Response to SDAA Audit Question

Question Number: A-12.2-3

Receipt Date: 07/03/2023

Question:

Please address the following items associated with liquid radioactive waste system component source terms.

1. Table 12.2-11 identified decontamination factors for LCW and HCW granulated activated charcoal (GAC) units. Table 12.2-12b provides a source term for the HCW GAC unit but there is no source term for the LCW GAC unit provided. In addition, Table 11.2-1 does not appear to include either the HCW and LCW GAC unit nor provide information on the RG 1.143 classification for either the HCW or LCW GAC units. Finally, Chapter 11 does not appear to provide any discussion of these units in the system descriptions. The Chapter 11 system description should discuss these units.

2. Table 12.2-11 indicates that source terms for the LCW filters, ion exchange vessels, accumulators, and polishers are combined together in the source term for “LCW Processing Skid.” Table 12.3-6 identifies some of these components, such as ion exchangers and filters, as being located in separate shielded areas. In addition, Table 11.2-1 identifies these components as having separate RG 1.143 classifications.

Consistent with DSRS Section 12.2, a listing of isotope, quantity, form, and use of all radiation sources exceeding 100 millicuries that may warrant shielding design consideration should be provided. The source terms for individual components is also necessary for staff to verify the RG 1.143 component classifications. Please provide the source terms and source term assumptions for the relevant components in the LCW processing skid.

3. SDA Table 11.2-1 references chapter 12 tables for the radionuclide content of certain liquid waste management system components. Some of the referenced Chapter 12 tables appear to be incorrect. Please review Table 11.2-1 and correct the references to the chapter 12 tables, as appropriate.

Response:

Table 11.2-1 of the SDAA describes the HCW Processing charcoal filters as RW-IIb per RG 1.143. SDAA Section 11.2.2.2 describes the HCW processing equipment which includes the two carbon filter vessels filled with granulated activated charcoal (GAC). The HCW charcoal filters use GAC for processing the HCW collection tank contents. Table 12.2-12b defines the source term for HCW GAC, but not for LCW because the LCW does not have a processing charcoal filter unit. Updates to Table 12.2-11 reflect this clarification.

Updates to Table 11.2-1 correct the table references to SDAA Section 12.2. Table 11.2-1 references reflect the assumed radioactive source terms for components in the LCW processing skid as modeled in the shielding analysis. The LCW processing skid source term includes the LCW filters, ion exchangers, accumulators, and polishers as they are all located in the same area with the exception of the LCW solids collection filter (SCF). The SCF, pre-conditioning filter, accumulators, and ion exchanger (IX) vessels are upstream of the reverse osmosis (RO) unit. The polishing IX vessels are downstream of the RO unit. The SCF only receives the crud isotopes (accounted for in both the total processing skid source and the SCF source).

Revisions to Tables 12.2-12c and 12.2-13c clarify the contributions of the components upstream of the RO unit and the components downstream of the RO unit with respect to the total LCW processing skid source term. SDAA Revision 2 incorporates the aforementioned table changes and clarifications as shown below.

Markups of the affected changes, as described in the response, are provided below:

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Table 11.2-1: Major Component Design Parameters

Component (Quantity)	RG 1.143 Safety Classification	Type	Capacity	Design Pressure (psig)	Design Temperature (°F)	Material	Table for Assumed Radioactive Content
Degasifier (2)	RW-IIa	Vertical	12,500 gallons	150	550	Stainless Steel	Table 12.2-15a
Degasifier Liquid Transfer Pumps (2)	RW-IIc	Sealless Centrifugal	28 gpm	150	210	Stainless Steel	-
LCW collection tank (2)	RW-IIc	Vertical, conical	16,000 gallons	15	240	Stainless Steel	Table 12.2-12a
LCW collection tank transfer pump (2)	RW-IIc	Sealless Centrifugal	39 gpm	290	155	Stainless Steel	-
HCW collection tank (2)	RW-IIc	Vertical Conical	16,000 gallons	15	200	Stainless Steel	Table 12.2-12a
HCW collection tank transfer pump (2)	RW-IIc	Sealless Centrifugal	39 gpm	230	155	Stainless Steel	-
LCW sample tank (2)	RW-IIc	Vertical conical	16,000 gallons	15	155	Stainless Steel	Table 12.2-12a~~Table 12.2-12b~~
LCW sample tank transfer pump (2)	RW-IIc	Sealless Centrifugal	28 gpm	150	155	Stainless Steel	-
HCW sample tank (2)	RW-IIc	Vertical conical	16,000 gallons	15	155	Stainless Steel	Table 12.2-12a~~Table 12.2-12b~~
HCW sample tank transfer pump (2)	RW-IIc	Sealless Centrifugal	28 gpm	150	155	Stainless Steel	-
Oil separator (1)	RW-IIc	-	240 gpm	150	155	Stainless Steel	Table 12.2-12d~~Table 12.2-12a~~
Detergent waste collection tank (1)	RW-IIc	Vertical conical	500 gallons	15	200	Stainless Steel	-
Detergent waste drain filter (1)	RW-IIc	Cartridge	20 micron	150	155	Stainless Steel	-
Demineralized water break tank (1)	RW-IIc	Vertical	10,000 gallons	15	155	Stainless Steel	-
HCW Processing charcoal filter (2)	RW-IIb	Vertical Vessel	35 gpm	230	155	Stainless Steel	Table 12.2-12b~~LCW Table 12.2-12a HCW Table 12.2-12b~~
LCW Reverse Osmosis Skid (1)	RW-IIc	Vertical	35 gpm	290	155	Stainless Steel	Table 12.2-12b~~LCW Table 12.2-12a HCW Table 12.2-12b~~
Clean-In-Place Skid (1)	RW-IIc	-	55 gallons	150	155	Stainless Steel	-
Drum Dryer Skids (1)	RW-IIc	-	55 gpd	15	155	Stainless Steel	-
LCW Pre-conditioning filter vessels (2)	RW-IIa	-	35 gpm	290	155	Stainless Steel	Table 12.2-12d
LCW accumulator vessels (3)	RW-IIa	-	35 gpm	290	155	Stainless Steel	Table 12.2-12d
LCW Ion Exchange vessel (5)	RW-IIa	-	35 gpm	290	155	Stainless Steel	Table 12.2-12d~~Table 12.2-12a~~
LCW solids collection filter (1)	RW-IIc	-	35 gpm	290	155	Stainless Steel	Table 12.2-12b

