

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Actinium (89)	Ac-223	NA	2.20E+00	m	-	-	-	-	-	-	1.55E-08
	Ac-224	NA	2.90E+00	h	S	5.00E-04	5.59E-12	8.03E-12	1.53E-11	4.07E-10	6.06E-07
	Ac-225	014265-85-1	1.00E+01	d	S	5.00E-04	1.890e-10	2.71E-10	5.18E-10	2.86E-08	4.50E-08
	Ac-226	NA	2.90E+01	h	S	5.00E-04	6.92E-11	1.01E-10	2.00E-10	4.33E-09	4.46E-07
	Ac-227	014952-40-0	2.18E+01	y	S	5.00E-04	2.01E-10	2.45E-10	3.81E-10	1.49E-07	3.48E-10
	Ac-227+D	014952-40-0(+D)	2.18E+01	y	S	5.00E-04	4.86E-10	6.53E-10	1.16E-09	2.09E-07	1.47E-06
	Ac-228	014331-83-0	6.13E+00	h	S	5.00E-04	1.99E-12	2.89E-12	5.55E-12	4.92E-11	4.53E-06
Aluminum (13)	Al-26	NA	7.16E+05	y	M	1.00E-02	1.73E-11	2.49E-11	4.70E-11	6.92E-11	1.33E-05
	Al-28	NA	2.24E+00	m	-	-	-	-	-	-	9.32E-06
Americium (95)	Am-237	NA	7.30E+01	m	M	5.00E-04	5.07E-14	7.18E-14	1.24E-13	5.77E-14	1.35E-06
	Am-238	NA	9.80E+01	m	M	5.00E-04	9.62E-14	1.35E-13	2.28E-13	9.51E-14	4.02E-06
	Am-239	NA	1.19E+01	h	M	5.00E-04	1.38E-12	2.01E-12	3.89E-12	8.40E-13	6.91E-07
	Am-240	NA	5.08E+01	h	M	5.00E-04	2.59E-12	3.70E-12	6.81E-12	1.41E-12	4.69E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Am-241	014596-10-2	4.32E+02 y	M	5.00E-04	1.04E-10	1.34E-10	2.17E-10	2.81E-08	2.76E-08
	Am-242	013981-54-9	1.60E+01 h	M	5.00E-04	1.79E-12	2.62E-12	5.14E-12	5.03E-11	3.48E-08
	Am-242m	013981-54-9m	1.52E+02 y	M	5.00E-04	7.07E-11	8.77E-11	1.29E-10	1.56E-08	1.05E-09
	Am-242m+ D	013981-54-9m(+D)	1.52E+02 y	M	5.00E-04	1.04E-10	1.36E-10	2.21E-10	2.81E-08	4.83E-08
	Am-243	014993-75-0	7.38E+03 y	M	5.00E-04	1.03E-10	1.34E-10	2.17E-10	2.70E-08	9.47E-08
	Am-243+D	014993-75-0(+D)	7.38E+03 y	M	5.00E-04	1.08E-10	1.42E-10	2.32E-10	2.70E-08	6.36E-07
	Am-244	NA	1.01E+01 h	M	5.00E-04	2.52E-12	3.66E-12	7.03E-12	3.09E-12	3.58E-06
	Am-244m	NA	2.60E+01 m	M	5.00E-04	5.11E-14	7.10E-14	1.18E-13	1.02E-13	5.09E-09
	Am-245	NA	2.05E+00 h	M	5.00E-04	2.22E-13	3.22E-13	6.11E-13	1.56E-13	1.04E-07
	Am-246	NA	3.90E+01 m	M	5.00E-04	1.23E-13	1.73E-13	2.93E-13	1.31E-13	2.93E-06
	Am-246m	NA	2.50E+01 m	M	5.00E-04	6.59E-14	9.10E-14	1.48E-13	3.96E-14	4.83E-06
Antimony (51)	Sb-115	NA	3.18E+01 m	M	1.00E-01	5.14E-14	7.10E-14	1.16E-13	2.33E-14	3.92E-06
	Sb-116	NA	1.58E+01 m	M	1.00E-01	4.96E-14	6.81E-14	1.07E-13	1.88E-14	1.05E-05

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Sb-116m	NA	6.03E+01	m	M	1.00E-01	1.76E-13	2.45E-13	4.00E-13	8.81E-14	1.47E-05
	Sb-117	NA	2.80E+00	h	M	1.00E-01	6.59E-14	9.44E-14	1.70E-13	4.07E-14	5.78E-07
	Sb-118m	NA	5.00E+00	h	M	1.00E-01	6.99E-13	9.81E-13	1.67E-12	2.64E-13	1.21E-05
	Sb-119	NA	3.81E+01	h	M	1.00E-01	4.77E-13	6.96E-13	1.35E-12	1.74E-13	2.58E-09
	Sb-120a	NA	1.59E+01	m	M	1.00E-01	2.48E-14	3.42E-14	5.44E-14	1.12E-14	1.94E-06
	Sb-120b	NA	5.76E+00	d	M	1.00E-01	4.44E-12	6.22E-12	1.08E-11	3.30E-12	1.15E-05
	Sb-122	014374-79-9	2.70E+00	d	M	1.00E-01	1.06E-11	1.55E-11	3.03E-11	5.48E-12	1.97E-06
	Sb-124	014683-10-4	6.02E+01	d	M	1.00E-01	1.29E-11	1.85E-11	3.50E-11	2.43E-11	8.89E-06
	Sb-124m	NA	9.30E+01	s	M	-	-	-	-	-	1.56E-06
	Sb-124n	NA	2.02E+01	m	M	1.00E-01	1.67E-14	2.32E-14	3.81E-14	1.15E-14	7.76E-12
	Sb-125	014234-35-6	2.77E+00	y	M	1.00E-01	4.37E-12	6.14E-12	1.12E-11	1.66E-11	1.81E-06
	Sb-125+D	014234-35-6(+D)	2.77E+00	y	M	1.00E-01	5.13E-12	7.21E-12	1.32E-11	1.93E-11	1.81E-06
Antimony (51)	Sb-126	015756-32-8	1.24E+01	d	M	1.00E-01	1.11E-11	1.59E-11	2.93E-11	1.15E-11	1.28E-05

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Sb-126m	015756-32-8m	1.90E+01	m	M	1.00E-01	6.66E-14	9.21E-14	1.48E-13	3.16E-14	6.94E-06
	Sb-127	013968-50-8	3.85E+00	d	M	1.00E-01	1.01E-11	1.47E-11	2.85E-11	7.51E-12	3.07E-06
	Sb-128a	NA	1.04E+01	m	M	1.00E-01	5.51E-14	7.55E-14	1.19E-13	2.12E-14	9.03E-06
	Sb-128b	NA	9.01E+00	h	M	1.00E-01	3.45E-12	4.96E-12	9.21E-12	1.44E-12	1.40E-05
	Sb-129	014331-88-5	4.32E+00	h	M	1.00E-01	2.19E-12	3.19E-12	6.11E-12	9.62E-13	6.85E-06
	Sb-130	NA	4.00E+01	m	M	1.00E-01	2.07E-13	2.88E-13	4.77E-13	9.73E-14	1.51E-05
	Sb-131	NA	2.30E+01	m	M	1.00E-01	2.56E-13	3.59E-13	6.48E-13	9.73E-14	9.08E-06
Argon (18)	Ar-37	NA	3.50E+01	d	-	-	-	-	-	-	0
	Ar-39	NA	2.69E+02	y	-	-	-	-	-	-	5.94E-10
	Ar-41	014163-25-8	1.83E+00	h	-	-	-	-	-	-	6.39E-06
Arsenic (33)	As-69	NA	1.52E+01	m	M	5.00E-01	1.05E-13	1.46E-13	2.39E-13	4.29E-14	4.43E-06
	As-70	NA	5.26E+01	m	M	5.00E-01	3.20E-13	4.48E-13	7.40E-13	1.37E-13	1.96E-05
	As-71	NA	6.48E+01	h	M	5.00E-01	2.28E-12	3.29E-12	6.07E-12	1.52E-12	2.37E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	As-72	NA	2.60E+01 h	M	5.00E-01	1.02E-11	1.48E-11	2.79E-11	4.29E-12	8.21E-06
	As-73	NA	8.03E+01 d	M	5.00E-01	1.56E-12	2.28E-12	4.40E-12	3.88E-12	5.78E-09
	As-74	NA	1.78E+01 d	M	5.00E-01	6.70E-12	9.69E-12	1.82E-11	8.44E-12	3.35E-06
	As-76	NA	2.63E+01 h	M	5.00E-01	9.66E-12	1.42E-11	2.70E-11	4.14E-12	2.01E-06
	As-77	NA	3.88E+01 h	M	5.00E-01	2.50E-12	3.67E-12	7.03E-12	1.76E-12	3.58E-08
	As-78	NA	9.07E+01 m	M	5.00E-01	6.33E-13	9.03E-13	1.61E-12	2.69E-13	6.11E-06
Astatine (85)	At-207	NA	1.80E+00 h	M	1.00E+00	6.96E-13	9.51E-13	1.66E-12	7.77E-12	6.11E-06
	At-211	NA	7.21E+00 h	M	1.00E+00	3.37E-11	4.63E-11	8.21E-11	3.58E-10	7.94E-08
	At-215	NA	1.00E-01 ms	-	-	-	-	-	-	8.09E-10
	At-216	NA	3.00E-01 ms	-	-	-	-	-	-	3.08E-09
	At-217	017239-90-6	3.23E-02 s	-	-	-	-	-	-	1.32E-09
	At-218	NA	2.00E+00 s	-	-	-	-	-	-	3.57E-09
Barium (56)	Ba-126	NA	9.65E+01 m	M	2.00E-01	8.51E-13	1.22E-12	2.24E-12	3.49E-13	5.83E-07

