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Air and Radon Pathways Screening Methodologies for the next Revision of the E-Area PA

J. A. Dyer

November 2017

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EXECUTIVE SUMMARY

The strategic plan for the next E-Area Low-Level Waste Facility Performance Assessment includes recommended changes to the screening criteria used to reduce the number of radioisotopes that are to be considered in the air and radon pathways incorporated into the GoldSim® atmospheric release model (ARM).

For the air pathway, a revised screening methodology was developed based on refinement of previous E-Area PA screening approaches and consideration of the strategic plan recommendations. The revised methodology has three sequential screening steps for each radioisotope: (1) volatility test using the Periodic Table of the Elements, (2) stability test based on half-life, and (3) stability test based on volatility as measured by the Henry's Law constant for the assumed dominant gaseous species or vapor pressure in the case of tritiated water. Of the 1252 radioisotopes listed in the International Commission on Radiological Protection Publication 107, only the 10 that satisfied all three steps of the revised screening methodology will be included in the ARM. They are: Ar-37, Ar-39, Ar-42, C-14, H-3, Hg-194, Hg-203, Kr-81, Kr-85, and Xe-127.

For the radon pathway, a revised screening methodology was developed that also has three sequential steps: (1) identify all decay chains that terminate at Rn-222, (2) screen out parents that decay through U-238 because of its 4.5-billion-year primordial half-life, and (3) eliminate remaining parents whose half-life is shorter than one day. Of the 86 possible decay chains leading to Rn-222, six decay chains consist of 15 unique radioisotopes that will be incorporated into the ARM. The 15 radioisotopes are: U-238, Th-234, Pa-234m, Pu-238, U-234, Th-230, Ra-226, Cf-246, Cm-242, Am-242m, Am-242, Np-238, Np-234, Pa-230, and Rn-222.

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ARM	Atmospheric Release Model
CIG	Components in Grout
E_h	oxidation-reduction potential
ICRP	International Commission on Radiological Protection
ILV	Intermediate Level Vault
LAW	Low Activity Waste
LLWF	Low-Level Waste Facility
NCRP	National Council on Radiation and Protection & Measurements
NIST	National Institute of Standards and Technology
PA	Performance Assessment
SRNL	Savannah River National Laboratory

1.0 Introduction

The strategic plan developed by Butcher and Phifer (2016) for the next E-Area Low-Level Waste Facility (LLWF) Performance Assessment (PA) and documented in SRNL-STI-2015-0062 (Rev. 0) contains recommended changes to the screening criteria employed to reduce the number of radioisotopes included in both the air and radon pathways incorporated into the GoldSim® atmospheric release model (ARM). The relevant recommendations are:

Topic 3.3 – Non-Groundwater Pathways Calculation Improvements for Next PA Revision

- **Recommendation 73**: Start the radionuclide screening for all pathways/performance objectives with the full set of 1252 isotopes listed in International Commission on Radiological Protection (ICRP) Publication 107 (ICRP, 2008) and included in the new SRNL Radionuclide Data Package.
- **Recommendation 72**: Do away with trigger values for all pathways.
- **Recommendation 84**: Simplify radionuclide screening.
    - The National Council on Radiation Protection & Measurements (NCRP) Level I screening (NCRP, 1996) used in the 2008 PA was ineffective (started with 10^7 Ci). Instead, consider using 10x final projected inventories at closure.
    - Following the NCRP screening step, screen the list of elements comprising the remaining isotopes based on their potential to form a vapor phase in the disposal environment.
- **Recommendation 79**: The radionuclide screening approach used in 2008 PA for the radon pathway was based on decay chain and half-life considerations only. For the PA revision, perform radionuclide screening based on decay chain considerations only and do not consider half-life for chains leading to Rn-222 (i.e., screen full decay chains). However, screen out Rn-220 from consideration based on its very short half-life.

This report describes the revised radioisotope screening methodologies to be used for the next E-Area PA revision.

2.0 Air Pathway Screening Methodology

For the 2008 E-Area PA, a multi-tiered process based on the NCRP's Level I screening (NCRP, 1996), process knowledge, and professional judgement was applied for eliminating radionuclides from the air pathway analysis. The NCRP Level I screening, however, proved ineffective and eliminated only 10 of 826 radionuclides from further consideration, even though a conservative inventory of 10^7 Ci was assumed.

For this reason, a three-step screening methodology was developed based on refinement of previous E-Area PA screening approaches (Cook and Wilhite, 2004; Crapse and Cook, 2006) and consideration of the strategic plan recommendations above. The revised methodology includes three sequential screening steps for each radioisotope:

1. Volatility test using the Periodic Table of the Elements
2. Stability test based upon half-life
3. Stability test based upon volatility

The screening process begins with the complete set of 1252 isotopes listed in ICRP Publication 107 (ICRP, 2008) and included in the new SRNL Radionuclide Data Package.

2.1 Volatility Test using the Periodic Table of the Elements

The Periodic Table of the Elements shown in Figure 2-1 was used to select radioisotopes of elements identified as gases (shaded in teal blue) and liquids (shaded in rose) as well as radioisotopes that border the gaseous elements and form small covalently bonded nonpolar volatile molecules with O and H. In addition, the E-Area PA non-groundwater task team chose to include radioisotopes of antimony (Sb) and tin (Sn) from the 2008 E-Area PA ARM because of their potential to form volatile methylated species, even though the formation of methylated species is unlikely under oxidizing, partially water-saturated conditions. Isotopes of radon (Rn) were excluded because the radon air pathway is modeled separately.

Radioisotopes of the elements outlined in red and teal in Figure 2-1 that satisfied the step one screening criterion and were carried forward to step two are highlighted in yellow in Table A-1 in Appendix A. Table A-1 contains the complete list of 1252 radioisotopes for reference. The total number of radioisotopes that met the step one criterion was 192 or approximately 15% of the complete set.

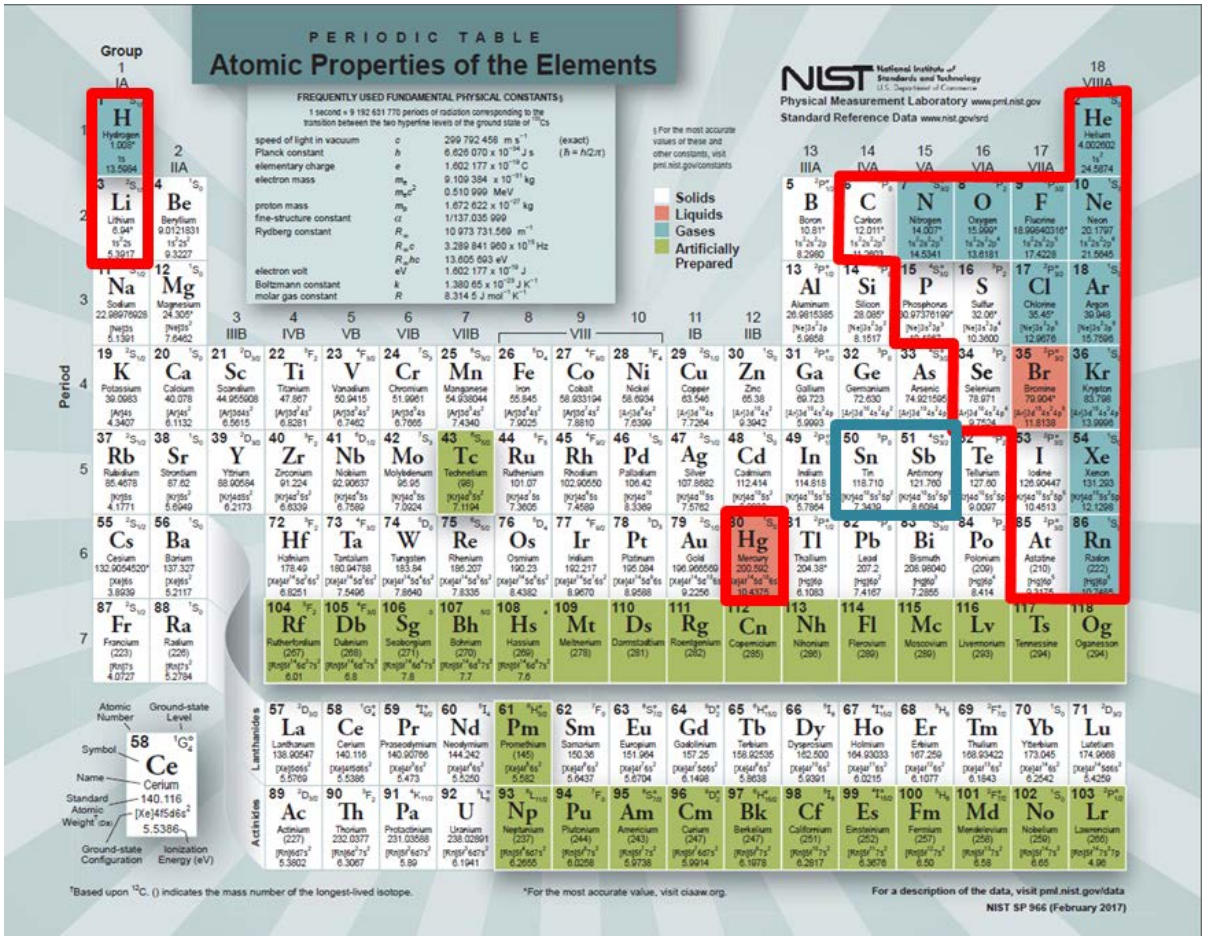

Figure 2-1. NIST Periodic Table of the Elements (Dragoset et al., 2017)

2.2 Stability Test Based Upon Half-Life

In step two, radioisotopes were screened out if they had a half-life shorter than 30 days (i.e., more than 12 half-lives of decay will occur in one year, which is equivalent to the loss of greater than 99.97% of the original radionuclide mass). A 30-day half-life screening criterion was deemed reasonable by the E-Area PA non-groundwater task team based on historical and planned disposal unit timelines: 30^{+}-year operational period, 100-year institutional control period, and 1000^{+}-year PA assessment period.

Radioisotopes that satisfied the step two screening criterion and were carried forward to step three are highlighted in rose in Table B-1 in Appendix B. Only radioisotopes that met the step one screening criterion are shown in Table B-1. The total number of radioisotopes meeting both step one and step two of the screening criteria was 23, or approximately 1.8% of the complete set of 1252 radioisotopes.

2.3 Stability Test Based Upon Volatility

The following step three screening criteria were applied to each of the 23 remaining radioisotopes:

- The most likely gas-phase molecular species for all radioisotopes except tritium (H-3) will have a dimensionless Henry's Law constant greater than 4.1E-04 molar vapor/molar liquid (equivalent to 1E-05 atm-m^3/mole; see explanation below) at 25 ^{o}C.
- For tritiated water (HTO), a Henry's Law screening criterion is not applicable. Instead, H-3 will satisfy the step three criteria if the HTO vapor pressure is greater than 1 mm Hg at 25 ^{o}C.

The step three screening criteria are the same as those used by the United States Environmental Protection Agency for vapor intrusion screening-level calculations, where a volatile species is defined as having either a vapor pressure greater than 1 mm Hg or a Henry's Law constant greater than 1E-05 atm-m^3/mole (Tillman and Weaver, 2005; U. S. EPA, 2015). In addition, utilizing the Henry's Law constant as a screening criterion allows for the effect of pH on volatility to be considered.

The Henry's Law constants employed in the step three screening were calculated by Dyer (2017). Two different geochemical environments described by Denham (2010) were considered in this screening step. The first was a mildly oxidizing, clayey, sediment soil (pH 5.5, E_h +370 mV) referred to as Soil Condition A by Denham (2010). The second was an alkaline, oxidizing soil (pH 8.23, E_h +730 mV) referred to as Aged Concrete. Aged Concrete better characterizes the geochemical environment that will control volatilization in the CIG Trench, LAW Vault, and ILV (Hiergesell and Taylor, 2011). Henry's Law constants for volatile species of the elements, chlorine (Cl), mercury (Hg), carbon (C), iodine (I), phosphorus (P), sulfur (S), antimony (Sb), selenium (Se) and tin (Sn), will be greater (reflecting higher volatility) under mildly acidic, oxidizing conditions (Soil Condition A) than under alkaline, oxidizing conditions (Aged Concrete). As a result, screening based on Henry's Law constants at pH 5.5 will be conservative for these nine elements.

Table 2-1 lists the Henry's Law constants used in the step three screening, along with the assumed dominant gaseous species that will exist under both mildly acidic and alkaline oxidizing conditions (Soil Condition A and Aged Concrete). Elements that exceeded the volatility screening criteria are highlighted in light green. Specific radioisotopes that satisfied the step three screening criteria are highlighted in teal in Table C-1 in Appendix C. Only radioisotopes that met the step two screening criterion are shown in

Table C-1. Ten radioisotopes (approximately 0.8% of the complete set of 1252 radioisotopes) satisfied all three steps of the screening criteria and are summarized in Table 2-2.

