



Appendix G

Radiological Airborne Emissions at Oak Ridge National Laboratory

This appendix presents annual radioactive airborne emissions for ORNL in 2020. All data were determined to be statistically different from zero at the 95 percent confidence level. Any number not statistically different from zero was not included in the emission calculation. Because measuring a radionuclide requires counting random radioactive emissions from a sample, the same result may not be obtained if the sample is analyzed repeatedly. This deviation is referred to as the “counting uncertainty.” Statistical significance at the 95 percent confidence level means that there is a 5 percent chance that the results could be erroneous.

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
²²³ Ac	B	unspecified										3.97E-13	3.97E-13
²²⁵ Ac	M	particulate										2.18E-06	2.18E-06
²²⁶ Ac	M	particulate										1.07E-07	1.07E-07
²²⁷ Ac	M	particulate										1.86E-08	1.86E-08
²²⁸ Ac	M	particulate										1.64E-13	1.64E-13
¹⁰⁶ Ag	M	particulate										2.8E-25	2.8E-25
¹⁰⁸ Ag	B	unspecified										1.82E-18	1.82E-18
^{108m} Ag	M	particulate										2.48E-13	2.48E-13
^{109m} Ag	B	unspecified										5.5E-12	5.5E-12
¹¹⁰ Ag	B	unspecified										1.51E-07	1.51E-07
^{110m} Ag	M	particulate										1.13E-05	1.13E-05
¹¹¹ Ag	M	particulate										4.23E-06	4.23E-06
¹¹² Ag	M	particulate										5.62E-08	5.62E-08
²⁶ Al	M	particulate										2.68E-17	2.68E-17
²⁴¹ Am	M	particulate	2.82E-08	5.83E-07					3.69E-09			1.24E-05	1.3E-05
²⁴¹ Am	F	particulate			1.07E-07		4.95E-09	2.41E-07				1.84E-09	3.55E-07
²⁴² Am	M	particulate										5.77E-08	5.77E-08
^{242m} Am	M	particulate										6.25E-08	6.25E-08
²⁴³ Am	M	particulate										2.8E-07	2.8E-07
²⁴⁴ Am	M	particulate										3.03E-29	3.03E-29
²⁴⁵ Am	M	particulate										1.32E-18	1.32E-18
²⁴⁶ Am	M	particulate										1.59E-23	1.59E-23
³⁷ Ar	B	unspecified										1.37E-04	1.37E-04
³⁹ Ar	B	unspecified										5.97E-05	5.97E-05
⁴¹ Ar	B	unspecified							1.09E+03	2.90E+01			1.12E+03

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
⁷⁴ As	M	particulate										3.63E-33	3.63E-33
¹⁹⁹ Au	M	particulate										1.14E-10	1.14E-10
¹³¹ Ba	M	particulate										2.15E-06	2.15E-06
¹³³ Ba	M	particulate										2.65E-05	2.65E-05
^{137m} Ba	B	unspecified										3.63E-07	3.63E-07
¹³⁹ Ba	M	particulate								2.91E-01		2.91E-01	2.91E-01
¹⁴⁰ Ba	M	particulate								6.80E-04		7.26E-07	6.81E-04
¹⁰ Be	M	particulate										7.33E-13	7.33E-13
⁷ Be	M	particulate	2.07E-07	1.32E-07		4.77E-08				4.99E-07		6.41E-06	7.3E-06
⁷ Be	S	particulate				3.61E-06						1.19E-06	4.8E-06
²⁰⁶ Bi	M	particulate										3.21E-07	3.21E-07
²⁰⁷ Bi	M	particulate										6.0E-16	6.0E-16
²⁰⁸ Bi	B	unspecified										8.67E-17	8.67E-17
²¹⁰ Bi	M	particulate										3.12E-16	3.12E-16
^{210m} Bi	M	particulate										4.04E-17	4.04E-17
²¹¹ Bi	B	unspecified										5.82E-11	5.82E-11
²¹² Bi	M	particulate										4.14E-07	4.14E-07
²¹³ Bi	M	particulate										3.62E-15	3.62E-15
²¹⁴ Bi	M	particulate										5.19E-15	5.19E-15
²⁴⁹ Bk	M	particulate										7.01E-11	7.01E-11
²⁵⁰ Bk	M	particulate										3.5E-20	3.5E-20
⁸² Br	M	particulate										6.58E-08	6.58E-08
¹¹ C	G	dioxide									2.0E+04		2.0E+04
¹⁴ C	M	particulate										1.36E-07	1.36E-07
⁴¹ Ca	M	particulate										7.04E-09	7.04E-09
⁴⁵ Ca	M	particulate										4.34E-06	4.34E-06
⁴⁷ Ca	M	particulate										1.08E-10	1.08E-10
¹⁰⁹ Cd	M	particulate										5.26E-11	5.26E-11