Table 11.2-1: Major Component Design Parameters (Continued)

Component (Quantity)	RG 1.143 Safety Classification	Type	Capacity	Design Pressure (psig)	Design Temperature (°F)	Material	Table for Assumed Radioactive Content
LCW Polishing Ion Exchange Vessel (4)	RW-IIc	-	35 gpm	290	155	Stainless Steel	Table 12.2-12d~~Table 12.2-12a~~
Demineralized water break tank transfer pump (1)	RW-IIc	Sealless centrifugal	220 gpm	150	155	Stainless Steel	-

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Table 12.2-11: Liquid Radioactive Waste System Component Source Term Inputs and Assumptions

Model Parameter	Value
LRWS degasifier	-
Contents	CVCS Letdown
Geometry	Vertical Cylinder
Source dimensions	Diameter=138 in, Height=193 in
Shield thickness of steel shell	1.75 in
Volume	12500 Gallons
LCW and HCW collection tanks	-
Inputs	Table 11.2-3
Geometry	Vertical Cylinder
Source dimensions	Diameter=12 ft, Height=21 ft
Shield thickness of steel shell	0.25 in
Volume	14400 gallons
LRWS oil separator	-
Inputs	Table 11.2-3
Geometry	Horizontal Cylinder
Source dimensions	Diameter=51 in, Height=118 in
Shield thickness of steel shell	0.25 in
~~LCW and~~ HCW granulated activated charcoal (GAC) units	-
Decontamination Factors	-
Cr-51	256
Mn-54	107
Co-58	13.2
Co-60	6.7
Ag-110m	3250
Antimony	7.1
Nb-95	639
Geometry	Vertical Cylinder
Source dimensions of vessel	Diameter=71 in, Height=71 in
Shield thickness of steel shell	0.25 in
LCW reverse osmosis (RO) unit	-
Decontamination factors	-
All nuclides	10
Geometry	Horizontal Cylinder
Source dimensions	Diameter=59 in, Length=102 in
Shield thickness of steel shell	0.25 in
LCW and HCW sample tanks	-
Geometry	Vertical Cylinder
Source dimensions	Diameter=12 ft, Height=21 ft
Shield thickness of steel shell	0.25 in
Drum dryer and holdup tank	-
Inputs	RO Rejects
Geometry	Vertical Cylinder
Source dimensions	Diameter=65.0 in, Height=118 in
Shield thickness of steel shell	0.25 in
LCW processing skid	-

Table 12.2-11: Liquid Radioactive Waste System Component Source Term Inputs and Assumptions (Continued)

Model Parameter	Value
Inputs	LCW Filters, Ixs, Accumulators, ~~and Polishers~~ total Accumulation (LCW Processing Skid Upstream of RO Unit) LCW Polishers (LCW Processing Skid Downstream of RO Unit)
Geometry	Horizontal Cylinder
Source Dimensions	Diameter=71 in, Length=299 in
Shield thickness of steel shell	0.25 in
Additional Shielding	1 in Steel
Solids collection filter	-
Inputs	Crud isotopes from LCW filters, Ixs, and accumulators upstream of RO
Geometry	Vertical Cylinder
Source dimensions	Diameter=91 in, Height=71 in
Shield thickness of steel shell	0.25 in

Note: Assumes the plant consists of 6 NPMs operating on an 18-month refueling cycle.