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						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Ba-128	NA	2.43E+00 d	M	2.00E-01	1.52E-11	2.23E-11	4.33E-11	7.22E-12	2.10E-07
	Ba-131	014914-75-1	1.18E+01 d	M	2.00E-01	2.00E-12	2.87E-12	5.25E-12	2.91E-12	1.77E-06
	Ba-131m	NA	1.46E+01 m	M	2.00E-01	9.25E-15	1.29E-14	2.11E-14	1.69E-14	1.67E-07
	Ba-133	013981-41-4	1.07E+01 y	M	2.00E-01	6.81E-12	9.44E-12	1.39E-11	1.16E-11	1.44E-06
	Ba-133m	013981-41-4m	3.89E+01 h	M	2.00E-01	3.19E-12	4.66E-12	9.07E-12	2.04E-12	1.96E-07
	Ba-135m	NA	2.87E+01 h	M	2.00E-01	2.56E-12	3.74E-12	7.29E-12	1.61E-12	1.70E-07
	Ba-137m	013981-97-0	2.55E+00 m	-	-	-	-	-	-	2.69E-06
	Ba-139	014378-25-7	8.27E+01 m	M	2.00E-01	3.70E-13	5.33E-13	9.73E-13	1.79E-13	1.65E-07
	Ba-140	014798-08-4	1.27E+01 d	M	2.00E-01	1.49E-11	2.17E-11	4.18E-11	2.03E-11	7.61E-07
	Ba-141	NA	1.83E+01 m	M	2.00E-01	2.14E-13	3.07E-13	5.59E-13	9.69E-14	3.79E-06
	Ba-142	NA	1.06E+01 m	M	2.00E-01	9.29E-14	1.31E-13	2.27E-13	4.55E-14	4.85E-06
Berkelium (97)	Bk-245	NA	4.94E+00 d	M	5.00E-04	3.43E-12	5.00E-12	9.73E-12	7.22E-12	7.09E-07
	Bk-246	NA	1.83E+00 d	M	5.00E-04	2.01E-12	2.88E-12	5.25E-12	9.25E-13	4.25E-06

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Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Bk-247	NA	1.38E+03 y	M	5.00E-04	1.24E-10	1.60E-10	2.49E-10	3.26E-08	3.09E-07
	Bk-249	NA	3.20E+02 d	M	5.00E-04	1.11E-12	1.57E-12	2.95E-12	5.14E-11	2.63E-12
	Bk-250	NA	3.22E+00 h	M	5.00E-04	5.66E-13	8.18E-13	1.54E-12	1.03E-12	4.23E-06
Beryllium (4)	Be-7	013966-02-4	5.33E+01 d	S	5.00E-03	8.66E-14	1.20E-13	2.02E-13	2.13E-13	2.13E-07
	Be-10	NA	1.60E+06 y	S	5.00E-03	7.03E-12	1.02E-11	2.02E-11	9.40E-11	7.43E-10
Bismuth (83)	Bi-200	NA	3.64E+01 m	M	5.00E-02	1.52E-13	2.13E-13	3.65E-13	7.55E-14	1.06E-05
	Bi-201	NA	1.08E+02 m	M	5.00E-02	4.22E-13	6.03E-13	1.09E-12	1.90E-13	6.05E-06
	Bi-202	NA	1.67E+00 h	M	5.00E-02	2.65E-13	3.69E-13	6.18E-13	1.12E-13	1.24E-05
	Bi-203	NA	1.18E+01 h	M	5.00E-02	1.92E-12	2.73E-12	4.85E-12	8.21E-13	1.16E-05
	Bi-205	NA	1.53E+01 d	M	5.00E-02	3.32E-12	4.66E-12	8.18E-12	3.24E-12	8.19E-06
	Bi-206	015776-19-9	6.24E+00 d	M	5.00E-02	7.73E-12	1.10E-11	1.98E-11	5.85E-12	1.52E-05
	Bi-207	013982-38-2	3.80E+01 y	M	5.00E-02	5.66E-12	8.14E-12	1.49E-11	2.10E-11	7.08E-06
	Bi-210	014331-79-4	5.01E+00 d	M	5.00E-02	8.92E-12	1.30E-11	2.55E-11	3.17E-10	2.76E-09

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						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Bi-210m	014331-79-4m	3.00E+06 y	M	5.00E-02	5.51E-11	7.77E-11	1.45E-10	1.17E-08	1.01E-06
	Bi-211	015229-37-5	2.14E+00 m	M	-	-	-	-	-	1.88E-07
	Bi-212	014913-49-6	6.06E+01 m	M	5.00E-02	7.10E-13	9.99E-13	1.78E-12	7.77E-11	8.87E-07
	Bi-213	015776-20-2	4.57E+01 m	M	5.00E-02	5.11E-13	7.18E-13	1.28E-12	6.85E-11	5.65E-07
	Bi-214	014733-03-0	1.99E+01 m	M	5.00E-02	1.92E-13	2.65E-13	4.33E-13	2.90E-11	7.48E-06
Bromine (35)	Br-74	NA	2.53E+01 m	M	1.00E+00	1.50E-13	2.05E-13	3.19E-13	6.44E-14	2.32E-05
	Br-74m	NA	4.15E+01 m	M	1.00E+00	2.46E-13	3.36E-13	5.29E-13	1.15E-13	2.00E-05
	Br-75	NA	9.80E+01 m	M	1.00E+00	1.57E-13	2.13E-13	3.42E-13	1.13E-13	5.21E-06
	Br-76	NA	1.62E+01 h	M	1.00E+00	1.45E-12	1.97E-12	3.34E-12	1.10E-12	1.30E-05
	Br-77	NA	5.60E+01 h	M	1.00E+00	3.01E-13	4.03E-13	6.51E-13	2.06E-13	1.34E-06
	Br-80	NA	1.74E+01 m	M	1.00E+00	4.70E-14	6.48E-14	1.03E-13	1.80E-14	3.55E-07
	Br-80m	NA	4.42E+00 h	M	1.00E+00	2.82E-13	3.89E-13	6.70E-13	2.43E-13	5.95E-09
	Br-82	014686-69-2	3.53E+01 h	M	1.00E+00	1.71E-12	2.30E-12	3.70E-12	1.66E-12	1.24E-05

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
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Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Br-83	NA	2.39E+00 h	M	1.00E+00	8.44E-14	1.16E-13	1.94E-13	1.21E-13	3.46E-08
	Br-84	NA	3.18E+01 m	M	1.00E+00	1.48E-13	2.02E-13	3.21E-13	7.18E-14	9.35E-06
Cadmium (48)	Cd-104	NA	5.77E+01 m	S	5.00E-02	1.72E-13	2.41E-13	4.14E-13	7.66E-14	9.70E-07
	Cd-107	NA	6.49E+00 h	S	5.00E-02	3.50E-13	5.11E-13	9.99E-13	3.10E-13	3.48E-08
	Cd-109	014109-32-1	4.64E+02 d	S	5.00E-02	5.00E-12	6.70E-12	1.14E-11	2.19E-11	8.73E-09
	Cd-113	NA	9.30E+15 y	F	5.00E-02	2.28E-11	2.90E-11	3.85E-11	1.12E-10	7.36E-11
	Cd-113m	NA	1.36E+01 y	F	5.00E-02	2.87E-11	3.64E-11	5.11E-11	1.30E-10	4.45E-10
	Cd-115	014336-68-6	5.35E+01 h	S	5.00E-02	8.66E-12	1.27E-11	2.47E-11	5.14E-12	1.01E-06
	Cd-115m	014336-68-6m	4.46E+01 d	S	5.00E-02	1.70E-11	2.46E-11	4.74E-11	2.92E-11	1.13E-07
	Cd-117	NA	2.49E+00 h	S	5.00E-02	1.37E-12	1.99E-12	3.81E-12	6.51E-13	5.23E-06
	Cd-117m	NA	3.36E+00 h	S	5.00E-02	1.22E-12	1.76E-12	3.26E-12	6.55E-13	1.03E-05
Calcium (20)	Ca-41	NA	1.40E+05 y	M	3.00E-01	3.53E-13	4.37E-13	5.74E-13	2.09E-13	0
	Ca-45	013966-05-7	1.63E+02 d	M	3.00E-01	2.47E-12	3.37E-12	6.07E-12	9.40E-12	3.96E-11

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Ca-47	014391-99-2	4.53E+00 d	M	3.00E-01	7.55E-12	1.08E-11	2.02E-11	7.88E-12	5.24E-06
	Ca-49	NA	8.72E+00 m	M	-	-	-	-	-	1.75E-05
Californium (98)	Cf-244	NA	1.94E+01 m	M	5.00E-04	1.25E-13	1.74E-13	2.93E-13	2.96E-11	6.83E-11
	Cf-246	NA	3.57E+01 h	M	5.00E-04	2.11E-11	3.09E-11	6.11E-11	1.47E-09	9.25E-11
	Cf-248	NA	3.34E+02 d	M	5.00E-04	4.44E-11	6.22E-11	1.18E-10	1.81E-08	4.73E-11
	Cf-249	NA	3.51E+02 y	M	5.00E-04	1.27E-10	1.63E-10	2.54E-10	3.40E-08	1.37E-06
	Cf-250	NA	1.31E+01 y	M	5.00E-04	8.62E-11	1.12E-10	1.85E-10	2.66E-08	4.48E-11
	Cf-251	NA	8.98E+02 y	M	5.00E-04	1.32E-10	1.70E-10	2.67E-10	3.40E-08	3.76E-07
	Cf-252	013981-17-4	2.64E+00 y	-	-	-	-	-	-	8.66E-11
	Cf-253	NA	1.78E+01 d	M	5.00E-04	4.26E-12	6.11E-12	1.20E-11	4.22E-09	4.86E-11
	Cf-254	NA	6.05E+01 d	M	-	-	-	-	-	1.46E-13
Carbon (6)	C-11 ^h	014333-33-6	2.04E+01 m	M	1.00E+00	4.07E-14	5.59E-14	8.70E-14	2.78E-14	4.45E-06
				G	1.00E+00	-	-	-	8.25E-15	-