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
¹¹³ Cd	M	particulate										1.27E-21	1.27E-21
^{113m} Cd	M	particulate										1.21E-06	1.21E-06
¹¹⁵ Cd	M	particulate										1.16E-06	1.16E-06
^{115m} Cd	M	particulate										3.53E-08	3.53E-08
¹³⁴ Ce	M	particulate										2.77E-09	2.77E-09
¹³⁹ Ce	M	particulate										3.98E-08	3.98E-08
¹⁴¹ Ce	M	particulate							9.69E-07			1.26E-05	1.35E-05
¹⁴³ Ce	M	particulate										8.38E-08	8.38E-08
¹⁴⁴ Ce	M	particulate										1.17E-02	1.17E-02
²⁴⁹ Cf	M	particulate										7.13E-16	7.13E-16
²⁵⁰ Cf	M	particulate										3.13E-15	3.13E-15
²⁵¹ Cf	M	particulate										1.25E-17	1.25E-17
²⁵² Cf	M	particulate						5.45E-10				1.85E-08	1.9E-08
²⁵³ Cf	M	particulate										9.69E-24	9.69E-24
²⁵⁴ Cf	M	particulate										1.48E-21	1.48E-21
³⁶ Cl	M	particulate										1.26E-10	1.26E-10
²⁴¹ Cm	M	particulate										6.3E-14	6.3E-14
²⁴² Cm	M	particulate										1.23E-04	1.23E-04
²⁴³ Cm	F	particulate						1.80E-08	9.70E-09			3.88E-10	2.81E-08
²⁴³ Cm	M	particulate	8.50E-08	5.20E-09		8.95E-11				1.95E-09		7.98E-07	8.91E-07
²⁴⁴ Cm	M	particulate	8.50E-08	5.20E-09		8.95E-11				1.95E-09		3.28E-05	3.29E-05
²⁴⁴ Cm	F	particulate						1.80E-08	9.70E-09			3.88E-10	2.81E-08
²⁴⁵ Cm	M	particulate										9.37E-09	9.37E-09
²⁴⁶ Cm	M	particulate										8.05E-09	8.05E-09
²⁴⁷ Cm	M	particulate										2.29E-12	2.29E-12
²⁴⁸ Cm	M	particulate										2.82E-09	2.82E-09
²⁴⁹ Cm	M	particulate										3.01E-26	3.01E-26
⁵⁷ Co	M	particulate										2.01E-07	2.01E-07