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Table 12.2-12c: ~~Liquid Radioactive Waste System Component Source Terms – Radionuclide Content –~~

~~Isotope~~	~~LCW Processing Skid (Ci)~~	~~Oil Separator (Ci)~~
~~Kr83m~~	~~-~~	~~-~~
~~Kr85m~~	~~-~~	~~-~~
~~Kr85~~	~~-~~	~~-~~
~~Kr87~~	~~-~~	~~-~~
~~Kr88~~	~~-~~	~~-~~
~~Kr89~~	~~-~~	~~-~~
~~Xe131m~~	~~-~~	~~-~~
~~Xe133m~~	~~-~~	~~-~~
~~Xe133~~	~~-~~	~~-~~
~~Xe135m~~	~~-~~	~~-~~
~~Xe135~~	~~-~~	~~-~~
~~Xe137~~	~~-~~	~~-~~
~~Xe138~~	~~-~~	~~-~~
~~Br82~~	~~1.7E-05~~	~~4.1E-06~~
~~Br83~~	~~6.6E-06~~	~~2.3E-05~~
~~Br84~~	~~6.8E-07~~	~~1.1E-05~~
~~Br85~~	~~7.4E-09~~	~~1.3E-06~~
~~I129~~	~~9.6E-08~~	~~6.7E-11~~
~~I130~~	~~4.8E-05~~	~~3.3E-05~~
~~I131~~	~~3.0E-02~~	~~8.4E-04~~
~~I132~~	~~5.7E-04~~	~~3.9E-04~~
~~I133~~	~~3.2E-03~~	~~1.3E-03~~
~~I134~~	~~2.4E-05~~	~~2.3E-04~~
~~I135~~	~~6.3E-04~~	~~8.1E-04~~
~~Rb86m~~	~~2.0E-11~~	~~9.6E-10~~
~~Rb86~~	~~3.1E-03~~	~~5.6E-06~~
~~Rb88~~	~~3.5E-04~~	~~9.6E-04~~
~~Rb89~~	~~1.4E-05~~	~~4.4E-05~~
~~Cs132~~	~~2.1E-05~~	~~1.1E-07~~
~~Cs134~~	~~8.7E+00~~	~~8.0E-04~~
~~Cs135m~~	~~7.2E-07~~	~~6.7E-07~~
~~Cs136~~	~~6.8E-02~~	~~1.7E-04~~
~~Cs137~~	~~6.0E+00~~	~~4.1E-04~~
~~Cs138~~	~~2.4E-04~~	~~3.6E-04~~
~~P32~~	~~8.7E-10~~	~~1.6E-11~~
~~Co57~~	~~1.1E-10~~	~~1.2E-13~~
~~Sr89~~	~~1.5E-04~~	~~7.1E-07~~
~~Sr90~~	~~2.1E-04~~	~~1.1E-07~~
~~Sr91~~	~~5.8E-07~~	~~3.7E-07~~
~~Sr92~~	~~8.6E-08~~	~~2.0E-07~~
~~Y90~~	~~9.4E-05~~	~~2.7E-08~~
~~Y91m~~	~~1.8E-07~~	~~2.0E-07~~
~~Y91~~	~~2.4E-05~~	~~1.0E-07~~
~~Y92~~	~~1.3E-07~~	~~1.7E-07~~

Table 12.2-12c: ~~Liquid Radioactive Waste System Component Source Terms – Radionuclide Content (Continued)~~