Table 2-1. Henry's Law Constants used in Step Three Screening

Periodic Table Element	Assumed Dominant Gaseous Species	Dimensionless H_i Soil at pH 5.4 (molar vapor/molar liquid) [1]	Vapor Pressure @ 25 °C (mm Hg)
Ar	Ar^0	29	
C	CO_2	1.1	
Cl	HCl	7.9E-14	
H	HTO		23.756 [2]
Hg	Hg^0 (Soil pH 5.4) $HgCl_2$ (Soil pH 5.4) $HgCl_2$ (Oxid'd, pH 8.23)	0.32 (Hg^0) 1.1E-07 ($HgCl_2$)	
I	HI (Soil pH 5.4) I_2 (Oxid'd, pH 8.23)	6.5E-17	
Kr	Kr^0	17	
S	SO_2	9.4E-06	
Sb	$SbCl_3$	5.9E-35	
Se	H_2Se (Soil pH 5.4) $SeCl_4$ (Oxid'd, pH 8.23)	1.5E-27	
Sn	$SnCl_4$	4.3E-56	
Xe	Xe^0	9.4	

Cells highlighted in light green exceed the screening criteria.

[1] Dyer (2017)

[2] Dean (1992)

Table 2-2. Volatile Radioisotopes to be included in the Atmospheric Release Model

Periodic Table Element	Radioisotopes Satisfying All Screening Criteria (Periodic Table Test, Half-Life Test, and Volatility Test)		
Ar	Ar-37	Ar-39	Ar-42
C	C-14		
H	H-3		
Hg	Hg-194	Hg-203	
Kr	Kr-81	Kr-85	
Xe	Xe-127		

3.0 Radon Pathway Screening Methodology

The objective of the radon screening methodology is to identify relevant radionuclide decay chains leading to radon-222 (Rn-222), beginning with the decay chain data provided in the radionuclide data package (SRNL Radionuclide, Element and Dose Parameters Data Package_12-30-15_version 1.1) for the E-Area PA. The radionuclide data package provides the decay chains for all 1252 ICRP Publication 107 radioisotopes (ICRP, 2008).

The revised radon screening methodology includes three steps:

1. Identify all decay chains that terminate at Rn-222.
2. Screen out parents that decay through uranium-238 (U-238) because of its 4.5-billion-year primordial half-life.
3. Eliminate remaining parents whose half-life is shorter than one day.

The first screening step identified 86 decay chains of varying length leading to Rn-222. Next, step two eliminated slightly more than half of the 86 decay chains from step one. Finally, step three screened out all but six of the decay chains remaining from step two.

The six decay chains that comprise the radon pathway and will be included in the ARM are shown below and in Figure 3-1. The colored numerals 1 through 6 in Figure 3-1 correspond to the following decay chains:

1 U-238 → Th-234 → Pa-234m → U-234 → Th-230 → Ra-226 → Rn-222

2 Cf-246 → Cm-242 → Pu-238 → U-234 → Th-230 →Ra-226 → Rn-222

3 Am-242m → Am-242 → Cm-242 → Pu-238 → U-234 → Th-230 → Ra-226 → Rn-222

4 Am-242m → Np-238 → Pu-238 → U-234 → Th-230 →Ra-226 → Rn-222

5 Np-234 → U-234 → Th-230 → Ra-226 → Rn-222

6 Pa-230 → Th-230 → Ra-226 → Rn-222

Glossary: Americium-242 (Am-242), Americium-242m (Am-242m), Californium-246 (Cf-246), Curium-242 (Cm-242), Neptunium-234 (Np-234), Neptunium-238 (Np-238), Plutonium-238 (Pu-238), Protactinium-230 (Pa-230), Protactinium-234m (Pa-234m), Radium-226 (Ra-226), Radon-222 (Rn-222), Thorium-230 (Th-230), Thorium-234 (Th-234), Uranium-234 (U-234), Uranium-238 (U-238).

Two exceptions to the step three screening criterion were made for Pa-234m and Am-242, whose half lives are 1.17 minutes and 16 hours, respectively. Both were retained in the ARM because they participate in the decay sequence for longer-lived parents U-238 (chain 1) and Am-242m (chain 3), respectively. However, inventory limits will not be established for Pa-234m and Am-242 to satisfy the step three screening criterion.

The six decay chains contain a total of 14 unique parent radioisotopes in addition to Rn-222. The 14 parents are U-238, Th-234, Pa-234m, Pu-238, U-234, Th-230, Ra-226, Cf-246, Cm-242, Am-242m, Am-242, Np-238, Np-234, and Pa-230. In contrast, the 2008 E-Area PA included only two decay chains

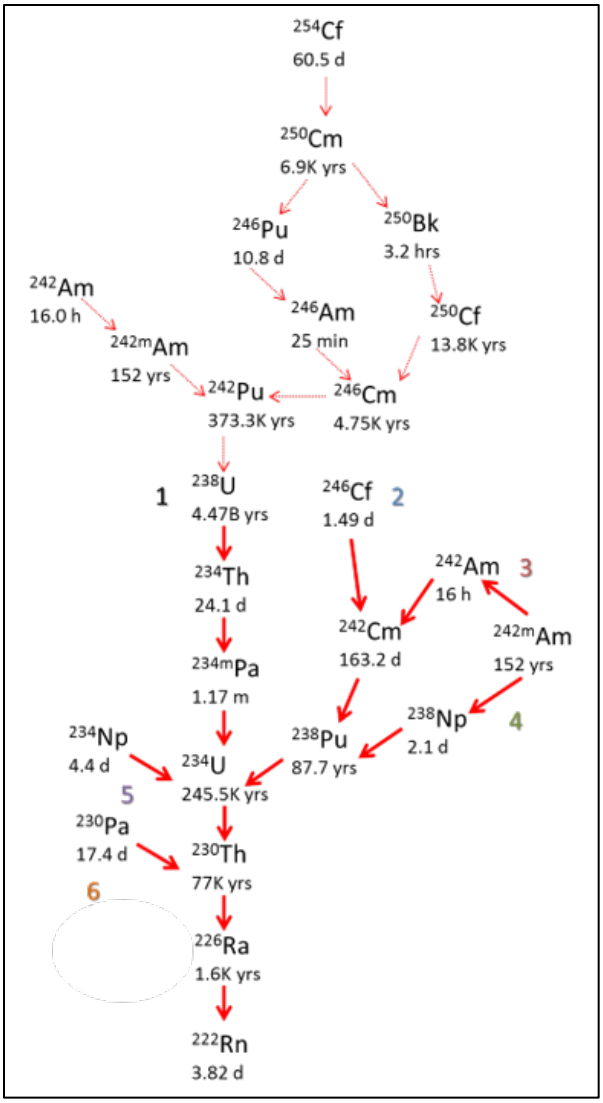

Figure 3-1. Decay Pathways to Rn-222

(portions of chains 1 and 2 above) containing five unique parents (U-238, Pu-238, U-234, Th-230, and Ra-226).

4.0 Conclusions

For the air pathway, a revised three-step screening methodology was developed that includes three sequential screening steps for each radioisotope: (1) volatility test using the Periodic Table of the Elements, (2) stability test based on half-life, and (3) stability test based on volatility as measured by the Henry's Law constant for the assumed dominant gaseous species or vapor pressure in the case of tritiated water. From the complete set of 1252 radioisotopes, only 10 satisfied all screening criteria: Ar-37, Ar-39, Ar-42, C-14, H-3, Hg-194, Hg-203, Kr-81, Kr-85, and Xe-127.

For the radon pathway, a revised screening methodology was developed that also includes three sequential steps: (1) identify all decay chains that terminate at Rn-222, (2) screen out parents that decay

through U-238 because of its 4.5-billion-year primordial half-life, and (3) eliminate remaining parents whose half-life is shorter than one day. Of the 86 possible decay chains leading to Rn-222, six decay chains consist of 15 unique radioisotopes that will be incorporated into the ARM. The 15 radioisotopes are: U-238, Th-234, Pa-234m, Pu-238, U-234, Th-230, Ra-226, Cf-246, Cm-242, Am-242m, Am-242, Np-238, Np-234, Pa-230, and Rn-222.

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Appendix A. Step One Screening

Table A-1. Results of Step One Screening

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	Volatile Species?
1	Hydrogen	H-3	3	1.2320E+01	y	Y
4	Beryllium	Be-7	7	5.3220E+01	d	N
		Be-10	10	1.5100E+06	y	N
6	Carbon	C-10	10	1.9255E+01	s	Y
		C-11	11	2.0390E+01	m	Y
		C-14	14	5.7000E+03	y	Y
7	Nitrogen	N-13	13	9.9650E+00	m	Y
		N-16	16	7.1300E+00	s	Y
8	Oxygen	O-14	14	7.0606E+01	s	Y
		O-15	15	1.2224E+02	s	Y
		O-19	19	2.6464E+01	s	Y
9	Fluorine	F-17	17	6.4490E+01	s	Y
		F-18	18	1.0977E+02	m	Y
10	Neon	Ne-19	19	1.7220E+01	s	Y
		Ne-24	24	3.3800E+00	m	Y
11	Sodium	Na-22	22	2.6019E+00	y	N
		Na-24	24	1.4959E+01	h	N
12	Magnesium	Mg-27	27	9.4580E+00	m	N
		Mg-28	28	2.0915E+01	h	N
13	Aluminium	Al-26	26	7.1700E+05	y	N
		Al-28	28	2.2414E+00	m	N
		Al-29	29	6.5600E+00	m	N
14	Silicon	Si-31	31	1.5730E+02	m	N
		Si-32	32	1.3200E+02	y	N
15	Phosphorus	P-30	30	2.4980E+00	m	Y
		P-32	32	1.4263E+01	d	Y
		P-33	33	2.5340E+01	d	Y
16	Sulphur	S-35	35	8.7510E+01	d	Y
		S-37	37	5.0500E+00	m	Y
		S-38	38	1.7030E+02	m	Y
17	Chlorine	Cl-34	34	1.5264E+00	s	Y
		Cl-34m	34	3.2000E+01	m	Y
		Cl-36	36	3.0100E+05	y	Y
		Cl-38	38	3.7240E+01	m	Y
		Cl-39	39	5.5600E+01	m	Y
		Cl-40	40	1.3500E+00	m	Y
18	Argon	Ar-37	37	3.5040E+01	d	Y
		Ar-39	39	2.6900E+02	y	Y
		Ar-41	41	1.0961E+02	m	Y
		Ar-42	42	3.2900E+01	y	Y
		Ar-43	43	5.3700E+00	m	Y
		Ar-44	44	1.1870E+01	m	Y