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
⁵⁸ Co	M	particulate										4.2E-05	4.2E-05
⁶⁰ Co	M	particulate										2.05E-04	2.05E-04
⁶⁰ Co	S	particulate			2.43E-07				2.29E-07				4.72E-07
^{60m} Co	M	particulate										3.15E-13	3.15E-13
⁵¹ Cr	M	particulate										7.25E-04	7.25E-04
¹³¹ Cs	F	particulate										2.2E-06	2.2E-06
¹³² Cs	F	particulate										1.04E-07	1.04E-07
¹³⁴ Cs	F	particulate										3.32E-03	3.32E-03
¹³⁴ Cs	S	particulate							5.07E-07				5.07E-07
¹³⁵ Cs	F	particulate										1.26E-08	1.26E-08
¹³⁶ Cs	F	particulate										8.93E-07	8.93E-07
¹³⁷ Cs	F	particulate	5.53E-07	2.77E-06					4.48E-06			5.68E-03	5.69E-03
¹³⁷ Cs	S	particulate			2.43E-05		1.38E-08					4.38E-07	2.48E-05
¹³⁸ Cs	F	particulate							1.07E+03				1.07E+03
⁶⁴ Cu	M	particulate										3.0E-05	3.0E-05
⁶⁷ Cu	M	particulate										1.06E-08	1.06E-08
¹⁵⁹ Dy	M	particulate										7.33E-16	7.33E-16
¹⁶⁹ Er	M	particulate										5.96E-08	5.96E-08
²⁵³ Es	M	particulate										3.76E-22	3.76E-22
²⁵⁴ Es	M	particulate										3.49E-20	3.49E-20
¹⁵⁰ Eu	M	particulate										2.8E-13	2.8E-13
¹⁵² Eu	M	particulate										5.27E-07	5.27E-07
¹⁵⁴ Eu	M	particulate										1.96E-04	1.96E-04
¹⁵⁵ Eu	M	particulate										1.23E-04	1.23E-04
¹⁵⁶ Eu	M	particulate										2.28E-09	2.28E-09
⁵⁵ Fe	M	particulate										5.35E-04	5.35E-04
⁵⁹ Fe	M	particulate										1.53E-05	1.53E-05
⁶⁰ Fe	M	particulate										2.24E-14	2.24E-14

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
²²³ Fr	M	particulate										1.18E-15	1.18E-15
⁶⁸ Ga	M	particulate										7.37E-12	7.37E-12
⁷² Ga	M	particulate										1.13E-11	1.13E-11
¹⁵¹ Gd	M	particulate										5.9E-12	5.9E-12
¹⁵² Gd	M	particulate										7.67E-21	7.67E-21
¹⁵³ Gd	M	particulate										7.94E-06	7.94E-06
¹⁵⁹ Gd	M	particulate										2.56E-15	2.56E-15
⁶⁸ Ge	M	particulate										7.37E-12	7.37E-12
⁷¹ Ge	M	particulate										1.1E-09	1.1E-09
³ H	V	vapor	3.24E-03		2.16E+00	3.49E-03	7.27E-01		6.07E+01	9.59E+02	2.25E-01	1.02E+03	
¹⁷⁵ Hf	M	particulate										4.17E-06	4.17E-06
^{178m} Hf	M	particulate										4.17E-08	4.17E-08
^{179m} Hf	M	particulate										1.47E-08	1.47E-08
¹⁸¹ Hf	M	particulate										1.06E-04	1.06E-04
¹⁸² Hf	M	particulate										2.77E-12	2.77E-12
²⁰³ Hg	M	inorganic										2.29E-09	2.29E-09
¹⁶³ Ho	B	unspecified										6.41E-14	6.41E-14
^{166m} Ho	M	particulate										2.6E-11	2.6E-11
¹²⁶ I	F	particulate										1.57E-07	1.57E-07
¹²⁹ I	F	particulate										1.24E-05	1.24E-05
¹³¹ I	F	particulate			1.43E-02	1.70E-02			4.15E-02		2.68E-06	7.28E-02	
¹³² I	M	particulate			6.85E-03							6.85E-03	
¹³² I	F	particulate				3.08E-02		3.64E-01				3.95E-01	
¹³³ I	F	particulate						1.72E-01				1.72E-01	
¹³⁴ I	F	particulate						3.33E-01				3.33E-01	
¹³⁵ I	F	particulate						6.50E-01				6.5E-01	
^{113m} In	M	particulate										2.62E-06	2.62E-06
¹¹⁴ In	B	unspecified										3.04E-07	3.04E-07