~~Isotope~~	~~LCW Processing Skid~~ ~~(Ci)~~	~~Oil Separator~~ ~~(Ci)~~
~~Y93~~	~~1.3E-07~~	~~7.9E-08~~
~~Zr97~~	~~3.2E-07~~	~~1.2E-07~~
~~Nb95~~	~~1.0E-03~~	~~2.1E-07~~
~~Mo99~~	~~2.3E-03~~	~~2.1E-04~~
~~Mo101~~	~~3.2E-07~~	~~8.1E-06~~
~~Tc99m~~	~~1.1E-03~~	~~2.0E-04~~
~~Tc99~~	~~7.9E-06~~	~~4.0E-09~~
~~Ru103~~	~~3.1E-05~~	~~2.0E-07~~
~~Ru105~~	~~4.8E-08~~	~~6.7E-08~~
~~Ru106~~	~~1.4E-04~~	~~1.3E-07~~
~~Rh103m~~	~~1.4E-05~~	~~2.0E-07~~
~~Rh105~~	~~8.1E-07~~	~~1.4E-07~~
~~Rh106~~	~~6.1E-05~~	~~1.3E-07~~
~~Ag110~~	~~1.2E-04~~	~~3.9E-07~~
~~Sb124~~	~~7.1E-08~~	~~3.0E-10~~
~~Sb125~~	~~3.5E-06~~	~~2.3E-09~~
~~Sb127~~	~~1.7E-07~~	~~1.1E-08~~
~~Sb129~~	~~1.0E-08~~	~~1.4E-08~~
~~Te125m~~	~~7.4E-05~~	~~3.3E-07~~
~~Te127m~~	~~5.2E-04~~	~~1.2E-06~~
~~Te127~~	~~2.3E-04~~	~~4.9E-06~~
~~Te129m~~	~~4.7E-04~~	~~3.6E-0~~
~~Te129~~	~~1.3E-04~~	~~5.1E-06~~
~~Te131m~~	~~5.7E-05~~	~~1.2E-05~~
~~Te131~~	~~5.9E-06~~	~~5.8E-06~~
~~Te132~~	~~1.1E-03~~	~~8.5E-05~~
~~Te133m~~	~~1.1E-0~~	~~7.3E-06~~
~~Te134~~	~~1.2E-06~~	~~1.0E-05~~
~~Ba137m~~	~~4.6E+00~~	~~3.9E-04~~
~~Ba139~~	~~4.3E-08~~	~~1.9E-07~~
~~Ba140~~	~~5.2E-05~~	~~1.0E-06~~
~~La140~~	~~2.5E-05~~	~~3.0E-07~~
~~La141~~	~~3.8E-08~~	~~6.0E-08~~
~~La142~~	~~7.0E-09~~	~~2.8E-08~~
~~Ce141~~	~~2.0E-05~~	~~1.6E-07~~
~~Ce143~~	~~6.5E-07~~	~~1.2E-07~~
~~Ce144~~	~~1.3E-04~~	~~1.4E-07~~
~~Pr143~~	~~7.8E-06~~	~~1.4E-07~~
~~Pr144~~	~~5.5E-05~~	~~1.3E-07~~
~~Np239~~	~~2.3E-05~~	~~2.5E-06~~
~~Na24~~	~~2.5E-03~~	~~1.0E-03~~
~~Cr51~~	~~3.6E-02~~	~~5.8E-05~~
~~Mn54~~	~~1.8E-01~~	~~3.0E-05~~
~~Fe55~~	~~2.1E-01~~	~~2.2E-05~~
~~Fe59~~	~~5.7E-03~~	~~5.6E-06~~

Table 12.2-12c: ~~Liquid Radioactive Waste System Component Source Terms – Radionuclide Content (Continued)~~

~~Isotope~~	~~LCW Processing Skid~~	~~Oil Separator~~
	~~(Ci)~~	~~(Ci)~~
~~Co58~~	~~1.2E+00~~	~~8.5E-05~~
~~Co60~~	~~1.0E-01~~	~~9.8E-06~~
~~Ni63~~	~~5.9E-02~~	~~4.9E-06~~
~~Zn65~~	~~4.8E-02~~	~~9.4E-06~~
~~Zr95~~	~~1.1E-02~~	~~7.2E-06~~
~~Ag110m~~	~~1.2E-01~~	~~2.4E-05~~
~~W187~~	~~4.1E-04~~	~~5.2E-05~~
~~H3~~	~~-~~	~~6.1E-01~~
~~C14~~	~~-~~	~~2.0E-05~~
~~N16~~	~~-~~	~~-~~
~~Ar41~~	~~-~~	~~-~~
~~**Total**~~	~~**2.1E+01**~~	~~**6.2E-01**~~

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Table 12.2-12d: Liquid Radioactive Waste System Component Source Terms - Radionuclide Content