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
19	Potassium	K-38	38	7.6360E+00	m	N
		K-40	40	1.2510E+09	y	N
		K-42	42	1.2360E+01	h	N
		K-43	43	2.2300E+01	h	N
		K-44	44	2.2130E+01	m	N
		K-45	45	1.7300E+01	m	N
		K-46	46	1.0500E+02	s	N
20	Calcium	Ca-41	41	1.0200E+05	y	N
		Ca-45	45	1.6267E+02	d	N
		Ca-47	47	4.5360E+00	d	N
		Ca-49	49	8.7180E+00	m	N
21	Scandium	Sc-42m	42	6.2000E+01	s	N
		Sc-43	43	3.8910E+00	h	N
		Sc-44	44	3.9700E+00	h	N
		Sc-44m	44	5.8610E+01	h	N
		Sc-46	46	8.3790E+01	d	N
		Sc-47	47	3.3492E+00	d	N
		Sc-48	48	4.3670E+01	h	N
		Sc-49	49	5.7200E+01	m	N
		Sc-50	50	1.0250E+02	s	N
22	Titanium	Ti-44	44	6.0000E+01	y	N
		Ti-45	45	1.8480E+02	m	N
		Ti-51	51	5.7600E+00	m	N
		Ti-52	52	1.7000E+00	m	N
23	Vanadium	V-47	47	3.2600E+01	m	N
		V-48	48	1.5974E+01	d	N
		V-49	49	3.3000E+02	d	N
		V-50	50	1.5000E+17	y	N
		V-52	52	3.7430E+00	m	N
		V-53	53	1.6100E+00	m	N
24	Chromium	Cr-48	48	2.1560E+01	h	N
		Cr-49	49	4.2300E+01	m	N
		Cr-51	51	2.7703E+01	d	N
		Cr-55	55	3.4970E+00	m	N
		Cr-56	56	5.9400E+00	m	N
25	Manganese	Mn-50m	50	1.7500E+00	m	N
		Mn-51	51	4.6200E+01	m	N
		Mn-52m	52	2.1100E+01	m	N
		Mn-52	52	5.5910E+00	d	N
		Mn-53	53	3.7000E+06	y	N
		Mn-54	54	3.1212E+02	d	N
		Mn-56	56	2.5789E+00	h	N
		Mn-57	57	8.5400E+01	s	N
		Mn-58m	58	6.5200E+01	s	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
26	Iron	Fe-52	52	8.2750E+00	h	N
		Fe-53	53	8.5100E+00	m	N
		Fe-53m	53	2.5260E+00	m	N
		Fe-55	55	2.7370E+00	y	N
		Fe-59	59	4.4495E+01	d	N
		Fe-60	60	1.5000E+06	y	N
		Fe-61	61	5.9800E+00	m	N
		Fe-62	62	6.8000E+01	s	N
27	Cobalt	Co-54m	54	1.4800E+00	m	N
		Co-55	55	1.7530E+01	h	N
		Co-56	56	7.7230E+01	d	N
		Co-57	57	2.7174E+02	d	N
		Co-58	58	7.0860E+01	d	N
		Co-58m	58	9.0400E+00	h	N
		Co-60	60	5.2713E+00	y	N
		Co-60m	60	1.0467E+01	m	N
		Co-61	61	1.6500E+00	h	N
		Co-62	62	1.5000E+00	m	N
		Co-62m	62	1.3910E+01	m	N
28	Nickel	Ni-56	56	6.0750E+00	d	N
		Ni-57	57	3.5600E+01	h	N
		Ni-59	59	1.0100E+05	y	N
		Ni-63	63	1.0010E+02	y	N
		Ni-65	65	2.5172E+00	h	N
		Ni-66	66	5.4600E+01	h	N
29	Copper	Cu-57	57	1.9630E-01	s	N
		Cu-59	59	8.1500E+01	s	N
		Cu-60	60	2.3700E+01	m	N
		Cu-61	61	3.3330E+00	h	N
		Cu-62	62	9.6730E+00	m	N
		Cu-64	64	1.2700E+01	h	N
		Cu-66	66	5.1200E+00	m	N
		Cu-67	67	6.1830E+01	h	N
		Cu-69	69	2.8500E+00	m	N
30	Zinc	Zn-60	60	2.3800E+00	m	N
		Zn-61	61	8.9100E+01	s	N
		Zn-62	62	9.1860E+00	h	N
		Zn-63	63	3.8470E+01	m	N
		Zn-65	65	2.4406E+02	d	N
		Zn-69m	69	1.3760E+01	h	N
		Zn-69	69	5.6400E+01	m	N
		Zn-71m	71	3.9600E+00	h	N
		Zn-71	71	2.4500E+00	m	N
		Zn-72	72	4.6500E+01	h	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
31	Gallium	Ga-64	64	2.6270E+00	m	N
		Ga-65	65	1.5200E+01	m	N
		Ga-66	66	9.4900E+00	h	N
		Ga-67	67	3.2612E+00	d	N
		Ga-68	68	6.7710E+01	m	N
		Ga-70	70	2.1140E+01	m	N
		Ga-72	72	1.4100E+01	h	N
		Ga-73	73	4.8600E+00	h	N
		Ga-74	74	8.1200E+00	m	N
32	Germanium	Ge-66	66	2.2600E+00	h	N
		Ge-67	67	1.8900E+01	m	N
		Ge-68	68	2.7095E+02	d	N
		Ge-69	69	3.9050E+01	h	N
		Ge-71	71	1.1430E+01	d	N
		Ge-75	75	8.2780E+01	m	N
		Ge-77	77	1.1300E+01	h	N
		Ge-78	78	8.8000E+01	m	N
33	Arsenic	As-68	68	1.5160E+02	s	N
		As-69	69	1.5230E+01	m	N
		As-70	70	5.2600E+01	m	N
		As-71	71	6.5280E+01	h	N
		As-72	72	2.6000E+01	h	N
		As-73	73	8.0300E+01	d	N
		As-74	74	1.7770E+01	d	N
		As-76	76	1.0778E+00	d	N
		As-77	77	3.8830E+01	h	N
		As-78	78	9.0700E+01	m	N
		As-79	79	9.0100E+00	m	N
34	Selenium	Se-70	70	4.1100E+01	m	Y
		Se-71	71	4.7400E+00	m	Y
		Se-72	72	8.4000E+00	d	Y
		Se-73	73	7.1500E+00	h	Y
		Se-73m	73	3.9800E+01	m	Y
		Se-75	75	1.1978E+02	d	Y
		Se-77m	77	1.7360E+01	s	Y
		Se-79	79	2.9500E+05	y	Y
		Se-79m	79	3.9200E+00	m	Y
		Se-81	81	1.8450E+01	m	Y
		Se-81m	81	5.7280E+01	m	Y
		Se-83	83	2.2300E+01	m	Y
		Se-83m	83	7.0100E+01	s	Y
		Se-84	84	3.1000E+00	m	Y

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	Volatile Species?
35	Bromine	Br-72	72	7.8600E+01	s	Y
		Br-73	73	3.4000E+00	m	Y
		Br-74	74	2.5400E+01	m	Y
		Br-74m	74	4.6000E+01	m	Y
		Br-75	75	9.6700E+01	m	Y
		Br-76	76	1.6200E+01	h	Y
		Br-76m	76	1.3100E+00	s	Y
		Br-77	77	5.7036E+01	h	Y
		Br-77m	77	4.2800E+00	m	Y
		Br-78	78	6.4600E+00	m	Y
		Br-80	80	1.7680E+01	m	Y
		Br-80m	80	4.4205E+00	h	Y
		Br-82	82	3.5300E+01	h	Y
		Br-82m	82	6.1300E+00	m	Y
		Br-83	83	2.4000E+00	h	Y
		Br-84	84	3.1800E+01	m	Y
		Br-84m	84	6.0000E+00	m	Y
		Br-85	85	2.9000E+00	m	Y
36	Krypton	Kr-74	74	1.1500E+01	m	Y
		Kr-75	75	4.2900E+00	m	Y
		Kr-76	76	1.4800E+01	h	Y
		Kr-77	77	7.4400E+01	m	Y
		Kr-79	79	3.5040E+01	h	Y
		Kr-81	81	2.2900E+05	y	Y
		Kr-81m	81	1.3100E+01	s	Y
		Kr-83m	83	1.8300E+00	h	Y
		Kr-85	85	1.0756E+01	y	Y
		Kr-85m	85	4.4800E+00	h	Y
		Kr-87	87	7.6300E+01	m	Y
		Kr-88	88	2.8400E+00	h	Y
		Kr-89	89	3.1500E+00	m	Y
37	Rubidium	Rb-77	77	3.7700E+00	m	N
		Rb-78	78	1.7660E+01	m	N
		Rb-78m	78	5.7400E+00	m	N
		Rb-79	79	2.2900E+01	m	N
		Rb-80	80	3.3400E+01	s	N
		Rb-81	81	4.5760E+00	h	N
		Rb-81m	81	3.0500E+01	m	N
		Rb-82	82	1.2730E+00	m	N
		Rb-82m	82	6.4720E+00	h	N
		Rb-83	83	8.6200E+01	d	N
		Rb-84	84	3.2770E+01	d	N
		Rb-84m	84	2.0260E+01	m	N
		Rb-86	86	1.8642E+01	d	N
		Rb-86m	86	1.0170E+00	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	Volatile Species?
		Rb-87	87	4.9230E+10	y	N
		Rb-88	88	1.7780E+01	m	N
		Rb-89	89	1.5150E+01	m	N
		Rb-90	90	1.5800E+02	s	N
		Rb-90m	90	2.5800E+02	s	N
38	Strontium	Sr-79	79	2.2500E+00	m	N
		Sr-80	80	1.0630E+02	m	N
		Sr-81	81	2.2300E+01	m	N
		Sr-82	82	2.5360E+01	d	N
		Sr-83	83	3.2410E+01	h	N
		Sr-85	85	6.4840E+01	d	N
		Sr-85m	85	6.7630E+01	m	N
		Sr-87m	87	2.8150E+00	h	N
		Sr-89	89	5.0530E+01	d	N
		Sr-90	90	2.8790E+01	y	N
		Sr-91	91	9.6300E+00	h	N
		Sr-92	92	2.6600E+00	h	N
		Sr-93	93	7.4230E+00	m	N
		Sr-94	94	7.5300E+01	s	N
39	Yttrium	Y-81	81	7.0400E+01	s	N
		Y-83	83	7.0800E+00	m	N
		Y-83m	83	2.8500E+00	m	N
		Y-84m	84	3.9500E+01	m	N
		Y-85	85	2.6800E+00	h	N
		Y-85m	85	4.8600E+00	h	N
		Y-86	86	1.4740E+01	h	N
		Y-86m	86	4.8000E+01	m	N
		Y-87	87	7.9800E+01	h	N
		Y-87m	87	1.3370E+01	h	N
		Y-88	88	1.0665E+02	d	N
		Y-89m	89	1.5663E+01	s	N
		Y-90	90	6.4100E+01	h	N
		Y-90m	90	3.1900E+00	h	N
		Y-91	91	5.8510E+01	d	N
		Y-91m	91	4.9710E+01	m	N
		Y-92	92	3.5400E+00	h	N
		Y-93	93	1.0180E+01	h	N
		Y-94	94	1.8700E+01	m	N
		Y-95	95	1.0300E+01	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	Volatile Species?
40	Zirconium	Zr-85	85	7.8600E+00	m	N
		Zr-86	86	1.6500E+01	h	N
		Zr-87	87	1.6800E+00	h	N
		Zr-88	88	8.3400E+01	d	N
		Zr-89	89	7.8410E+01	h	N
		Zr-89m	89	4.1610E+00	m	N
		Zr-93	93	1.5300E+06	y	N
		Zr-95	95	6.4032E+01	d	N
		Zr-97	97	1.6744E+01	h	N
41	Niobium	Nb-87	87	3.7500E+00	m	N
		Nb-88	88	1.4500E+01	m	N
		Nb-88m	88	7.7800E+00	m	N
		Nb-89	89	2.0300E+00	h	N
		Nb-89m	89	6.6000E+01	m	N
		Nb-90	90	1.4600E+01	h	N
		Nb-91	91	6.8000E+02	y	N
		Nb-91m	91	6.0860E+01	d	N
		Nb-92	92	3.4700E+07	y	N
		Nb-92m	92	1.0150E+01	d	N
		Nb-93m	93	1.6130E+01	y	N
		Nb-94	94	2.0300E+04	y	N
		Nb-94m	94	6.2630E+00	m	N
		Nb-95	95	3.4991E+01	d	N
		Nb-95m	95	3.6100E+00	d	N
		Nb-96	96	2.3350E+01	h	N
		Nb-97	97	7.2100E+01	m	N
		Nb-98m	98	5.1300E+01	m	N
		Nb-99	99	1.5000E+01	s	N
		Nb-99m	99	2.6000E+00	m	N
42	Molybdenum	Mo-89	89	2.1100E+00	m	N
		Mo-90	90	5.5600E+00	h	N
		Mo-91	91	1.5490E+01	m	N
		Mo-91m	91	6.4600E+01	s	N
		Mo-93	93	4.0000E+03	y	N
		Mo-93m	93	6.8500E+00	h	N
		Mo-99	99	6.5940E+01	h	N
		Mo-101	101	1.4610E+01	m	N
		Mo-102	102	1.1300E+01	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
43	Technetium	Tc-91	91	3.1400E+00	m	N
		Tc-91m	91	3.3000E+00	m	N
		Tc-92	92	4.2500E+00	m	N
		Tc-93	93	2.7500E+00	h	N
		Tc-93m	93	4.3500E+01	m	N
		Tc-94	94	2.9300E+02	m	N
		Tc-94m	94	5.2000E+01	m	N
		Tc-95	95	2.0000E+01	h	N
		Tc-95m	95	6.1000E+01	d	N
		Tc-96	96	4.2800E+00	d	N
		Tc-96m	96	5.1500E+01	m	N
		Tc-97	97	2.6000E+06	y	N
		Tc-97m	97	9.0100E+01	d	N
		Tc-98	98	4.2000E+06	y	N
		Tc-99	99	2.1110E+05	y	N
		Tc-99m	99	6.0150E+00	h	N
		Tc-101	101	1.4200E+01	m	N
		Tc-102	102	5.2800E+00	s	N
		Tc-102m	102	4.3500E+00	m	N
		Tc-104	104	1.8300E+01	m	N
		Tc-105	105	7.6000E+00	m	N
44	Ruthenium	Ru-92	92	3.6500E+00	m	N
		Ru-94	94	5.1800E+01	m	N
		Ru-95	95	1.6430E+00	h	N
		Ru-97	97	2.9000E+00	d	N
		Ru-103	103	3.9260E+01	d	N
		Ru-105	105	4.4400E+00	h	N
		Ru-106	106	3.7359E+02	d	N
		Ru-107	107	3.7500E+00	m	N
		Ru-108	108	4.5500E+00	m	N
45	Rhodium	Rh-94	94	7.0600E+01	s	N
		Rh-95	95	5.0200E+00	m	N
		Rh-95m	95	1.9600E+00	m	N
		Rh-96	96	9.9000E+00	m	N
		Rh-96m	96	1.5100E+00	m	N
		Rh-97	97	3.0700E+01	m	N
		Rh-97m	97	4.6200E+01	m	N
		Rh-98	98	8.7000E+00	m	N
		Rh-99	99	1.6100E+01	d	N
		Rh-99m	99	4.7000E+00	h	N
		Rh-100	100	2.0800E+01	h	N
		Rh-100m	100	4.6000E+00	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Rh-101	101	3.3000E+00	y	N
		Rh-101m	101	4.3400E+00	d	N
		Rh-102	102	2.0700E+02	d	N
		Rh-102m	102	3.7420E+00	y	N
		Rh-103m	103	5.6114E+01	m	N
		Rh-104	104	4.2300E+01	s	N
		Rh-104m	104	4.3400E+00	m	N
		Rh-105	105	3.5360E+01	h	N
		Rh-106	106	2.9800E+01	s	N
		Rh-106m	106	1.3100E+02	m	N
		Rh-107	107	2.1700E+01	m	N
		Rh-108	108	1.6800E+01	s	N
		Rh-109	109	8.0000E+01	s	N
46	Palladium	Pd-96	96	1.2200E+02	s	N
		Pd-97	97	3.1000E+00	m	N
		Pd-98	98	1.7700E+01	m	N
		Pd-99	99	2.1400E+01	m	N
		Pd-100	100	3.6300E+00	d	N
		Pd-101	101	8.4700E+00	h	N
		Pd-103	103	1.6991E+01	d	N
		Pd-107	107	6.5000E+06	y	N
		Pd-109	109	1.3701E+01	h	N
		Pd-109m	109	4.6900E+00	m	N
		Pd-111	111	2.3400E+01	m	N
		Pd-112	112	2.1030E+01	h	N
		Pd-114	114	2.4200E+00	m	N
47	Silver	Ag-99	99	1.2400E+02	s	N
		Ag-100m	100	2.2400E+00	m	N
		Ag-101	101	1.1100E+01	m	N
		Ag-102	102	1.2900E+01	m	N
		Ag-102m	102	7.7000E+00	m	N
		Ag-103	103	6.5700E+01	m	N
		Ag-104	104	6.9200E+01	m	N
		Ag-104m	104	3.3500E+01	m	N
		Ag-105	105	4.1290E+01	d	N
		Ag-105m	105	7.2300E+00	m	N
		Ag-106	106	2.3960E+01	m	N
		Ag-106m	106	8.2800E+00	d	N
		Ag-108	108	2.3700E+00	m	N
		Ag-108m	108	4.1800E+02	y	N
		Ag-109m	109	3.9600E+01	s	N
		Ag-110	110	2.4600E+01	s	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Ag-110m	110	2.4976E+02	d	N
		Ag-111	111	7.4500E+00	d	N
		Ag-111m	111	6.4800E+01	s	N
		Ag-112	112	3.1300E+00	h	N
		Ag-113	113	5.3700E+00	h	N
		Ag-113m	113	6.8700E+01	s	N
		Ag-114	114	4.6000E+00	s	N
		Ag-115	115	2.0000E+01	m	N
		Ag-116	116	2.6800E+00	m	N
		Ag-117	117	7.3600E+01	s	N
48	Cadmium	Cd-101	101	1.3600E+00	m	N
		Cd-102	102	5.5000E+00	m	N
		Cd-103	103	7.3000E+00	m	N
		Cd-104	104	5.7700E+01	m	N
		Cd-105	105	5.5500E+01	m	N
		Cd-107	107	6.5000E+00	h	N
		Cd-109	109	4.6140E+02	d	N
		Cd-111m	111	4.8500E+01	m	N
		Cd-113	113	7.7000E+15	y	N
		Cd-113m	113	1.4100E+01	y	N
		Cd-115	115	5.3460E+01	h	N
		Cd-115m	115	4.4600E+01	d	N
		Cd-117	117	2.4900E+00	h	N
		Cd-117m	117	3.3600E+00	h	N
		Cd-118	118	5.0300E+01	m	N
		Cd-119	119	2.6900E+00	m	N
		Cd-119m	119	2.2000E+00	m	N
49	Indium	In-103	103	6.0000E+01	s	N
		In-105	105	5.0700E+00	m	N
		In-106m	106	5.2000E+00	m	N
		In-106	106	6.2000E+00	m	N
		In-107	107	3.2400E+01	m	N
		In-108m	108	3.9600E+01	m	N
		In-108	108	5.8000E+01	m	N
		In-109m	109	1.3400E+00	m	N
		In-109	109	4.2000E+00	h	N
		In-110m	110	6.9100E+01	m	N
		In-110	110	4.9000E+00	h	N
		In-111m	111	7.7000E+00	m	N
		In-111	111	2.8047E+00	d	N
		In-112m	112	2.0560E+01	m	N
		In-112	112	1.4970E+01	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	Volatile Species?
		In-113m	113	1.6579E+00	h	N
		In-114m	114	4.9510E+01	d	N
		In-114	114	7.1900E+01	s	N
		In-115m	115	4.4860E+00	h	N
		In-115	115	4.4100E+14	y	N
		In-116m	116	5.4410E+01	m	N
		In-117m	117	1.1620E+02	m	N
		In-117	117	4.3200E+01	m	N
		In-118m	118	4.3640E+00	m	N
		In-118	118	5.0000E+00	s	N
		In-119m	119	1.8000E+01	m	N
		In-119	119	2.4000E+00	m	N
		In-121m	121	3.8800E+00	m	N
		In-121	121	2.3100E+01	s	N
50	Tin	Sn-106	106	1.9200E+00	m	Y
		Sn-108	108	1.0300E+01	m	Y
		Sn-109	109	1.8000E+01	m	Y
		Sn-110	110	4.1100E+00	h	Y
		Sn-111	111	3.5300E+01	m	Y
		Sn-113m	113	2.1400E+01	m	Y
		Sn-113	113	1.1509E+02	d	Y
		Sn-117m	117	1.3760E+01	d	Y
		Sn-119m	119	2.9310E+02	d	Y
		Sn-121m	121	4.3900E+01	y	Y
		Sn-121	121	2.7030E+01	h	Y
		Sn-123m	123	4.0060E+01	m	Y
		Sn-123	123	1.2920E+02	d	Y
		Sn-125m	125	9.5200E+00	m	Y
		Sn-125	125	9.6400E+00	d	Y
		Sn-126	126	2.3000E+05	y	Y
		Sn-127m	127	4.1300E+00	m	Y
		Sn-127	127	2.1000E+00	h	Y
		Sn-128	128	5.9070E+01	m	Y
		Sn-129	129	2.2300E+00	m	Y
		Sn-130m	130	1.7000E+00	m	Y
		Sn-130	130	3.7200E+00	m	Y

