E+02	2.25E+02	4.89E+02	7.24E+02	1.74E+03	1.81E+03	3.46E+02
Sb-126	3.66E+02	3.67E+02	3.66E+02	3.66E+02	3.66E+02	3.65E+02	3.62E+02	3.60E+02	3.55E+02	3.47E+02	3.42E+02	3.20E+02	2.98E+02	1.84E+02	4.59E+01	3.58E-01
Sb-126m	2.62E+03	2.62E+03	2.62E+03	2.61E+03	2.61E+03	2.60E+03	2.59E+03	2.57E+03	2.53E+03	2.48E+03	2.45E+03	2.28E+03	2.13E+03	1.31E+03	3.28E+02	2.56E+00
Se-79	1.02E+03	1.02E+03	1.02E+03	1.02E+03	1.02E+03	1.02E+03	1.02E+03	1.01E+03	1.01E+03	1.00E+03	9.99E+02	9.78E+02	9.58E+02	8.27E+02	5.43E+02	1.25E+02
Sm-147	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03	3.56E-03
Sm-151	5.67E+05	2.62E+05	1.21E+05	5.62E+04	2.60E+04	5.53E+02	2.50E-01	1.13E-04	2.30E-11	2.12E-21	4.32E-28	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Sn-126	2.62E+03	2.62E+03	2.62E+03	2.61E+03	2.61E+03	2.60E+03	2.59E+03	2.57E+03	2.53E+03	2.48E+03	2.45E+03	2.28E+03	2.13E+03	1.31E+03	3.28E+02	2.56E+00
Sr-90	1.50E+07	1.28E+06	1.09E+05	9.28E+03	7.91E+02	3.55E-03	7.16E-14	1.45E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00
Tc-99	1.84E+04	1.84E+04	1.84E+04	1.84E+04	1.84E+04	1.83E+04	1.83E+04	1.82E+04	1.81E+04	1.79E+04	1.78E+04	1.72E+04	1.67E+04	1.33E+04	6.87E+03	6.90E+02
Th-227	6.93E-06	2.88E-05	6.65E-05	1.20E-04	1.89E-04	8.13E-04	3.14E-03	6.90E-03	1.84E-02	4.48E-02	6.77E-02	2.30E-01	4.42E-01	1.83E+00	2.60E+00	2.61E+00
Th-228	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Th-229	1.55E-04	5.52E-04	1.23E-03	2.22E-03	3.55E-03	1.59E-02	7.18E-02	1.70E-01	4.82E-01	1.19E+00	1.79E+00	5.75E+00	1.05E+01	4.17E+01	9.24E+01	1.02E+02
Th-230	1.46E+00	3.77E+00	6.51E+00	9.43E+00	1.24E+01	2.77E+01	5.82E+01	8.82E+01	1.47E+02	2.33E+02	2.89E+02	5.47E+02	7.75E+02	1.73E+03	1.80E+03	3.46E+02
Th-231	9.09E-03	1.67E-02	2.42E-02	3.18E-02	3.93E-02	7.66E-02	1.50E-01	2.20E-01	3.56E-01	5.46E-01	6.63E-01	1.16E+00	1.53E+00	2.50E+00	2.65E+00	2.65E+00
Th-232	5.55E-10	1.87E-09	3.94E-09	6.78E-09	1.04E-08	3.92E-08	1.49E-07	3.22E-07	8.32E-07	1.93E-06	2.84E-06	8.66E-06	1.55E-05	6.73E-05	2.15E-04	7.23E-04
Th-234	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01
Ti-206	2.04E-08	1.27E-07	3.61E-07	7.40E-07	1.27E-06	6.41E-06	2.46E-05	5.04E-05	1.15E-04	2.23E-04	2.96E-04	6.46E-04	9.55E-04	2.29E-03	2.38E-03	4.57E-04
Ti-207	7.05E-06	2.92E-05	6.72E-05	1.21E-04	1.91E-04	8.22E-04	3.17E-03	6.97E-03	1.86E-02	4.53E-02	6.85E-02	2.33E-01	4.47E-01	1.85E+00	2.63E+00	2.64E+00
Ti-208	2.00E-10	6.71E-10	1.42E-09	2.44E-09	3.72E-09	1.41E-08	5.35E-08	1.16E-07	2.99E-07	6.95E-07	1.02E-06	3.11E-06	5.58E-06	2.42E-05	7.71E-05	2.60E-04
Ti-209	3.25E-06	1.16E-05	2.59E-05	4.67E-05	7.46E-05	3.33E-04	1.51E-03	3.57E-03	1.01E-02	2.50E-02	3.76E-02	1.21E-01	2.20E-01	8.75E-01	1.94E+00	2.15E+00
U-233	3.05E-02	6.11E-02	9.57E-02	1.34E-01	1.75E-01	4.10E-01	9.51E-01	1.52E+00	2.65E+00	4.34E+00	5.45E+00	1.09E+01	1.60E+01	4.60E+01	9.14E+01	1.02E+02
U-234	2.14E+03	2.81E+03	3.11E+03	3.25E+03	3.31E+03	3.36E+03	3.35E+03	3.34E+03	3.32E+03	3.29E+03	3.27E+03	3.18E+03	3.10E+03	2.55E+03	1.48E+03	2.59E+02
U-235	9.09E-03	1.67E-02	2.42E-02	3.18E-02	3.93E-02	7.66E-02	1.50E-01	2.20E-01	3.56E-01	5.46E-01	6.63E-01	1.16E+00	1.53E+00	2.50E+00	2.65E+00	2.65E+00
U-236	1.88E-01	3.44E-01	4.98E-01	6.50E-01	8.01E-01	1.53E+00	2.88E+00	4.10E+00	6.18E+00	8.58E+00	9.80E+00	1.32E+01	1.44E+01	1.50E+01	1.49E+01	1.46E+01
U-237	7.23E-01	5.75E-03	4.58E-05	3.66E-07	2.92E-09	9.42E-20	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
U-238	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01	6.28E+01
Y-90	1.50E+07	1.28E+06	1.09E+05	9.28E+03	7.91E+02	3.55E-03	7.17E-14	1.45E-24	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00	0.00E+00

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment II

Page II-3

Nuclide	2130	2230	2330	2430	2530	3030	4030	5030	7030	10030	12030	22030	32030	102030	302030	1002030
Zr-93	6.70E+03	6.70E+03	6.70E+03	6.70E+03	6.70E+03	6.70E+03	6.69E+03	6.69E+03	6.69E+03	6.68E+03	6.67E+03	6.64E+03	6.61E+03	6.40E+03	5.85E+03	4.26E+03
Total	6.69E+06	1.65E+06	7.87E+05	5.14E+05	2.42E+05	1.69E+05	1.51E+05	1.39E+05	1.28E+05	1.23E+05	1.08E+05	1.04E+05	1.49E+05	3.36E+05	1.01E+06	0.00E+00

Source Terms for HLW Glass Canisters

CAL-MGR-NU-000002 REV 01

Attachment III

Page III-1

Thermal Output (watts) Per Canister by Calendar Year

Year	WVDP Short	SRS Short	CIC w/ IP Short	Metal Short	Ceramic Short	Hanford Long	Year	INTEC Short
2010	199.72	699.39	705.27	2.87	79.64	56.38	2035.5	66.04
2011	194.69	634.70	649.01	2.44	77.84	55.08	2036	65.23
2012	190.66	594.02	613.77	2.09	76.15	53.78	2037	63.71
2013	186.63	568.37	590.55	1.80	74.55	52.48	2038	62.29
2014	181.59	549.65	573.36	1.54	72.85	51.28	2039	60.87
2015	177.56	534.06	560.19	1.34	71.35	50.08	2040	59.45
2016	173.53	520.49	548.04	1.16	69.75	48.88	2041	58.04
2017	169.50	506.94	537.92	1.01	68.25	47.68	2042	56.72
2018	165.48	495.42	525.80	0.88	66.75	46.58	2043	55.40
2019	162.45	482.80	515.70	0.77	65.35	45.48	2044	54.18
2020	158.42	472.30	506.62	0.67	63.95	44.38	2045	52.96
2021	155.40	460.82	496.54	0.59	62.65	43.38	2046	51.74
2022	151.37	450.34	487.47	0.52	61.25	42.38	2047	50.53
2023	148.35	440.87	478.42	0.45	59.95	41.38	2048	49.41
2024	144.32	430.52	470.36	0.40	58.75	40.38	2049	48.29
2025	141.30	421.07	461.32	0.35	57.45	39.48	2050	47.17
2026	138.27	411.62	453.28	0.31	56.25	38.48	2051	46.05
2027	135.25	402.18	445.25	0.28	55.15	37.58	2052	45.04
2028	132.22	392.75	437.22	0.25	53.95	36.78	2053	44.02
2029	129.20	384.42	430.19	0.22	52.85	35.88	2054	43.00
2030	126.18	375.99	422.17	0.20	51.75	34.98	2055	41.98
2031	123.15	367.57	414.15	0.18	50.65	34.18	2056	41.07
2032	120.13	359.25	408.13	0.16	49.65	33.38	2057	40.15
2033	118.11	351.83	401.11	0.14	48.65	32.58	2058	39.23
2034	115.09	344.51	395.10	0.13	47.65	31.88	2059	38.32
2035	113.06	336.10	387.09	0.12	46.65	31.08	2060	37.50
2036	110.04	328.79	381.08	0.11	45.74	30.38	2061	36.58
2037	107.82	322.38	375.07	0.10	44.74	29.68	2062	35.77
2038	105.40	315.07	368.06	0.09	43.84	28.98	2063	34.95
2039	103.08	307.66	363.05	0.08	43.04	28.28	2064	34.23
2040	100.86	301.35	357.04	0.08	42.14	27.68	2065	33.42
2041	98.64	295.04	351.04	0.07	41.34	26.98	2066	32.70
2042	96.42	288.64	345.03	0.07	40.44	26.38	2067	31.89
2043	94.29	282.33	340.03	0.06	39.64	25.78	2068	31.17
2044	92.27	276.03	334.03	0.06	38.94	25.18	2069	30.56
2045	90.25	270.73	329.02	0.06	38.13	24.58	2070	29.84
2046	88.24	264.32	324.02	0.05	37.43	23.98	2071	29.12
2047	86.32	259.02	320.02	0.05	36.63	23.38	2072	28.51
2048	84.50	253.72	314.02	0.05	35.93	22.88	2073	27.89
2049	82.68	248.42	310.01	0.05	35.23	22.38	2074	27.28
2050	80.86	243.11	305.01	0.05	34.63	21.78	2075	26.66
2051	79.14	237.81	300.01	0.04	33.93	21.28	2076	26.05
2052	77.42	232.51	296.01	0.04	33.33	20.78	2077	25.44
2053	75.70	227.21	292.01	0.04	32.62	20.38	2078	24.92
2054	74.08	222.91	287.01	0.04	32.02	19.88	2079	24.31
2055	72.47	218.61	283.01	0.04	31.42	19.37	2080	23.79
2056	70.95	213.31	279.01	0.04	30.82	18.97	2081	23.28

Source Terms for HLW Glass Canisters

CAL-MGR-NU-000002 REV 01

Attachment III

Page III-2

Year	WVDP Short	SRS Short	CIC w/ IP Short	Metal Short	Ceramic Short	Hanford Long	Year	INTEC Short
2057	69.43	209.01	275.00	0.04	30.22	18.47	2082	22.76
2058	67.91	204.80	271.00	0.04	29.72	18.07	2083	22.25
2059	66.49	200.50	267.00	0.04	29.11	17.67	2084	21.74
2060	65.08	196.20	264.00	0.04	28.61	17.27	2085	21.32
2061	63.76	191.90	260.00	0.04	28.11	16.87	2086	20.81
2062	62.34	188.70	256.00	0.04	27.61	16.47	2087	20.39
2063	61.02	184.40	253.00	0.04	27.11	16.07	2088	19.88
2064	59.81	180.10	250.00	0.04	26.61	15.67	2089	19.47
2065	58.49	176.80	246.00	0.04	26.11	15.37	2090	19.05
2066	57.27	173.60	243.00	0.04	25.70	14.97	2091	18.64
2067	56.16	169.30	240.00	0.04	25.20	14.67	2092	18.23
2068	54.94	166.10	236.00	0.04	24.80	14.27	2093	17.81
2069	53.82	162.80	233.00	0.04	24.40	13.97	2094	17.40
2070	52.71	159.50	231.00	0.04	23.90	13.67	2095	17.09
2071	51.59	156.30	228.00	0.04	23.50	13.27	2096	16.68
2072	50.58	153.00	225.00	0.03	23.10	12.97	2097	16.36
2073	49.56	149.80	222.00	0.03	22.69	12.67	2098	15.95
2074	48.54	146.50	220.00	0.03	22.39	12.37	2099	15.64
2075	47.53	144.30	217.30	0.03	21.99	12.17	2100	15.33
2076	46.51	141.10	213.90	0.03	21.59	11.87	2101	15.01
2077	45.60	137.80	211.70	0.03	21.29	11.57	2102	14.60
2078	44.68	135.60	209.40	0.03	20.89	11.27	2103	14.29
2079	43.77	132.30	207.30	0.03	20.58	11.07	2104	13.98
2080	42.95	130.20	204.10	0.03	20.28	10.77	2105	13.77
2081	42.03	127.60	202.10	0.03	19.88	10.57	2106	13.45
2082	41.22	125.10	200.10	0.03	19.58	10.27	2107	13.14
2083	40.40	122.60	197.10	0.03	19.28	10.07	2108	12.83
2084	39.59	120.20	195.20	0.03	18.98	9.84	2109	12.62
2085	38.77	117.90	193.30	0.03	18.67	9.61	2110	12.31
2086	38.06	115.60	191.50	0.03	18.37	9.39	2111	12.10
2087	37.34	113.20	188.70	0.03	18.17	9.17	2112	11.78
2088	36.63	111.10	186.90	0.03	17.87	8.96	2113	11.56
2089	35.92	108.90	185.20	0.03	17.57	8.76	2114	11.32
2090	35.20	106.80	183.60	0.03	17.37	8.56	2115	11.08
2091	34.49	104.80	181.90	0.03	17.07	8.36	2125	8.98
2092	33.87	102.80	179.30	0.03	16.86	8.16	2135	7.32
2093	33.16	100.70	177.80	0.03	16.56	7.98	2145	5.99
2094	32.54	98.80	176.30	0.03	16.33	7.80	2155	4.94
2095	31.93	96.90	174.80	0.03	16.10	7.62	2165	4.10
2096	31.31	95.10	172.40	0.03	15.88	7.44	2175	3.43
2097	30.80	93.30	171.00	0.03	15.66	7.27	2185	2.89
2098	30.19	91.50	169.60	0.03	15.43	7.11	2195	2.46
2099	29.57	89.80	168.30	0.03	15.22	6.95	2205	2.11
2100	29.06	88.10	165.90	0.03	15.02	6.79	2215	1.83
2101	28.54	86.50	164.70	0.03	14.82	6.64	2265	1.02
2102	28.03	84.80	163.40	0.03	14.62	6.49	2315	0.68
2103	27.52	83.30	162.20	0.03	14.43	6.34	2365	0.52
2104	27.00	81.80	161.00	0.03	14.24	6.20	2415	0.43
2105	26.49	80.30	158.80	0.03	14.06	6.06	2465	0.37