Isotope	LCW Filters, IX, Accumulators Total Accumulation (Ci)	LCW Polishers Downstream of RO Unit (Ci)	LCW Processing Skid Total (Ci)	Oil Separator (Ci)
Kr83m	-	-	-	-
Kr85m	-	-	-	-
Kr85	-	-	-	-
Kr87	-	-	-	-
Kr88	-	-	-	-
Kr89	-	-	-	-
Xe131m	-	-	-	-
Xe133m	-	-	-	-
Xe133	-	-	-	-
Xe135m	-	-	-	-
Xe135	-	-	-	-
Xe137	-	-	-	-
Xe138	-	-	-	-
Br82	1.7E-05	1.7E-08	1.7E-05	4.1E-06
Br83	6.6E-06	6.6E-09	6.6E-06	2.3E-05
Br84	6.7E-07	6.7E-10	6.8E-07	1.1E-05
Br85	7.4E-09	7.4E-12	7.4E-09	1.3E-06
I129	9.6E-08	9.6E-11	9.6E-08	6.7E-11
I130	4.8E-05	4.8E-08	4.8E-05	3.3E-05
I131	3.0E-02	3.0E-05	3.0E-02	8.4E-04
I132	5.7E-04	5.7E-07	5.7E-04	3.9E-04
I133	3.2E-03	3.2E-06	3.2E-03	1.3E-03
I134	2.4E-05	2.4E-08	2.4E-05	2.3E-04
I135	6.3E-04	6.3E-07	6.3E-04	8.1E-04
Rb86m	2.0E-11	1.2E-13	2.0E-11	9.6E-10
Rb86	3.1E-03	1.8E-05	3.1E-03	5.6E-06
Rb88	3.4E-04	2.0E-06	3.5E-04	9.6E-04
Rb89	1.3E-05	7.9E-08	1.4E-05	4.4E-05
Cs132	2.1E-05	1.2E-07	2.1E-05	1.1E-07
Cs134	8.7E+00	5.1E-02	8.7E+00	8.0E-04
Cs135m	7.2E-07	4.2E-09	7.2E-07	6.7E-07
Cs136	6.7E-02	4.0E-04	6.8E-02	1.7E-04
Cs137	6.0E+00	3.5E-02	6.0E+00	4.1E-04
Cs138	2.4E-04	1.4E-06	2.4E-04	3.6E-04
P32	8.7E-10	8.7E-13	8.7E-10	1.6E-11
Co57	1.1E-10	1.1E-13	1.1E-10	1.2E-13
Sr89	1.5E-04	2.0E-07	1.5E-04	7.1E-07
Sr90	2.1E-04	2.1E-07	2.1E-04	1.1E-07
Sr91	5.8E-07	5.8E-10	5.8E-07	3.7E-07
Sr92	8.6E-08	8.6E-11	8.6E-08	2.0E-07
Y90	9.4E-05	9.4E-08	9.4E-05	2.7E-08
Y91m	1.8E-07	1.8E-10	1.8E-07	2.0E-07
Y91	2.4E-05	2.4E-08	2.4E-05	1.0E-07

Table 12.2-12d: Liquid Radioactive Waste System Component Source Terms - Radionuclide Content (Continued)

Isotope	LCW Filters, IX, Accumulators Total Accumulation (Ci)	LCW Polishers Downstream of RO Unit (Ci)	LCW Processing Skid Total (Ci)	Oil Separator (Ci)
Y92	1.3E-07	1.3E-10	1.3E-07	1.7E-07
Y93	1.3E-07	1.3E-10	1.3E-07	7.9E-08
Zr97	3.2E-07	3.2E-10	3.2E-07	1.2E-07
Nb95	1.0E-03	1.0E-06	1.0E-03	2.1E-07
Mo99	2.3E-03	2.3E-06	2.3E-03	2.1E-04
Mo101	3.2E-07	3.2E-10	3.2E-07	8.1E-06
Tc99m	1.1E-03	1.1E-06	1.1E-03	2.0E-04
Tc99	7.9E-06	7.9E-09	7.9E-06	4.0E-09
Ru103	3.1E-05	3.1E-08	3.1E-05	2.0E-07
Ru105	4.8E-08	4.8E-11	4.8E-08	6.7E-08
Ru106	1.4E-04	1.4E-07	1.4E-04	1.3E-07
Rh103m	1.3E-05	1.3E-08	1.4E-05	2.0E-07
Rh105	8.1E-07	8.1E-10	8.1E-07	1.4E-07
Rh106	6.0E-05	6.0E-08	6.1E-05	1.3E-07
Ag110	1.2E-04	1.2E-07	1.2E-04	3.9E-07
Sb124	7.1E-08	7.1E-11	7.1E-08	3.0E-10
Sb125	3.5E-06	3.5E-09	3.5E-06	2.3E-09
Sb127	1.7E-07	1.7E-10	1.7E-07	1.1E-08
Sb129	1.0E-08	10.0E-12	1.0E-08	1.4E-08
Te125m	7.4E-05	7.4E-08	7.4E-05	3.3E-07
Te127m	5.2E-04	5.2E-07	5.2E-04	1.2E-06
Te127	2.3E-04	2.3E-07	2.3E-04	4.9E-06
Te129m	4.7E-04	4.7E-07	4.7E-04	3.6E-06
Te129	1.3E-04	1.3E-07	1.3E-04	5.1E-06
Te131m	5.7E-05	5.7E-08	5.7E-05	1.2E-05
Te131	5.9E-06	5.9E-09	5.9E-06	5.8E-06
Te132	1.1E-03	1.1E-06	1.1E-03	8.5E-05
Te133m	1.1E-06	1.1E-09	1.1E-06	7.3E-06
Te134	1.2E-06	1.2E-09	1.2E-06	1.0E-05
Ba137m	4.6E+00	2.7E-02	4.6E+00	3.9E-04
Ba139	4.3E-08	4.3E-11	4.3E-08	1.9E-07
Ba140	5.2E-05	5.2E-08	5.2E-05	1.0E-06
La140	2.5E-05	2.5E-08	2.5E-05	3.0E-07
La141	3.8E-08	3.8E-11	3.8E-08	6.0E-08
La142	7.0E-09	7.0E-12	7.0E-09	2.8E-08
Ce141	2.0E-05	2.0E-08	2.0E-05	1.6E-07
Ce143	6.5E-07	6.5E-10	6.5E-07	1.2E-07
Ce144	1.3E-04	1.3E-07	1.3E-04	1.4E-07
Pr143	7.8E-06	7.8E-09	7.8E-06	1.4E-07
Pr144	5.5E-05	5.5E-08	5.5E-05	1.3E-07
Np239	2.3E-05	2.3E-08	2.3E-05	2.5E-06
Na24	2.5E-03	2.5E-06	2.5E-03	1.0E-03
Cr51	3.6E-02	3.6E-05	3.6E-02	5.8E-05