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Cs-127	NA	6.25E+00 h	F	1.00E+00	6.51E-14	8.73E-14	1.38E-13	2.47E-14	1.68E-06
	Cs-128	NA	3.90E+00 m	F	-	-	-	-	-	3.92E-06
	Cs-129	NA	3.21E+01 h	F	1.00E+00	1.85E-13	2.48E-13	4.00E-13	7.44E-14	1.05E-06
	Cs-130	NA	2.99E+01 m	F	1.00E+00	4.74E-14	6.48E-14	1.02E-13	1.24E-14	2.22E-06
	Cs-131	014914-76-2	9.69E+00 d	F	1.00E+00	1.86E-13	2.49E-13	4.11E-13	7.51E-14	4.90E-09
	Cs-132	NA	6.48E+00 d	F	1.00E+00	1.46E-12	1.91E-12	2.89E-12	5.92E-13	3.11E-06
	Cs-134	013967-70-9	2.06E+00 y	F	1.00E+00	4.22E-11	5.14E-11	5.81E-11	1.65E-11	7.10E-06
	Cs-134m	013967-70-9m	2.90E+00 h	F	1.00E+00	4.14E-14	5.55E-14	8.84E-14	1.99E-14	5.02E-08
	Cs-135	015726-30-4	2.30E+06 y	F	1.00E+00	4.74E-12	5.88E-12	7.18E-12	1.86E-12	2.36E-11
	Cs-135m	015726-30-4m	5.30E+01 m	F	1.00E+00	4.51E-14	6.07E-14	9.10E-14	1.32E-14	7.37E-06
	Cs-136	014234-29-8	1.31E+01 d	F	1.00E+00	8.66E-12	1.12E-11	1.65E-11	3.49E-12	1.00E-05
Cesium (55)	Cs-137	010045-97-3	3.00E+01 y	F	1.00E+00	3.04E-11	3.74E-11	4.33E-11	1.19E-11	5.32E-10
	Cs-137+D	010045-97-3(+D)	3.00E+01 y	F	1.00E+00	3.04E-11	3.74E-11	4.33E-11	1.19E-11	2.55E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Cs-138	015758-29-9	3.22E+01	m	F	1.00E+00	1.58E-13	2.16E-13	3.40E-13	4.00E-14	1.19E-05
Chlorine (17)	Cl-36	013981-43-6	3.01E+05	y	M	1.00E+00	3.30E-12	4.44E-12	7.66E-12	2.50E-11	1.74E-09
	Cl-38	014158-34-0	3.72E+01	m	M	1.00E+00	1.93E-13	2.64E-13	4.22E-13	9.40E-14	7.93E-06
	Cl-39	NA	5.56E+01	m	M	1.00E+00	1.52E-13	2.08E-13	3.31E-13	9.36E-14	7.09E-06
Chromium (24)	Cr-48	NA	2.30E+01	h	S	1.00E-01	7.44E-13	1.05E-12	1.84E-12	7.51E-13	1.62E-06
	Cr-49	NA	4.21E+01	m	S	1.00E-01	1.35E-13	1.89E-13	3.20E-13	7.36E-14	4.43E-06
	Cr-51	014392-02-0	2.77E+01	d	S	1.00E-01	1.85E-13	2.66E-13	4.96E-13	1.67E-13	1.27E-07
Cobalt (27)	Co-55	NA	1.75E+01	h	M	1.00E-01	4.63E-12	6.70E-12	1.23E-11	2.07E-12	9.21E-06
	Co-56	NA	7.88E+01	d	M	1.00E-01	1.01E-11	1.43E-11	2.56E-11	1.85E-11	1.80E-05
	Co-57	013981-50-5	2.71E+02	d	M	1.00E-01	1.04E-12	1.49E-12	2.78E-12	2.09E-12	3.55E-07
	Co-58	013981-38-9	7.08E+01	d	M	1.00E-01	2.95E-12	4.18E-12	7.44E-12	5.99E-12	4.48E-06
	Co-58m	013981-38-9m	9.15E+00	h	M	1.00E-01	1.26E-13	1.83E-13	3.47E-13	6.88E-14	1.00E-12
	Co-60	010198-40-0	5.27E+00	y	M	1.00E-01	1.57E-11	2.23E-11	4.03E-11	3.58E-11	1.24E-05

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Copper (29)	Co-60m	010198-40-0m	1.05E+01 m	M	1.00E-01	2.66E-15	3.66E-15	5.88E-15	3.96E-15	1.86E-08
	Co-61	NA	1.65E+00 h	M	1.00E-01	2.43E-13	3.49E-13	6.40E-13	1.43E-13	2.48E-07
	Co-62m	NA	1.39E+01 m	M	1.00E-01	8.25E-14	1.13E-13	1.79E-13	3.17E-14	1.35E-05
	Cu-60	NA	2.32E+01 m	S	5.00E-01	1.37E-13	1.89E-13	3.00E-13	5.77E-14	1.93E-05
	Cu-61	NA	3.41E+00 h	S	5.00E-01	4.63E-13	6.70E-13	1.20E-12	2.41E-13	3.63E-06
	Cu-62	NA	9.74E+00 m	-	-	-	-	-	-	4.43E-06
	Cu-64	013981-25-4	1.27E+01 h	S	5.00E-01	6.40E-13	9.32E-13	1.72E-12	4.33E-13	8.30E-07
	Cu-66	NA	5.10E+00 m	-	-	-	-	-	-	4.32E-07
Curium (96)	Cu-67	NA	6.19E+01 h	S	5.00E-01	1.94E-12	2.83E-12	5.29E-12	2.35E-12	3.83E-07
	Cm-238	NA	2.40E+00 h	M	5.00E-04	3.28E-13	4.70E-13	8.70E-13	1.35E-11	1.90E-07
	Cm-240	NA	2.70E+01 d	M	5.00E-04	3.49E-11	5.07E-11	9.88E-11	9.51E-09	6.19E-11
	Cm-241	NA	3.28E+01 d	M	5.00E-04	4.85E-12	7.03E-12	1.35E-11	1.01E-10	1.94E-06
	Cm-242	015510-73-3	1.63E+02 d	M	5.00E-04	3.85E-11	5.48E-11	1.05E-10	1.51E-08	7.73E-11

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	y	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Cm-243	015757-87-6	2.85E+01	y	M	5.00E-04	9.47E-11	1.23E-10	2.05E-10	2.69E-08	4.19E-07
	Cm-244	013981-15-2	1.81E+01	y	M	5.00E-04	8.36E-11	1.08E-10	1.81E-10	2.53E-08	4.85E-11
	Cm-245	015621-76-8	8.50E+03	y	M	5.00E-04	1.04E-10	1.35E-10	2.18E-10	2.77E-08	2.38E-07
	Cm-246	015757-90-1	4.73E+03	y	M	5.00E-04	1.02E-10	1.31E-10	2.12E-10	2.77E-08	4.57E-11
	Cm-247	015758-32-4	1.56E+07	y	M	5.00E-04	9.95E-11	1.30E-10	2.11E-10	2.50E-08	1.31E-06
	Cm-248	015758-33-5	3.39E+05	y	-	-	-	-	-	-	3.42E-11
	Cm-249	NA	6.42E+01	m	M	5.00E-04	8.40E-14	1.20E-13	2.18E-13	7.25E-14	8.51E-08
Dysprosium (66)	Dy-155	NA	1.00E+01	h	M	5.00E-04	5.25E-13	7.47E-13	1.35E-12	2.45E-13	2.44E-06
	Dy-157	NA	8.10E+00	h	M	5.00E-04	2.26E-13	3.20E-13	5.62E-13	8.33E-14	1.32E-06
	Dy-159	NA	1.44E+02	d	M	5.00E-04	5.29E-13	7.70E-13	1.47E-12	1.28E-12	3.19E-08
	Dy-165	013967-64-1	2.33E+00	h	M	5.00E-04	4.14E-13	6.03E-13	1.15E-12	2.10E-13	9.49E-08
Dysprosium (66)	Dy-166	015840-01-4	8.16E+01	h	M	5.00E-04	1.11E-11	1.63E-11	3.22E-11	8.36E-12	6.02E-08
Einsteinium (99)	Es-250	NA	2.10E+00	h	M	5.00E-04	5.96E-14	8.36E-14	1.44E-13	5.07E-13	1.69E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e		ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Es-251	NA	3.30E+01	h	M	5.00E-04	1.02E-12	1.49E-12	2.89E-12	6.40E-12	2.55E-07
	Es-253	NA	2.05E+01	d	M	5.00E-04	3.49E-11	5.11E-11	1.01E-10	8.84E-09	1.25E-09
	Es-254	NA	2.76E+02	d	M	5.00E-04	5.51E-11	7.81E-11	1.50E-10	1.85E-08	8.55E-09
	Es-254m	NA	3.93E+01	h	M	5.00E-04	2.73E-11	4.00E-11	7.88E-11	1.53E-09	2.10E-06
Erbium (68)	Er-161	NA	3.24E+00	h	M	5.00E-04	3.15E-13	4.51E-13	8.10E-13	1.34E-13	4.09E-06
	Er-165	NA	1.04E+01	h	M	5.00E-04	8.95E-14	1.30E-13	2.42E-13	3.13E-14	3.05E-08
	Er-169	015840-13-8	9.30E+00	d	M	5.00E-04	2.53E-12	3.70E-12	7.36E-12	3.85E-12	9.10E-11
	Er-171	014391-45-8	7.52E+00	h	M	5.00E-04	2.02E-12	2.96E-12	5.74E-12	9.40E-13	1.42E-06
	Er-172	NA	4.93E+01	h	M	5.00E-04	5.99E-12	8.77E-12	1.70E-11	4.74E-12	2.20E-06
Europium (63)	Eu-145	NA	5.94E+00	d	M	5.00E-04	2.73E-12	3.85E-12	6.77E-12	1.81E-12	6.95E-06
	Eu-146	NA	4.61E+00	d	M	5.00E-04	4.55E-12	6.40E-12	1.12E-11	2.59E-12	1.16E-05
	Eu-147	NA	2.40E+01	d	M	5.00E-04	2.02E-12	2.90E-12	5.37E-12	3.85E-12	2.04E-06
	Eu-148	NA	5.45E+01	d	M	5.00E-04	4.29E-12	6.03E-12	1.04E-11	9.92E-12	9.84E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e		ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Eu-149	NA	9.31E+01	d	M	5.00E-04	5.14E-13	7.40E-13	1.40E-12	1.07E-12	1.42E-07
	Eu-150a	NA	1.26E+01	h	M	5.00E-04	2.38E-12	3.50E-12	6.88E-12	1.03E-12	1.95E-07
	Eu-150b	NA	3.42E+01	y	M	5.00E-04	4.33E-12	6.07E-12	1.08E-11	1.12E-10	6.49E-06
	Eu-152	014683-23-9	1.33E+01	y	M	5.00E-04	6.07E-12	8.70E-12	1.62E-11	9.10E-11	5.30E-06
	Eu-152m	014683-23-9m	9.32E+00	h	M	5.00E-04	2.98E-12	4.37E-12	8.51E-12	1.12E-12	1.33E-06
	Eu-154	015585-10-1	8.80E+00	y	M	5.00E-04	1.03E-11	1.49E-11	2.85E-11	1.15E-10	5.83E-06
	Eu-155	014391-16-3	4.96E+00	y	M	5.00E-04	1.90E-12	2.77E-12	5.40E-12	1.48E-11	1.24E-07
	Eu-156	014280-35-4	1.52E+01	d	M	5.00E-04	1.27E-11	1.84E-11	3.56E-11	1.37E-11	6.62E-06
	Eu-157	NA	1.52E+01	h	M	5.00E-04	3.70E-12	5.40E-12	1.06E-11	1.57E-12	9.60E-07
	Eu-158	NA	4.59E+01	m	M	5.00E-04	2.14E-13	3.01E-13	5.22E-13	1.10E-13	5.06E-06
Fermium (100)	Fm-252	NA	2.27E+01	h	M	5.00E-04	1.69E-11	2.48E-11	4.92E-11	1.03E-09	5.09E-11
	Fm-253	NA	3.00E+00	d	M	5.00E-04	5.14E-12	7.51E-12	1.48E-11	1.28E-09	2.24E-07
	Fm-254	NA	3.24E+00	h	M	5.00E-04	2.15E-12	3.13E-12	6.07E-12	1.98E-10	1.23E-10