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment III

Page III-3

Year	WVDP Short	SRS Short	CIC w/ IP Short	Metal Short	Ceramic Short	Hanford Long	Year	INTEC Short
2106	26.08	78.80	157.70	0.03	13.88	5.92	2515	0.32
2107	25.56	77.30	156.60	0.03	13.71	5.79	2565	0.29
2108	25.15	75.90	155.50	0.03	13.54	5.66	2615	0.26
2109	24.64	74.50	153.50	0.03	13.37	5.53	2665	0.24
2110	24.22	73.10	152.40	0.03	13.21	5.41	2715	0.23
2120	20.39	61.20	141.40	0.03	11.77	4.31	2765	0.21
2130	17.37	51.50	132.30	0.03	10.65	3.45	2815	0.20
2140	14.97	43.60	124.70	0.03	9.75	2.77	2865	0.19
2150	13.04	37.20	119.30	0.03	9.05	2.24	2915	0.18
2160	11.50	32.10	113.80	0.03	8.48	1.82	2965	0.18
2170	10.27	27.80	109.70	0.03	8.05	1.49	3015	0.17
2180	9.29	24.23	106.15	0.03	7.70	1.22	3515	0.12
2190	8.48	21.31	103.16	0.03	7.42	1.01	4015	0.10
2200	7.84	18.90	100.63	0.03	7.19	0.85	4515	0.09
2210	7.31	16.81	98.38	0.03	7.02	0.72	5015	0.08
2260	5.74	10.35	90.68	0.03	6.54	0.37	5515	0.08
2310	4.99	7.09	86.07	0.03	6.35	0.26	6015	0.08
2360	4.52	5.19	82.82	0.03	6.27	0.22	6515	0.07
2410	4.16	4.00	80.34	0.03	6.22	0.21	7015	0.07
2460	3.85	3.20	78.32	0.03	6.17	0.20	7515	0.07
2510	3.57	2.65	76.61	0.03	6.13	0.19	8015	0.07
2560	3.32	2.26	75.11	0.03	6.10	0.18	8515	0.07
2610	3.09	1.98	73.81	0.03	6.06	0.18	9015	0.07
2660	2.88	1.77	72.71	0.03	6.03	0.17	9515	0.06
2710	2.69	1.61	71.71	0.03	6.00	0.17	10015	0.06
2760	2.51	1.49	70.71	0.03	5.98	0.16	10515	0.06
2810	2.35	1.39	69.81	0.03	5.95	0.16	11015	0.06
2860	2.20	1.31	69.01	0.03	5.93	0.15	11515	0.06
2910	2.06	1.25	68.31	0.03	5.90	0.15	12015	0.06
2960	1.93	1.19	67.61	0.03	5.88	0.15	17015	0.05
3010	1.81	1.14	66.91	0.03	5.86	0.14	22015	0.04
3510	1.02	0.86	62.21	0.03	5.69	0.12	27015	0.04
4010	0.66	0.72	59.41	0.03	5.56	0.11	32015	0.03
4510	0.50	0.66	57.41	0.03	5.45	0.11	37015	0.03
5010	0.42	0.62	55.81	0.03	5.35	0.10	42015	0.03
5510	0.38	0.59	54.41	0.03	5.26	0.10	47015	0.03
6010	0.35	0.57	53.21	0.03	5.17	0.10	52015	0.03
6510	0.34	0.56	52.01	0.03	5.08	0.10	57015	0.02
7010	0.33	0.54	50.91	0.03	5.00	0.09	62015	0.02
7510	0.32	0.53	49.81	0.03	4.92	0.09	67015	0.02
8010	0.31	0.52	48.71	0.03	4.84	0.09	72015	0.02
8510	0.30	0.51	47.71	0.03	4.76	0.09	77015	0.02
9010	0.30	0.49	46.71	0.03	4.68	0.09	82015	0.02
9510	0.29	0.48	45.81	0.03	4.60	0.09	87015	0.02
10010	0.28	0.47	44.81	0.03	4.53	0.09	92015	0.02
10510	0.28	0.46	43.91	0.03	4.46	0.08	97015	0.02
11010	0.27	0.45	43.11	0.03	4.39	0.08	102015	0.02
11510	0.27	0.44	42.21	0.03	4.32	0.08	152015	0.02
12010	0.26	0.43	41.41	0.03	4.25	0.08	202015	0.02

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment III

Page III-4

Year	WVDP Short	SRS Short	CIC w/ IP Short	Metal Short	Ceramic Short	Hanford Long		Year	INTEC Short
17010	0.21	0.36	34.31	0.03	3.63	0.07		252015	0.02
22010	0.18	0.30	28.81	0.03	3.12	0.06		302015	0.02
27010	0.15	0.26	24.41	0.03	2.69	0.06		352015	0.02
32010	0.13	0.23	20.81	0.03	2.32	0.05		402015	0.01
37010	0.12	0.21	17.91	0.03	2.00	0.04		452015	0.01
42010	0.11	0.19	15.41	0.03	1.73	0.04		502015	0.01
47010	0.10	0.17	13.31	0.03	1.50	0.04		552015	0.01
52010	0.09	0.16	11.51	0.03	1.30	0.03		602015	0.01
57010	0.08	0.15	9.92	0.03	1.13	0.03		652015	0.01
62010	0.07	0.14	8.60	0.03	0.98	0.03		702015	0.01
67010	0.07	0.14	7.45	0.03	0.85	0.03		752015	0.01
72010	0.06	0.13	6.47	0.03	0.73	0.02		802015	0.01
77010	0.06	0.12	5.62	0.03	0.64	0.02		852015	0.01
82010	0.06	0.12	4.88	0.03	0.55	0.02		902015	0.00
87010	0.05	0.12	4.24	0.03	0.48	0.02		952015	0.00
92010	0.05	0.11	3.68	0.03	0.42	0.02		1002015	0.00
97010	0.05	0.11	3.21	0.03	0.36	0.02			
102010	0.05	0.11	2.79	0.03	0.31	0.02			
152010	0.04	0.10	0.77	0.03	0.08	0.01			
202010	0.04	0.09	0.29	0.03	0.03	0.01			
252010	0.04	0.09	0.17	0.03	0.01	0.01			
302010	0.04	0.08	0.14	0.03	0.01	0.01			
352010	0.04	0.08	0.13	0.02	0.01	0.01			
402010	0.04	0.07	0.12	0.02	0.01	0.01			
452010	0.04	0.06	0.11	0.02	0.01	0.01			
502010	0.04	0.06	0.11	0.02	0.01	0.01			
552010	0.04	0.05	0.10	0.02	0.01	0.01			
602010	0.03	0.04	0.10	0.01	0.01	0.01			
652010	0.03	0.04	0.10	0.01	0.01	0.01			
702010	0.03	0.04	0.09	0.01	0.01	0.01			
752010	0.03	0.03	0.09	0.01	0.01	0.01			
802010	0.03	0.03	0.09	0.01	0.01	0.01			
852010	0.03	0.03	0.08	0.01	0.01	0.01			
902010	0.03	0.02	0.08	0.01	0.01	0.01			
952010	0.03	0.02	0.08	0.01	0.01	0.01			
1002010	0.03	0.02	0.07	0.01	0.01	0.01			

Heat Output of a SRS HLW Glass Canister

Heat Output of a WVDP HLW Glass Canister

Heat Output of a Hanford HLW Glass Canister

Heat Output of a INTEC HLW Glass Canister

Heat Output of a ANL-West HLW Ceramic Canister

Heat Output of a ANL-West HLW Metal Canister

Heat Output of a CIC HLW Glass Canister

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment V

Page V-1

Gamma Source Spectra of SRS HLW Canister											
Calendar Year	year 2010.1		year 2015		year 2020		year 2060		year 2110		
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	
1.0000E-02 to 5.0000E-02	1.29E+15	3.87E+13	9.01E+14	2.70E+13	7.85E+14	2.36E+13	2.95E+14	8.85E+12	8.85E+13	2.66E+12	
5.0000E-02 to 1.0000E-01	3.89E+14	2.91E+13	2.66E+14	1.99E+13	2.32E+14	1.74E+13	8.70E+13	6.52E+12	2.60E+13	1.95E+12	
1.0000E-01 to 2.0000E-01	3.02E+14	4.53E+13	1.85E+14	2.77E+13	1.60E+14	2.40E+13	5.84E+13	8.77E+12	1.71E+13	2.56E+12	
2.0000E-01 to 3.0000E-01	8.58E+13	2.15E+13	5.78E+13	1.45E+13	5.06E+13	1.26E+13	1.87E+13	4.67E+12	5.46E+12	1.36E+12	
3.0000E-01 to 4.0000E-01	6.27E+13	2.19E+13	4.10E+13	1.44E+13	3.59E+13	1.26E+13	1.34E+13	4.68E+12	3.91E+12	1.37E+12	
4.0000E-01 to 6.0000E-01	8.55E+13	4.27E+13	3.52E+13	1.76E+13	2.63E+13	1.31E+13	8.97E+12	4.48E+12	2.62E+12	1.31E+12	
6.0000E-01 to 8.0000E-01	1.34E+15	9.38E+14	1.17E+15	8.16E+14	1.03E+15	7.24E+14	4.09E+14	2.86E+14	1.29E+14	9.01E+13	
8.0000E-01 to 1.0000E+00	2.08E+13	1.87E+13	1.07E+13	9.64E+12	7.77E+12	6.99E+12	1.84E+12	1.65E+12	5.04E+11	4.54E+11	
1.0000E+00 to 1.3300E+00	2.91E+13	3.39E+13	1.64E+13	1.91E+13	1.08E+13	1.25E+13	1.24E+12	1.44E+12	2.99E+11	3.49E+11	
1.3300E+00 to 1.6600E+00	6.18E+12	9.24E+12	2.52E+12	3.77E+12	1.54E+12	2.30E+12	2.06E+11	3.07E+11	5.61E+10	8.38E+10	
1.6600E+00 to 2.0000E+00	4.86E+11	8.89E+11	1.13E+11	2.08E+11	9.26E+10	1.69E+11	3.43E+10	6.28E+10	1.00E+10	1.83E+10	
2.0000E+00 to 2.5000E+00	2.70E+12	6.07E+12	4.29E+10	9.65E+10	5.26E+09	1.18E+10	1.76E+09	3.95E+09	5.13E+08	1.15E+09	
2.5000E+00 to 3.0000E+00	1.91E+10	5.27E+10	6.30E+08	1.73E+09	2.14E+07	5.89E+07	2.84E+05	7.81E+05	6.36E+04	1.75E+05	
3.0000E+00 to 4.0000E+00	2.15E+09	7.51E+09	7.74E+07	2.71E+08	3.59E+06	1.26E+07	2.54E+05	8.87E+05	5.59E+04	1.96E+05	
4.0000E+00 to 5.0000E+00	5.20E+05	2.34E+06	4.33E+05	1.95E+06	3.60E+05	1.62E+06	8.50E+04	3.83E+05	1.85E+04	8.31E+04	
5.0000E+00 to 6.5000E+00	2.09E+05	1.20E+06	1.74E+05	9.99E+05	1.44E+05	8.29E+05	3.39E+04	1.95E+05	7.27E+03	4.18E+04	
6.5000E+00 to 8.0000E+00	4.09E+04	2.96E+05	3.40E+04	2.47E+05	2.82E+04	2.05E+05	6.62E+03	4.80E+04	1.40E+03	1.02E+04	
8.0000E+00 to 1.0000E+01	8.67E+03	7.81E+04	7.22E+03	6.50E+04	5.99E+03	5.39E+04	1.40E+03	1.26E+04	2.94E+02	2.65E+03	
Total	3.61E+15	1.21E+15	2.68E+15	9.70E+14	2.34E+15	8.50E+14	8.94E+14	3.28E+14	2.73E+14	1.02E+14	