Table 12.2-12d: Liquid Radioactive Waste System Component Source Terms - Radionuclide Content (Continued)

Isotope	LCW Filters, IX, Accumulators Total Accumulation (Ci)	LCW Polishers Downstream of RO Unit (Ci)	LCW Processing Skid Total (Ci)	Oil Separator (Ci)
Mn54	1.8E-01	1.8E-04	1.8E-01	3.0E-05
Fe55	2.1E-01	2.1E-04	2.1E-01	2.2E-05
Fe59	5.7E-03	5.7E-06	5.7E-03	5.6E-06
Co58	1.2E+00	1.2E-03	1.2E+00	8.5E-05
Co60	1.0E-01	1.0E-04	1.0E-01	9.8E-06
Ni63	5.9E-02	5.9E-05	5.9E-02	4.9E-06
Zn65	4.8E-02	4.8E-05	4.8E-02	9.4E-06
Zr95	1.1E-02	1.1E-05	1.1E-02	7.2E-06
Ag110m	1.2E-01	1.2E-04	1.2E-01	2.4E-05
W187	4.1E-04	4.1E-07	4.1E-04	5.2E-05
H3	-	-	-	6.1E-01
C14	-	-	-	2.0E-05
N16	-	-	-	-
Ar41	-	-	-	-
Total	**2.1E+01**	**1.2E-01**	**2.1E+01**	**6.2E-01**

Note: The LCW processing skid components upstream of the RO unit include the solid collections filter (SCF), pre-conditioning filter, accumulators, and IX vessels. The SCF only receives the crud isotopes (accounted for in both the processing skid source and the SCF source). The LCW processing skid components downstream of the RO unit are the polishing IX vessels.

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Table 12.2-13c: ~~Liquid Radioactive Waste System Component Source Terms – Source Strengths~~