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Fm-255	NA	2.01E+01	h	M	5.00E-04	1.65E-11	2.42E-11	4.77E-11	8.84E-10	3.85E-09
	Fm-257	NA	1.01E+02	d	M	5.00E-04	4.40E-11	6.29E-11	1.23E-10	2.04E-08	3.06E-07
Fluorine (9)	F-18	013981-56-1	1.10E+02	m	M	1.00E+00	9.73E-14	1.30E-13	2.00E-13	1.21E-13	4.45E-06
Francium (87)	Fr-219	NA	2.10E+01	ms	-	-	-	-	-	-	1.44E-08
	Fr-220	NA	2.74E+01	s	-	-	-	-	-	-	3.25E-08
	Fr-221	015756-41-9	4.80E+00	m	-	-	-	-	-	-	1.11E-07
Francium (87)	Fr-222	NA	1.44E+01	m	F	1.00E+00	1.48E-12	2.02E-12	3.43E-12	2.42E-11	1.14E-08
	Fr-223	015756-98-6	2.18E+01	m	F	1.00E+00	7.29E-12	1.00E-11	1.78E-11	3.06E-12	1.40E-07
Gadolinium (64)	Gd-145	NA	2.29E+01	m	M	5.00E-04	8.92E-14	1.23E-13	1.99E-13	3.63E-14	1.13E-05
	Gd-146	NA	4.83E+01	d	M	5.00E-04	5.03E-12	7.29E-12	1.39E-11	2.27E-11	5.56E-07
	Gd-147	NA	3.81E+01	h	M	5.00E-04	2.46E-12	3.50E-12	6.33E-12	1.34E-12	5.87E-06
Gadolinium (64)	Gd-148	NA	9.30E+01	y	F	5.00E-04	4.22E-11	5.51E-11	9.07E-11	1.26E-08	0
	Gd-149	NA	9.40E+00	d	M	5.00E-04	2.23E-12	3.22E-12	6.03E-12	2.76E-12	1.59E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e		ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Gd-151	NA	1.20E+02	d	M	5.00E-04	1.14E-12	1.65E-12	3.20E-12	2.92E-12	1.20E-07
	Gd-152	NA	1.08E+14	y	F	5.00E-04	2.97E-11	3.85E-11	6.29E-11	9.10E-09	0
	Gd-153	014276-65-4	2.42E+02	d	M	5.00E-04	1.52E-12	2.22E-12	4.26E-12	6.55E-12	1.62E-07
	Gd-159	014041-42-0	1.86E+01	h	M	5.00E-04	3.19E-12	4.66E-12	9.21E-12	1.46E-12	1.74E-07
Gallium (31)	Ga-65	NA	1.52E+01	m	M	1.00E-03	6.33E-14	8.73E-14	1.39E-13	2.84E-14	5.04E-06
	Ga-66	NA	9.40E+00	h	M	1.00E-03	6.40E-12	9.32E-12	1.80E-11	2.18E-12	1.26E-05
	Ga-67	014119-09-6	7.83E+01	h	M	1.00E-03	1.04E-12	1.51E-12	2.89E-12	9.55E-13	5.36E-07
	Ga-68	NA	6.80E+01	m	M	1.00E-03	2.83E-13	4.03E-13	7.18E-13	1.28E-13	4.17E-06
	Ga-70	NA	2.12E+01	m	M	1.00E-03	5.22E-14	7.22E-14	1.19E-13	2.92E-14	4.39E-08
	Ga-72	013982-22-4	1.41E+01	h	M	1.00E-03	5.59E-12	8.07E-12	1.53E-11	2.17E-12	1.37E-05
	Ga-73	NA	4.91E+00	h	M	1.00E-03	1.39E-12	2.03E-12	3.92E-12	6.14E-13	1.25E-06
Germanium (32)	Ge-66	NA	2.27E+00	h	M	1.00E+00	3.70E-13	4.88E-13	7.99E-13	2.50E-13	2.86E-06
	Ge-67	NA	1.87E+01	m	M	1.00E+00	1.06E-13	1.45E-13	2.28E-13	4.59E-14	6.24E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Ge-68	NA	2.88E+02 d	M	1.00E+00	6.96E-12	9.88E-12	1.85E-11	4.88E-11	4.69E-13
	Ge-69	NA	3.91E+01 h	M	1.00E+00	9.84E-13	1.35E-12	2.35E-12	8.81E-13	4.02E-06
	Ge-71	014374-81-3	1.18E+01 d	M	1.00E+00	6.48E-14	9.18E-14	1.73E-13	5.18E-14	4.74E-13
	Ge-75	NA	8.28E+01 m	M	1.00E+00	8.66E-14	1.17E-13	1.85E-13	8.44E-14	1.38E-07
	Ge-77	NA	1.13E+01 h	M	1.00E+00	1.22E-12	1.65E-12	2.81E-12	1.15E-12	4.82E-06
	Ge-78	NA	8.70E+01 m	M	1.00E+00	3.09E-13	4.03E-13	6.22E-13	2.48E-13	1.10E-06
Gold (79)	Au-193	NA	1.77E+01 h	S	1.00E-01	7.36E-13	1.07E-12	2.05E-12	4.55E-13	4.30E-07
	Au-194	NA	3.95E+01 h	S	1.00E-01	1.66E-12	2.36E-12	4.22E-12	7.92E-13	4.93E-06
	Au-195	NA	1.83E+02 d	S	1.00E-01	1.50E-12	2.19E-12	4.22E-12	6.48E-12	1.38E-07
	Au-195m	NA	3.05E+01 s	-	-	-	-	-	-	7.37E-07
	Au-198	010043-49-0	2.70E+00 d	S	1.00E-01	6.29E-12	9.18E-12	1.78E-11	4.00E-12	1.70E-06
	Au-198m	010043-49-0m	2.30E+00 d	S	1.00E-01	7.44E-12	1.08E-11	2.09E-11	7.77E-12	1.89E-06
	Au-199	NA	3.14E+00 d	S	1.00E-01	2.78E-12	4.07E-12	7.92E-12	3.12E-12	2.79E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Au-200	NA	4.84E+01	m	S	1.00E-01	1.55E-13	2.20E-13	3.85E-13	8.55E-14	1.30E-06
	Au-200m	NA	1.87E+01	h	S	1.00E-01	5.44E-12	7.88E-12	1.48E-11	2.81E-12	9.04E-06
	Au-201	NA	2.64E+01	m	S	1.00E-01	4.33E-14	6.03E-14	1.01E-13	3.30E-14	2.29E-07
Hafnium (72)	Hf-170	NA	1.60E+01	h	M	2.00E-03	2.19E-12	3.14E-12	5.81E-12	1.20E-12	2.04E-06
	Hf-172	NA	1.87E+00	y	F	2.00E-03	4.96E-12	7.14E-12	1.37E-11	6.92E-11	1.62E-07
	Hf-173	NA	2.40E+01	h	M	2.00E-03	1.06E-12	1.52E-12	2.85E-12	5.92E-13	1.34E-06
	Hf-175	NA	7.00E+01	d	M	2.00E-03	1.96E-12	2.83E-12	5.29E-12	4.29E-12	1.35E-06
	Hf-177m	NA	5.14E+01	m	M	2.00E-03	2.01E-13	2.81E-13	4.74E-13	1.81E-13	8.58E-06
	Hf-178m	NA	3.10E+01	y	F	2.00E-03	1.51E-11	2.13E-11	3.89E-11	3.70E-10	9.57E-06
	Hf-179m	NA	2.51E+01	d	M	2.00E-03	6.55E-12	9.51E-12	1.81E-11	1.38E-11	3.42E-06
	Hf-180m	NA	5.50E+00	h	M	2.00E-03	7.18E-13	1.03E-12	1.89E-12	4.14E-13	3.93E-06
Hafnium (72)	Hf-181	NA	4.24E+01	d	M	2.00E-03	6.36E-12	9.25E-12	1.79E-11	1.76E-11	2.24E-06
	Hf-182	NA	9.00E+06	y	F	2.00E-03	5.37E-12	7.25E-12	1.27E-11	3.41E-10	9.10E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Hf-182m	NA	6.15E+01	m	M	2.00E-03	1.11E-13	1.57E-13	2.70E-13	1.04E-13	3.83E-06
	Hf-183	NA	6.40E+01	m	M	2.00E-03	2.39E-13	3.42E-13	6.25E-13	1.65E-13	3.30E-06
	Hf-184	NA	4.12E+00	h	M	2.00E-03	2.91E-12	4.26E-12	8.18E-12	1.38E-12	8.64E-07
Holmium (67)	Ho-155	NA	4.80E+01	m	M	5.00E-04	1.05E-13	1.49E-13	2.63E-13	5.29E-14	1.52E-06
	Ho-157	NA	1.26E+01	m	M	5.00E-04	1.54E-14	2.13E-14	3.49E-14	7.36E-15	1.84E-06
	Ho-159	NA	3.30E+01	m	M	5.00E-04	1.78E-14	2.46E-14	3.96E-14	1.22E-14	1.16E-06
	Ho-161	NA	2.50E+00	h	M	5.00E-04	4.96E-14	7.14E-14	1.33E-13	1.98E-14	5.52E-08
	Ho-162	NA	1.50E+01	m	M	5.00E-04	5.96E-15	8.18E-15	1.29E-14	5.40E-15	6.02E-07
	Ho-162m	NA	6.80E+01	m	M	5.00E-04	7.47E-14	1.05E-13	1.81E-13	5.18E-14	2.46E-06
	Ho-164	NA	2.90E+01	m	M	5.00E-04	1.75E-14	2.45E-14	4.11E-14	1.65E-14	2.78E-08
	Ho-164m	NA	3.75E+01	m	M	5.00E-04	4.14E-14	5.88E-14	1.05E-13	3.48E-14	3.63E-08
	Ho-166	013967-65-2	2.68E+01	h	M	5.00E-04	9.21E-12	1.35E-11	2.67E-11	3.85E-12	1.18E-07
	Ho-166m	NA	1.20E+03	y	M	5.00E-04	8.03E-12	1.14E-11	2.10E-11	3.09E-10	7.69E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Ho-167	NA	3.10E+00	h	M	5.00E-04	3.64E-13	5.25E-13	9.95E-13	2.25E-13	1.45E-06
Hydrogen (1)	H-3 ⁱ	010028-17-8	1.24E+01	y	V	1.00E+00	5.07E-14	6.51E-14	9.25E-14	5.6200e-14	0
					M	1.00E+00	1.1200e-13	1.44000e-13	2.20000e-13	1.9900e-13	-
Indium (49)	In-109	NA	4.20E+00	h	M	2.00E-02	2.46E-13	3.50E-13	6.25E-13	1.11E-13	2.90E-06
	In-110a	NA	6.91E+01	m	M	2.00E-02	2.81E-13	4.00E-13	7.03E-13	1.17E-13	7.13E-06
	In-110b	NA	4.90E+00	h	M	2.00E-02	7.59E-13	1.05E-12	1.77E-12	2.65E-13	1.41E-05
	In-111	NA	2.83E+00	d	M	2.00E-02	1.29E-12	1.85E-12	3.40E-12	8.03E-13	1.42E-06
	In-112	NA	1.44E+01	m	M	2.00E-02	1.68E-14	2.32E-14	3.70E-14	1.10E-14	1.15E-06
	In-113m	014885-78-0	1.66E+00	h	M	2.00E-02	9.47E-14	1.35E-13	2.47E-13	5.18E-14	1.05E-06
	In-114	013981-55-0	7.19E+01	s	-	-	-	-	-	-	1.35e-08
	In-114m	013981-55-0m	4.95E+01	d	M	2.00E-02	2.48E-11	3.60E-11	7.03E-11	3.00E-11	3.57E-07
	In-115	014191-71-0	5.10E+15	y	F	2.00E-02	3.38E-11	4.33E-11	5.85E-11	4.03E-10	2.70E-10
	In-115m	014191-71-0m	4.49E+00	h	M	2.00E-02	4.40E-13	6.40E-13	1.24E-12	2.15E-13	6.27E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Iodine (53)	In-116m	NA	5.42E+01	m	M	2.00E-02	1.62E-13	2.26E-13	3.77E-13	8.77E-14	1.23E-05
	In-117	NA	4.38E+01	m	M	2.00E-02	7.03E-14	9.84E-14	1.67E-13	5.59E-14	2.90E-06
	In-117m	NA	1.17E+02	m	M	2.00E-02	4.44E-13	6.44E-13	1.22E-12	2.33E-13	3.35E-07
	In-119	NA	2.40E+00	m	-	-	-	-	-	-	3.54E-06
	In-119m	NA	1.80E+01	m	M	2.00E-02	7.55E-14	1.04E-13	1.70E-13	3.34E-14	5.63E-08
	I-120 ^j	NA	8.10E+01	m	F	1.00E+00	9.03E-13	2.46E-12	2.33E-12	3.89E-13	1.33E-05
					V	1.00E+00	-	-	-	1.11E-12	-
	I-120m ^j	NA	5.30E+01	m	F	1.00E+00	5.03E-13	1.30E-12	1.20E-12	1.98E-13	2.55E-05
					V	1.00E+00	-	-	-	6.18E-13	-
	I-121 ^j	NA	2.12E+00	h	F	1.00E+00	2.27E-13	6.03E-13	5.59E-13	9.81E-14	1.63E-06
				V	1.00E+00	-	-	-	2.98E-13	-	
Iodine (53)	I-122	018287-75-7	3.62E+00	m	-	-	-	-	-	-	4.17E-06
	I-123 ^j	015715-08-9	1.32E+01	h	F	1.00E+00	6.96E-13	2.05E-12	1.96E-12	3.03E-13	5.10E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
				V	1.00E+00	-	-	-	8.21E-13	-
	I-124 ^j	NA	4.18E+00 d	F	1.00E+00	4.14E-11	1.22E-10	1.16E-10	1.76E-11	5.10E-06
				V	1.00E+00	-	-	-	4.55E-11	-
	I-125 ^j	014158-31-7	6.01E+01 d	F	1.00E+00	2.54E-11	6.29E-11	5.55E-11	1.06E-11	7.24E-09
				V	1.00E+00	-	-	-	2.77E-11	-
	I-126 ^j	014158-32-8	1.30E+01 d	F	1.00E+00	8.73E-11	2.48E-10	2.31E-10	3.70E-11	1.96E-06
				V	1.00E+00	-	-	-	9.58E-11	-
	I-128 ^j	NA	2.50E+01 m	F	1.00E+00	8.14E-14	2.06E-13	1.89E-13	3.04E-14	3.74E-07
				V	1.00E+00	-	-	-	2.11E-13	-
	I-129 ^j	015046-84-1	1.57E+07 y	F	1.00E+00	1.48E-10	3.22E-10	2.71E-10	6.07E-11	6.10E-09
				V	1.00E+00	-	-	-	1.60E-10	-
	I-130 ^j	014914-02-4	1.24E+01 h	F	1.00E+00	6.36E-12	1.88E-11	1.80E-11	2.76E-12	9.67E-06
				V	1.00E+00	-	-	-	7.29E-12	-