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	Volatile Species?
51	Antimony	Sb-111	111	7.5000E+01	s	Y
		Sb-113	113	6.6700E+00	m	Y
		Sb-114	114	3.4900E+00	m	Y
		Sb-115	115	3.2100E+01	m	Y
		Sb-116	116	1.5800E+01	m	Y
		Sb-116m	116	6.0300E+01	m	Y
		Sb-117	117	2.8000E+00	h	Y
		Sb-118	118	3.6000E+00	m	Y
		Sb-118m	118	5.0000E+00	h	Y
		Sb-119	119	3.8190E+01	h	Y
		Sb-120	120	1.5890E+01	m	Y
		Sb-120m	120	5.7600E+00	d	Y
		Sb-122	122	2.7238E+00	d	Y
		Sb-122m	122	4.1910E+00	m	Y
		Sb-124	124	6.0200E+01	d	Y
		Sb-124m	124	9.3000E+01	s	Y
		Sb-124n	124	2.0200E+01	m	Y
		Sb-125	125	2.7586E+00	y	Y
		Sb-126	126	1.2350E+01	d	Y
		Sb-126m	126	1.9150E+01	m	Y
		Sb-127	127	3.8500E+00	d	Y
		Sb-128	128	9.0100E+00	h	Y
		Sb-128m	128	1.0400E+01	m	Y
		Sb-129	129	4.4000E+00	h	Y
		Sb-130	130	3.9500E+01	m	Y
		Sb-130m	130	6.3000E+00	m	Y
		Sb-131	131	2.3030E+01	m	Y
		Sb-133	133	2.5000E+00	m	Y
52	Tellurium	Te-113	113	1.7000E+00	m	N
		Te-114	114	1.5200E+01	m	N
		Te-115	115	5.8000E+00	m	N
		Te-115m	115	6.7000E+00	m	N
		Te-116	116	2.4900E+00	h	N
		Te-117	117	6.2000E+01	m	N
		Te-118	118	6.0000E+00	d	N
		Te-119	119	1.6050E+01	h	N
		Te-119m	119	4.7000E+00	d	N
		Te-121	121	1.9160E+01	d	N
		Te-121m	121	1.5400E+02	d	N
		Te-123	123	6.0000E+14	y	N
		Te-123m	123	1.1925E+02	d	N
		Te-125m	125	5.7400E+01	d	N
		Te-127	127	9.3500E+00	h	N
		Te-127m	127	1.0900E+02	d	N
		Te-129	129	6.9600E+01	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Te-129m	129	3.3600E+01	d	N
		Te-131	131	2.5000E+01	m	N
		Te-131m	131	3.0000E+01	h	N
		Te-132	132	3.2040E+00	d	N
		Te-133	133	1.2500E+01	m	N
		Te-133m	133	5.5400E+01	m	N
		Te-134	134	4.1800E+01	m	N
53	Iodine	I-118	118	1.3700E+01	m	Y
		I-118m	118	8.5000E+00	m	Y
		I-119	119	1.9100E+01	m	Y
		I-120	120	8.1600E+01	m	Y
		I-120m	120	5.3000E+01	m	Y
		I-121	121	2.1200E+00	h	Y
		I-122	122	3.6300E+00	m	Y
		I-123	123	1.3270E+01	h	Y
		I-124	124	4.1760E+00	d	Y
		I-125	125	5.9400E+01	d	Y
		I-126	126	1.2930E+01	d	Y
		I-128	128	2.4990E+01	m	Y
		I-129	129	1.5700E+07	y	Y
		I-130	130	1.2360E+01	h	Y
		I-130m	130	8.8400E+00	m	Y
		I-131	131	8.0207E+00	d	Y
		I-132	132	2.2950E+00	h	Y
		I-132m	132	1.3870E+00	h	Y
		I-133	133	2.0800E+01	h	Y
		I-134	134	5.2500E+01	m	Y
		I-134m	134	3.6000E+00	m	Y
		I-135	135	6.5700E+00	h	Y
54	Xenon	Xe-120	120	4.0000E+01	m	Y
		Xe-121	121	4.0100E+01	m	Y
		Xe-122	122	2.0100E+01	h	Y
		Xe-123	123	2.0800E+00	h	Y
		Xe-125	125	1.6900E+01	h	Y
		Xe-127	127	3.6400E+01	d	Y
		Xe-127m	127	6.9200E+01	s	Y
		Xe-129m	129	8.8800E+00	d	Y
		Xe-131m	131	1.1840E+01	d	Y
		Xe-133	133	5.2430E+00	d	Y
		Xe-133m	133	2.1900E+00	d	Y
		Xe-135	135	9.1400E+00	h	Y
		Xe-135m	135	1.5290E+01	m	Y
		Xe-137	137	3.8180E+00	m	Y
		Xe-138	138	1.4080E+01	m	Y