Calendar Year	year 2510		year 3010		year 12010		year 102010		year 1002010		
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	
1.0000E-02 to 5.0000E-02	2.13E+11	6.38E+09	9.06E+10	2.72E+09	2.93E+10	8.79E+08	1.89E+10	5.68E+08	4.75E+09	1.43E+08	
5.0000E-02 to 1.0000E-01	3.36E+11	2.52E+10	1.57E+11	1.18E+10	1.23E+10	9.22E+08	1.12E+10	8.43E+08	1.91E+09	1.43E+08	
1.0000E-01 to 2.0000E-01	2.36E+09	3.54E+08	1.27E+09	1.90E+08	1.25E+09	1.88E+08	2.21E+09	3.31E+08	5.98E+08	8.97E+07	
2.0000E-01 to 3.0000E-01	8.17E+08	2.04E+08	5.25E+08	1.31E+08	9.32E+08	2.33E+08	3.96E+09	9.90E+08	8.97E+08	2.24E+08	
3.0000E-01 to 4.0000E-01	7.09E+08	2.48E+08	5.48E+08	1.92E+08	1.11E+09	3.88E+08	4.78E+09	1.67E+09	1.12E+09	3.92E+08	
4.0000E-01 to 6.0000E-01	1.38E+10	6.92E+09	1.37E+10	6.83E+09	1.29E+10	6.45E+09	7.39E+09	3.70E+09	2.85E+08	1.42E+08	
6.0000E-01 to 8.0000E-01	4.57E+10	3.20E+10	3.32E+10	2.32E+10	3.18E+10	2.23E+10	2.21E+10	1.55E+10	1.13E+09	7.92E+08	
8.0000E-01 to 1.0000E+00	8.35E+08	7.52E+08	8.07E+08	7.26E+08	8.40E+08	7.56E+08	1.05E+09	9.48E+08	1.36E+08	1.23E+08	
1.0000E+00 to 1.3300E+00	4.54E+08	5.29E+08	4.43E+08	5.16E+08	7.72E+08	9.00E+08	3.03E+09	3.53E+09	5.70E+08	6.65E+08	
1.3300E+00 to 1.6600E+00	6.58E+07	9.84E+07	6.57E+07	9.82E+07	2.43E+08	3.63E+08	1.47E+09	2.19E+09	3.02E+08	4.52E+08	
1.6600E+00 to 2.0000E+00	2.20E+06	4.03E+06	6.69E+06	1.22E+07	3.08E+08	5.64E+08	2.38E+09	4.36E+09	4.80E+08	8.79E+08	
2.0000E+00 to 2.5000E+00	5.71E+05	1.28E+06	2.46E+06	5.53E+06	1.18E+08	2.65E+08	9.10E+08	2.05E+09	1.83E+08	4.13E+08	
2.5000E+00 to 3.0000E+00	1.58E+04	4.36E+04	4.61E+04	1.27E+05	1.94E+06	5.32E+06	1.49E+07	4.11E+07	3.01E+06	8.29E+06	
3.0000E+00 to 4.0000E+00	8.29E+03	2.90E+04	1.45E+04	5.06E+04	4.46E+05	1.56E+06	3.43E+06	1.20E+07	6.92E+05	2.42E+06	
4.0000E+00 to 5.0000E+00	2.08E+03	9.35E+03	1.74E+03	7.85E+03	8.26E+02	3.72E+03	2.22E+02	1.00E+03	5.72E+01	2.57E+02	
5.0000E+00 to 6.5000E+00	8.19E+02	4.71E+03	6.93E+02	3.99E+03	3.29E+02	1.89E+03	8.87E+01	5.10E+02	2.28E+01	1.31E+02	
6.5000E+00 to 8.0000E+00	1.58E+02	1.15E+03	1.35E+02	9.78E+02	6.41E+01	4.65E+02	1.73E+01	1.26E+02	4.47E+00	3.24E+01	
8.0000E+00 to 1.0000E+01	3.32E+01	2.98E+02	2.85E+01	2.56E+02	1.36E+01	1.22E+02	3.66E+00	3.30E+01	9.46E-01	8.51E+00	
Total	6.13E+11	7.27E+10	2.98E+11	4.64E+10	9.19E+10	3.42E+10	7.95E+10	3.67E+10	1.24E+10	4.47E+09	

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment V

Page V-2

Gamma Source Spectra of WVDP HLW Canister										
Calendar Year	year 2010		year 2015		year 2020		year 2060		year 2110	
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s
1.0000E-02 to 5.0000E-02	3.41E+14	1.02E+13	3.02E+14	9.07E+12	2.68E+14	8.03E+12	1.02E+14	3.06E+12	3.09E+13	9.26E+11
5.0000E-02 to 1.0000E-01	1.00E+14	7.54E+12	8.91E+13	6.68E+12	7.91E+13	5.93E+12	3.10E+13	2.32E+12	1.04E+13	7.82E+11
1.0000E-01 to 2.0000E-01	6.70E+13	1.00E+13	5.90E+13	8.86E+12	5.21E+13	7.81E+12	1.94E+13	2.91E+12	5.71E+12	8.56E+11
2.0000E-01 to 3.0000E-01	2.12E+13	5.31E+12	1.87E+13	4.68E+12	1.65E+13	4.14E+12	6.17E+12	1.54E+12	1.82E+12	4.55E+11
3.0000E-01 to 4.0000E-01	1.51E+13	5.28E+12	1.33E+13	4.67E+12	1.18E+13	4.12E+12	4.41E+12	1.54E+12	1.29E+12	4.52E+11
4.0000E-01 to 6.0000E-01	1.03E+13	5.13E+12	9.03E+12	4.51E+12	7.95E+12	3.97E+12	2.94E+12	1.47E+12	8.68E+11	4.34E+11
6.0000E-01 to 8.0000E-01	5.25E+14	3.68E+14	4.68E+14	3.27E+14	4.16E+14	2.91E+14	1.65E+14	1.16E+14	5.20E+13	3.64E+13
8.0000E-01 to 1.0000E+00	2.73E+12	2.45E+12	2.24E+12	2.01E+12	1.86E+12	1.68E+12	5.78E+11	5.20E+11	1.66E+11	1.49E+11
1.0000E+00 to 1.3300E+00	2.58E+12	3.00E+12	1.97E+12	2.29E+12	1.53E+12	1.78E+12	3.57E+11	4.16E+11	9.76E+10	1.14E+11
1.3300E+00 to 1.6600E+00	2.92E+11	4.36E+11	2.41E+11	3.60E+11	2.02E+11	3.02E+11	6.43E+10	9.61E+10	1.84E+10	2.76E+10
1.6600E+00 to 2.0000E+00	3.87E+10	7.07E+10	3.42E+10	6.25E+10	3.02E+10	5.52E+10	1.13E+10	2.06E+10	3.29E+09	6.02E+09
2.0000E+00 to 2.5000E+00	1.97E+09	4.44E+09	1.74E+09	3.92E+09	1.54E+09	3.47E+09	5.75E+08	1.29E+09	1.68E+08	3.78E+08
2.5000E+00 to 3.0000E+00	3.81E+08	1.05E+09	3.69E+08	1.02E+09	3.57E+08	9.83E+08	2.80E+08	7.70E+08	2.18E+08	5.98E+08
3.0000E+00 to 4.0000E+00	1.99E+05	6.95E+05	1.65E+05	5.78E+05	1.37E+05	4.81E+05	3.46E+04	1.21E+05	1.01E+04	3.55E+04
4.0000E+00 to 5.0000E+00	6.69E+04	3.01E+05	5.56E+04	2.50E+05	4.63E+04	2.08E+05	1.15E+04	5.18E+04	3.27E+03	1.47E+04
5.0000E+00 to 6.5000E+00	2.68E+04	1.54E+05	2.23E+04	1.28E+05	1.85E+04	1.06E+05	4.58E+03	2.63E+04	1.27E+03	7.32E+03
6.5000E+00 to 8.0000E+00	5.25E+03	3.81E+04	4.36E+03	3.16E+04	3.63E+03	2.63E+04	8.92E+02	6.46E+03	2.43E+02	1.76E+03
8.0000E+00 to 1.0000E+01	1.11E+03	1.00E+04	9.25E+02	8.32E+03	7.69E+02	6.92E+03	1.88E+02	1.69E+03	5.07E+01	4.56E+02
Total	1.09E+15	4.17E+14	9.64E+14	3.71E+14	8.55E+14	3.29E+14	3.32E+14	1.29E+14	1.03E+14	4.06E+13

Calendar Year	year 2510		year 3010		year 12010		year 102010		year 1002010	
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s
1.0000E-02 to 5.0000E-02	4.02E+11	1.21E+10	2.09E+11	6.28E+09	3.93E+10	1.18E+09	1.91E+10	5.73E+08	9.57E+09	2.87E+08
5.0000E-02 to 1.0000E-01	1.05E+12	7.85E+10	4.97E+11	3.73E+10	3.19E+10	2.39E+09	1.22E+10	9.15E+08	5.66E+09	4.25E+08
1.0000E-01 to 2.0000E-01	2.49E+10	3.74E+09	2.31E+10	3.46E+09	1.13E+10	1.70E+09	2.27E+09	3.40E+08	1.53E+09	2.30E+08
2.0000E-01 to 3.0000E-01	1.61E+10	4.03E+09	1.54E+10	3.84E+09	7.72E+09	1.93E+09	1.44E+09	3.60E+08	1.08E+09	2.71E+08
3.0000E-01 to 4.0000E-01	4.39E+09	1.54E+09	4.36E+09	1.53E+09	3.47E+09	1.21E+09	2.32E+09	8.11E+08	1.52E+09	5.33E+08
4.0000E-01 to 6.0000E-01	1.30E+10	6.50E+09	1.29E+10	6.47E+09	1.23E+10	6.17E+09	7.27E+09	3.63E+09	1.23E+09	6.15E+08
6.0000E-01 to 8.0000E-01	3.55E+10	2.49E+10	3.04E+10	2.13E+10	2.86E+10	2.00E+10	1.56E+10	1.09E+10	1.98E+08	1.39E+08
8.0000E-01 to 1.0000E+00	9.76E+08	8.78E+08	9.60E+08	8.64E+08	9.11E+08	8.20E+08	5.81E+08	5.23E+08	1.83E+08	1.65E+08
1.0000E+00 to 1.3300E+00	4.19E+08	4.89E+08	4.11E+08	4.79E+08	4.09E+08	4.76E+08	3.69E+08	4.29E+08	7.78E+07	9.06E+07
1.3300E+00 to 1.6600E+00	9.86E+07	1.47E+08	9.88E+07	1.48E+08	1.21E+08	1.81E+08	1.99E+08	2.98E+08	1.46E+08	2.19E+08
1.6600E+00 to 2.0000E+00	3.98E+06	7.28E+06	4.36E+06	7.99E+06	2.12E+07	3.88E+07	1.30E+08	2.38E+08	4.92E+07	9.01E+07
2.0000E+00 to 2.5000E+00	1.98E+05	4.45E+05	4.08E+05	9.18E+05	6.85E+06	1.54E+07	4.84E+07	1.09E+08	1.77E+07	3.98E+07
2.5000E+00 to 3.0000E+00	1.22E+08	3.35E+08	1.20E+08	3.30E+08	1.18E+08	3.25E+08	1.03E+08	2.83E+08	8.00E+07	2.20E+08
3.0000E+00 to 4.0000E+00	5.17E+03	1.81E+04	5.41E+03	1.89E+04	2.74E+04	9.58E+04	1.83E+05	6.41E+05	6.68E+04	2.34E+05
4.0000E+00 to 5.0000E+00	1.46E+03	6.57E+03	1.29E+03	5.79E+03	5.17E+02	2.33E+03	1.13E+02	5.07E+02	2.69E+01	1.21E+02
5.0000E+00 to 6.5000E+00	5.66E+02	3.25E+03	5.06E+02	2.91E+03	2.06E+02	1.19E+03	4.50E+01	2.59E+02	1.07E+01	6.13E+01
6.5000E+00 to 8.0000E+00	1.07E+02	7.79E+02	9.76E+01	7.07E+02	4.02E+01	2.91E+02	8.78E+00	6.37E+01	2.07E+00	1.50E+01
8.0000E+00 to 1.0000E+01	2.23E+01	2.01E+02	2.05E+01	1.84E+02	8.50E+00	7.65E+01	1.86E+00	1.67E+01	4.35E+01	3.91E+00
Total	1.54E+12	1.33E+11	7.95E+11	8.20E+10	1.36E+11	3.65E+10	6.16E+10	1.94E+10	2.13E+10	3.32E+09