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	I-131 ^j	010043-66-0	8.04E+00	d	F	1.00E+00	4.55E-11	1.34E-10	1.26E-10	1.95E-11	1.59E-06
					V	1.00E+00	-	-	-	5.03E-11	-
	I-132 ^j	014683-16-0	2.30E+00	h	F	1.00E+00	8.44E-13	2.34E-12	2.22E-12	3.74E-13	1.06E-05
					V	1.00E+00	-	-	-	1.15E-12	-
	I-132m ^j	014683-16-0m	8.36E+01	m	F	1.00E+00	6.11E-13	1.78E-12	1.70E-12	2.70E-13	1.40E-06
					V	1.00E+00	-	-	-	8.77E-13	-
	I-133 ^j	014834-67-4	2.08E+01	h	F	1.00E+00	1.44E-11	4.40E-11	4.26E-11	6.25E-12	2.72E-06
					V	1.00E+00	-	-	-	1.62E-11	-
	I-134 ^j	014914-27-3	5.26E+01	m	F	1.00E+00	2.50E-13	6.44E-13	5.96E-13	1.02E-13	1.24E-05
					V	1.00E+00	-	-	-	4.40E-13	-
	I-135 ^j	014834-68-5	6.61E+00	h	F	1.00E+00	3.05E-12	8.99E-12	8.62E-12	1.34E-12	7.83E-06
					V	1.00E+00	-	-	-	3.65E-12	-
Iridium (77)	Ir-182	NA	1.50E+01	m	S	1.00E-02	9.95E-14	1.39E-13	2.33E-13	5.03E-14	5.85E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e		ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Ir-184	NA	3.02E+00	h	S	1.00E-02	6.44E-13	9.21E-13	1.67E-12	3.30E-13	8.66E-06
	Ir-185	NA	1.40E+01	h	S	1.00E-02	1.32E-12	1.91E-12	3.61E-12	7.25E-13	2.69E-06
	Ir-186a	NA	1.58E+01	h	S	1.00E-02	2.08E-12	2.98E-12	5.44E-12	1.06E-12	7.40E-06
	Ir-186b	NA	1.75E+00	h	S	1.00E-02	2.00E-13	2.84E-13	5.07E-13	1.11E-13	4.22E-06
	Ir-187	NA	1.05E+01	h	S	1.00E-02	5.77E-13	8.33E-13	1.57E-12	2.87E-13	1.42E-06
	Ir-188	NA	4.15E+01	h	S	1.00E-02	2.52E-12	3.58E-12	6.40E-12	1.38E-12	7.68E-06
	Ir-189	NA	1.33E+01	d	S	1.00E-02	1.51E-12	2.21E-12	4.29E-12	2.33E-12	1.69E-07
	Ir-190	014981-91-0	1.21E+01	d	S	1.00E-02	5.66E-12	8.10E-12	1.50E-11	8.81E-12	5.99E-06
	Ir-190m	014981-91-0m	1.20E+00	h	S	1.00E-02	3.17E-14	4.55E-14	8.44E-14	3.89E-14	8.69E-13
	Ir-190n	NA	3.10E+00	h	S	1.00E-02	4.26E-13	6.03E-13	1.07E-12	2.14E-13	6.48E-06
	Ir-191m	NA	4.94E+00	s	-	-	-	-	-	-	1.58E-07
Iridium (77)	Ir-192	NA	7.40E+01	d	S	1.00E-02	7.36E-12	1.07E-11	2.04E-11	2.41E-11	3.40E-06
	Ir-192m	NA	2.41E+02	y	S	1.00E-02	9.81E-13	1.32E-12	2.16E-12	1.02E-10	5.39E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	s	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Kr-81m	NA	1.30E+01	s	-	-	-	-	-	-	4.60E-07
	Kr-83m	013965-98-5	1.83E+00	h	-	-	-	-	-	-	1.34E-11
	Kr-85	013983-27-2	1.07E+01	y	-	-	-	-	-	-	1.05E-08
	Kr-85m	013983-27-2m	4.48E+00	h	-	-	-	-	-	-	5.46E-07
	Kr-87	014809-68-8	7.63E+01	m	-	-	-	-	-	-	4.00E-06
	Kr-88	014995-61-0	2.84E+00	h	-	-	-	-	-	-	1.02E-05
Lanthanum (57)	La-131	NA	5.90E+01	m	M	5.00E-04	9.32E-14	1.31E-13	2.28E-13	5.48E-14	2.76E-06
	La-132	NA	4.80E+00	h	M	5.00E-04	1.78E-12	2.58E-12	4.85E-12	6.25E-13	9.52E-06
	La-134	NA	6.67E+00	m	-	-	-	-	-	-	3.05E-06
	La-135	NA	1.95E+01	h	M	5.00E-04	1.46E-13	2.11E-13	3.96E-13	5.03E-14	5.21E-08
	La-137	NA	6.00E+04	y	F	5.00E-04	3.48E-13	5.00E-13	9.44E-13	1.39E-11	6.75E-09
	La-138	NA	1.35E+11	y	F	5.00E-04	3.53E-12	4.96E-12	8.81E-12	3.05E-10	6.07E-06
	La-140	013981-28-7	4.03E+01	h	M	5.00E-04	1.10E-11	1.59E-11	3.05E-11	4.77E-12	1.15E-05