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
^{114m} In	M	particulate										2.86E-07	2.86E-07
¹¹⁵ In	M	particulate										6.11E-19	6.11E-19
^{115m} In	M	particulate										2.38E-12	2.38E-12
^{191m} Ir	B	unspecified										3.8E-10	3.8E-10
¹⁹² Ir	M	particulate										9.0E-08	9.0E-08
^{192m} Ir	B	unspecified										2.36E-17	2.36E-17
¹⁹⁴ Ir	M	particulate										1.05E-10	1.05E-10
^{194m} Ir	M	particulate										7.2E-10	7.2E-10
⁴⁰ K	M	particulate										3.33E-07	3.33E-07
⁴² K	M	particulate										1.03E-11	1.03E-11
⁸¹ Kr	B	unspecified										7.72E-10	7.72E-10
^{83m} Kr	B	unspecified										4.47E-19	4.47E-19
⁸⁵ Kr	B	unspecified							1.61E+02			1.81E+02	3.42E+02
^{85m} Kr	B	unspecified							1.18E+01				1.18E+01
⁸⁷ Kr	B	unspecified							5.59E+01	4.30E+01			9.89E+01
⁸⁸ Kr	B	unspecified							5.62E+01	1.44E+02			2.0E+02
⁸⁹ Kr	B	unspecified							2.92E+01				2.92E+01
¹³⁷ La	M	particulate										1.16E-19	1.16E-19
¹³⁸ La	M	particulate										1.18E-17	1.18E-17
¹⁴⁰ La	M	particulate							1.09E-02			7.4E-07	1.09E-02
¹⁷³ Lu	M	particulate										2.21E-11	2.21E-11
¹⁷⁴ Lu	M	particulate										7.82E-11	7.82E-11
^{174m} Lu	M	particulate										2.16E-11	2.16E-11
¹⁷⁶ Lu	M	particulate										1.2E-13	1.2E-13
^{176m} Lu	M	particulate										3.39E-13	3.39E-13
¹⁷⁷ Lu	M	particulate										6.67E-05	6.67E-05
^{177m} Lu	M	particulate										8.63E-09	8.63E-09
⁵³ Mn	M	particulate										1.07E-17	1.07E-17

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
⁵⁴ Mn	M	particulate										3.76E-05	3.76E-05
⁵⁶ Mn	M	particulate										5.33E-12	5.33E-12
⁹³ Mo	M	particulate										1.75E-06	1.75E-06
⁹⁹ Mo	M	particulate										2.01E-06	2.01E-06
¹³ N	B	unspecified									4.31E+02		4.31E+02
²² Na	M	particulate										9.98E-10	9.98E-10
²⁴ Na	M	particulate										3.95E-06	3.95E-06
⁹¹ Nb	B	unspecified										9.3E-08	9.3E-08
^{91m} Nb	B	unspecified										1.12E-06	1.12E-06
⁹² Nb	B	unspecified										4.66E-15	4.66E-15
^{92m} Nb	B	unspecified										1.79E-08	1.79E-08
^{93m} Nb	M	particulate										1.76E-06	1.76E-06
⁹⁴ Nb	M	particulate										6.45E-08	6.45E-08
⁹⁵ Nb	M	particulate										1.23E-03	1.23E-03
^{95m} Nb	M	particulate										5.25E-06	5.25E-06
⁹⁶ Nb	M	particulate										9.67E-09	9.67E-09
⁹⁷ Nb	M	particulate										5.95E-09	5.95E-09
¹⁴⁷ Nd	M	particulate										2.12E-07	2.12E-07
⁵⁹ Ni	M	particulate										3.01E-07	3.01E-07
⁶³ Ni	M	particulate										3.43E-03	3.43E-03
²³⁵ Np	M	particulate										4.56E-16	4.56E-16
²³⁶ Np	M	particulate										1.06E-18	1.06E-18
²³⁷ Np	M	particulate										1.38E-07	1.38E-07
²³⁸ Np	M	particulate										3.23E-15	3.23E-15
²³⁹ Np	M	particulate										1.69E-09	1.69E-09
²⁴⁰ Np	M	particulate										2.32E-26	2.32E-26
^{240m} Np	B	unspecified										1.93E-23	1.93E-23
¹⁸⁵ Os	M	particulate										2.13E-09	2.13E-09