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
55	Cesium	Cs-121	121	1.5500E+02	s	N
		Cs-121m	121	1.2200E+02	s	N
		Cs-123	123	5.8800E+00	m	N
		Cs-124	124	3.0800E+01	s	N
		Cs-125	125	4.5000E+01	m	N
		Cs-126	126	1.6400E+00	m	N
		Cs-127	127	6.2500E+00	h	N
		Cs-128	128	3.6400E+00	m	N
		Cs-129	129	3.2060E+01	h	N
		Cs-130	130	2.9210E+01	m	N
		Cs-130m	130	3.4600E+00	m	N
		Cs-131	131	9.6890E+00	d	N
		Cs-132	132	6.4790E+00	d	N
		Cs-134	134	2.0648E+00	y	N
		Cs-134m	134	2.9030E+00	h	N
		Cs-135	135	2.3000E+06	y	N
		Cs-135m	135	5.3000E+01	m	N
		Cs-136	136	1.3160E+01	d	N
		Cs-137	137	3.0167E+01	y	N
		Cs-138	138	3.3410E+01	m	N
		Cs-138m	138	2.9100E+00	m	N
		Cs-139	139	9.2700E+00	m	N
		Cs-140	140	6.3700E+01	s	N
56	Barium	Ba-124	124	1.1000E+01	m	N
		Ba-126	126	1.0000E+02	m	N
		Ba-127	127	1.2700E+01	m	N
		Ba-128	128	2.4300E+00	d	N
		Ba-129	129	2.2300E+00	h	N
		Ba-129m	129	2.1600E+00	h	N
		Ba-131	131	1.1500E+01	d	N
		Ba-131m	131	1.4600E+01	m	N
		Ba-133	133	1.0520E+01	y	N
		Ba-133m	133	3.8900E+01	h	N
		Ba-135m	135	2.8700E+01	h	N
		Ba-137m	137	2.5520E+00	m	N
		Ba-139	139	8.3060E+01	m	N
		Ba-140	140	1.2752E+01	d	N
		Ba-141	141	1.8270E+01	m	N
		Ba-142	142	1.0600E+01	m	N
57	Lanthanum	La-128	128	5.1800E+00	m	N
		La-129	129	1.1600E+01	m	N
		La-130	130	8.7000E+00	m	N
		La-131	131	5.9000E+01	m	N
		La-132	132	4.8000E+00	h	N
		La-132m	132	2.4300E+01	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		La-133	133	3.9120E+00	h	N
		La-134	134	6.4500E+00	m	N
		La-135	135	1.9500E+01	h	N
		La-136	136	9.8700E+00	m	N
		La-137	137	6.0000E+04	y	N
		La-138	138	1.0200E+11	y	N
		La-140	140	1.6781E+00	d	N
		La-141	141	3.9200E+00	h	N
		La-142	142	9.1100E+01	m	N
		La-143	143	1.4200E+01	m	N
58	Cerium	Ce-130	130	2.2900E+01	m	N
		Ce-131	131	1.0200E+01	m	N
		Ce-132	132	3.5100E+00	h	N
		Ce-133	133	9.7000E+01	m	N
		Ce-133m	133	4.9000E+00	h	N
		Ce-134	134	3.1600E+00	d	N
		Ce-135	135	1.7700E+01	h	N
		Ce-137	137	9.0000E+00	h	N
		Ce-137m	137	3.4400E+01	h	N
		Ce-139	139	1.3764E+02	d	N
		Ce-141	141	3.2508E+01	d	N
		Ce-143	143	3.3039E+01	h	N
		Ce-144	144	2.8491E+02	d	N
		Ce-145	145	3.0100E+00	m	N
59	Praseodymium	Pr-134	134	1.1000E+01	m	N
		Pr-134m	134	1.7000E+01	m	N
		Pr-135	135	2.4000E+01	m	N
		Pr-136	136	1.3100E+01	m	N
		Pr-137	137	1.2800E+00	h	N
		Pr-138	138	1.4500E+00	m	N
		Pr-138m	138	2.1200E+00	h	N
		Pr-139	139	4.4100E+00	h	N
		Pr-140	140	3.3900E+00	m	N
		Pr-142	142	1.9120E+01	h	N
		Pr-142m	142	1.4600E+01	m	N
		Pr-143	143	1.3570E+01	d	N
		Pr-144	144	1.7280E+01	m	N
		Pr-144m	144	7.2000E+00	m	N
		Pr-145	145	5.9840E+00	h	N
		Pr-146	146	2.4150E+01	m	N
		Pr-147	147	1.3400E+01	m	N
		Pr-148	148	2.2900E+00	m	N
		Pr-148m	148	2.0100E+00	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
60	Neodymium	Nd-134	134	8.5000E+00	m	N
		Nd-135	135	1.2400E+01	m	N
		Nd-136	136	5.0650E+01	m	N
		Nd-137	137	3.8500E+01	m	N
		Nd-138	138	5.0400E+00	h	N
		Nd-139	139	2.9700E+01	m	N
		Nd-139m	139	5.5000E+00	h	N
		Nd-140	140	3.3700E+00	d	N
		Nd-141	141	2.4900E+00	h	N
		Nd-141m	141	6.2000E+01	s	N
		Nd-144	144	2.2900E+15	y	N
		Nd-147	147	1.0980E+01	d	N
		Nd-149	149	1.7280E+00	h	N
		Nd-151	151	1.2440E+01	m	N
		Nd-152	152	1.1400E+01	m	N
61	Promethium	Pm-136	136	1.0700E+02	s	N
		Pm-137m	137	2.4000E+00	m	N
		Pm-139	139	4.1500E+00	m	N
		Pm-140	140	9.2000E+00	s	N
		Pm-140m	140	5.9500E+00	m	N
		Pm-141	141	2.0900E+01	m	N
		Pm-142	142	4.0500E+01	s	N
		Pm-143	143	2.6500E+02	d	N
		Pm-144	144	3.6300E+02	d	N
		Pm-145	145	1.7700E+01	y	N
		Pm-146	146	5.5300E+00	y	N
		Pm-147	147	2.6234E+00	y	N
		Pm-148	148	5.3680E+00	d	N
		Pm-148m	148	4.1290E+01	d	N
		Pm-149	149	5.3080E+01	h	N
		Pm-150	150	2.6800E+00	h	N
		Pm-151	151	2.8400E+01	h	N
		Pm-152	152	4.1200E+00	m	N
		Pm-152m	152	7.5200E+00	m	N
		Pm-153	153	5.2500E+00	m	N
		Pm-154	154	1.7300E+00	m	N
		Pm-154m	154	2.6800E+00	m	N
62	Samarium	Sm-139	139	2.5700E+00	m	N
		Sm-140	140	1.4820E+01	m	N
		Sm-141	141	1.0200E+01	m	N
		Sm-141m	141	2.2600E+01	m	N
		Sm-142	142	7.2490E+01	m	N
		Sm-143	143	8.7500E+00	m	N
		Sm-143m	143	6.6000E+01	s	N
		Sm-145	145	3.4000E+02	d	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Sm-146	146	1.0300E+08	y	N
		Sm-147	147	1.0600E+11	y	N
		Sm-148	148	7.0000E+15	y	N
		Sm-151	151	9.0000E+01	y	N
		Sm-153	153	4.6500E+01	h	N
		Sm-155	155	2.2300E+01	m	N
		Sm-156	156	9.4000E+00	h	N
		Sm-157	157	8.0300E+00	m	N
63	Europium	Eu-142	142	2.3400E+00	s	N
		Eu-142m	142	1.2230E+00	m	N
		Eu-143	143	2.5900E+00	m	N
		Eu-144	144	1.0200E+01	s	N
		Eu-145	145	5.9300E+00	d	N
		Eu-146	146	4.6100E+00	d	N
		Eu-147	147	2.4100E+01	d	N
		Eu-148	148	5.4500E+01	d	N
		Eu-149	149	9.3100E+01	d	N
		Eu-150	150	3.6900E+01	y	N
		Eu-150m	150	1.2800E+01	h	N
		Eu-152	152	1.3537E+01	y	N
		Eu-152m	152	9.3116E+00	h	N
		Eu-152n	152	9.6000E+01	m	N
		Eu-154	154	8.5930E+00	y	N
		Eu-154m	154	4.6000E+01	m	N
		Eu-155	155	4.7611E+00	y	N
		Eu-156	156	1.5190E+01	d	N
		Eu-157	157	1.5180E+01	h	N
		Eu-158	158	4.5900E+01	m	N
		Eu-159	159	1.8100E+01	m	N
64	Gadolinium	Gd-142	142	7.0200E+01	s	N
		Gd-143m	143	1.1000E+02	s	N
		Gd-144	144	4.4700E+00	m	N
		Gd-145	145	2.3000E+01	m	N
		Gd-145m	145	8.5000E+01	s	N
		Gd-146	146	4.8270E+01	d	N
		Gd-147	147	3.8100E+01	h	N
		Gd-148	148	7.4600E+01	y	N
		Gd-149	149	9.2800E+00	d	N
		Gd-150	150	1.7900E+06	y	N
		Gd-151	151	1.2400E+02	d	N
		Gd-152	152	1.0800E+14	y	N
		Gd-153	153	2.4040E+02	d	N
		Gd-159	159	1.8479E+01	h	N
		Gd-162	162	8.4000E+00	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
65	Terbium	Tb-146	146	2.3000E+01	s	N
		Tb-147	147	1.6400E+00	h	N
		Tb-147m	147	1.8700E+00	m	N
		Tb-148	148	6.0000E+01	m	N
		Tb-148m	148	2.2000E+00	m	N
		Tb-149	149	4.1180E+00	h	N
		Tb-149m	149	4.1600E+00	m	N
		Tb-150	150	3.4800E+00	h	N
		Tb-150m	150	5.8000E+00	m	N
		Tb-151	151	1.7609E+01	h	N
		Tb-151m	151	2.5000E+01	s	N
		Tb-152	152	1.7500E+01	h	N
		Tb-152m	152	4.2000E+00	m	N
		Tb-153	153	2.3400E+00	d	N
		Tb-154	154	2.1500E+01	h	N
		Tb-155	155	5.3200E+00	d	N
		Tb-156	156	5.3500E+00	d	N
		Tb-156m	156	2.4400E+01	h	N
		Tb-156n	156	5.3000E+00	h	N
		Tb-157	157	7.1000E+01	y	N
		Tb-158	158	1.8000E+02	y	N
		Tb-160	160	7.2300E+01	d	N
		Tb-161	161	6.9060E+00	d	N
		Tb-162	162	7.6000E+00	m	N
		Tb-163	163	1.9500E+01	m	N
		Tb-164	164	3.0000E+00	m	N
		Tb-165	165	2.1100E+00	m	N
66	Dysprosium	Dy-148	148	3.3000E+00	m	N
		Dy-149	149	4.2000E+00	m	N
		Dy-150	150	7.1700E+00	m	N
		Dy-151	151	1.7900E+01	m	N
		Dy-152	152	2.3800E+00	h	N
		Dy-153	153	6.4000E+00	h	N
		Dy-154	154	3.0000E+06	y	N
		Dy-155	155	9.9000E+00	h	N
		Dy-157	157	8.1400E+00	h	N
		Dy-159	159	1.4440E+02	d	N
		Dy-165	165	2.3340E+00	h	N
		Dy-165m	165	1.2570E+00	m	N
		Dy-166	166	8.1600E+01	h	N
		Dy-167	167	6.2000E+00	m	N
		Dy-168	168	8.7000E+00	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
67	Holmium	Ho-150	150	7.6800E+01	s	N
		Ho-153	153	2.0100E+00	m	N
		Ho-153m	153	9.3000E+00	m	N
		Ho-154	154	1.1760E+01	m	N
		Ho-154m	154	3.1000E+00	m	N
		Ho-155	155	4.8000E+01	m	N
		Ho-156	156	5.6000E+01	m	N
		Ho-157	157	1.2600E+01	m	N
		Ho-159	159	3.3050E+01	m	N
		Ho-160	160	2.5600E+01	m	N
		Ho-161	161	2.4800E+00	h	N
		Ho-162	162	1.5000E+01	m	N
		Ho-162m	162	6.7000E+01	m	N
		Ho-163	163	4.5700E+03	y	N
		Ho-164	164	2.9000E+01	m	N
		Ho-164m	164	3.8000E+01	m	N
		Ho-166	166	2.6800E+01	h	N
		Ho-166m	166	1.2000E+03	y	N
		Ho-167	167	3.1000E+00	h	N
		Ho-168	168	2.9900E+00	m	N
		Ho-168m	168	1.3200E+02	s	N
		Ho-170	170	2.7600E+00	m	N
68	Erbium	Er-154	154	3.7300E+00	m	N
		Er-156	156	1.9500E+01	m	N
		Er-159	159	3.6000E+01	m	N
		Er-161	161	3.2100E+00	h	N
		Er-163	163	7.5000E+01	m	N
		Er-165	165	1.0360E+01	h	N
		Er-167m	167	2.2690E+00	s	N
		Er-169	169	9.4000E+00	d	N
		Er-171	171	7.5160E+00	h	N
		Er-172	172	4.9300E+01	h	N
		Er-173	173	1.4340E+00	m	N
69	Thulium	Tm-161	161	3.0200E+01	m	N
		Tm-162	162	2.1700E+01	m	N
		Tm-163	163	1.8100E+00	h	N
		Tm-164	164	2.0000E+00	m	N
		Tm-165	165	3.0060E+01	h	N
		Tm-166	166	7.7000E+00	h	N
		Tm-167	167	9.2500E+00	d	N
		Tm-168	168	9.3100E+01	d	N
		Tm-170	170	1.2860E+02	d	N
		Tm-171	171	1.9200E+00	y	N
		Tm-172	172	6.3600E+01	h	N
		Tm-173	173	8.2400E+00	h	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Tm-174	174	5.4000E+00	m	N
		Tm-175	175	1.5200E+01	m	N
		Tm-176	176	1.8500E+00	m	N
70	Ytterbium	Yb-162	162	1.8870E+01	m	N
		Yb-163	163	1.1050E+01	m	N
		Yb-164	164	7.5800E+01	m	N
		Yb-165	165	9.9000E+00	m	N
		Yb-166	166	5.6700E+01	h	N
		Yb-167	167	1.7500E+01	m	N
		Yb-169	169	3.2026E+01	d	N
		Yb-175	175	4.1850E+00	d	N
		Yb-177	177	1.9110E+00	h	N
		Yb-178	178	7.4000E+01	m	N
		Yb-179	179	8.0000E+00	m	N
71	Lutetium	Lu-165	165	1.0740E+01	m	N
		Lu-167	167	5.1500E+01	m	N
		Lu-169	169	3.4060E+01	h	N
		Lu-169m	169	1.6000E+02	s	N
		Lu-170	170	2.0120E+00	d	N
		Lu-171	171	8.2400E+00	d	N
		Lu-171m	171	7.9000E+01	s	N
		Lu-172	172	6.7000E+00	d	N
		Lu-172m	172	3.7000E+00	m	N
		Lu-173	173	1.3700E+00	y	N
		Lu-174	174	3.3100E+00	y	N
		Lu-174m	174	1.4200E+02	d	N
		Lu-176	176	3.8500E+10	y	N
		Lu-176m	176	3.6350E+00	h	N
		Lu-177	177	6.6470E+00	d	N
		Lu-177m	177	1.6040E+02	d	N
		Lu-178	178	2.8400E+01	m	N
		Lu-178m	178	2.3100E+01	m	N
		Lu-179	179	4.5900E+00	h	N
		Lu-180	180	5.7000E+00	m	N
		Lu-181	181	3.5000E+00	m	N
72	Hafnium	Hf-167	167	2.0500E+00	m	N
		Hf-169	169	3.2400E+00	m	N
		Hf-170	170	1.6010E+01	h	N
		Hf-172	172	1.8700E+00	y	N
		Hf-173	173	2.3600E+01	h	N
		Hf-174	174	2.0000E+15	y	N
		Hf-175	175	7.0000E+01	d	N
		Hf-177m	177	5.1400E+01	m	N
		Hf-178m	178	3.1000E+01	y	N
		Hf-179m	179	2.5050E+01	d	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Hf-180m	180	5.5000E+00	h	N
		Hf-181	181	4.2390E+01	d	N
		Hf-182	182	9.0000E+06	y	N
		Hf-182m	182	6.1500E+01	m	N
		Hf-183	183	1.0670E+00	h	N
		Hf-184	184	4.1200E+00	h	N
73	Tantalum	Ta-170	170	6.7600E+00	m	N
		Ta-172	172	3.6800E+01	m	N
		Ta-173	173	3.1400E+00	h	N
		Ta-174	174	1.1400E+00	h	N
		Ta-175	175	1.0500E+01	h	N
		Ta-176	176	8.0900E+00	h	N
		Ta-177	177	5.6560E+01	h	N
		Ta-178	178	9.3100E+00	m	N
		Ta-178m	178	2.3600E+00	h	N
		Ta-179	179	1.8200E+00	y	N
		Ta-180	180	8.1520E+00	h	N
		Ta-182	182	1.1443E+02	d	N
		Ta-182m	182	1.5840E+01	m	N
		Ta-183	183	5.1000E+00	d	N
		Ta-184	184	8.7000E+00	h	N
		Ta-185	185	4.9400E+01	m	N
		Ta-186	186	1.0500E+01	m	N
74	Tungsten	W-177	177	1.3200E+02	m	N
		W-178	178	2.1600E+01	d	N
		W-179	179	3.7050E+01	m	N
		W-179m	179	6.4000E+00	m	N
		W-181	181	1.2120E+02	d	N
		W-185	185	7.5100E+01	d	N
		W-185m	185	1.5970E+00	m	N
		W-187	187	2.3720E+01	h	N
		W-188	188	6.9780E+01	d	N
		W-190	190	3.0000E+01	m	N
75	Rhenium	Re-178	178	1.3200E+01	m	N
		Re-179	179	1.9500E+01	m	N
		Re-180	180	2.4400E+00	m	N
		Re-181	181	1.9900E+01	h	N
		Re-182	182	6.4000E+01	h	N
		Re-182m	182	1.2700E+01	h	N
		Re-183	183	7.0000E+01	d	N
		Re-184	184	3.8000E+01	d	N
		Re-184m	184	1.6900E+02	d	N
		Re-186	186	3.7183E+00	d	N
		Re-186m	186	2.0000E+05	y	N
		Re-187	187	4.1200E+10	y	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Re-188	188	1.7004E+01	h	N
		Re-188m	188	1.8590E+01	m	N
		Re-189	189	2.4300E+01	h	N
		Re-190	190	3.1000E+00	m	N
		Re-190m	190	3.2000E+00	h	N
76	Osmium	Os-180	180	2.1500E+01	m	N
		Os-181	181	1.0500E+02	m	N
		Os-182	182	2.2100E+01	h	N
		Os-183	183	1.3000E+01	h	N
		Os-183m	183	9.9000E+00	h	N
		Os-185	185	9.3600E+01	d	N
		Os-186	186	2.0000E+15	y	N
		Os-189m	189	5.8000E+00	h	N
		Os-190m	190	9.9000E+00	m	N
		Os-191	191	1.5400E+01	d	N
		Os-191m	191	1.3100E+01	h	N
		Os-193	193	3.0110E+01	h	N
		Os-194	194	6.0000E+00	y	N
		Os-196	196	3.4900E+01	m	N
77	Iridium	Ir-180	180	1.5000E+00	m	N
		Ir-182	182	1.5000E+01	m	N
		Ir-183	183	5.8000E+01	m	N
		Ir-184	184	3.0900E+00	h	N
		Ir-185	185	1.4400E+01	h	N
		Ir-186	186	1.6640E+01	h	N
		Ir-186m	186	1.9200E+00	h	N
		Ir-187	187	1.0500E+01	h	N
		Ir-188	188	4.1500E+01	h	N
		Ir-189	189	1.3200E+01	d	N
		Ir-190	190	1.1780E+01	d	N
		Ir-190m	190	1.1200E+00	h	N
		Ir-190n	190	3.0870E+00	h	N
		Ir-191m	191	4.9400E+00	s	N
		Ir-192	192	7.3827E+01	d	N
		Ir-192m	192	1.4500E+00	m	N
		Ir-192n	192	2.4100E+02	y	N
		Ir-193m	193	1.0530E+01	d	N
		Ir-194	194	1.9280E+01	h	N
		Ir-194m	194	1.7100E+02	d	N
		Ir-195	195	2.5000E+00	h	N
		Ir-195m	195	3.8000E+00	h	N
		Ir-196	196	5.2000E+01	s	N
		Ir-196m	196	1.4000E+00	h	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
78	Platinum	Pt-184	184	1.7300E+01	m	N
		Pt-186	186	2.0800E+00	h	N
		Pt-187	187	2.3500E+00	h	N
		Pt-188	188	1.0200E+01	d	N
		Pt-189	189	1.0870E+01	h	N
		Pt-190	190	6.5000E+11	y	N
		Pt-191	191	2.8020E+00	d	N
		Pt-193	193	5.0000E+01	y	N
		Pt-193m	193	4.3300E+00	d	N
		Pt-195m	195	4.0200E+00	d	N
		Pt-197	197	1.9892E+01	h	N
		Pt-197m	197	9.5410E+01	m	N
		Pt-199	199	3.0800E+01	m	N
		Pt-200	200	1.2500E+01	h	N
		Pt-202	202	4.4000E+01	h	N
79	Gold	Au-186	186	1.0700E+01	m	N
		Au-187	187	8.4000E+00	m	N
		Au-190	190	4.2800E+01	m	N
		Au-191	191	3.1800E+00	h	N
		Au-192	192	4.9400E+00	h	N
		Au-193	193	1.7650E+01	h	N
		Au-193m	193	3.9000E+00	s	N
		Au-194	194	3.8020E+01	h	N
		Au-195	195	1.8610E+02	d	N
		Au-195m	195	3.0500E+01	s	N
		Au-196	196	6.1830E+00	d	N
		Au-196m	196	9.6000E+00	h	N
		Au-198	198	2.6952E+00	d	N
		Au-198m	198	2.2700E+00	d	N
		Au-199	199	3.1390E+00	d	N
		Au-200	200	4.8400E+01	m	N
		Au-200m	200	1.8700E+01	h	N
		Au-201	201	2.6000E+01	m	N
		Au-202	202	2.8800E+01	s	N
80	Mercury	Hg-190	190	2.0000E+01	m	Y
		Hg-191m	191	5.0800E+01	m	Y
		Hg-192	192	4.8500E+00	h	Y
		Hg-193	193	3.8000E+00	h	Y
		Hg-193m	193	1.1800E+01	h	Y
		Hg-194	194	4.4000E+02	y	Y
		Hg-195	195	1.0530E+01	h	Y
		Hg-195m	195	4.1600E+01	h	Y
		Hg-197	197	6.4940E+01	h	Y
		Hg-197m	197	2.3800E+01	h	Y
		Hg-199m	199	4.2660E+01	m	Y