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	La-141	NA	3.93E+00	h	M	5.00E-04	1.88E-12	2.74E-12	5.37E-12	7.44E-13	2.37E-07
	La-142	NA	9.25E+01	m	M	5.00E-04	5.77E-13	8.21E-13	1.48E-12	2.42E-13	1.44E-05
	La-143	NA	1.42E+01	m	M	5.00E-04	1.26E-13	1.78E-13	3.14E-13	5.66E-14	5.11E-07
Lead (82)	Pb-195m	NA	1.58E+01	m	M	2.00E-01	5.48E-14	7.55E-14	1.20E-13	4.37E-14	6.90E-06
	Pb-198	NA	2.40E+00	h	M	2.00E-01	2.60E-13	3.63E-13	6.18E-13	1.43E-13	1.62E-06
	Pb-199	NA	9.00E+01	m	M	2.00E-01	1.42E-13	1.97E-13	3.28E-13	7.44E-14	6.87E-06
	Pb-200	NA	2.15E+01	h	M	2.00E-01	1.58E-12	2.24E-12	4.03E-12	1.16E-12	5.97E-07
	Pb-201	NA	9.40E+00	h	M	2.00E-01	5.92E-13	8.36E-13	1.47E-12	3.50E-13	3.18E-06
	Pb-202	NA	3.00E+05	y	M	2.00E-01	2.22E-11	2.93E-11	3.74E-11	1.43E-11	3.09E-12
	Pb-202m	NA	3.62E+00	h	M	2.00E-01	4.18E-13	5.85E-13	9.84E-13	2.25E-13	9.32E-06
	Pb-203	014687-25-3	5.21E+01	h	M	2.00E-01	1.02E-12	1.46E-12	2.65E-12	7.55E-13	1.09E-06
Lead (82)	Pb-205	NA	1.43E+07	y	M	2.00E-01	6.33e-13	8.25e-13	1.26e-12	6.44e-13	3.50e-12
	Pb-209	014119-30-3	3.25E+00	h	M	2.00E-01	2.41e-13	3.49e-13	6.55e-13	1.90e-13	5.37e-10

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	y	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Pb-210	014255-04-0	2.23E+01	y	M	2.00E-01	8.81e-10	1.18e-09	1.84e-09	2.77e-09	1.41e-09
	Pb-210+D	014255-04-0(+D)	2.23E+01	y	M	2.00E-01	1.27e-09	3.44e-09	2.66e-09	1.39e-08	4.21e-09
	Pb-211	015816-77-0	3.61E+01	m	M	2.00E-01	4.11e-13	5.81e-13	1.04e-12	3.70e-11	2.29e-07
	Pb-212	015092-94-1	1.06E+01	h	M	2.00E-01	2.50e-11	3.54e-11	6.70e-11	5.77e-10	5.09e-07
	Pb-214	015067-28-4	2.68E+01	m	M	2.00E-01	3.44e-13	4.85e-13	8.51e-13	3.63e-11	9.82e-07
Lutetium (71)	Lu-169	NA	3.41E+01	h	S	5.00E-04	1.94e-12	2.77e-12	5.03e-12	1.33e-12	4.73e-06
	Lu-170	NA	2.00E+00	d	S	5.00E-04	4.14e-12	5.88e-12	1.06e-11	2.25e-12	1.26e-05
	Lu-171	NA	8.22E+00	d	S	5.00E-04	3.27e-12	4.70e-12	8.84e-12	3.50e-12	2.90e-06
	Lu-172	NA	6.70E+00	d	S	5.00E-04	5.59e-12	8.03e-12	1.47e-11	6.03e-12	8.70e-06
	Lu-173	NA	1.37E+00	y	S	5.00E-04	1.35e-12	1.96e-12	3.74e-12	8.70e-12	2.92e-07
	Lu-174	NA	3.31E+00	y	S	5.00E-04	1.46e-12	2.12e-12	4.11e-12	1.42e-11	4.26e-07
	Lu-174m	NA	1.42E+02	d	S	5.00E-04	3.38E-12	4.96E-12	9.73E-12	1.51E-11	9.88E-08
	Lu-176	NA	3.60E+10	y	S	5.00E-04	9.29E-12	1.35E-11	2.60E-11	1.41E-10	1.83E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Lu-176m	NA	3.68E+00	h	S	5.00E-04	8.55E-13	1.25E-12	2.43E-12	4.55E-13	2.78E-08
	Lu-177	014265-75-9	6.71E+00	d	S	5.00E-04	3.53E-12	5.18E-12	1.02E-11	4.66E-12	1.14E-07
	Lu-177m	014265-75-9m	1.61E+02	d	S	5.00E-04	9.36E-12	1.36E-11	2.60E-11	5.70E-11	3.63E-06
	Lu-178	NA	2.84E+01	m	S	5.00E-04	8.62E-14	1.20E-13	2.02E-13	5.29E-14	6.76E-07
	Lu-178m	NA	2.27E+01	m	S	5.00E-04	7.10E-14	9.84E-14	1.59E-13	5.85E-14	4.26E-06
	Lu-179	NA	4.59E+00	h	S	5.00E-04	1.12E-12	1.64E-12	3.21E-12	5.14E-13	1.19E-07
Magnesium (12)	Mg-28	NA	2.09E+01	h	M	5.00E-01	1.14E-11	1.65E-11	3.06E-11	5.14E-12	6.56E-06
Manganese (25)	Mn-51	NA	4.62E+01	m	M	1.00E-01	2.09E-13	2.95E-13	5.11E-13	9.55E-14	4.37E-06
	Mn-52	014092-99-0	5.59E+00	d	M	1.00E-01	6.44E-12	9.07E-12	1.58E-11	4.40E-12	1.67E-05
	Mn-52m	014092-99-0m	2.11E+01	m	M	1.00E-01	1.27E-13	1.75E-13	2.82E-13	5.07E-14	1.15E-05
	Mn-53	NA	3.70E+06	y	M	1.00E-01	1.56E-13	2.25E-13	4.37E-13	2.17E-13	0
	Mn-54	013966-31-9	3.13E+02	d	M	1.00E-01	2.28E-12	3.11E-12	5.14E-12	5.88E-12	3.89E-06
	Mn-56	014681-52-8	2.58E+00	h	M	1.00E-01	1.03E-12	1.48E-12	2.78E-12	4.14E-13	8.44E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Mendelevium (101)	Md-257	NA	5.20E+00	h	M	5.00E-04	5.88E-13	8.58E-13	1.67E-12	7.70E-11	3.62E-07
	Md-258	NA	5.50E+01	d	M	5.00E-04	4.33E-11	6.25E-11	1.23E-10	1.68E-08	1.31E-09
Mercury (80)	Hg-193 ^k	NA	3.50E+00	h	M	2.00E-02	4.11E-13	5.99E-13	1.14E-12	2.53E-13	5.55E-07
					V						
	Hg-193m ^k	NA	1.11E+01	h	M	2.00E-02	1.97E-12	2.84E-12	5.37E-12	9.40E-13	4.54E-06
					V						
	Hg-194 ^k	NA	2.60E+02	y	M	1.00E+00	8.07E-11	1.06E-10	1.55E-10	2.88E-11	5.04E-12
					V						
Hg-195 ^k	NA	9.90E+00	h	M	2.00E-02	5.07E-13	7.36E-13	1.41E-12	2.84E-13	7.34E-07	
				V							-
Mercury (80)	Hg-195m ^k	NA	4.16E+01	h	M	2.00E-02	3.36E-12	4.92E-12	9.55E-12	2.33E-12	7.68E-07
					V						
	Hg-197 ^k	013981-51-6	6.41E+01	h	M	2.00E-02	1.43E-12	2.09E-12	4.07E-12	1.25E-12	1.14E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
				V		-	-	-	1.45E-11	-
	Hg-197m ^k	013981-51-6m	2.38E+01 h	M	2.00E-02	3.00E-12	4.40E-12	8.62E-12	2.28E-12	2.50E-07
				V		-	-	-	1.92E-11	-
	Hg-199m ^k	NA	4.26E+01 m	M	2.00E-02	6.70E-14	9.44E-14	1.63E-13	6.33E-14	5.77E-07
				V		-	-	-	5.88E-13	-
	Hg-203 ^k	013982-78-0	4.66E+01 d	M	1.00E+00	5.70E-12	7.62E-12	1.27E-11	8.95E-12	9.21E-07
				V		-	-	-	2.45E-11	-
Molybdenum (42)	Mo-90	NA	5.67E+00 h	M	1.00E+00	6.59E-13	8.73E-13	1.39E-12	1.24E-12	3.41E-06
	Mo-93	NA	3.50E+03 y	M	1.00E+00	3.35E-12	4.18E-12	5.29E-12	1.27E-12	2.17E-10
	Mo-93m	NA	6.85E+00 h	M	1.00E+00	3.20E-13	4.26E-13	6.62E-13	4.33E-13	1.09E-05
	Mo-99	014119-15-4	6.60E+01 h	M	1.00E+00	1.60E-12	2.11E-12	3.50E-12	4.29E-12	6.64E-07
	Mo-101	NA	1.46E+01 m	M	1.00E+00	6.88E-14	9.44E-14	1.48E-13	4.33E-14	6.62E-06
Neodymium (60)	Nd-136	NA	5.07E+01 m	S	5.00E-04	2.70E-13	3.81E-13	6.70E-13	1.34E-13	1.01E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Nd-138	NA	5.04E+00	h	S	5.00E-04	3.42E-12	5.00E-12	9.69E-12	1.24E-12	6.73E-08
	Nd-139	NA	2.97E+01	m	S	5.00E-04	4.96E-14	6.96E-14	1.21E-13	2.37E-14	1.72E-06
	Nd-139m	NA	5.50E+00	h	S	5.00E-04	1.08E-12	1.56E-12	2.86E-12	4.96E-13	7.13E-06
	Nd-141	NA	2.49E+00	h	S	5.00E-04	3.09E-14	4.40E-14	8.07E-14	1.34E-14	2.28E-07
	Nd-141m	NA	6.24E+01	s	-	-	-	-	-	-	3.48E-06
	Nd-147	014269-74-0	1.10E+01	d	S	5.00E-04	6.96E-12	1.02E-11	2.01E-11	9.36E-12	4.87E-07
	Nd-149	015749-81-2	1.73E+00	h	S	5.00E-04	5.44E-13	7.92E-13	1.51E-12	3.19E-13	1.49E-06
	Nd-151	NA	1.24E+01	m	S	5.00E-04	7.36E-14	1.04E-13	1.83E-13	3.92E-14	4.10E-06
Neon (10)	Ne-19	NA	1.72E+01	s	-	-	-	-	-	-	4.47E-06
Neptunium (93)	Np-232	NA	1.47E+01	m	M	5.00E-04	1.97E-14	2.70E-14	4.14E-14	3.17E-14	5.25E-06
	Np-233	NA	3.62E+01	m	M	5.00E-04	5.03E-15	6.99E-15	1.14E-14	2.49E-15	2.29E-07
	Np-234	NA	4.40E+00	d	M	5.00E-04	3.40E-12	4.85E-12	8.77E-12	1.86E-12	7.06E-06
	Np-235	NA	3.96E+02	d	M	5.00E-04	3.46E-13	5.07E-13	9.99E-13	1.15E-12	2.13E-09