~~Energy Group~~	~~Lower Bound~~	~~Upper Bound~~	~~LCW Processing Skid~~	~~Oil Separator~~
	~~(MeV)~~	~~(Mev)~~	~~(γ/s)~~	~~(γ/s)~~
~~1~~	~~1.00E-02~~	~~2.00E-02~~	~~1.6E+09~~	~~4.4E+06~~
~~2~~	~~2.00E-02~~	~~3.00E-02~~	~~9.5E+08~~	~~6.0E+06~~
~~3~~	~~3.00E-02~~	~~4.50E-02~~	~~1.4E+10~~	~~4.6E+06~~
~~4~~	~~4.50E-02~~	~~6.00E-02~~	~~4.3E+08~~	~~1.7E+06~~
~~5~~	~~6.00E-02~~	~~7.00E-02~~	~~3.2E+08~~	~~1.3E+06~~
~~6~~	~~7.00E-02~~	~~7.50E-02~~	~~8.2E+07~~	~~5.2E+05~~
~~7~~	~~7.50E-02~~	~~1.00E-01~~	~~4.4E+08~~	~~2.2E+06~~
~~8~~	~~1.00E-01~~	~~1.50E-01~~	~~3.2E+08~~	~~1.0E+07~~
~~9~~	~~1.50E-01~~	~~2.00E-01~~	~~5.4E+08~~	~~2.9E+06~~
~~10~~	~~2.00E-01~~	~~2.60E-01~~	~~1.9E+08~~	~~4.5E+06~~
~~11~~	~~2.60E-01~~	~~3.00E-01~~	~~3.7E+08~~	~~4.6E+06~~
~~12~~	~~3.00E-01~~	~~4.00E-01~~	~~2.2E+09~~	~~3.1E+07~~
~~13~~	~~4.00E-01~~	~~4.50E-01~~	~~1.9E+08~~	~~4.4E+06~~
~~14~~	~~4.50E-01~~	~~5.10E-01~~	~~4.8E+09~~	~~6.7E+06~~
~~15~~	~~5.10E-01~~	~~5.12E-01~~	~~1.3E+10~~	~~1.9E+06~~
~~16~~	~~5.12E-01~~	~~6.00E-01~~	~~7.8E+10~~	~~5.6E+07~~
~~17~~	~~6.00E-01~~	~~7.00E-01~~	~~4.5E+11~~	~~6.7E+07~~
~~18~~	~~7.00E-01~~	~~8.00E-01~~	~~3.1E+11~~	~~4.7E+07~~
~~19~~	~~8.00E-01~~	~~9.00E-01~~	~~6.8E+10~~	~~3.6E+07~~
~~20~~	~~9.00E-01~~	~~1.00E+00~~	~~1.6E+09~~	~~7.8E+06~~
~~21~~	~~1.00E+00~~	~~1.20E+00~~	~~1.6E+10~~	~~2.6E+07~~
~~22~~	~~1.20E+00~~	~~1.33E+00~~	~~2.6E+09~~	~~1.4E+07~~
~~23~~	~~1.33E+00~~	~~1.44E+00~~	~~1.3E+10~~	~~5.2E+07~~
~~24~~	~~1.44E+00~~	~~1.50E+00~~	~~1.9E+08~~	~~3.4E+06~~
~~25~~	~~1.50E+00~~	~~1.57E+00~~	~~6.7E+08~~	~~1.1E+06~~
~~26~~	~~1.57E+00~~	~~1.66E+00~~	~~2.1E+06~~	~~5.3E+05~~
~~27~~	~~1.66E+00~~	~~1.80E+00~~	~~2.3E+08~~	~~6.9E+06~~
~~28~~	~~1.80E+00~~	~~2.00E+00~~	~~4.4E+06~~	~~9.0E+06~~
~~29~~	~~2.00E+00~~	~~2.15E+00~~	~~5.8E+05~~	~~7.7E+05~~
~~30~~	~~2.15E+00~~	~~2.35E+00~~	~~1.7E+06~~	~~2.5E+06~~
~~31~~	~~2.35E+00~~	~~2.50E+00~~	~~3.1E+05~~	~~4.3E+05~~
~~32~~	~~2.50E+00~~	~~2.75E+00~~	~~4.9E+07~~	~~2.2E+07~~
~~33~~	~~2.75E+00~~	~~3.00E+00~~	~~4.4E+07~~	~~1.8E+07~~
~~34~~	~~3.00E+00~~	~~3.50E+00~~	~~1.1E+05~~	~~2.7E+05~~
~~35~~	~~3.50E+00~~	~~4.00E+00~~	~~9.0E+04~~	~~1.0E+05~~
~~36~~	~~4.00E+00~~	~~4.50E+00~~	~~4.8E+03~~	~~1.1E+04~~
~~37~~	~~4.50E+00~~	~~5.00E+00~~	~~2.4E+04~~	~~6.7E+04~~
~~38~~	~~5.00E+00~~	~~5.50E+00~~	~~4.6E+01~~	~~1.3E+02~~
~~39~~	~~5.50E+00~~	~~6.00E+00~~	~~-~~	~~-~~
~~40~~	~~6.00E+00~~	~~6.50E+00~~	~~-~~	~~-~~
~~41~~	~~6.50E+00~~	~~7.00E+00~~	~~-~~	~~-~~
~~42~~	~~7.00E+00~~	~~7.50E+00~~	~~-~~	~~-~~
~~43~~	~~7.50E+00~~	~~8.00E+00~~	~~-~~	~~-~~

Table 12.2-13c: ~~Liquid Radioactive Waste System Component Source Terms – Source Strengths (Continued)~~

~~Energy Group~~	~~Lower Bound~~	~~Upper Bound~~	~~LCW Processing Skid~~	~~Oil Separator~~
	~~(MeV)~~	~~(Mev)~~	~~(γ/s)~~	~~(γ/s)~~
~~44~~	~~8.00E+00~~	~~1.00E+01~~	~~-~~	~~-~~
~~45~~	~~1.00E+01~~	~~1.20E+01~~	~~-~~	~~-~~
~~46~~	~~1.20E+01~~	~~1.40E+01~~	~~-~~	~~-~~
~~47~~	~~1.40E+01~~	~~2.00E+01~~	~~-~~	~~-~~
~~Total~~			~~9.8E+11~~	~~4.6E+08~~

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Table 12.2-13d: Liquid Radioactive Waste System Component Source Terms - Source Strengths