2020 Annual Site Environmental Report for the Oak Ridge Reservation

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Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
¹⁹¹ Os	M	particulate				9.09E-01				1.11E-07		9.86E-10	9.09E-01
¹⁹⁴ Os	M	particulate										1.1E-10	1.1E-10
³² P	M	particulate										1.51E-06	1.51E-06
³³ P	M	particulate										4.7E-09	4.7E-09
²²⁸ P _a	M	particulate										5.5E-09	5.5E-09
²³⁰ P _a	M	particulate										3.72E-07	3.72E-07
²³¹ P _a	M	particulate										1.01E-12	1.01E-12
²³² P _a	M	particulate										1.4E-08	1.4E-08
²³³ P _a	M	particulate										3.81E-06	3.81E-06
²³⁴ P _a	M	particulate										5.65E-12	5.65E-12
^{234m} P _a	B	unspecified										4.38E-13	4.38E-13
²⁰⁵ P _b	M	particulate										1.83E-17	1.83E-17
²⁰⁹ P _b	M	particulate										3.67E-15	3.67E-15
²¹⁰ P _b	M	particulate										3.13E-16	3.13E-16
²¹¹ P _b	M	particulate										8.66E-14	8.66E-14
²¹² P _b	M	particulate	3.77E-01	3.68E-01		2.16E-02				2.92E-02		4.14E-07	7.96E-01
²¹² P _b	S	particulate			1.28E+01		2.46E-01					6.56E-02	1.31E+01
²¹⁴ P _b	S	particulate			7.81E-01								7.81E-01
²¹⁴ P _b	M	particulate				2.65E-03						5.19E-15	2.65E-03
¹⁰³ Pd	M	particulate										2.77E-32	2.77E-32
¹⁰⁷ Pd	M	particulate										3.56E-09	3.56E-09
¹⁴⁶ Pm	M	particulate										8.09E-08	8.09E-08
¹⁴⁷ Pm	M	particulate										5.42E-03	5.42E-03
¹⁴⁸ Pm	M	particulate										5.11E-08	5.11E-08
^{148m} Pm	M	particulate										9.3E-07	9.3E-07
²⁰⁹ Po	B	unspecified										9.3E-10	9.3E-10
²¹⁰ Po	B	inorganic										4.6E-10	4.6E-10
¹⁴³ Pr	M	particulate										3.22E-07	3.22E-07

2020 Annual Site Environmental Report for the Oak Ridge Reservation

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Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
¹⁴⁴ P _r	M	particulate										1.17E-02	1.17E-02
^{144m} P _r	B	unspecified										1.02E-10	1.02E-10
¹⁹³ P _t	M	particulate										2.19E-09	2.19E-09
²³⁶ P _u	M	particulate										9.15E-14	9.15E-14
²³⁷ P _u	M	particulate										1.06E-19	1.06E-19
²³⁸ P _u	M	particulate	8.64E-09	3.40E-08						8.57E-10		1.04E-06	1.09E-06
²³⁸ P _u	F	particulate			1.16E-08		2.20E-09	8.87E-08					1.03E-07
²³⁹ P _u	M	particulate	1.79E-08	2.26E-07								2.17E-07	4.61E-07
²³⁹ P _u	F	particulate			2.94E-07		4.22E-09	3.20E-08				3.13E-08	3.62E-07
²⁴⁰ P _u	F	particulate			2.94E-07		4.22E-09	3.20E-08				2.77E-13	3.3E-07
²⁴⁰ P _u	M	particulate	1.79E-08	2.26E-07								1.21E-07	3.65E-07
²⁴¹ P _u	M	particulate										3.36E-06	3.36E-06
²⁴² P _u	M	particulate										6.26E-09	6.26E-09
²⁴³ P _u	M	particulate										1.66E-24	1.66E-24
²⁴⁴ P _u	M	particulate										8.72E-15	8.72E-15
²²³ R _a	M	particulate										2.34E-06	2.34E-06
²²⁴ R _a	M	particulate										9.13E-07	9.13E-07
²²⁵ R _a	M	particulate										1.09E-07	1.09E-07
²²⁶ R _a	M	particulate										1.0E-07	1.0E-07
²²⁸ R _a	M	particulate										6.01E-10	6.01E-10
⁸³ R _b	M	particulate										5.6E-19	5.6E-19
⁸⁴ R _b	M	particulate										8.09E-14	8.09E-14
⁸⁶ R _b	M	particulate										1.46E-09	1.46E-09
⁸⁷ R _b	M	particulate										1.35E-12	1.35E-12
¹⁸³ R _e	B	unspecified										3.32E-11	3.32E-11
¹⁸⁴ R _e	M	particulate										3.36E-09	3.36E-09
^{184m} R _e	M	particulate										3.27E-09	3.27E-09
¹⁸⁶ R _e	M	particulate										3.39E-05	3.39E-05