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Np-236a	15700-36-4a	1.15E+05 y	M	5.00E-04	1.05E-11	1.44E-11	2.56E-11	9.77E-10	3.25E-07
	Np-236b	15700-36-4b	2.25E+01 h	M	5.00E-04	1.11E-12	1.63E-12	3.19E-12	8.07E-12	1.34E-07
	Np-237	013994-20-2	2.14E+06 y	M	5.00E-04	6.18E-11	8.29E-11	1.46E-10	1.77E-08	5.36E-08
	Np-237+D	013994-20-2(+D)	2.14E+06 y	M	5.00E-04	6.74E-11	9.10E-11	1.62E-10	1.77E-08	7.97E-07
	Np-238	015766-25-3	2.12E+00 d	M	5.00E-04	5.40E-12	7.88E-12	1.52E-11	4.18E-12	2.62E-06
	Np-239	013968-59-7	2.36E+00 d	M	5.00E-04	5.14E-12	7.51E-12	1.47E-11	4.00E-12	5.41E-07
	Np-240	015690-84-3	6.50E+01 m	M	5.00E-04	2.23E-13	3.16E-13	5.55E-13	1.95E-13	5.80E-06
	Np-240m	015690-84-3m	7.40E+00 m	-	-	-	-	-	-	1.51E-06
Nickel (28)	Ni-56	NA	6.10E+00 d	M	5.00E-02	2.83E-12	3.96E-12	6.70E-12	2.88E-12	7.74E-06
				V	5.00E-02	-	-	-	4.22E-12	-
Nickel (28)	Ni-57	NA	3.61E+01 h	M	5.00E-02	3.89E-12	5.55E-12	1.02E-11	1.78E-12	9.43E-06
				V	5.00E-02	-	-	-	1.47E-12	-
	Ni-59	014336-70-0	7.50E+04 y	M	5.00E-02	2.74E-13	3.89E-13	7.33E-13	4.66E-13	0

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
				V	5.00E-02	-	-	-	2.41E-12	-
	Ni-63	013981-37-8	9.60E+01 y	M	5.00E-02	6.70E-13	9.51E-13	1.79E-12	1.64E-12	0
				V	5.00E-02	-	-	-	5.77E-12	-
	Ni-65	014833-49-9	2.52E+00 h	M	5.00E-02	6.96E-13	1.01E-12	1.92E-12	3.03E-13	2.74E-06
				V	5.00E-02	-	-	-	7.07E-13	-
	Ni-66	NA	5.46E+01 h	M	5.00E-02	2.00E-11	2.94E-11	5.77E-11	8.99E-12	2.67E-11
				V	5.00E-02	-	-	-	4.59E-12	-
Niobium (41)	Nb-88	NA	1.43E+01 m	M	1.00E-02	1.13E-13	1.55E-13	2.45E-13	4.51E-14	1.89E-05
	Nb-89a	NA	6.60E+01 m	M	1.00E-02	4.00E-13	5.66E-13	1.01E-12	1.74E-13	8.48E-06
	Nb-89b	NA	1.22E+02 m	M	1.00E-02	1.04E-12	1.51E-12	2.82E-12	4.07E-13	6.64E-06
	Nb-90	NA	1.46E+01 h	M	1.00E-02	5.70E-12	8.21E-12	1.52E-11	2.27E-12	2.13E-05
	Nb-93m	007440-03-1	1.36E+01 y	M	1.00E-02	8.03E-13	1.17E-12	2.31E-12	1.90E-12	3.83E-11
	Nb-94	014681-63-1	2.03E+04 y	M	1.00E-02	7.77E-12	1.11E-11	2.05E-11	3.77E-11	7.29E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Nb-95	013967-76-5	3.52E+01	d	M	1.00E-02	2.45E-12	3.50E-12	6.36E-12	5.44E-12	3.53E-06
	Nb-95m	013967-76-5m	8.66E+01	h	M	1.00E-02	3.66E-12	5.37E-12	1.05E-11	3.27E-12	2.32E-07
	Nb-96	NA	2.34E+01	h	M	1.00E-02	5.03E-12	7.25E-12	1.35E-11	2.28E-12	1.15E-05
	Nb-97	018496-04-3	7.21E+01	m	M	1.00E-02	1.96E-13	2.79E-13	5.00E-13	1.07E-13	2.97E-06
	Nb-97m	018496-04-3m	6.00E+01	s	-	-	-	-	-	-	3.34E-06
	Nb-98	NA	5.15E+01	m	M	1.00E-02	2.80E-13	3.92E-13	6.73E-13	1.23E-13	1.16E-05
Nitrogen (7)	N-13	NA	9.97E+00	m	-	-	-	-	-	-	4.45E-06
Osmium (76)	Os-180	NA	2.20E+01	m	M	1.00E-02	3.63E-14	5.00E-14	7.92E-14	2.62E-14	1.08E-07
	Os-181	NA	1.05E+02	m	M	1.00E-02	3.54E-13	5.07E-13	9.21E-13	1.95E-13	5.41E-06
	Os-182	NA	2.20E+01	h	M	1.00E-02	2.59E-12	3.74E-12	6.92E-12	1.45E-12	1.63E-06
	Os-185	015766-50-4	9.40E+01	d	M	1.00E-02	1.92E-12	2.70E-12	4.77E-12	6.14E-12	3.11E-06
	Os-189m	NA	6.00E+00	h	M	1.00E-02	1.02E-13	1.50E-13	2.94E-13	3.44E-14	7.20E-13
	Os-190m	NA	9.90E+00	m	M	-	-	-	-	-	6.76E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Os-191	014119-24-5	1.54E+01	d	M	1.00E-02	3.64E-12	5.33E-12	1.05E-11	7.10E-12	1.66E-07
	Os-191m	014119-24-5m	1.30E+01	h	M	1.00E-02	6.11E-13	8.95E-13	1.76E-12	6.36E-13	1.05E-08
	Os-193	016057-77-5	3.00E+01	h	M	1.00E-02	5.29E-12	7.77E-12	1.53E-11	2.71E-12	2.69E-07
Osmium (76)	Os-194	NA	6.00E+00	y	M	1.00E-02	1.53E-11	2.23E-11	4.37E-11	2.55E-10	6.57E-10
Oxygen (8)	O-15	NA	1.22E+02	s	-	-	-	-	-	-	4.46E-06
Palladium (46)	Pd-100	015690-69-4	3.63E+00	d	S	5.00E-03	4.03E-12	5.77E-12	1.05E-11	3.10E-12	2.22E-07
	Pd-101	015749-54-9	8.27E+00	h	S	5.00E-03	4.22E-13	6.07E-13	1.12E-12	1.97E-13	1.38E-06
	Pd-103	014967-68-1	1.70E+01	d	S	5.00E-03	1.25E-12	1.84E-12	3.61E-12	1.77E-12	1.15E-09
	Pd-107	017637-99-9	6.50E+06	y	S	5.00E-03	2.50E-13	3.67E-13	7.25E-13	1.69E-12	0
	Pd-109	014981-64-7	1.34E+01	h	S	5.00E-03	3.50E-12	5.14E-12	1.01E-11	1.85E-12	1.27E-08
Phosphorus (15)	P-30	NA	2.50E+00	m	-	-	-	-	-	-	4.50E-06
	P-32	014596-37-3	1.43E+01	d	M	8.00E-01	8.95E-12	1.23E-11	2.21E-11	1.22E-11	9.41E-09
	P-33	015749-66-3	2.54E+01	d	M	8.00E-01	9.81E-13	1.36E-12	2.47E-12	5.11E-12	3.72E-11