Energy Group	Lower Bound	Upper Bound	LCW Filters, IX, Accumulators Total Accumulation	LCW Polishers Downstream of RO Unit	LCW Processing Skid Total	Oil Separator
	(MeV)	(MeV)	(y/s)	(y/s)	(y/s)	(y/s)
1	1.00E-02	2.00E-02	1.6E+09	8.8E+06	1.6E+09	4.4E+06
2	2.00E-02	3.00E-02	9.5E+08	4.7E+06	9.5E+08	6.0E+06
3	3.00E-02	4.50E-02	1.4E+10	8.1E+07	1.4E+10	4.6E+06
4	4.50E-02	6.00E-02	4.3E+08	2.3E+06	4.3E+08	1.7E+06
5	6.00E-02	7.00E-02	3.2E+08	1.8E+06	3.2E+08	1.3E+06
6	7.00E-02	7.50E-02	8.2E+07	4.4E+05	8.2E+07	5.2E+05
7	7.50E-02	1.00E-01	4.4E+08	2.4E+06	4.4E+08	2.2E+06
8	1.00E-01	1.50E-01	3.1E+08	1.5E+06	3.2E+08	1.0E+07
9	1.50E-01	2.00E-01	5.4E+08	3.0E+06	5.4E+08	2.9E+06
10	2.00E-01	2.60E-01	1.9E+08	8.9E+05	1.9E+08	4.5E+06
11	2.60E-01	3.00E-01	3.7E+08	1.8E+06	3.7E+08	4.6E+06
12	3.00E-01	4.00E-01	2.2E+09	7.6E+06	2.2E+09	3.1E+07
13	4.00E-01	4.50E-01	1.9E+08	2.1E+05	1.9E+08	4.4E+06
14	4.50E-01	5.10E-01	4.7E+09	2.8E+07	4.8E+09	6.7E+06
15	5.10E-01	5.12E-01	1.3E+10	1.3E+07	1.3E+10	1.9E+06
16	5.12E-01	6.00E-01	7.8E+10	4.6E+08	7.8E+10	5.6E+07
17	6.00E-01	7.00E-01	4.5E+11	2.6E+09	4.5E+11	6.7E+07
18	7.00E-01	8.00E-01	3.1E+11	1.8E+09	3.1E+11	4.7E+07
19	8.00E-01	9.00E-01	6.8E+10	1.4E+08	6.8E+10	3.6E+07
20	9.00E-01	1.00E+00	1.6E+09	1.6E+06	1.6E+09	7.8E+06
21	1.00E+00	1.20E+00	1.6E+10	6.8E+07	1.6E+10	2.6E+07
22	1.20E+00	1.33E+00	2.6E+09	5.0E+06	2.6E+09	1.4E+07
23	1.33E+00	1.44E+00	1.3E+10	5.9E+07	1.3E+10	5.2E+07
24	1.44E+00	1.50E+00	1.9E+08	1.9E+05	1.9E+08	3.4E+06
25	1.50E+00	1.57E+00	6.7E+08	6.9E+05	6.7E+08	1.1E+06
26	1.57E+00	1.66E+00	2.1E+06	2.2E+03	2.1E+06	5.3E+05
27	1.66E+00	1.80E+00	2.3E+08	2.3E+05	2.3E+08	6.9E+06
28	1.80E+00	2.00E+00	4.3E+06	1.8E+04	4.4E+06	9.0E+06
29	2.00E+00	2.15E+00	5.8E+05	1.2E+03	5.8E+05	7.7E+05
30	2.15E+00	2.35E+00	1.7E+06	8.7E+03	1.7E+06	2.5E+06
31	2.35E+00	2.50E+00	3.1E+05	4.1E+02	3.1E+05	4.3E+05
32	2.50E+00	2.75E+00	4.9E+07	5.5E+04	4.9E+07	2.2E+07
33	2.75E+00	3.00E+00	4.4E+07	4.4E+04	4.4E+07	1.8E+07
34	3.00E+00	3.50E+00	1.1E+05	6.3E+02	1.1E+05	2.7E+05
35	3.50E+00	4.00E+00	9.0E+04	1.8E+02	9.0E+04	1.0E+05
36	4.00E+00	4.50E+00	4.8E+03	2.4E+01	4.8E+03	1.1E+04
37	4.50E+00	5.00E+00	2.4E+04	1.4E+02	2.4E+04	6.7E+04
38	5.00E+00	5.50E+00	4.6E+01	2.7E-01	4.6E+01	1.3E+02
39	5.50E+00	6.00E+00	-	-	-	-
40	6.00E+00	6.50E+00	-	-	-	-
41	6.50E+00	7.00E+00	-	-	-	-

Table 12.2-13d: Liquid Radioactive Waste System Component Source Terms - Source Strengths (Continued)

Energy Group	Lower Bound	Upper Bound	LCW Filters, IX, Accumulators Total Accumulation	LCW Polishers Downstream of RO Unit	LCW Processing Skid Total	Oil Separator
	(MeV)	(MeV)	(y/s)	(y/s)	(y/s)	(y/s)
42	7.00E+00	7.50E+00	-	-	-	-
43	7.50E+00	8.00E+00	-	-	-	-
44	8.00E+00	1.00E+01	-	-	-	-
45	1.00E+01	1.20E+01	-	-	-	-
46	1.20E+01	1.40E+01	-	-	-	-
47	1.40E+01	2.00E+01	-	-	-	-
Total			**9.8E+11**	**5.3E+09**	**9.8E+11**	**4.6E+08**