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Hg-203	203	4.6612E+01	d	Y
		Hg-205	205	5.2000E+00	m	Y
		Hg-206	206	8.1500E+00	m	Y
		Hg-207	207	2.9000E+00	m	Y
81	Thallium	Tl-190	190	2.6000E+00	m	N
		Tl-190m	190	3.7000E+00	m	N
		Tl-194	194	3.3000E+01	m	N
		Tl-194m	194	3.2800E+01	m	N
		Tl-195	195	1.1600E+00	h	N
		Tl-196	196	1.8400E+00	h	N
		Tl-197	197	2.8400E+00	h	N
		Tl-198	198	5.3000E+00	h	N
		Tl-198m	198	1.8700E+00	h	N
		Tl-199	199	7.4200E+00	h	N
		Tl-200	200	2.6100E+01	h	N
		Tl-201	201	7.2912E+01	h	N
		Tl-202	202	1.2230E+01	d	N
		Tl-204	204	3.7800E+00	y	N
		Tl-206	206	4.2000E+00	m	N
		Tl-206m	206	3.7400E+00	m	N
		Tl-207	207	4.7700E+00	m	N
		Tl-208	208	3.0530E+00	m	N
		Tl-209	209	2.1610E+00	m	N
		Tl-210	210	1.3000E+00	m	N
82	Lead	Pb-194	194	1.2000E+01	m	N
		Pb-195m	195	1.5000E+01	m	N
		Pb-196	196	3.7000E+01	m	N
		Pb-197	197	8.0000E+00	m	N
		Pb-197m	197	4.3000E+01	m	N
		Pb-198	198	2.4000E+00	h	N
		Pb-199	199	9.0000E+01	m	N
		Pb-200	200	2.1500E+01	h	N
		Pb-201	201	9.3300E+00	h	N
		Pb-201m	201	6.1000E+01	s	N
		Pb-202	202	5.2500E+04	y	N
		Pb-202m	202	3.5300E+00	h	N
		Pb-203	203	5.1873E+01	h	N
		Pb-204m	204	6.7200E+01	m	N
		Pb-205	205	1.5300E+07	y	N
		Pb-209	209	3.2530E+00	h	N
		Pb-210	210	2.2200E+01	y	N
		Pb-211	211	3.6100E+01	m	N
		Pb-212	212	1.0640E+01	h	N
		Pb-214	214	2.6800E+01	m	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
83	Bismuth	Bi-197	197	9.3000E+00	m	N
		Bi-200	200	3.6400E+01	m	N
		Bi-201	201	1.0800E+02	m	N
		Bi-202	202	1.7200E+00	h	N
		Bi-203	203	1.1760E+01	h	N
		Bi-204	204	1.1220E+01	h	N
		Bi-205	205	1.5310E+01	d	N
		Bi-206	206	6.2430E+00	d	N
		Bi-207	207	3.2900E+01	y	N
		Bi-208	208	3.6800E+05	y	N
		Bi-210	210	5.0130E+00	d	N
		Bi-210m	210	3.0400E+06	y	N
		Bi-211	211	2.1400E+00	m	N
		Bi-212	212	6.0550E+01	m	N
		Bi-212n	212	7.0000E+00	m	N
		Bi-213	213	4.5590E+01	m	N
		Bi-214	214	1.9900E+01	m	N
		Bi-215	215	7.6000E+00	m	N
		Bi-216	216	2.1700E+00	m	N
84	Polonium	Po-203	203	3.6700E+01	m	N
		Po-204	204	3.5300E+00	h	N
		Po-205	205	1.6600E+00	h	N
		Po-206	206	8.8000E+00	d	N
		Po-207	207	5.8000E+00	h	N
		Po-208	208	2.8980E+00	y	N
		Po-209	209	1.0200E+02	y	N
		Po-210	210	1.3838E+02	d	N
		Po-211	211	5.1600E-01	s	N
		Po-212	212	2.9900E-07	s	N
		Po-212m	212	4.5100E+01	s	N
		Po-213	213	4.2000E-06	s	N
		Po-214	214	1.6430E-04	s	N
		Po-215	215	1.7810E-03	s	N
		Po-216	216	1.4500E-01	s	N
		Po-218	218	3.1000E+00	m	N
85	Astatine	At-204	204	9.2000E+00	m	Y
		At-205	205	2.6200E+01	m	Y
		At-206	206	3.0600E+01	m	Y
		At-207	207	1.8000E+00	h	Y
		At-208	208	1.6300E+00	h	Y
		At-209	209	5.4100E+00	h	Y
		At-210	210	8.1000E+00	h	Y
		At-211	211	7.2140E+00	h	Y
		At-215	215	1.0000E-04	s	Y
		At-216	216	3.0000E-04	s	Y