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
^{186m} Re	M	particulate										2.48E-12	2.48E-12
¹⁸⁷ Re	M	particulate										1.68E-18	1.68E-18
¹⁸⁸ Re	M	particulate										1.74E-04	1.74E-04
¹⁰² Rh	M	particulate										1.06E-07	1.06E-07
^{102m} Rh	M	particulate										2.22E-15	2.22E-15
^{103m} Rh	M	particulate										3.09E-05	3.09E-05
¹⁰⁵ Rh	M	particulate										5.44E-07	5.44E-07
¹⁰⁶ Rh	B	unspecified										1.25E-08	1.25E-08
²¹⁹ Rn	B	unspecified										3.8E-11	3.8E-11
²²⁰ Rn	B	unspecified										4.14E-07	4.14E-07
²²² Rn	B	unspecified										4.62E-10	4.62E-10
¹⁰³ Ru	M	particulate										3.51E-05	3.51E-05
¹⁰⁶ Ru	M	particulate										4.72E-03	4.72E-03
³⁵ S	M	particulate										5.46E-07	5.46E-07
^{120m} Sb	M	particulate										1.46E-07	1.46E-07
¹²² Sb	M	particulate				3.09E-03						3.01E-07	3.09E-03
¹²⁴ Sb	M	particulate				9.50E-03						6.84E-07	9.5E-03
¹²⁵ Sb	M	particulate				1.20E-03						2.6E-04	1.46E-03
¹²⁶ Sb	M	particulate				1.98E-02						5.3E-07	1.98E-02
^{126m} Sb	M	particulate										2.74E-08	2.74E-08
¹²⁷ Sb	M	particulate										4.53E-07	4.53E-07
⁴⁶ Sc	M	particulate										3.91E-06	3.91E-06
⁴⁷ Sc	M	particulate										7.45E-08	7.45E-08
⁴⁸ Sc	M	particulate										2.36E-07	2.36E-07
⁷⁵ Se	F	particulate										2.08E-05	2.08E-05
⁷⁹ Se	F	particulate										4.98E-09	4.98E-09
³² Si	M	particulate										2.0E-12	2.0E-12
¹⁴⁵ Sm	M	particulate										2.91E-10	2.91E-10

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
¹⁴⁶ Sm	M	particulate										5.57E-15	5.57E-15
¹⁴⁷ Sm	M	particulate										2.02E-13	2.02E-13
¹⁵¹ Sm	M	particulate										7.5E-06	7.5E-06
¹¹³ Sn	M	particulate										2.76E-06	2.76E-06
^{117m} Sn	M	particulate										1.76E-07	1.76E-07
^{119m} Sn	M	particulate										9.08E-07	9.08E-07
¹²¹ Sn	M	particulate										4.15E-09	4.15E-09
^{121m} Sn	M	particulate										1.43E-08	1.43E-08
¹²³ Sn	M	particulate										4.23E-06	4.23E-06
^{123m} Sn	M	particulate										3.36E-12	3.36E-12
¹²⁵ Sn	M	particulate										3.65E-07	3.65E-07
¹²⁶ Sn	M	particulate										1.2E-08	1.2E-08
⁸⁵ Sr	M	particulate										1.51E-07	1.51E-07
⁸⁹ Sr	S	particulate			4.86E-06		1.96E-08					1.9E-07	5.07E-06
⁸⁹ Sr	M	particulate	5.10E-08	1.18E-06		1.61E-08			7.50E-06			1.8E-04	1.89E-04
⁹⁰ Sr	M	particulate	5.10E-08	1.18E-06		1.61E-08			7.50E-06			4.68E-03	4.69E-03
⁹⁰ Sr	S	particulate			4.86E-06		1.96E-08	1.13E-06				6.94E-07	6.7E-06
⁹¹ Sr	M	particulate										1.19E-11	1.19E-11
¹⁷⁹ Ta	M	particulate										3.79E-10	3.79E-10
¹⁸² Ta	M	particulate										1.69E-05	1.69E-05
^{182m} Ta	M	particulate										9.0E-11	9.0E-11
¹⁸³ Ta	M	particulate										5.63E-06	5.63E-06
¹⁵⁸ Tb	M	particulate										6.45E-13	6.45E-13
¹⁶⁰ Tb	M	particulate										2.75E-07	2.75E-07
¹⁶¹ Tb	M	particulate										3.13E-09	3.13E-09
⁹⁶ Tc	M	particulate										1.97E-08	1.97E-08
^{97m} Tc	M	particulate										1.99E-10	1.99E-10
⁹⁸ Tc	M	particulate										1.61E-13	1.61E-13