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment V

Page V-3

Gamma Source Spectra of Hanford HLW Canister											
Calendar Year	year 2010		year 2015		year 2020		year 2060		year 2110		
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	
1.0000E-02 to 5.0000E-02	9.88E+13	2.97E+12	8.75E+13	2.63E+12	7.76E+13	2.33E+12	2.95E+13	8.84E+11	8.81E+12	2.64E+11	
5.0000E-02 to 1.0000E-01	2.83E+13	2.13E+12	2.51E+13	1.88E+12	2.22E+13	1.66E+12	8.38E+12	6.28E+11	2.50E+12	1.88E+11	
1.0000E-01 to 2.0000E-01	1.90E+13	2.85E+12	1.68E+13	2.52E+12	1.49E+13	2.23E+12	5.57E+12	8.35E+11	1.64E+12	2.45E+11	
2.0000E-01 to 3.0000E-01	6.04E+12	1.51E+12	5.34E+12	1.34E+12	4.72E+12	1.18E+12	1.77E+12	4.42E+11	5.18E+11	1.29E+11	
3.0000E-01 to 4.0000E-01	4.32E+12	1.51E+12	3.82E+12	1.34E+12	3.38E+12	1.18E+12	1.26E+12	4.42E+11	3.69E+11	1.29E+11	
4.0000E-01 to 6.0000E-01	2.89E+12	1.44E+12	2.55E+12	1.27E+12	2.25E+12	1.13E+12	8.42E+11	4.21E+11	2.48E+11	1.24E+11	
6.0000E-01 to 8.0000E-01	1.60E+14	1.12E+14	1.42E+14	9.95E+13	1.27E+14	8.87E+13	5.02E+13	3.52E+13	1.58E+13	1.11E+13	
8.0000E-01 to 1.0000E+00	5.83E+11	5.25E+11	5.09E+11	4.58E+11	4.45E+11	4.01E+11	1.62E+11	1.46E+11	4.72E+10	4.25E+10	
1.0000E+00 to 1.3300E+00	3.86E+11	4.49E+11	3.27E+11	3.81E+11	2.80E+11	3.26E+11	9.60E+10	1.12E+11	2.78E+10	3.24E+10	
1.3300E+00 to 1.6600E+00	6.62E+10	9.90E+10	5.73E+10	8.57E+10	4.99E+10	7.46E+10	1.80E+10	2.70E+10	5.26E+09	7.86E+09	
1.6600E+00 to 2.0000E+00	1.10E+10	2.02E+10	9.76E+09	1.79E+10	8.63E+09	1.58E+10	3.22E+09	5.90E+09	9.41E+08	1.72E+09	
2.0000E+00 to 2.5000E+00	5.65E+08	1.27E+09	4.99E+08	1.12E+09	4.41E+08	9.93E+08	1.65E+08	3.71E+08	4.81E+07	1.08E+08	
2.5000E+00 to 3.0000E+00	1.09E+08	3.00E+08	9.89E+07	2.72E+08	9.11E+07	2.51E+08	5.90E+07	1.62E+08	3.66E+07	1.01E+08	
3.0000E+00 to 4.0000E+00	8.19E+02	2.87E+03	6.65E+02	2.33E+03	6.42E+02	2.25E+03	5.71E+02	2.00E+03	5.54E+02	1.94E+03	
4.0000E+00 to 5.0000E+00	2.09E+02	9.38E+02	2.01E+02	9.04E+02	1.95E+02	8.76E+02	1.71E+02	7.67E+02	1.64E+02	7.36E+02	
5.0000E+00 to 6.5000E+00	8.21E+01	4.72E+02	7.90E+01	4.55E+02	7.65E+01	4.40E+02	6.69E+01	3.85E+02	6.42E+01	3.69E+02	
6.5000E+00 to 8.0000E+00	1.58E+01	1.15E+02	1.52E+01	1.10E+02	1.47E+01	1.07E+02	1.28E+01	9.31E+01	1.23E+01	8.94E+01	
8.0000E+00 to 1.0000E+01	3.32E+00	2.99E+01	3.19E+00	2.87E+01	3.09E+00	2.78E+01	2.69E+00	2.42E+01	2.58E+00	2.32E+01	
Total	3.20E+14	1.25E+14	2.84E+14	1.11E+14	2.52E+14	9.92E+13	9.78E+13	3.91E+13	3.00E+13	1.22E+13	
Calendar Year	year 2510		year 3010		year 12010		year 102010		year 1002010		
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	
1.0000E-02 to 5.0000E-02	1.77E+10	5.32E+08	1.22E+10	3.67E+08	7.94E+09	2.38E+08	5.35E+09	1.60E+08	2.14E+09	6.41E+07	
5.0000E-02 to 1.0000E-01	2.83E+10	2.12E+09	1.45E+10	1.09E+09	3.67E+09	2.75E+08	2.84E+09	2.13E+08	1.04E+09	7.81E+07	
1.0000E-01 to 2.0000E-01	5.88E+08	8.82E+07	5.00E+08	7.50E+07	6.44E+08	9.65E+07	6.43E+08	9.64E+07	3.57E+08	5.36E+07	
2.0000E-01 to 3.0000E-01	4.11E+08	1.03E+08	3.88E+08	9.70E+07	4.67E+08	1.17E+08	4.87E+08	1.22E+08	4.15E+08	1.04E+08	
3.0000E-01 to 4.0000E-01	3.82E+08	1.34E+08	3.65E+08	1.28E+08	3.69E+08	1.29E+08	4.40E+08	1.54E+08	4.92E+08	1.72E+08	
4.0000E-01 to 6.0000E-01	2.65E+09	1.32E+09	2.64E+09	1.32E+09	2.64E+09	1.32E+09	1.59E+09	7.96E+08	1.45E+08	7.25E+07	
6.0000E-01 to 8.0000E-01	7.78E+09	5.44E+09	6.23E+09	4.36E+09	5.89E+09	4.12E+09	3.41E+09	2.39E+09	4.50E+08	3.15E+08	
8.0000E-01 to 1.0000E+00	1.75E+08	1.58E+08	1.72E+08	1.55E+08	1.67E+08	1.50E+08	1.23E+08	1.11E+08	6.37E+07	5.73E+07	
1.0000E+00 to 1.3300E+00	8.75E+07	1.02E+08	8.62E+07	1.00E+08	9.89E+07	1.15E+08	1.87E+08	2.18E+08	2.29E+08	2.67E+08	
1.3300E+00 to 1.6600E+00	1.46E+07	2.19E+07	1.55E+07	2.31E+07	3.57E+07	5.33E+07	9.87E+07	1.48E+08	1.22E+08	1.83E+08	
1.6600E+00 to 2.0000E+00	8.04E+05	1.47E+06	9.96E+05	1.82E+06	1.41E+07	2.58E+07	1.18E+08	2.16E+08	1.91E+08	3.49E+08	
2.0000E+00 to 2.5000E+00	5.26E+04	1.18E+05	1.45E+05	3.26E+05	5.16E+06	1.16E+07	4.49E+07	1.01E+08	7.26E+07	1.63E+08	
2.5000E+00 to 3.0000E+00	2.50E+06	6.87E+06	1.85E+06	5.09E+06	1.93E+06	5.30E+06	2.58E+06	7.09E+06	3.04E+06	8.35E+06	
3.0000E+00 to 4.0000E+00	6.47E+02	2.26E+03	9.80E+02	3.43E+03	1.97E+04	6.90E+04	1.69E+05	5.93E+05	2.74E+05	9.60E+05	
4.0000E+00 to 5.0000E+00	1.54E+02	6.94E+02	1.47E+02	6.60E+02	8.35E+01	3.76E+02	4.21E+01	1.89E+02	4.06E+01	1.83E+02	
5.0000E+00 to 6.5000E+00	6.08E+01	3.50E+02	5.80E+01	3.34E+02	3.30E+01	1.90E+02	1.68E+01	9.66E+01	1.63E+01	9.35E+01	
6.5000E+00 to 8.0000E+00	1.17E+01	8.51E+01	1.12E+01	8.15E+01	6.40E+00	4.64E+01	3.28E+00	3.18E+01	6.18E+00	2.31E+01	
8.0000E+00 to 1.0000E+01	2.47E+00	2.22E+01	2.37E+00	2.13E+01	1.35E+00	1.21E+01	6.95E-01	6.25E+00	3.75E-01	6.07E+00	
Total	5.81E+10	1.00E+10	3.71E+10	7.72E+09	2.19E+10	6.66E+09	1.53E+10	4.73E+09	5.72E+09	1.89E+09	

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment V

Page V-4

Gamma Source Spectra of INTEC HLW Canister										
Calendar Year	year 2036		year 2040		year 2045		year 2065		year 2115	
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s
1.0000E-02 to 5.0000E-02	1.17E+14	3.51E+12	1.06E+14	3.18E+12	9.39E+13	2.82E+12	5.78E+13	1.73E+12	1.72E+13	5.17E+11
5.0000E-02 to 1.0000E-01	3.52E+13	2.64E+12	3.19E+13	2.39E+12	2.82E+13	2.12E+12	1.73E+13	1.30E+12	5.16E+12	3.87E+11
1.0000E-01 to 2.0000E-01	2.38E+13	3.57E+12	2.16E+13	3.24E+12	1.91E+13	2.86E+12	1.17E+13	1.75E+12	3.42E+12	5.13E+11
2.0000E-01 to 3.0000E-01	7.63E+12	1.91E+12	6.92E+12	1.73E+12	6.11E+12	1.53E+12	3.74E+12	9.34E+11	1.09E+12	2.73E+11
3.0000E-01 to 4.0000E-01	5.48E+12	1.92E+12	4.97E+12	1.74E+12	4.39E+12	1.54E+12	2.69E+12	9.40E+11	7.85E+11	2.75E+11
4.0000E-01 to 6.0000E-01	3.67E+12	1.84E+12	3.33E+12	1.66E+12	2.94E+12	1.47E+12	1.80E+12	8.98E+11	5.26E+11	2.63E+11
6.0000E-01 to 8.0000E-01	1.47E+14	1.03E+14	1.34E+14	9.36E+13	1.19E+14	8.34E+13	7.50E+13	5.25E+13	2.36E+13	1.65E+13
8.0000E-01 to 1.0000E+00	7.55E+11	6.79E+11	6.75E+11	6.07E+11	5.89E+11	5.30E+11	3.50E+11	3.15E+11	1.01E+11	9.08E+10
1.0000E+00 to 1.3300E+00	5.07E+11	5.90E+11	4.42E+11	5.15E+11	3.77E+11	4.39E+11	2.12E+11	2.47E+11	5.95E+10	6.94E+10
1.3300E+00 to 1.6600E+00	8.33E+10	1.25E+11	7.46E+10	1.11E+11	6.52E+10	9.74E+10	3.89E+10	5.81E+10	1.12E+10	1.68E+10
1.6600E+00 to 2.0000E+00	1.41E+10	2.58E+10	1.28E+10	2.34E+10	1.13E+10	2.07E+10	6.90E+09	1.26E+10	2.01E+09	3.68E+09
2.0000E+00 to 2.5000E+00	7.21E+08	1.62E+09	6.53E+08	1.47E+09	5.77E+08	1.30E+09	3.53E+08	7.94E+08	1.03E+08	2.32E+08
2.5000E+00 to 3.0000E+00	1.86E+04	5.12E+04	4.35E+04	1.20E+05	4.80E+04	1.32E+05	4.10E+04	1.13E+05	2.61E+04	7.18E+04
3.0000E+00 to 4.0000E+00	2.97E+03	1.04E+04	2.92E+03	1.02E+04	2.85E+03	9.99E+03	2.62E+03	9.19E+03	2.21E+03	7.73E+03
4.0000E+00 to 5.0000E+00	9.22E+02	4.15E+03	9.03E+02	4.06E+03	8.80E+02	3.96E+03	7.96E+02	3.58E+03	6.35E+02	2.86E+03
5.0000E+00 to 6.5000E+00	3.53E+02	2.03E+03	3.46E+02	1.99E+03	3.38E+02	1.94E+03	3.06E+02	1.76E+03	2.45E+02	1.41E+03
6.5000E+00 to 8.0000E+00	6.65E+01	4.82E+02	6.51E+01	4.72E+02	6.35E+01	4.60E+02	5.76E+01	4.18E+02	4.64E+01	3.36E+02
8.0000E+00 to 1.0000E+01	1.37E+01	1.23E+02	1.34E+01	1.21E+02	1.31E+01	1.18E+02	1.19E+01	1.07E+02	9.59E+00	8.63E+01
Total	3.41E+14	1.20E+14	3.10E+14	1.09E+14	2.75E+14	9.68E+13	1.71E+14	6.07E+13	5.20E+13	1.89E+13