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		At-217	217	3.2300E-02	s	Y
		At-218	218	1.5000E+00	s	Y
		At-219	219	5.6000E+01	s	Y
		At-220	220	3.7100E+00	m	Y
86	Radon	Rn-207	207	9.2500E+00	m	N
		Rn-209	209	2.8500E+01	m	N
		Rn-210	210	2.4000E+00	h	N
		Rn-211	211	1.4600E+01	h	N
		Rn-212	212	2.3900E+01	m	N
		Rn-215	215	2.3000E+00	us	N
		Rn-216	216	4.5000E-05	s	N
		Rn-217	217	5.4000E-04	s	N
		Rn-218	218	3.5000E-02	s	N
		Rn-219	219	3.9600E+00	s	N
		Rn-220	220	5.5600E+01	s	N
		Rn-222	222	3.8235E+00	d	N
		Rn-223	223	2.4300E+01	m	N
87	Francium	Fr-212	212	2.0000E+01	m	N
		Fr-219	219	2.0000E-02	s	N
		Fr-220	220	2.7400E+01	s	N
		Fr-221	221	4.9000E+00	m	N
		Fr-222	222	1.4200E+01	m	N
		Fr-223	223	2.2000E+01	m	N
		Fr-224	224	3.3300E+00	m	N
		Fr-227	227	2.4700E+00	m	N
88	Radium	Ra-219	219	1.0000E+01	ms	N
		Ra-220	220	1.7900E-02	s	N
		Ra-221	221	2.8000E+01	s	N
		Ra-222	222	3.8000E+01	s	N
		Ra-223	223	1.1430E+01	d	N
		Ra-224	224	3.6600E+00	d	N
		Ra-225	225	1.4900E+01	d	N
		Ra-226	226	1.6000E+03	y	N
		Ra-227	227	4.2200E+01	m	N
		Ra-228	228	5.7500E+00	y	N
		Ra-230	230	9.3000E+01	m	N
89	Actinium	Ac-223	223	2.1000E+00	m	N
		Ac-224	224	2.7800E+00	h	N
		Ac-225	225	1.0000E+01	d	N
		Ac-226	226	2.9370E+01	h	N
		Ac-227	227	2.1772E+01	y	N
		Ac-228	228	6.1500E+00	h	N
		Ac-230	230	1.2200E+02	s	N
		Ac-231	231	7.5000E+00	m	N
		Ac-232	232	1.1900E+02	s	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Ac-233	233	1.4500E+02	s	N
90	Thorium	Th-223	223	6.0000E-01	s	N
		Th-224	224	1.0500E+00	s	N
		Th-226	226	3.0570E+01	m	N
		Th-227	227	1.8680E+01	d	N
		Th-228	228	1.9116E+00	y	N
		Th-229	229	7.3400E+03	y	N
		Th-230	230	7.5380E+04	y	N
		Th-231	231	2.5520E+01	h	N
		Th-232	232	1.4050E+10	y	N
		Th-233	233	2.2300E+01	m	N
		Th-234	234	2.4100E+01	d	N
		Th-235	235	7.1000E+00	m	N
		Th-236	236	3.7500E+01	m	N
91	Protactinium	Pa-227	227	3.8300E+01	m	N
		Pa-228	228	2.2000E+01	h	N
		Pa-229	229	1.5000E+00	d	N
		Pa-230	230	1.7400E+01	d	N
		Pa-231	231	3.2760E+04	y	N
		Pa-232	232	1.3100E+00	d	N
		Pa-233	233	2.6967E+01	d	N
		Pa-234	234	6.7000E+00	h	N
		Pa-234m	234	1.1700E+00	m	N
		Pa-235	235	2.4500E+01	m	N
		Pa-236	236	9.1000E+00	m	N
		Pa-237	237	8.7000E+00	m	N
92	Uranium	U-227	227	1.1000E+00	m	N
		U-228	228	9.1000E+00	m	N
		U-230	230	2.0800E+01	d	N
		U-231	231	4.2000E+00	d	N
		U-232	232	6.8900E+01	y	N
		U-233	233	1.5920E+05	y	N
		U-234	234	2.4550E+05	y	N
		U-235	235	7.0400E+08	y	N
		U-235m	235	2.6000E+01	m	N
		U-236	236	2.3420E+07	y	N
		U-237	237	6.7500E+00	d	N
		U-238	238	4.4680E+09	y	N
		U-239	239	2.3450E+01	m	N
		U-240	240	1.4100E+01	h	N
		U-242	242	1.6800E+01	m	N
93	Neptunium	Np-232	232	1.4700E+01	m	N
		Np-233	233	3.6200E+01	m	N
		Np-234	234	4.4000E+00	d	N
		Np-235	235	3.9610E+02	d	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Np-236	236	1.5400E+05	y	N
		Np-236m	236	2.2500E+01	h	N
		Np-237	237	2.1440E+06	y	N
		Np-238	238	2.1170E+00	d	N
		Np-239	239	2.3565E+00	d	N
		Np-240	240	6.1900E+01	m	N
		Np-240m	240	7.2200E+00	m	N
		Np-241	241	1.3900E+01	m	N
		Np-242	242	2.2000E+00	m	N
		Np-242m	242	5.5000E+00	m	N
94	Plutonium	Pu-232	232	3.3700E+01	m	N
		Pu-234	234	8.8000E+00	h	N
		Pu-235	235	2.5300E+01	m	N
		Pu-236	236	2.8580E+00	y	N
		Pu-237	237	4.5200E+01	d	N
		Pu-238	238	8.7700E+01	y	N
		Pu-239	239	2.4110E+04	y	N
		Pu-240	240	6.5640E+03	y	N
		Pu-241	241	1.4350E+01	y	N
		Pu-242	242	3.7500E+05	y	N
		Pu-243	243	4.9560E+00	h	N
		Pu-244	244	8.0000E+07	y	N
		Pu-245	245	1.0500E+01	h	N
		Pu-246	246	1.0840E+01	d	N
95	Americium	Am-237	237	7.3000E+01	m	N
		Am-238	238	9.8000E+01	m	N
		Am-239	239	1.1900E+01	h	N
		Am-240	240	5.0800E+01	h	N
		Am-241	241	4.3220E+02	y	N
		Am-242	242	1.6020E+01	h	N
		Am-242m	242	1.4100E+02	y	N
		Am-243	243	7.3700E+03	y	N
		Am-244	244	1.0100E+01	h	N
		Am-244m	244	2.6000E+01	m	N
		Am-245	245	2.0500E+00	h	N
		Am-246	246	3.9000E+01	m	N
		Am-246m	246	2.5000E+01	m	N
		Am-247	247	2.3000E+01	m	N
96	Curium	Cm-238	238	2.4000E+00	h	N
		Cm-239	239	2.9000E+00	h	N
		Cm-240	240	2.7000E+01	d	N
		Cm-241	241	3.2800E+01	d	N
		Cm-242	242	1.6280E+02	d	N
		Cm-243	243	2.9100E+01	y	N
		Cm-244	244	1.8100E+01	y	N

ICRP Publication 107 Radionuclide Data						
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	
		Cm-245	245	8.5000E+03	y	N
		Cm-246	246	4.7600E+03	y	N
		Cm-247	247	1.5600E+07	y	N
		Cm-248	248	3.4800E+05	y	N
		Cm-249	249	6.4150E+01	m	N
		Cm-250	250	8.3000E+03	y	N
		Cm-251	251	1.6800E+01	m	N
97	Berkelium	Bk-245	245	4.9400E+00	d	N
		Bk-246	246	1.8000E+00	d	N
		Bk-247	247	1.3800E+03	y	N
		Bk-248m	248	2.3700E+01	h	N
		Bk-249	249	3.3000E+02	d	N
		Bk-250	250	3.2120E+00	h	N
		Bk-251	251	5.5600E+01	m	N
98	Californium	Cf-244	244	1.9400E+01	m	N
		Cf-246	246	3.5700E+01	h	N
		Cf-247	247	3.1100E+00	h	N
		Cf-248	248	3.3400E+02	d	N
		Cf-249	249	3.5100E+02	y	N
		Cf-250	250	1.3080E+01	y	N
		Cf-251	251	9.0000E+02	y	N
		Cf-252	252	2.6450E+00	y	N
		Cf-253	253	1.7810E+01	d	N
		Cf-254	254	6.0500E+01	d	N
		Cf-255	255	8.5000E+01	m	N
99	Einsteinium	Es-249	249	1.0220E+02	m	N
		Es-250	250	8.6000E+00	h	N
		Es-250m	250	2.2200E+00	h	N
		Es-251	251	3.3000E+01	h	N
		Es-253	253	2.0470E+01	d	N
		Es-254	254	2.7570E+02	d	N
		Es-254m	254	3.9300E+01	h	N
		Es-255	255	3.9800E+01	d	N
		Es-256	256	2.5400E+01	m	N
100	Fermium	Fm-251	251	5.3000E+00	h	N
		Fm-252	252	2.5390E+01	h	N
		Fm-253	253	3.0000E+00	d	N
		Fm-254	254	3.2400E+00	h	N
		Fm-255	255	2.0070E+01	h	N
		Fm-256	256	1.5760E+02	m	N
		Fm-257	257	1.0050E+02	d	N

[1] Units for half-lives are: y= years, d=days, h=hours, m=minutes, s=seconds, ms=milliseconds, μs=microseconds

Number of radioisotopes that pass Step One criterion (highlighted in yellow) **192**

Appendix B. Step Two Screening

Table B-1. Results of Step Two Screening

ICRP Publication 107 Radionuclide Data							
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?	Half-Life > 30 days
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]		
1	Hydrogen	H-3	3	1.2320E+01	y	Y	Y
6	Carbon	C-10	10	1.9255E+01	s	Y	N
		C-11	11	2.0390E+01	m	Y	N
		C-14	14	5.7000E+03	y	Y	Y
7	Nitrogen	N-13	13	9.9650E+00	m	Y	N
		N-16	16	7.1300E+00	s	Y	N
8	Oxygen	O-14	14	7.0606E+01	s	Y	N
		O-15	15	1.2224E+02	s	Y	N
		O-19	19	2.6464E+01	s	Y	N
9	Fluorine	F-17	17	6.4490E+01	s	Y	N
		F-18	18	1.0977E+02	m	Y	N
10	Neon	Ne-19	19	1.7220E+01	s	Y	N
		Ne-24	24	3.3800E+00	m	Y	N
15	Phosphorus	P-30	30	2.4980E+00	m	Y	N
		P-32	32	1.4263E+01	d	Y	N
		P-33	33	2.5340E+01	d	Y	N
16	Sulphur	S-35	35	8.7510E+01	d	Y	Y
		S-37	37	5.0500E+00	m	Y	N
		S-38	38	1.7030E+02	m	Y	N
17	Chlorine	Cl-34	34	1.5264E+00	s	Y	N
		Cl-34m	34	3.2000E+01	m	Y	N
		Cl-36	36	3.0100E+05	y	Y	Y
		Cl-38	38	3.7240E+01	m	Y	N
		Cl-39	39	5.5600E+01	m	Y	N
		Cl-40	40	1.3500E+00	m	Y	N
18	Argon	Ar-37	37	3.5040E+01	d	Y	Y
		Ar-39	39	2.6900E+02	y	Y	Y
		Ar-41	41	1.0961E+02	m	Y	N
		Ar-42	42	3.2900E+01	y	Y	Y
		Ar-43	43	5.3700E+00	m	Y	N
		Ar-44	44	1.1870E+01	m	Y	N
34	Selenium	Se-70	70	4.1100E+01	m	Y	N
		Se-71	71	4.7400E+00	m	Y	N
		Se-72	72	8.4000E+00	d	Y	N
		Se-73	73	7.1500E+00	h	Y	N
		Se-73m	73	3.9800E+01	m	Y	N
		Se-75	75	1.1978E+02	d	Y	Y
		Se-77m	77	1.7360E+01	s	Y	N
		Se-79	79	2.9500E+05	y	Y	Y
		Se-79m	79	3.9200E+00	m	Y	N