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total		
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915				
⁹⁹ Tc	M	particulate										2.11E-05	2.11E-05	
⁹⁹ Tc	S	particulate							7.64E-07					7.64E-07
^{99m} Tc	M	particulate										1.95E-07	1.95E-07	
¹²¹ Te	M	particulate										9.51E-05	9.51E-05	
^{121m} Te	M	particulate										5.41E-09	5.41E-09	
¹²³ Te	M	particulate										2.26E-24	2.26E-24	
^{123m} Te	M	particulate										2.63E-08	2.63E-08	
^{125m} Te	M	particulate										6.39E-05	6.39E-05	
¹²⁷ Te	M	particulate										6.24E-06	6.24E-06	
^{127m} Te	M	particulate										6.37E-06	6.37E-06	
¹²⁹ Te	M	particulate										1.91E-07	1.91E-07	
^{129m} Te	M	particulate										2.94E-07	2.94E-07	
^{131m} Te	M	particulate										9.13E-08	9.13E-08	
¹³² Te	M	particulate										3.03E-07	3.03E-07	
²²⁶ Th	S	particulate										2.59E-29	2.59E-29	
²²⁷ Th	S	particulate										1.61E-06	1.61E-06	
²²⁸ Th	S	particulate	4.71E-09	1.52E-08	2.10E-08	1.71E-09	6.78E-10			1.57E-08		5.88E-07	6.47E-07	
²²⁹ Th	S	particulate										4.09E-08	4.09E-08	
²³⁰ Th	S	particulate	8.84E-10	2.37E-09		6.76E-10				9.41E-09		1.42E-08	2.75E-08	
²³⁰ Th	F	particulate			1.45E-08		4.72E-10					3.43E-10	1.53E-08	
²³¹ Th	S	particulate										1.39E-10	1.39E-10	
²³² Th	S	particulate	1.41E-09	2.66E-09		7.90E-10				1.19E-08		7.41E-08	9.08E-08	
²³² Th	F	particulate			9.70E-09		5.69E-10					4.46E-10	1.07E-08	
²³⁴ Th	S	particulate										4.64E-12	4.64E-12	
⁴⁴ Ti	M	particulate										9.45E-11	9.45E-11	
²⁰⁴ Tl	M	particulate										9.76E-15	9.76E-15	
²⁰⁸ Tl	B	unspecified										4.14E-07	4.14E-07	
¹⁶⁸ Tm	B	unspecified										1.31E-14	1.31E-14	