Calendar year	year 2515		year 3015		year 12015		Year 102015		year 1002015	
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s
1.0000E-02 to 5.0000E-02	3.12E+10	9.35E+08	1.64E+10	4.91E+08	6.31E+09	1.89E+08	4.76E+09	1.43E+08	9.66E+08	2.90E+07
5.0000E-02 to 1.0000E-01	5.79E+10	4.34E+09	2.73E+10	2.05E+09	2.54E+09	1.91E+08	2.43E+09	1.82E+08	4.91E+08	3.68E+07
1.0000E-01 to 2.0000E-01	5.06E+08	7.60E+07	2.97E+08	4.46E+07	3.10E+08	4.64E+07	5.09E+08	7.63E+07	1.56E+08	2.34E+07
2.0000E-01 to 3.0000E-01	1.47E+08	3.67E+07	8.97E+07	2.24E+07	1.82E+08	4.54E+07	7.95E+08	1.99E+08	1.81E+08	4.52E+07
3.0000E-01 to 4.0000E-01	1.77E+08	6.20E+07	1.45E+08	5.06E+07	2.60E+08	9.09E+07	9.83E+08	3.44E+08	2.29E+08	8.01E+07
4.0000E-01 to 6.0000E-01	2.37E+09	1.19E+09	2.34E+09	1.17E+09	2.21E+09	1.10E+09	1.29E+09	6.45E+08	7.84E+07	3.92E+07
6.0000E-01 to 8.0000E-01	7.96E+09	5.57E+09	5.67E+09	3.97E+09	5.47E+09	3.83E+09	3.92E+09	2.74E+09	1.85E+08	1.29E+08
8.0000E-01 to 1.0000E+00	1.43E+08	1.29E+08	1.38E+08	1.24E+08	1.46E+08	1.32E+08	1.97E+08	1.77E+08	2.27E+07	2.04E+07
1.0000E+00 to 1.3300E+00	7.86E+07	9.16E+07	7.70E+07	8.97E+07	1.45E+08	1.68E+08	5.90E+08	6.87E+08	9.34E+07	1.09E+08
1.3300E+00 to 1.6600E+00	1.17E+07	1.75E+07	1.19E+07	1.79E+07	4.80E+07	7.18E+07	2.88E+08	4.30E+08	5.17E+07	7.73E+07
1.6600E+00 to 2.0000E+00	1.03E+06	1.88E+06	2.42E+06	4.43E+06	6.35E+07	1.16E+08	4.68E+08	8.56E+08	7.84E+07	1.43E+08
2.0000E+00 to 2.5000E+00	3.58E+05	8.06E+05	9.24E+05	2.08E+06	2.43E+07	5.46E+07	1.79E+08	4.02E+08	2.99E+07	6.74E+07
2.5000E+00 to 3.0000E+00	7.23E+03	1.99E+04	1.61E+04	4.42E+04	3.99E+05	1.10E+06	2.94E+06	8.07E+06	4.93E+05	1.36E+06
3.0000E+00 to 4.0000E+00	2.24E+03	7.85E+03	4.30E+03	1.51E+04	9.20E+04	3.22E+05	6.75E+05	2.36E+06	1.13E+05	3.96E+05
4.0000E+00 to 5.0000E+00	3.05E+02	1.37E+03	2.75E+02	1.24E+03	1.39E+02	6.27E+02	4.77E+01	2.14E+02	9.03E+00	4.06E+01
5.0000E+00 to 6.5000E+00	1.21E+02	6.93E+02	1.09E+02	6.29E+02	5.56E+01	3.20E+02	1.90E+01	1.09E+02	3.60E+00	2.07E+01
6.5000E+00 to 8.0000E+00	2.33E+01	1.69E+02	2.13E+01	1.54E+02	1.09E+01	7.87E+01	3.72E+00	2.69E+01	7.04E-01	5.10E+00
8.0000E+00 to 1.0000E+01	4.91E+00	4.42E+01	4.50E+00	4.05E+01	2.30E+00	2.07E+01	7.86E-01	7.08E+00	1.49E-01	1.34E+00
Total	1.00E+11	1.25E+10	5.24E+10	8.03E+09	1.77E+10	6.04E+09	1.64E+10	6.90E+09	2.56E+09	8.02E+08

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment V

Page V-5

Gamma Source Spectra of ANL-West Ceramic HLW Canister										
Calendar Year	year 2010		year 2015		year 2020		year 2060		year 2110	
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s
1.0000E-02 to 5.0000E-02	1.29E+14	3.86E+12	1.14E+14	3.41E+12	1.01E+14	3.02E+12	3.83E+13	1.15E+12	1.16E+13	3.47E+11
5.0000E-02 to 1.0000E-01	3.72E+13	2.79E+12	3.27E+13	2.45E+12	2.88E+13	2.16E+12	1.09E+13	8.18E+11	3.34E+12	2.50E+11
1.0000E-01 to 2.0000E-01	2.48E+13	3.72E+12	2.18E+13	3.27E+12	1.92E+13	2.88E+12	7.16E+12	1.07E+12	2.10E+12	3.15E+11
2.0000E-01 to 3.0000E-01	7.78E+12	1.94E+12	6.87E+12	1.72E+12	6.08E+12	1.52E+12	2.27E+12	5.68E+11	6.65E+11	1.66E+11
3.0000E-01 to 4.0000E-01	5.55E+12	1.94E+12	4.90E+12	1.72E+12	4.34E+12	1.52E+12	1.62E+12	5.67E+11	4.74E+11	1.66E+11
4.0000E-01 to 6.0000E-01	3.81E+12	1.90E+12	3.30E+12	1.65E+12	2.90E+12	1.45E+12	1.08E+12	5.39E+11	3.15E+11	1.57E+11
6.0000E-01 to 8.0000E-01	2.10E+14	1.47E+14	1.87E+14	1.31E+14	1.67E+14	1.17E+14	6.61E+13	4.63E+13	2.08E+13	1.46E+13
8.0000E-01 to 1.0000E+00	8.57E+11	7.71E+11	7.04E+11	6.34E+11	6.02E+11	5.42E+11	2.09E+11	1.88E+11	6.04E+10	5.44E+10
1.0000E+00 to 1.3300E+00	6.07E+11	7.08E+11	4.95E+11	5.76E+11	4.10E+11	4.77E+11	1.25E+11	1.46E+11	3.56E+10	4.15E+10
1.3300E+00 to 1.6600E+00	9.10E+10	1.36E+11	7.64E+10	1.14E+11	6.59E+10	9.85E+10	2.32E+10	3.47E+10	6.73E+09	1.01E+10
1.6600E+00 to 2.0000E+00	1.42E+10	2.60E+10	1.25E+10	2.29E+10	1.11E+10	2.03E+10	4.14E+09	7.57E+09	1.21E+09	2.21E+09
2.0000E+00 to 2.5000E+00	7.45E+08	1.68E+09	6.41E+08	1.44E+09	5.67E+08	1.27E+09	2.12E+08	4.76E+08	6.18E+07	1.39E+08
2.5000E+00 to 3.0000E+00	3.42E+05	9.39E+05	3.16E+05	8.70E+05	3.03E+05	8.32E+05	2.07E+05	5.69E+05	1.30E+05	3.58E+05
3.0000E+00 to 4.0000E+00	9.89E+03	3.46E+04	9.85E+03	3.45E+04	9.82E+03	3.44E+04	9.67E+03	3.38E+04	9.59E+03	3.36E+04
4.0000E+00 to 5.0000E+00	3.22E+03	1.45E+04	3.21E+03	1.44E+04	3.19E+03	1.44E+04	3.14E+03	1.41E+04	3.11E+03	1.40E+04
5.0000E+00 to 6.5000E+00	1.25E+03	7.20E+03	1.25E+03	7.17E+03	1.24E+03	7.15E+03	1.22E+03	7.02E+03	1.21E+03	6.95E+03
6.5000E+00 to 8.0000E+00	2.39E+02	1.73E+03	2.38E+02	1.72E+03	2.37E+02	1.72E+03	2.33E+02	1.69E+03	2.30E+02	1.67E+03
8.0000E+00 to 1.0000E+01	4.97E+01	4.47E+02	4.95E+01	4.45E+02	4.93E+01	4.44E+02	4.84E+01	4.36E+02	4.79E+01	4.31E+02
Total	4.20E+14	1.65E+14	3.72E+14	1.47E+14	3.30E+14	1.30E+14	1.28E+14	5.13E+13	3.94E+13	1.61E+13

Calendar Year	year 2510		year 3010		year 12010		year 102010		year 1002010	
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s
1.0000E-02 to 5.0000E-02	1.84E+11	5.52E+09	1.62E+11	4.86E+09	1.04E+11	3.11E+09	8.61E+09	2.58E+08	1.66E+09	4.97E+07
5.0000E-02 to 1.0000E-01	9.87E+10	7.40E+09	4.51E+10	3.38E+09	1.37E+09	1.03E+08	1.13E+09	8.47E+07	1.11E+09	8.30E+07
1.0000E-01 to 2.0000E-01	8.70E+08	1.30E+08	7.11E+08	1.07E+08	5.85E+08	8.77E+07	4.97E+08	7.46E+07	5.05E+08	7.58E+07
2.0000E-01 to 3.0000E-01	1.47E+08	3.69E+07	1.10E+08	2.75E+07	1.20E+08	3.00E+07	3.99E+08	9.98E+07	3.50E+08	8.75E+07
3.0000E-01 to 4.0000E-01	5.71E+08	2.00E+08	5.54E+08	1.94E+08	5.26E+08	1.84E+08	5.73E+08	2.01E+08	3.67E+08	1.28E+08
4.0000E-01 to 6.0000E-01	1.31E+08	6.55E+07	1.13E+08	5.66E+07	9.71E+07	4.86E+07	1.18E+08	5.89E+07	1.73E+08	8.65E+07
6.0000E-01 to 8.0000E-01	2.02E+09	1.41E+09	9.06E+06	6.34E+06	4.45E+07	3.12E+07	2.99E+08	2.10E+08	1.05E+08	7.34E+07
8.0000E-01 to 1.0000E+00	4.13E+06	3.72E+06	1.04E+06	9.39E+05	5.87E+06	5.28E+06	4.21E+07	3.79E+07	2.18E+07	1.97E+07
1.0000E+00 to 1.3300E+00	2.62E+06	3.05E+06	1.19E+06	1.38E+06	2.07E+07	2.41E+07	1.54E+08	1.80E+08	5.43E+07	6.33E+07
1.3300E+00 to 1.6600E+00	7.12E+05	1.06E+06	5.84E+05	8.73E+05	1.07E+07	1.60E+07	8.30E+07	1.24E+08	3.77E+07	5.64E+07
1.6600E+00 to 2.0000E+00	3.65E+05	6.68E+05	6.75E+05	1.24E+06	1.72E+07	3.15E+07	1.30E+08	2.37E+08	4.39E+07	8.03E+07
2.0000E+00 to 2.5000E+00	9.75E+04	2.19E+05	2.37E+05	5.33E+05	6.55E+06	1.47E+07	4.95E+07	1.11E+08	1.67E+07	3.76E+07
2.5000E+00 to 3.0000E+00	1.39E+04	3.83E+04	1.35E+04	3.73E+04	1.12E+05	3.08E+05	8.13E+05	2.24E+06	2.78E+05	7.64E+05
3.0000E+00 to 4.0000E+00	9.39E+03	3.29E+04	9.48E+03	3.32E+04	2.85E+04	9.98E+04	1.87E+05	6.54E+05	6.31E+04	2.21E+05
4.0000E+00 to 5.0000E+00	2.97E+03	1.33E+04	2.82E+03	1.27E+04	1.21E+03	5.46E+03	4.29E+01	1.93E+02	9.50E+00	4.28E+01
5.0000E+00 to 6.5000E+00	1.15E+03	6.63E+03	1.10E+03	6.30E+03	4.62E+02	2.65E+03	1.54E+01	8.83E+01	3.78E+00	2.17E+01
6.5000E+00 to 8.0000E+00	2.20E+02	1.59E+03	2.09E+02	1.51E+03	8.61E+01	6.24E+02	2.68E+00	1.94E+01	7.35E-01	5.33E+00
8.0000E+00 to 1.0000E+01	4.58E+01	4.12E+02	4.34E+01	3.91E+02	1.76E+01	1.59E+02	5.21E-01	4.69E+00	1.55E-01	1.40E+00
Total	2.87E+11	1.48E+10	2.09E+11	8.64E+09	1.07E+11	3.69E+09	1.21E+10	1.68E+09	4.44E+09	8.43E+08