ICRP Publication 107 Radionuclide Data							
			Data Extracted from ICRP Publication 107			Potential to Form	Half-Life > 30
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]	Volatile Species?	days
		Se-81	81	1.8450E+01	m	Y	N
		Se-81m	81	5.7280E+01	m	Y	N
		Se-83	83	2.2300E+01	m	Y	N
		Se-83m	83	7.0100E+01	s	Y	N
		Se-84	84	3.1000E+00	m	Y	N
35	Bromine	Br-72	72	7.8600E+01	s	Y	N
		Br-73	73	3.4000E+00	m	Y	N
		Br-74	74	2.5400E+01	m	Y	N
		Br-74m	74	4.6000E+01	m	Y	N
		Br-75	75	9.6700E+01	m	Y	N
		Br-76	76	1.6200E+01	h	Y	N
		Br-76m	76	1.3100E+00	s	Y	N
		Br-77	77	5.7036E+01	h	Y	N
		Br-77m	77	4.2800E+00	m	Y	N
		Br-78	78	6.4600E+00	m	Y	N
		Br-80	80	1.7680E+01	m	Y	N
		Br-80m	80	4.4205E+00	h	Y	N
		Br-82	82	3.5300E+01	h	Y	N
		Br-82m	82	6.1300E+00	m	Y	N
		Br-83	83	2.4000E+00	h	Y	N
		Br-84	84	3.1800E+01	m	Y	N
		Br-84m	84	6.0000E+00	m	Y	N
		Br-85	85	2.9000E+00	m	Y	N
36	Krypton	Kr-74	74	1.1500E+01	m	Y	N
		Kr-75	75	4.2900E+00	m	Y	N
		Kr-76	76	1.4800E+01	h	Y	N
		Kr-77	77	7.4400E+01	m	Y	N
		Kr-79	79	3.5040E+01	h	Y	N
		Kr-81	81	2.2900E+05	y	Y	Y
		Kr-81m	81	1.3100E+01	s	Y	N
		Kr-83m	83	1.8300E+00	h	Y	N
		Kr-85	85	1.0756E+01	y	Y	Y
		Kr-85m	85	4.4800E+00	h	Y	N
		Kr-87	87	7.6300E+01	m	Y	N
		Kr-88	88	2.8400E+00	h	Y	N
		Kr-89	89	3.1500E+00	m	Y	N
50	Tin	Sn-106	106	1.9200E+00	m	Y	N
		Sn-108	108	1.0300E+01	m	Y	N
		Sn-109	109	1.8000E+01	m	Y	N
		Sn-110	110	4.1100E+00	h	Y	N
		Sn-111	111	3.5300E+01	m	Y	N

ICRP Publication 107 Radionuclide Data							
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?	Half-Life > 30 days
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]		
		Sn-113m	113	2.1400E+01	m	Y	N
		Sn-113	113	1.1509E+02	d	Y	Y
		Sn-117m	117	1.3760E+01	d	Y	N
		Sn-119m	119	2.9310E+02	d	Y	Y
		Sn-121m	121	4.3900E+01	y	Y	Y
		Sn-121	121	2.7030E+01	h	Y	N
		Sn-123m	123	4.0060E+01	m	Y	N
		Sn-123	123	1.2920E+02	d	Y	Y
		Sn-125m	125	9.5200E+00	m	Y	N
		Sn-125	125	9.6400E+00	d	Y	N
		Sn-126	126	2.3000E+05	y	Y	Y
		Sn-127m	127	4.1300E+00	m	Y	N
		Sn-127	127	2.1000E+00	h	Y	N
		Sn-128	128	5.9070E+01	m	Y	N
		Sn-129	129	2.2300E+00	m	Y	N
		Sn-130m	130	1.7000E+00	m	Y	N
		Sn-130	130	3.7200E+00	m	Y	N
51	Antimony	Sb-111	111	7.5000E+01	s	Y	N
		Sb-113	113	6.6700E+00	m	Y	N
		Sb-114	114	3.4900E+00	m	Y	N
		Sb-115	115	3.2100E+01	m	Y	N
		Sb-116	116	1.5800E+01	m	Y	N
		Sb-116m	116	6.0300E+01	m	Y	N
		Sb-117	117	2.8000E+00	h	Y	N
		Sb-118	118	3.6000E+00	m	Y	N
		Sb-118m	118	5.0000E+00	h	Y	N
		Sb-119	119	3.8190E+01	h	Y	N
		Sb-120	120	1.5890E+01	m	Y	N
		Sb-120m	120	5.7600E+00	d	Y	N
		Sb-122	122	2.7238E+00	d	Y	N
		Sb-122m	122	4.1910E+00	m	Y	N
		Sb-124	124	6.0200E+01	d	Y	Y
		Sb-124m	124	9.3000E+01	s	Y	N
		Sb-124n	124	2.0200E+01	m	Y	N
		Sb-125	125	2.7586E+00	y	Y	Y
		Sb-126	126	1.2350E+01	d	Y	N
		Sb-126m	126	1.9150E+01	m	Y	N
		Sb-127	127	3.8500E+00	d	Y	N
		Sb-128	128	9.0100E+00	h	Y	N
		Sb-128m	128	1.0400E+01	m	Y	N

ICRP Publication 107 Radionuclide Data							
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?	Half-Life > 30 days
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]		
		Sb-129	129	4.4000E+00	h	Y	N
		Sb-130	130	3.9500E+01	m	Y	N
		Sb-130m	130	6.3000E+00	m	Y	N
		Sb-131	131	2.3030E+01	m	Y	N
		Sb-133	133	2.5000E+00	m	Y	N
53	Iodine	I-118	118	1.3700E+01	m	Y	N
		I-118m	118	8.5000E+00	m	Y	N
		I-119	119	1.9100E+01	m	Y	N
		I-120	120	8.1600E+01	m	Y	N
		I-120m	120	5.3000E+01	m	Y	N
		I-121	121	2.1200E+00	h	Y	N
		I-122	122	3.6300E+00	m	Y	N
		I-123	123	1.3270E+01	h	Y	N
		I-124	124	4.1760E+00	d	Y	N
		I-125	125	5.9400E+01	d	Y	Y
		I-126	126	1.2930E+01	d	Y	N
		I-128	128	2.4990E+01	m	Y	N
		I-129	129	1.5700E+07	y	Y	Y
		I-130	130	1.2360E+01	h	Y	N
		I-130m	130	8.8400E+00	m	Y	N
		I-131	131	8.0207E+00	d	Y	N
		I-132	132	2.2950E+00	h	Y	N
		I-132m	132	1.3870E+00	h	Y	N
		I-133	133	2.0800E+01	h	Y	N
		I-134	134	5.2500E+01	m	Y	N
		I-134m	134	3.6000E+00	m	Y	N
		I-135	135	6.5700E+00	h	Y	N
54	Xenon	Xe-120	120	4.0000E+01	m	Y	N
		Xe-121	121	4.0100E+01	m	Y	N
		Xe-122	122	2.0100E+01	h	Y	N
		Xe-123	123	2.0800E+00	h	Y	N
		Xe-125	125	1.6900E+01	h	Y	N
		Xe-127	127	3.6400E+01	d	Y	Y
		Xe-127m	127	6.9200E+01	s	Y	N
		Xe-129m	129	8.8800E+00	d	Y	N
		Xe-131m	131	1.1840E+01	d	Y	N
		Xe-133	133	5.2430E+00	d	Y	N
		Xe-133m	133	2.1900E+00	d	Y	N
		Xe-135	135	9.1400E+00	h	Y	N
		Xe-135m	135	1.5290E+01	m	Y	N

ICRP Publication 107 Radionuclide Data							
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?	Half-Life > 30 days
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]		
		Xe-137	137	3.8180E+00	m	Y	N
		Xe-138	138	1.4080E+01	m	Y	N
80	Mercury	Hg-190	190	2.0000E+01	m	Y	N
		Hg-191m	191	5.0800E+01	m	Y	N
		Hg-192	192	4.8500E+00	h	Y	N
		Hg-193	193	3.8000E+00	h	Y	N
		Hg-193m	193	1.1800E+01	h	Y	N
		Hg-194	194	4.4000E+02	y	Y	Y
		Hg-195	195	1.0530E+01	h	Y	N
		Hg-195m	195	4.1600E+01	h	Y	N
		Hg-197	197	6.4940E+01	h	Y	N
		Hg-197m	197	2.3800E+01	h	Y	N
		Hg-199m	199	4.2660E+01	m	Y	N
		Hg-203	203	4.6612E+01	d	Y	Y
		Hg-205	205	5.2000E+00	m	Y	N
		Hg-206	206	8.1500E+00	m	Y	N
		Hg-207	207	2.9000E+00	m	Y	N
85	Astatine	At-204	204	9.2000E+00	m	Y	N
		At-205	205	2.6200E+01	m	Y	N
		At-206	206	3.0600E+01	m	Y	N
		At-207	207	1.8000E+00	h	Y	N
		At-208	208	1.6300E+00	h	Y	N
		At-209	209	5.4100E+00	h	Y	N
		At-210	210	8.1000E+00	h	Y	N
		At-211	211	7.2140E+00	h	Y	N
		At-215	215	1.0000E-04	s	Y	N
		At-216	216	3.0000E-04	s	Y	N
		At-217	217	3.2300E-02	s	Y	N
		At-218	218	1.5000E+00	s	Y	N
		At-219	219	5.6000E+01	s	Y	N
		At-220	220	3.7100E+00	m	Y	N

[1] Units for half-lives are: y= years, d=days, h=hours, m=minutes, s=seconds, ms=milliseconds, μs=microseconds

Radioisotopes that pass Step One and Step Two criteria (highlighted in rose) 23

Appendix C. Step Three Screening

Table C-1. Results of Step Three Screening

ICRP Publication 107 Radionuclide Data								
			Data Extracted from ICRP Publication 107			Potential to Form Volatile Species?	Half-Life > 30 days	H > 0.01 atm-kg/mole or VP > 1 mm Hg
Z	Element	Nuclide	Atomic Wt.	Half-life	Units[1]			
1	Hydrogen	H-3	3	1.2320E+01	y	Y	Y	Y
		C-14	14	5.7000E+03	y	Y	Y	Y
16	Sulphur	S-35	35	8.7510E+01	d	Y	Y	
		Cl-36	36	3.0100E+05	y	Y	Y	
18	Argon	Ar-37	37	3.5040E+01	d	Y	Y	Y
		Ar-39	39	2.6900E+02	y	Y	Y	Y
		Ar-42	42	3.2900E+01	y	Y	Y	Y
		Se-75	75	1.1978E+02	d	Y	Y	
		Se-79	79	2.9500E+05	y	Y	Y	
		Kr-81	81	2.2900E+05	y	Y	Y	Y
		Kr-85	85	1.0756E+01	y	Y	Y	Y
		Sn-113	113	1.1509E+02	d	Y	Y	
		Sn-119m	119	2.9310E+02	d	Y	Y	
		Sn-121m	121	4.3900E+01	y	Y	Y	
		Sn-123	123	1.2920E+02	d	Y	Y	
		Sn-126	126	2.3000E+05	y	Y	Y	
		Sb-124	124	6.0200E+01	d	Y	Y	
		Sb-125	125	2.7586E+00	y	Y	Y	
		I-125	125	5.9400E+01	d	Y	Y	
		I-129	129	1.5700E+07	y	Y	Y	
		Xe-127	127	3.6400E+01	d	Y	Y	Y
		Hg-194	194	4.4000E+02	y	Y	Y	Y
		Hg-203	203	4.6612E+01	d	Y	Y	Y

[1] Units for half-lives are: y= years, d=days, h=hours, m=minutes, s=seconds, ms=milliseconds, µs=microseconds

Radioisotopes that pass Step One and Step Two criteria (highlighted in teal) 10

Intentionally Blank

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