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack								Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911	X-8915			
¹⁷⁰ Tm	M	particulate										5.89E-07	5.89E-07
¹⁷¹ Tm	M	particulate										6.63E-05	6.63E-05
¹⁷² Tm	M	particulate										4.86E-11	4.86E-11
²³⁰ U	M	particulate										2.55E-29	2.55E-29
²³² U	M	particulate										1.7E-07	1.7E-07
²³³ U	S	particulate			4.51E-08		5.60E-09					3.53E-09	5.42E-08
²³³ U	M	particulate	2.85E-08	1.42E-07		1.30E-09			2.07E-08			4.56E-08	2.38E-07
²³⁴ U	M	particulate	2.85E-08	1.42E-07		1.30E-09			2.07E-08			3.37E-05	3.39E-05
²³⁴ U	S	particulate			4.51E-08		5.60E-09					3.53E-09	5.42E-08
²³⁵ U	M	particulate	1.22E-09	4.27E-09		1.23E-10			5.01E-09			1.53E-04	1.53E-04
²³⁵ U	S	particulate			4.23E-09							9.2E-10	5.15E-09
²³⁶ U	M	particulate										3.39E-11	3.39E-11
²³⁷ U	M	particulate										7.81E-13	7.81E-13
²³⁸ U	M	particulate	2.93E-09	2.48E-08		1.77E-09			1.92E-08			8.24E-03	8.24E-03
²³⁸ U	S	particulate			2.75E-08		1.34E-09					4.4E-09	3.32E-08
²⁴⁰ U	M	particulate										4.23E-23	4.23E-23
⁴⁸ V	M	particulate										8.86E-11	8.86E-11
⁴⁹ V	M	particulate										1.94E-07	1.94E-07
¹⁷⁶ W	M	particulate										2.32E-06	2.32E-06
¹⁸¹ W	M	particulate										4.61E-05	4.61E-05
¹⁸⁵ W	M	particulate										3.19E-03	3.19E-03
¹⁸⁷ W	M	particulate										2.75E-09	2.75E-09
¹⁸⁸ W	M	particulate										2.12E-04	2.12E-04
¹²⁷ Xe	B	unspecified									9.20E+02	6.33E-08	9.2E+02
^{131m} Xe	B	unspecified							1.57E+02			1.71E-07	1.57E+02
¹³³ Xe	B	unspecified				3.49E-04			8.17E+00				8.17E+00
^{133m} Xe	B	unspecified							2.58E+01				2.58E+01
¹³⁵ Xe	B	unspecified							5.72E+01				5.72E+01

2020 Annual Site Environmental Report for the Oak Ridge Reservation

Table G.1. Radiological airborne emissions from all sources at ORNL, 2020 (Ci)^a (continued)

Isotope	Inhalation form ^b	Chemical form	Stack							Total minor sources	ORNL total	
			X-2026	X-3020	X-3039	X-4501	X-7503	X-7880	X-7911			X-8915
^{135m} Xe	B	unspecified							3.83E+01			3.83E+01
¹³⁷ Xe	B	unspecified							7.50E+01			7.5E+01
¹³⁸ Xe	B	unspecified							1.90E+02			1.9E+02
⁸⁸ Y	M	particulate									1.28E-07	1.28E-07
⁸⁸ Y	F	particulate							3.38E-07			3.38E-07
^{89m} Y	B	unspecified									1.96E-17	1.96E-17
⁹⁰ Y	M	particulate									4.54E-03	4.54E-03
⁹¹ Y	M	particulate									2.11E-04	2.11E-04
¹⁶⁹ Yb	M	particulate									2.33E-08	2.33E-08
¹⁷⁵ Yb	M	particulate									4.93E-06	4.93E-06
⁶⁵ Zn	M	particulate									3.39E-05	3.39E-05
⁶⁹ Zn	M	particulate									9.87E-07	9.87E-07
^{69m} Zn	M	particulate									9.2E-07	9.2E-07
⁸⁸ Zr	M	particulate									1.24E-09	1.24E-09
⁸⁹ Zr	M	particulate									6.29E-09	6.29E-09
⁹³ Zr	M	particulate									1.24E-09	1.24E-09
⁹⁵ Zr	M	particulate									2.33E-04	2.33E-04
⁹⁷ Zr	M	particulate									3.72E-09	3.72E-09
Totals			3.80E-01	3.68E-01	1.58E+01	1.02E+00	9.73E-01	3.38E-06	3.09E+03	2.25E+04	1.81E+02	2.58E+04

^a Emissions given in curies (Ci). 1 Ci = 3.7E+10 Bq

^b The designation of F, M, and S refers to the lung clearance type—fast (F), moderate (M), and slow (S) for the given radionuclide. G stands for gaseous, V stands for vapor, and B stands for blank, unspecified form.

Acronym:

ORNL = Oak Ridge National Laboratory