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment V

Page V-6

Gamma Source Spectra of ANL-West Metal Matrix HLW Canister											
Calendar Year	year 2010		year 2015		year 2020		year 2060		year 2110		
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	
1.0000E-02 to 5.0000E-02	5.58E+12	1.67E+11	1.61E+12	4.82E+10	4.95E+11	1.48E+10	3.27E+10	9.81E+08	3.12E+10	9.36E+08	
5.0000E-02 to 1.0000E-01	1.11E+11	8.35E+09	4.17E+10	3.13E+09	2.63E+10	1.97E+09	1.59E+10	1.19E+09	1.58E+10	1.19E+09	
1.0000E-01 to 2.0000E-01	6.16E+11	9.24E+10	1.70E+11	2.55E+10	4.98E+10	7.46E+09	1.83E+09	2.75E+08	1.82E+09	2.73E+08	
2.0000E-01 to 3.0000E-01	4.43E+10	1.11E+10	1.07E+10	2.69E+09	3.34E+09	8.34E+08	4.85E+08	1.21E+08	4.84E+08	1.21E+08	
3.0000E-01 to 4.0000E-01	1.46E+11	5.10E+10	3.95E+10	1.38E+10	1.13E+10	3.95E+09	2.54E+08	8.89E+07	2.53E+08	8.86E+07	
4.0000E-01 to 6.0000E-01	3.12E+12	1.56E+12	8.80E+11	4.40E+11	2.57E+11	1.29E+11	1.47E+10	7.36E+09	1.47E+10	7.36E+09	
6.0000E-01 to 8.0000E-01	1.66E+12	1.16E+12	5.00E+11	3.50E+11	1.78E+11	1.25E+11	5.26E+10	3.68E+10	5.26E+10	3.68E+10	
8.0000E-01 to 1.0000E+00	1.95E+10	1.76E+10	1.74E+10	1.57E+10	1.72E+10	1.55E+10	1.72E+10	1.54E+10	1.71E+10	1.54E+10	
1.0000E+00 to 1.3300E+00	8.26E+12	9.62E+12	4.28E+12	4.98E+12	2.22E+12	2.58E+12	1.20E+10	1.40E+10	4.86E+08	5.66E+08	
1.3300E+00 to 1.6600E+00	2.33E+12	3.49E+12	1.21E+12	1.81E+12	6.26E+11	9.35E+11	3.32E+09	4.96E+09	7.11E+07	1.06E+08	
1.6600E+00 to 2.0000E+00	3.37E+08	6.17E+08	1.16E+07	2.12E+07	7.81E+05	1.43E+06	4.17E+05	7.64E+05	4.35E+05	7.95E+05	
2.0000E+00 to 2.5000E+00	2.99E+08	6.72E+08	3.67E+07	8.26E+07	1.51E+07	3.40E+07	8.11E+04	1.82E+05	1.07E+04	2.41E+04	
2.5000E+00 to 3.0000E+00	3.18E+07	8.75E+07	1.31E+06	3.61E+06	2.73E+05	7.49E+05	1.45E+05	3.99E+05	8.84E+04	2.43E+05	
3.0000E+00 to 4.0000E+00	4.00E+06	1.40E+07	1.33E+05	4.65E+05	4.49E+03	1.57E+04	1.02E+02	3.55E+02	1.27E+02	4.44E+02	
4.0000E+00 to 5.0000E+00	3.05E+01	1.37E+02	3.05E+01	1.37E+02	3.05E+01	1.37E+02	3.05E+01	1.37E+02	3.05E+01	1.37E+02	
5.0000E+00 to 6.5000E+00	1.22E+01	7.01E+01	1.22E+01	7.01E+01	1.22E+01	7.01E+01	1.22E+01	7.02E+01	1.22E+01	7.02E+01	
6.5000E+00 to 8.0000E+00	2.38E+00	1.73E+01	2.38E+00	1.73E+01	2.38E+00	1.73E+01	2.39E+00	1.73E+01	2.39E+00	1.73E+01	
8.0000E+00 to 1.0000E+01	5.05E-01	4.55E+00	5.05E-01	4.55E+00	5.05E-01	4.55E+00	5.06E-01	4.56E+00	5.06E-01	4.56E+00	
Total	2.19E+13	1.62E+13	8.75E+12	7.69E+12	3.88E+12	3.81E+12	1.51E+11	8.12E+10	1.35E+11	6.29E+10	
Calendar Year	year 2510		year 3010		year 12010		year 102010		year 1002010		
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	
1.0000E-02 to 5.0000E-02	2.97E+10	8.92E+08	2.96E+10	8.87E+08	2.83E+10	8.50E+08	2.04E+10	6.13E+08	1.87E+09	5.60E+07	
5.0000E-02 to 1.0000E-01	1.58E+10	1.18E+09	1.57E+10	1.18E+09	1.50E+10	1.12E+09	9.76E+09	7.32E+08	8.43E+08	6.32E+07	
1.0000E-01 to 2.0000E-01	1.82E+09	2.73E+08	1.81E+09	2.72E+08	1.77E+09	2.66E+08	1.50E+09	2.25E+08	3.83E+08	5.75E+07	
2.0000E-01 to 3.0000E-01	4.84E+08	1.21E+08	4.86E+08	1.21E+08	5.80E+08	1.45E+08	1.19E+09	2.96E+08	4.52E+08	1.13E+08	
3.0000E-01 to 4.0000E-01	2.54E+08	8.88E+07	2.56E+08	8.96E+07	3.79E+08	1.33E+08	1.20E+09	4.19E+08	4.68E+08	1.64E+08	
4.0000E-01 to 6.0000E-01	1.47E+10	7.34E+09	1.46E+10	7.31E+09	1.38E+10	6.88E+09	7.48E+09	3.74E+09	7.31E+07	3.66E+07	
6.0000E-01 to 8.0000E-01	5.23E+10	3.66E+10	5.19E+10	3.63E+10	4.56E+10	3.19E+10	1.97E+10	1.38E+10	5.37E+08	3.76E+08	
8.0000E-01 to 1.0000E+00	1.69E+10	1.52E+10	1.67E+10	1.50E+10	1.24E+10	1.12E+10	1.13E+09	1.02E+09	6.86E+07	6.18E+07	
1.0000E+00 to 1.3300E+00	4.69E+08	5.47E+08	4.69E+08	5.47E+08	5.23E+08	6.10E+08	8.90E+08	1.04E+09	2.59E+08	3.02E+08	
1.3300E+00 to 1.6600E+00	6.67E+07	9.97E+07	6.73E+07	1.01E+08	1.05E+08	1.57E+08	3.66E+08	5.47E+08	1.31E+08	1.95E+08	
1.6600E+00 to 2.0000E+00	9.17E+05	1.68E+06	2.27E+06	4.15E+06	7.19E+07	1.32E+08	5.55E+08	1.02E+09	2.17E+08	3.98E+08	
2.0000E+00 to 2.5000E+00	1.95E+05	4.39E+05	7.10E+05	1.60E+06	2.73E+07	6.15E+07	2.12E+08	4.76E+08	8.29E+07	1.86E+08	
2.5000E+00 to 3.0000E+00	4.95E+03	1.36E+04	1.18E+04	3.23E+04	4.49E+05	1.23E+06	3.48E+06	9.56E+06	1.36E+06	3.75E+06	
3.0000E+00 to 4.0000E+00	8.23E+02	2.88E+03	2.77E+03	9.68E+03	1.03E+05	3.61E+05	7.99E+05	2.80E+06	3.13E+05	1.09E+06	
4.0000E+00 to 5.0000E+00	3.05E+01	1.37E+02	3.04E+01	1.37E+02	3.00E+01	1.35E+02	3.02E+01	1.36E+02	2.96E+01	1.33E+02	
5.0000E+00 to 6.5000E+00	1.22E+01	7.01E+01	1.22E+01	7.00E+01	1.20E+01	6.91E+01	1.20E+01	6.92E+01	1.18E+01	6.80E+01	
6.5000E+00 to 8.0000E+00	2.39E+00	1.73E+01	2.38E+00	1.73E+01	2.35E+00	1.70E+01	2.34E+00	1.70E+01	2.31E+00	1.68E+01	
8.0000E+00 to 1.0000E+01	5.06E-01	4.55E+00	5.05E-01	4.54E+00	4.97E-01	4.48E+00	4.95E-01	4.45E+00	4.90E-01	4.41E+00	
Total	1.32E+11	6.24E+10	1.32E+11	6.18E+10	1.19E+11	5.35E+10	6.44E+10	2.39E+10	5.38E+09	2.01E+09	

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment V

Page V-7

Gamma Source Spectra of CIC HLW Canister										
Calendar Year	year 2010.1		year 2015		year 2020		year 2060		year 2110	
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s
1.0000E-02 to 5.0000E-02	1.14E+15	3.42E+13	7.97E+14	2.39E+13	6.95E+14	2.09E+13	2.64E+14	7.93E+12	8.25E+13	2.48E+12
5.0000E-02 to 1.0000E-01	3.49E+14	2.62E+13	2.41E+14	1.81E+13	2.12E+14	1.59E+13	8.44E+13	6.33E+12	3.03E+13	2.27E+12
1.0000E-01 to 2.0000E-01	2.66E+14	3.98E+13	1.63E+14	2.44E+13	1.41E+14	2.11E+13	5.14E+13	7.71E+12	1.50E+13	2.26E+12
2.0000E-01 to 3.0000E-01	7.55E+13	1.89E+13	5.09E+13	1.27E+13	4.45E+13	1.11E+13	1.64E+13	4.11E+12	4.80E+12	1.20E+12
3.0000E-01 to 4.0000E-01	5.51E+13	1.93E+13	3.61E+13	1.26E+13	3.16E+13	1.11E+13	1.18E+13	4.12E+12	3.44E+12	1.21E+12
4.0000E-01 to 6.0000E-01	7.52E+13	3.76E+13	3.09E+13	1.55E+13	2.31E+13	1.16E+13	7.89E+12	3.94E+12	2.30E+12	1.15E+12
6.0000E-01 to 8.0000E-01	1.18E+15	8.25E+14	1.03E+15	7.18E+14	9.10E+14	6.37E+14	3.60E+14	2.52E+14	1.13E+14	7.93E+13
8.0000E-01 to 1.0000E+00	1.83E+13	1.65E+13	9.41E+12	8.47E+12	6.83E+12	6.15E+12	1.61E+12	1.45E+12	4.43E+11	3.99E+11
1.0000E+00 to 1.3300E+00	2.56E+13	2.98E+13	1.44E+13	1.68E+13	9.45E+12	1.10E+13	1.09E+12	1.27E+12	2.63E+11	3.07E+11
1.3300E+00 to 1.6600E+00	5.42E+12	8.11E+12	2.21E+12	3.31E+12	1.35E+12	2.02E+12	1.81E+11	2.70E+11	4.93E+10	7.37E+10
1.6600E+00 to 2.0000E+00	4.27E+11	7.81E+11	9.98E+10	1.83E+11	8.15E+10	1.49E+11	3.02E+10	5.53E+10	8.81E+09	1.61E+10
2.0000E+00 to 2.5000E+00	2.37E+12	5.33E+12	3.77E+10	8.48E+10	4.63E+09	1.04E+10	1.55E+09	3.48E+09	4.51E+08	1.02E+09
2.5000E+00 to 3.0000E+00	1.68E+10	4.63E+10	5.54E+08	1.52E+09	1.94E+07	5.33E+07	9.60E+05	2.64E+06	7.64E+05	2.10E+06
3.0000E+00 to 4.0000E+00	1.89E+09	6.61E+09	6.84E+07	2.39E+08	3.46E+06	1.21E+07	5.18E+05	1.81E+06	3.41E+05	1.20E+06
4.0000E+00 to 5.0000E+00	5.56E+05	2.50E+06	4.80E+05	2.16E+06	4.15E+05	1.87E+06	1.73E+05	7.77E+05	1.13E+05	5.10E+05
5.0000E+00 to 6.5000E+00	2.23E+05	1.28E+06	1.92E+05	1.10E+06	1.66E+05	9.53E+05	6.86E+04	3.94E+05	4.49E+04	2.58E+05
6.5000E+00 to 8.0000E+00	4.35E+04	3.16E+05	3.75E+04	2.72E+05	3.24E+04	2.35E+05	1.33E+04	9.67E+04	8.69E+03	6.30E+04
8.0000E+00 to 1.0000E+01	9.22E+03	8.30E+04	7.94E+03	7.15E+04	6.86E+03	6.17E+04	2.81E+03	2.53E+04	1.83E+03	1.65E+04
Total	3.19E+15	1.06E+15	2.37E+15	8.54E+14	2.08E+15	7.48E+14	7.99E+14	2.89E+14	2.52E+14	9.06E+13

Calendar Year	year 2510		year 3010		year 12010	
Energy Interval, Mev	photons/s	mev/s	photons/s	mev/s	photons/s	mev/s
1.0000E-02 to 5.0000E-02	3.51E+12	1.05E+11	2.60E+12	7.79E+10	1.17E+12	3.52E+10
5.0000E-02 to 1.0000E-01	4.23E+12	3.18E+11	1.91E+12	1.43E+11	2.22E+10	1.66E+09
1.0000E-01 to 2.0000E-01	1.06E+10	1.59E+09	8.24E+09	1.24E+09	6.00E+09	9.00E+08
2.0000E-01 to 3.0000E-01	1.42E+09	3.54E+08	1.16E+09	2.91E+08	1.54E+09	3.85E+08
3.0000E-01 to 4.0000E-01	4.77E+09	1.67E+09	5.07E+09	1.78E+09	5.41E+09	1.89E+09
4.0000E-01 to 6.0000E-01	1.31E+10	6.57E+09	1.30E+10	6.49E+09	1.22E+10	6.08E+09
6.0000E-01 to 8.0000E-01	4.03E+10	2.82E+10	2.92E+10	2.05E+10	2.81E+10	1.97E+10
8.0000E-01 to 1.0000E+00	7.41E+08	6.67E+08	7.16E+08	6.45E+08	7.53E+08	6.78E+08
1.0000E+00 to 1.3300E+00	4.04E+08	4.71E+08	3.94E+08	4.60E+08	7.10E+08	8.28E+08
1.3300E+00 to 1.6600E+00	5.86E+07	8.76E+07	5.87E+07	8.77E+07	2.30E+08	3.44E+08
1.6600E+00 to 2.0000E+00	3.41E+06	6.24E+06	7.68E+06	1.40E+07	2.95E+08	5.40E+08
2.0000E+00 to 2.5000E+00	1.09E+06	2.44E+06	2.86E+06	6.43E+06	1.13E+08	2.53E+08
2.5000E+00 to 3.0000E+00	7.05E+05	1.94E+06	7.17E+05	1.97E+06	2.35E+06	6.46E+06
3.0000E+00 to 4.0000E+00	2.85E+05	9.97E+05	2.76E+05	9.66E+05	5.34E+05	1.87E+06
4.0000E+00 to 5.0000E+00	9.42E+04	4.24E+05	8.90E+04	4.01E+05	3.65E+04	1.64E+05
5.0000E+00 to 6.5000E+00	3.74E+04	2.15E+05	3.53E+04	2.03E+05	1.44E+04	8.28E+04
6.5000E+00 to 8.0000E+00	7.25E+03	5.26E+04	6.86E+03	4.98E+04	2.78E+03	2.02E+04
8.0000E+00 to 1.0000E+01	1.53E+03	1.38E+04	1.45E+03	1.30E+04	5.84E+02	5.26E+03
totals	7.81E+12	4.62E+11	4.57E+12	2.53E+11	1.25E+12	6.84E+10

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment VI

Page VI-1

Neutron Source Spectra of SRS HLW Canister											
Energy Interval, Mev	2010	2010.1	2015	2020	2060	2110	2510	3010	12010	102010	1002010
6.43E+00 - 2.00E+01	3.01E+05	2.99E+05	2.51E+05	2.10E+05	5.56E+04	1.62E+04	1.65E+03	1.10E+03	4.77E+02	1.62E+02	3.89E+01
3.00E+00 - 6.43E+00	2.75E+07	2.74E+07	2.59E+07	2.44E+07	1.65E+07	1.10E+07	1.12E+06	4.56E+05	1.60E+05	5.65E+04	1.23E+04
1.85E+00 - 3.00E+00	2.12E+07	2.12E+07	1.99E+07	1.88E+07	1.25E+07	8.36E+06	8.46E+05	3.47E+05	1.22E+05	2.95E+04	6.42E+03
1.40E+00 - 1.85E+00	5.22E+06	5.21E+06	4.75E+06	4.34E+06	2.49E+06	1.56E+06	1.58E+05	6.69E+04	2.39E+04	6.24E+03	1.38E+03
9.00E-01 - 1.40E+00	5.99E+06	5.98E+06	5.40E+06	4.88E+06	2.63E+06	1.60E+06	1.62E+05	6.96E+04	2.51E+04	6.97E+03	1.54E+03
4.00E-01 - 9.00E-01	5.59E+06	5.58E+06	4.98E+06	4.46E+06	2.24E+06	1.31E+06	1.33E+05	5.81E+04	2.12E+04	5.49E+03	1.23E+03
1.00E-01 - 4.00E-01	1.61E+06	1.60E+06	1.47E+06	1.34E+06	7.78E+05	4.90E+05	4.96E+04	2.10E+04	7.48E+03	2.05E+03	4.51E+02
1.70E-02 - 1.00E-01	1.54E+05	1.54E+05	1.48E+05	1.42E+05	1.03E+05	7.09E+04	7.17E+03	2.90E+03	1.01E+03	2.82E+02	6.09E+01
3.00E-03 - 1.70E-02	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	0.00E+00
5.50E-04 - 3.00E-03	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	0.00E+00
1.00E-04 - 5.50E-04	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	0.00E+00
3.00E-05 - 1.00E-04	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	0.00E+00
1.00E-05 - 3.00E-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	0.00E+00
3.05E-06 - 1.00E-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	0.00E+00
1.77E-06 - 3.05E-06	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	0.00E+00
1.30E-06 - 1.77E-06	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	0.00E+00
1.13E-06 - 1.30E-06	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	0.00E+00
1.00E-06 - 1.13E-06	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	0.00E+00
8.00E-07 - 1.00E-06	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	0.00E+00
4.00E-07 - 8.00E-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	0.00E+00
3.25E-07 - 4.00E-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	0.00E+00
2.25E-07 - 3.25E-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	0.00E+00
1.00E-07 - 2.25E-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	0.00E+00
5.00E-08 - 1.00E-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	0.00E+00
3.00E-08 - 5.00E-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	0.00E+00
1.00E-08 - 3.00E-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	0.00E+00
1.00E-11 - 1.00E-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	0.00E+00
Total	6.75E+07	6.74E+07	6.27E+07	5.85E+07	3.73E+07	2.44E+07	2.47E+06	1.02E+06	3.61E+05	1.07E+05	2.34E+04

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment VI

Page VI-2

Neutron Source Spectra of WVDP HLW Canister											
Energy Interval, Mev	1996	2010	2015	2020	2060	2110	2510	3010	12010	102010	1002010
6.43E+00 - 2.00E+01	6.57E+04	4.01E+04	3.39E+04	2.87E+04	9.18E+03	4.34E+03	2.11E+03	1.34E+03	3.37E+02	6.53E+01	4.81E+01
3.00E+00 - 6.43E+00	6.59E+06	5.93E+06	5.75E+06	5.60E+06	4.79E+06	4.26E+06	2.20E+06	1.10E+06	1.43E+05	2.92E+04	2.95E+04
1.85E+00 - 3.00E+00	5.02E+06	4.51E+06	4.37E+06	4.24E+06	3.63E+06	3.22E+06	1.67E+06	8.34E+05	1.09E+05	2.22E+04	1.52E+04
1.40E+00 - 1.85E+00	1.21E+06	9.94E+05	9.39E+05	8.91E+05	6.87E+05	5.91E+05	3.05E+05	1.54E+05	2.09E+04	4.25E+03	3.04E+03
9.00E-01 - 1.40E+00	1.38E+06	1.10E+06	1.03E+06	9.65E+05	7.10E+05	6.01E+05	3.10E+05	1.57E+05	2.17E+04	4.41E+03	3.33E+03
4.00E-01 - 9.00E-01	1.28E+06	9.81E+05	9.06E+05	8.44E+05	5.87E+05	4.87E+05	2.51E+05	1.28E+05	1.81E+04	3.67E+03	2.51E+03
1.00E-01 - 4.00E-01	3.73E+05	3.09E+05	2.92E+05	2.78E+05	2.16E+05	1.86E+05	9.61E+04	4.85E+04	6.54E+03	1.33E+03	1.01E+03
1.70E-02 - 1.00E-01	3.73E+04	3.53E+04	3.47E+04	3.41E+04	3.06E+04	2.75E+04	1.42E+04	7.10E+03	9.07E+02	1.86E+02	1.49E+02
3.00E-03 - 1.70E-02	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	0.00E+00
5.50E-04 - 3.00E-03	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	0.00E+00
1.00E-04 - 5.50E-04	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	0.00E+00
3.00E-05 - 1.00E-04	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	0.00E+00
1.00E-05 - 3.00E-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	0.00E+00
3.05E-06 - 1.00E-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	0.00E+00
1.77E-06 - 3.05E-06	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	0.00E+00
1.30E-06 - 1.77E-06	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	0.00E+00
1.13E-06 - 1.30E-06	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	0.00E+00
1.00E-06 - 1.13E-06	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	0.00E+00
8.00E-07 - 1.00E-06	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	0.00E+00
4.00E-07 - 8.00E-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	0.00E+00
3.25E-07 - 4.00E-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	0.00E+00
2.25E-07 - 3.25E-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	0.00E+00
1.00E-07 - 2.25E-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	0.00E+00
5.00E-08 - 1.00E-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	0.00E+00
3.00E-08 - 5.00E-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	0.00E+00
1.00E-08 - 3.00E-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	0.00E+00
1.00E-11 - 1.00E-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	0.00E+00
Total	1.60E+07	1.39E+07	1.34E+07	1.29E+07	1.07E+07	9.37E+06	4.85E+06	2.43E+06	3.19E+05	6.53E+04	5.47E+04

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment VI

Page VI-3

Neutron Source Spectra of Hanford HLW Canister											
Energy Interval, Mev	1994	2010	2015	2020	2060	2110	2510	3010	12010	102010	1002010
6.43E+00 - 2.00E+01	1.88E+02	1.70E+02	1.66E+02	1.62E+02	1.47E+02	1.40E+02	1.16E+02	1.00E+02	5.57E+01	2.96E+01	2.37E+01
3.00E+00 - 6.43E+00	1.12E+05	1.16E+05	1.16E+05	1.16E+05	1.12E+05	1.06E+05	7.35E+04	5.42E+04	3.05E+04	9.77E+03	5.47E+03
1.85E+00 - 3.00E+00	8.50E+04	8.77E+04	8.77E+04	8.75E+04	8.47E+04	8.02E+04	5.58E+04	4.12E+04	2.32E+04	5.12E+03	2.91E+03
1.40E+00 - 1.85E+00	1.60E+04	1.64E+04	1.63E+04	1.63E+04	1.57E+04	1.49E+04	1.04E+04	7.78E+03	4.37E+03	1.09E+03	6.51E+02
9.00E-01 - 1.40E+00	1.64E+04	1.68E+04	1.67E+04	1.67E+04	1.61E+04	1.52E+04	1.07E+04	8.03E+03	4.51E+03	1.22E+03	7.42E+02
4.00E-01 - 9.00E-01	1.35E+04	1.37E+04	1.37E+04	1.36E+04	1.31E+04	1.24E+04	8.80E+03	6.63E+03	3.72E+03	9.65E+02	6.09E+02
1.00E-01 - 4.00E-01	5.02E+03	5.14E+03	5.13E+03	5.12E+03	4.94E+03	4.68E+03	3.28E+03	2.44E+03	1.37E+03	3.57E+02	2.12E+02
1.70E-02 - 1.00E-01	7.18E+02	7.44E+02	7.44E+02	7.43E+02	7.19E+02	6.81E+02	4.72E+02	3.47E+02	1.95E+02	4.87E+01	2.69E+01
3.00E-03 - 1.70E-02	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	0.00E+00
5.50E-04 - 3.00E-03	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	0.00E+00
1.00E-04 - 5.50E-04	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	0.00E+00
3.00E-05 - 1.00E-04	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	0.00E+00
1.00E-05 - 3.00E-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	0.00E+00
3.05E-06 - 1.00E-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	0.00E+00
1.77E-06 - 3.05E-06	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	0.00E+00
1.30E-06 - 1.77E-06	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	0.00E+00
1.13E-06 - 1.30E-06	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	0.00E+00
1.00E-06 - 1.13E-06	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	0.00E+00
8.00E-07 - 1.00E-06	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	0.00E+00
4.00E-07 - 8.00E-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	0.00E+00
3.25E-07 - 4.00E-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	0.00E+00
2.25E-07 - 3.25E-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	0.00E+00
1.00E-07 - 2.25E-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	0.00E+00
5.00E-08 - 1.00E-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	0.00E+00
3.00E-08 - 5.00E-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	0.00E+00
1.00E-08 - 3.00E-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	0.00E+00
1.00E-11 - 1.00E-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	0.00E+00
Total	2.49E+05	2.56E+05	2.56E+05	2.56E+05	2.47E+05	2.34E+05	1.63E+05	1.21E+05	6.78E+04	1.86E+04	1.06E+04

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment VI

Page VI-4

Neutron Source Spectra of INTEC HLW Canister											
Energy Interval, Mev	2035	2036	2040	2045	2065	2115	2515	3015	12015	102015	1002015
6.43E+00 - 2.00E+01	1.74E+03	1.73E+03	1.69E+03	1.64E+03	1.44E+03	1.07E+03	2.78E+02	1.96E+02	8.40E+01	3.99E+01	8.76E+00
3.00E+00 - 6.43E+00	2.09E+06	2.08E+06	2.02E+06	1.96E+06	1.71E+06	1.24E+06	2.16E+05	1.08E+05	3.31E+04	1.61E+04	4.01E+03
1.85E+00 - 3.00E+00	1.58E+06	1.57E+06	1.53E+06	1.48E+06	1.29E+06	9.34E+05	1.64E+05	8.19E+04	2.52E+04	8.38E+03	2.08E+03
1.40E+00 - 1.85E+00	2.89E+05	2.87E+05	2.79E+05	2.70E+05	2.36E+05	1.71E+05	3.04E+04	1.55E+04	4.87E+03	1.74E+03	4.27E+02
9.00E-01 - 1.40E+00	2.92E+05	2.91E+05	2.83E+05	2.74E+05	2.40E+05	1.73E+05	3.10E+04	1.59E+04	5.08E+03	1.94E+03	4.72E+02
4.00E-01 - 9.00E-01	2.36E+05	2.34E+05	2.28E+05	2.21E+05	1.93E+05	1.40E+05	2.53E+04	1.32E+04	4.26E+03	1.51E+03	3.64E+02
1.00E-01 - 4.00E-01	9.09E+04	9.03E+04	8.79E+04	8.50E+04	7.44E+04	5.37E+04	9.55E+03	4.85E+03	1.53E+03	5.74E+02	1.41E+02
1.70E-02 - 1.00E-01	1.35E+04	1.35E+04	1.31E+04	1.27E+04	1.11E+04	7.99E+03	1.39E+03	6.90E+02	2.10E+02	8.09E+01	2.02E+01
3.00E-03 - 1.70E-02	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	0.00E+00
5.50E-04 - 3.00E-03	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	0.00E+00
1.00E-04 - 5.50E-04	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	0.00E+00
3.00E-05 - 1.00E-04	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	0.00E+00
1.00E-05 - 3.00E-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	0.00E+00
3.05E-06 - 1.00E-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	0.00E+00
1.77E-06 - 3.05E-06	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	0.00E+00
1.30E-06 - 1.77E-06	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	0.00E+00
1.13E-06 - 1.30E-06	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	0.00E+00
1.00E-06 - 1.13E-06	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	0.00E+00
8.00E-07 - 1.00E-06	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	0.00E+00
4.00E-07 - 8.00E-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	0.00E+00
3.25E-07 - 4.00E-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	0.00E+00
2.25E-07 - 3.25E-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	0.00E+00
1.00E-07 - 2.25E-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	0.00E+00
5.00E-08 - 1.00E-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	0.00E+00
3.00E-08 - 5.00E-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	0.00E+00
1.00E-08 - 3.00E-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	0.00E+00
1.00E-11 - 1.00E-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	0.00E+00
totals	4.59E+06	4.56E+06	4.44E+06	4.30E+06	3.76E+06	2.72E+06	4.78E+05	2.40E+05	7.43E+04	3.04E+04	7.52E+03

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment VI

Page VI-5

Neutron Source Spectra of ANL-West Ceramic HLW Canister											
Energy Interval, Mev	2000	2010	2015	2020	2060	2110	2510	3010	12010	102010	1002010
6.43E+00 - 2.00E+01	2.66E+03	2.64E+03	2.64E+03	2.63E+03	2.60E+03	2.56E+03	2.41E+03	2.29E+03	1.25E+03	1.44E+02	9.27E+00
3.00E+00 - 6.43E+00	1.89E+06	1.90E+06	1.90E+06	1.91E+06	1.89E+06	1.87E+06	1.73E+06	1.64E+06	1.18E+06	1.05E+05	4.31E+03
1.85E+00 - 3.00E+00	1.44E+06	1.44E+06	1.44E+06	1.44E+06	1.43E+06	1.41E+06	1.31E+06	1.25E+06	8.93E+05	5.38E+04	2.23E+03
1.40E+00 - 1.85E+00	2.67E+05	2.68E+05	2.68E+05	2.69E+05	2.67E+05	2.63E+05	2.44E+05	2.32E+05	1.64E+05	1.07E+04	4.58E+02
9.00E-01 - 1.40E+00	2.73E+05	2.75E+05	2.75E+05	2.75E+05	2.73E+05	2.69E+05	2.50E+05	2.37E+05	1.67E+05	1.16E+04	5.06E+02
4.00E-01 - 9.00E-01	2.24E+05	2.24E+05	2.25E+05	2.25E+05	2.23E+05	2.20E+05	2.04E+05	1.94E+05	1.36E+05	8.68E+03	3.89E+02
1.00E-01 - 4.00E-01	8.39E+04	8.43E+04	8.44E+04	8.44E+04	8.38E+04	8.27E+04	7.67E+04	7.28E+04	5.17E+04	3.54E+03	1.51E+02
1.70E-02 - 1.00E-01	1.22E+04	1.22E+04	1.23E+04	1.23E+04	1.22E+04	1.20E+04	1.11E+04	1.06E+04	7.62E+03	5.32E+02	2.17E+01
3.00E-03 - 1.70E-02	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	0.00E+00
5.50E-04 - 3.00E-03	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	0.00E+00
1.00E-04 - 5.50E-04	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	0.00E+00
3.00E-05 - 1.00E-04	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	0.00E+00
1.00E-05 - 3.00E-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	0.00E+00
3.05E-06 - 1.00E-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	0.00E+00
1.77E-06 - 3.05E-06	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	0.00E+00
1.30E-06 - 1.77E-06	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	0.00E+00
1.13E-06 - 1.30E-06	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	0.00E+00
1.00E-06 - 1.13E-06	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	0.00E+00
8.00E-07 - 1.00E-06	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	0.00E+00
4.00E-07 - 8.00E-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	0.00E+00
3.25E-07 - 4.00E-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	0.00E+00
2.25E-07 - 3.25E-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	0.00E+00
1.00E-07 - 2.25E-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	0.00E+00
5.00E-08 - 1.00E-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	0.00E+00
3.00E-08 - 5.00E-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	0.00E+00
1.00E-08 - 3.00E-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	0.00E+00
1.00E-11 - 1.00E-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	0.00E+00
Total	4.19E+06	4.21E+06	4.21E+06	4.22E+06	4.19E+06	4.13E+06	3.83E+06	3.64E+06	2.60E+06	1.94E+05	8.08E+03

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment VI

Page VI-6

Neutron Source Spectra of ANL-West Metal Matrix HLW Canister											
Energy Interval, Mev	2000	2010	2015	2020	2060	2110	2510	3010	12010	102010	1002010
6.43E+00 - 2.00E+01	1.27E+01	1.27E+01	1.27E+01	1.27E+01	1.27E+01	1.27E+01	1.27E+01	1.27E+01	1.25E+01	1.23E+01	1.23E+01
3.00E+00 - 6.43E+00	1.44E+02	1.44E+02	1.44E+02	1.44E+02	1.44E+02	1.44E+02	1.44E+02	1.44E+02	1.44E+02	1.70E+02	1.51E+02
1.85E+00 - 3.00E+00	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.55E+02	1.54E+02	1.65E+02	1.55E+02
1.40E+00 - 1.85E+00	8.89E+01	8.88E+01	8.88E+01	8.88E+01	8.88E+01	8.87E+01	8.86E+01	8.85E+01	8.73E+01	8.88E+01	8.69E+01
9.00E-01 - 1.40E+00	1.22E+02	1.22E+02	1.22E+02	1.22E+02	1.21E+02	1.21E+02	1.21E+02	1.21E+02	1.19E+02	1.21E+02	1.19E+02
4.00E-01 - 9.00E-01	1.33E+02	1.33E+02	1.33E+02	1.33E+02	1.33E+02	1.33E+02	1.33E+02	1.33E+02	1.31E+02	1.31E+02	1.30E+02
1.00E-01 - 4.00E-01	2.62E+01	2.62E+01	2.61E+01	2.61E+01	2.61E+01	2.61E+01	2.61E+01	2.60E+01	2.57E+01	2.63E+01	2.56E+01
1.70E-02 - 1.00E-01	1.70E-02	1.71E-02	1.71E-02	1.71E-02	1.70E-02	1.69E-02	1.65E-02	1.67E-02	3.71E-02	1.67E-01	7.36E-02
3.00E-03 - 1.70E-02	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	0.00E+00
5.50E-04 - 3.00E-03	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	0.00E+00
1.00E-04 - 5.50E-04	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	0.00E+00
3.00E-05 - 1.00E-04	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	0.00E+00
1.00E-05 - 3.00E-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	0.00E+00
3.05E-06 - 1.00E-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	0.00E+00
1.77E-06 - 3.05E-06	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	0.00E+00
1.30E-06 - 1.77E-06	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	0.00E+00
1.13E-06 - 1.30E-06	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	0.00E+00
1.00E-06 - 1.13E-06	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	0.00E+00
8.00E-07 - 1.00E-06	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	0.00E+00
4.00E-07 - 8.00E-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	0.00E+00
3.25E-07 - 4.00E-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	0.00E+00
2.25E-07 - 3.25E-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	0.00E+00
1.00E-07 - 2.25E-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	0.00E+00
5.00E-08 - 1.00E-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	0.00E+00
3.00E-08 - 5.00E-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	0.00E+00
1.00E-08 - 3.00E-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	0.00E+00
1.00E-11 - 1.00E-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	0.00E+00
Total	6.82E+02	6.82E+02	6.82E+02	6.82E+02	6.82E+02	6.81E+02	6.80E+02	6.79E+02	6.74E+02	7.14E+02	6.80E+02

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment VI

Page VI-7

Neutron Source Spectra of CIC HLW Canister											
Energy Interval, Mev	2010	2010.1	2015	2010	2060	2110	2510	3010	12010	102010	1002010
6.43E+00 - 2.00E+01	3.33E+05	3.32E+05	2.90E+05	2.54E+05	1.17E+05	8.13E+04	6.27E+04	5.77E+04	2.64E+04	2.28E+03	2.17E+02
3.00E+00 - 6.43E+00	5.90E+07	5.90E+07	5.78E+07	5.67E+07	4.97E+07	4.38E+07	2.92E+07	2.51E+07	1.52E+07	1.23E+06	5.17E+04
1.85E+00 - 3.00E+00	4.48E+07	4.48E+07	4.39E+07	4.31E+07	3.77E+07	3.33E+07	2.22E+07	1.91E+07	1.15E+07	6.33E+05	2.75E+04
1.40E+00 - 1.85E+00	9.56E+06	9.55E+06	9.19E+06	8.87E+06	7.25E+06	6.29E+06	4.24E+06	3.67E+06	2.17E+06	1.28E+05	6.12E+03
9.00E-01 - 1.40E+00	1.04E+07	1.04E+07	9.94E+06	9.52E+06	7.54E+06	6.49E+06	4.40E+06	3.81E+06	2.24E+06	1.41E+05	6.96E+03
4.00E-01 - 9.00E-01	9.17E+06	9.16E+06	8.67E+06	8.24E+06	6.29E+06	5.36E+06	3.66E+06	3.18E+06	1.84E+06	1.07E+05	5.69E+03
1.00E-01 - 4.00E-01	2.97E+06	2.97E+06	2.86E+06	2.77E+06	2.27E+06	1.97E+06	1.33E+06	1.15E+06	6.82E+05	4.24E+04	1.99E+03
1.70E-02 - 1.00E-01	3.57E+05	3.56E+05	3.53E+05	3.49E+05	3.15E+05	2.80E+05	1.87E+05	1.60E+05	9.74E+04	6.20E+03	2.54E+02
3.00E-03 - 1.70E-02	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	0.00E+00
5.50E-04 - 3.00E-03	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	0.00E+00
1.00E-04 - 5.50E-04	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	0.00E+00
3.00E-05 - 1.00E-04	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	0.00E+00
1.00E-05 - 3.00E-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	0.00E+00
3.05E-06 - 1.00E-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	0.00E+00
1.77E-06 - 3.05E-06	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	0.00E+00
1.30E-06 - 1.77E-06	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	0.00E+00
1.13E-06 - 1.30E-06	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	0.00E+00
1.00E-06 - 1.13E-06	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	0.00E+00
8.00E-07 - 1.00E-06	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	0.00E+00
4.00E-07 - 8.00E-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	0.00E+00
3.25E-07 - 4.00E-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	0.00E+00
2.25E-07 - 3.25E-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	0.00E+00
1.00E-07 - 2.25E-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	0.00E+00
5.00E-08 - 1.00E-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	0.00E+00
3.00E-08 - 5.00E-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	0.00E+00
1.00E-08 - 3.00E-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	0.00E+00
1.00E-11 - 1.00E-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	0.00E+00
Total	1.37E+08	1.37E+08	1.33E+08	1.30E+08	1.11E+08	9.76E+07	6.53E+07	5.63E+07	3.38E+07	2.29E+06	1.00E+05

Source Terms for HLW Glass Canisters
CAL-MGR-NU-000002 REV 01
Attachment VII

Page VII-1

=origen

0\$\$\$ a8 26 all 71 e

1\$\$\$ 2

1t

Hanford HLW Canister, Blending 1.47+4 Ci and 3040 kg starts at year 1994

2** f1.0

3\$\$\$ A16 4 e

2t

35\$\$\$ 0

4t

56\$\$\$ 0 4 a6 0 a13 43 5 3 0 2 a20 1

57** 0 e

5t

Hanford HLW Canister - Activity input

1.47E+4 Ci in 1 Hanford 15-ft Canister

60** 0. 16. 21. 22.

61** f1-15

65\$\$\$ 3z 1 2z 1 2z 1 2z 1 a25 1 2z 1 2z 1 2z 1

a46 1 2z 1 2z 1 2z 1 e

73\$\$\$	60140	270600	280590	280630	
	340790	380900	400930	410931	430990
	441060	481131	501260	511250	531290
	551340	551370	621510	631520	631540
	631550	882260	882280	892270	902290
	902320	912310	922320	922330	922340
	922350	922360	922380	932370	942380
	942390	942400	942410	942420	952410
	952430	962420	962430	962440	
74**	6.63-6	8.48-1	6.44-2	6.34	
	5.33-2	6.71+3	2.50-1	1.86-1	2.25
	7.17	1.17	8.21-2	1.43+1	2.21-3
	6.13	7.72+3	1.90+2	1.02-1	1.01+1
	9.38	4.35-6	5.32-3	6.04-3	1.25-4
	1.46-4	1.08-2	8.48-3	3.28-2	2.39-2
	1.00-3	6.60-4	2.22-2	9.72-3	1.91-1
	2.70	6.16-1	1.58+1	8.00-5	4.82
	6.44-4	5.31-3	6.90-4	1.67-2	

75\$\$\$ 4r1 16r3 23r2

6t

Hanford HLW Canister, Input by Mass

3\$\$\$ A16 2 a33 -88 e

2t

35\$\$\$ 0

4t

56\$\$\$ 0 4 a6 1 a13 21 5 3 0 2 a20 1

57** 0 e

5t

HF Canister - mass starts at 1994, no Th and U

3040 kg in a Hanford HLW 15-ft Canister

60** 0. 16. 21. 22.

61** f1-15

65\$\$\$ 3z 1 2z 1 2z 1 2z 1 a25 1 2z 1 2z 1 2z 1

a46 1 2z 1 2z 1 2z 1 e

73\$\$\$	80000	130000	50000	830000	200000
	580000	240000	90000	260000	190000

Source Terms for HLW Glass Canisters
 CAL-MGR-NU-000002 REV 01
 Attachment VII

Page VII-2

570000	30000	250000	110000	280000
150000	820000	160000	140000	380000
400000				
902320	922380	400000		

74** 1329784 150045.7 66386.92 31412.19 18064.04
 29378.66 7500.658 8680.469 95632.39 4297.509
 2856.218 28435.42 22514.77 277836.3 25843.85
 20732.06 3692.932 687.3439 656339.9 4634.973
 85440.7

' 267.613 169535.7 85440.7

75\$\$ 21r4
 6t
 54\$\$ A11 1 e
 56\$\$ 0 10 a6 1 a14 5 3 0 2 a20 -1
 57** 0 e
 5t
 Hanford HLW Canister - decayed from 1994 to 2019
 Combined 1.47+4 Ci & 3040 kg in 15' Can
 60** 16 21 26 66 116 516 1016 10016 100016 1000016
 61** f1-15
 65\$\$ 3z 1 2z 1 2z 1 2z 1 a25 1 2z 1 2z 1 2z 1
 a46 1 2z 1 2z 1 2z 1 e
 81\$\$ 2 0 26 1 e
 82\$\$ f2
 6t
 year 2010
 year 2015
 year 2020
 yeqr 2060
 year 2110
 year 2510
 year 3010
 year 12010
 year 102010
 year 1002010
 56\$\$ f0
 6t
 end

OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT

1. QA: QA

SPECIAL INSTRUCTION SHEET

Page: 1 of: 1

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2. Record Date
08/15/2000

3. Accession Number

ATT-TO MOL. 2000823.0004

4. Author Name(s)
JABO S. TANG5. Author Organization
N/A6. Title
SOURCE TERMS FOR HLW GLASS CANISTERS7. Document Number(s)
CAL-MGR-NU-0000028. Version
REV. 019. Document Type
DATA10. Medium
CD-ROM - DISK11. Access Control Code
PUB12. Traceability Designator
DC #25511

13. Comments

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