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Platinum (78)	Pt-186	NA	2.00E+00 h	F	1.00E-02	3.92E-13	5.62E-13	1.03E-12	8.25E-14	3.20E-06
	Pt-188	NA	1.02E+01 d	F	1.00E-02	3.77E-12	5.44E-12	1.03E-11	1.88E-12	6.02E-07
	Pt-189	NA	1.09E+01 h	F	1.00E-02	5.92E-13	8.55E-13	1.61E-12	1.32E-13	1.17E-06
	Pt-191	015706-36-2	2.80E+00 d	F	1.00E-02	1.76E-12	2.55E-12	4.85E-12	4.63E-13	9.78E-07
	Pt-193	015735-70-3	5.00E+01 y	F	1.00E-02	2.11E-13	3.09E-13	6.14E-13	1.11E-13	2.78E-12
	Pt-193m	015735-70-3m	4.33E+00 d	F	1.00E-02	3.03E-12	4.44E-12	8.81E-12	7.73E-13	1.68E-08
	Pt-195m	NA	4.02E+00 d	F	1.00E-02	4.11E-12	6.03E-12	1.19E-11	1.05E-12	1.26E-07
	Pt-197	015735-74-7	1.83E+01 h	F	1.00E-02	2.62E-12	3.85E-12	7.59E-12	5.22E-13	5.63E-08
	Pt-197m	015735-74-7m	9.44E+01 m	F	1.00E-02	4.00E-13	5.81E-13	1.12E-12	8.66E-14	2.38E-07
	Pt-199	NA	3.08E+01 m	F	1.00E-02	8.84E-14	1.25E-13	2.18E-13	2.48E-14	8.69E-07
Pt-200	NA	1.25E+01 h	F	1.00E-02	7.73E-12	1.13E-11	2.23E-11	1.48E-12	1.58E-07	
Plutonium (94)	Pu-234	NA	8.80E+00 h	M	5.00E-04	8.58E-13	1.25E-12	2.39E-12	6.85E-11	1.61E-07
	Pu-235	NA	2.53E+01 m	M	5.00E-04	4.37E-15	6.03E-15	9.73E-15	2.39E-15	2.37E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Pu-236	015411-92-4	2.85E+00 y	M	5.00E-04	7.47E-11	9.92E-11	1.74E-10	2.28E-08	1.19E-10
	Pu-237	NA	4.53E+01 d	M	5.00E-04	5.77E-13	8.40E-13	1.62E-12	1.27E-12	1.12E-07
	Pu-238	013981-16-3	8.77E+01 y	M	5.00E-04	1.31E-10	1.69E-10	2.72E-10	3.36E-08	7.22E-11
	Pu-239	015117-48-3	2.41E+04 y	M	5.00E-04	1.35E-10	1.74E-10	2.76E-10	3.33E-08	2.00E-10
	Pu-240	014119-33-6	6.54E+03 y	M	5.00E-04	1.35E-10	1.74E-10	2.77E-10	3.33E-08	6.98E-11
	Pu-241	014119-32-5	1.44E+01 y	M	5.00E-04	1.76E-12	2.28E-12	3.29E-12	3.34E-10	4.11E-12
	Pu-242	013982-10-0	3.76E+05 y	M	5.00E-04	1.28E-10	1.65E-10	2.63E-10	3.13E-08	6.25E-11
	Pu-243	015706-37-3	4.96E+00 h	M	5.00E-04	4.74E-13	6.92E-13	1.34E-12	2.94E-13	5.50E-08
	Pu-244	014119-34-7	8.26E+07 y	M	5.00E-04	1.37E-10	1.80E-10	2.94E-10	2.93E-08	3.01E-11
	Pu-244+D	014119-34-7(+D)	8.26E+07 y	M	5.00E-04	1.44E-10	1.90E-10	3.14E-10	2.93E-08	1.51E-06
	Pu-245	NA	1.05E+01 h	M	5.00E-04	4.48E-12	6.55E-12	1.28E-11	2.07E-12	1.77E-06
	Pu-246	NA	1.09E+01 d	M	5.00E-04	1.73E-11	2.53E-11	4.92E-11	1.73E-11	4.04E-07
Polonium (84)	Po-203 ¹	NA	36.7 m	M	(l)	1.6300e-13	1.88000e-13	3.92000e-13	7.7300e-14	7.65E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Po-205 ¹	NA	1.80E+00 h	M	(I)	1.8100e-13	2.41000e-13	4.26000e-13	1.72E-13	7.36e-06
	Po-207 ¹	NA	3.50E+02 m	M	(I)	5.1800e-13	5.55000e-13	1.28000e-12	1.99E-13	6.08e-06
	Po-210 ¹	013981-52-7	1.38E+02 d	M	(I)	3.77e-10	2.25e-09	7.96e-10	1.08E-08	3.95E-11
	Po-211	NA	5.16E-01 s	-	-	-	-	-	-	3.58e-08
	Po-212	015389-34-1	3.05E-01 us	-	-	-	-	-	-	0
	Po-213	015756-57-7	4.20E+00 us	-	-	-	-	-	-	0
	Po-214	015735-67-8	1.64E+02 us	-	-	-	-	-	-	3.86E-10
	Po-215	015706-52-2	1.78E-03 s	-	-	-	-	-	-	7.48E-10
	Po-216	015756-58-8	1.50E-01 s	-	-	-	-	-	-	7.87E-11
	Po-218	015422-24-9	3.05E+00 m	-	-	-	-	-	-	4.26E-11
Potassium (19)	K-38	NA	7.64E+00 m	-	-	-	-	-	-	1.61E-05
	K-40	013966-00-2	1.28E+09 y	F	1.00E+00	2.47E-11	3.43E-11	6.18E-11	1.03E-11	7.97E-07
	K-42	014378-21-3	1.24E+01 h	F	1.00E+00	1.26E-12	1.74E-12	3.06E-12	4.33E-13	1.46E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Pr-145	NA	5.98E+00	h	S	5.00E-04	2.29E-12	3.36E-12	6.59E-12	9.25E-13	6.95E-08
	Pr-147	NA	1.36E+01	m	S	5.00E-04	5.85E-14	8.10E-14	1.32E-13	3.59E-14	3.78E-06
Promethium (61)	Pm-141	NA	2.09E+01	m	S	5.00E-04	6.66E-14	9.25E-14	1.52E-13	2.85E-14	3.33E-06
	Pm-142	NA	4.05E+01	s	-	-	-	-	-	-	3.86E-06
	Pm-143	NA	2.65E+02	d	S	5.00E-04	8.73E-13	1.24E-12	2.20E-12	5.37E-12	1.33E-06
	Pm-144	NA	3.63E+02	d	S	5.00E-04	3.34E-12	4.66E-12	8.10E-12	2.76E-11	6.90E-06
	Pm-145	NA	1.77E+01	y	S	5.00E-04	5.59E-13	8.07E-13	1.54E-12	6.59E-12	1.61E-08
	Pm-146	NA	2.02E+03	d	S	5.00E-04	4.18E-12	5.99E-12	1.12E-11	5.40E-11	3.29E-06
	Pm-147	014380-75-7	2.62E+00	y	S	5.00E-04	1.69E-12	2.48E-12	4.88E-12	1.61E-11	3.21E-11
	Pm-148	014683-19-3	5.37E+00	d	S	5.00E-04	1.72E-11	2.52E-11	4.96E-11	1.05E-11	2.80E-06
	Pm-148m	014683-19-3m	4.13E+01	d	S	5.00E-04	7.99E-12	1.15E-11	2.13E-11	2.12E-11	8.98E-06
	Pm-149	015765-31-8	5.31E+01	h	S	5.00E-04	6.66E-12	9.77E-12	1.93E-11	3.66E-12	4.60E-08
	Pm-150	NA	2.68E+00	h	S	5.00E-04	1.08E-12	1.56E-12	2.94E-12	4.63E-13	6.87E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Protactinium (91)	Pm-151	NA	2.84E+01	h	S	5.00E-04	4.51E-12	6.59E-12	1.28E-11	2.36E-12	1.27E-06
	Pa-227	NA	3.83E+01	m	S	5.00E-04	9.69E-13	1.37E-12	2.38E-12	2.12E-10	4.37E-08
	Pa-228	NA	2.20E+01	h	S	5.00E-04	3.60E-12	5.18E-12	9.84E-12	2.33E-10	5.10E-06
	Pa-230	NA	1.74E+01	d	S	5.00E-04	3.77E-12	5.40E-12	1.02E-11	2.58E-09	2.86E-06
	Pa-231	014331-85-2	3.28E+04	y	S	5.00E-04	1.73E-10	2.26E-10	3.74E-10	4.55E-08	1.39E-07
	Pa-232	NA	1.31E+00	d	S	5.00E-04	3.48E-12	5.03E-12	9.55E-12	6.81E-12	4.29E-06
	Pa-233	013981-14-1	2.70E+01	d	S	5.00E-04	5.55E-12	8.14E-12	1.59E-11	1.42E-11	7.43E-07
	Pa-234	015100-28-4	6.70E+00	h	S	5.00E-04	2.56E-12	3.70E-12	7.03E-12	1.46E-12	8.71E-06
	Pa-234m	015100-28-4m	1.17E+00	m	-	-	-	-	-	-	6.87E-08
Radium (88)	Ra-222	NA	3.80E+01	s	-	-	-	-	-	-	3.71E-08
	Ra-223	015623-45-7	1.14E+01	d	M	2.00E-01	2.38E-10	3.39E-10	6.44E-10	2.50E-08	4.34E-07
	Ra-224	013233-32-4	3.66E+00	d	M	2.00E-01	1.67E-10	2.38E-10	4.51E-10	9.99E-09	3.72E-08
	Ra-225	013981-53-8	1.48E+01	d	M	2.00E-01	1.14E-10	1.54E-10	2.72E-10	2.10E-08	5.91E-09

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e		ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Re-181	NA	2.00E+01	h	M	8.00E-01	1.41E-12	2.00E-12	3.64E-12	7.96E-13	3.18E-06
	Re-182a	NA	1.27E+01	h	M	8.00E-01	8.70E-13	1.22E-12	2.16E-12	5.51E-13	5.37E-06
	Re-182b	NA	6.40E+01	h	M	8.00E-01	4.96E-12	6.99E-12	1.26E-11	4.44E-12	8.22E-06
	Re-184	NA	3.80E+01	d	M	8.00E-01	3.16E-12	4.40E-12	7.66E-12	6.73E-12	3.93E-06
	Re-184m	NA	1.65E+02	d	M	8.00E-01	4.88E-12	6.96E-12	1.27E-11	2.26E-11	1.52E-06
	Re-186	NA	9.06E+01	h	M	8.00E-01	5.59E-12	8.03E-12	1.53E-11	4.26E-12	5.49E-08
	Re-186m	NA	2.00E+05	y	M	8.00E-01	7.33E-12	1.05E-11	1.95E-11	4.18E-11	1.75E-08
	Re-187	NA	5.00E+10	y	M	8.00E-01	1.79E-14	2.56E-14	4.81E-14	2.51E-14	0
	Re-188	NA	1.70E+01	h	M	8.00E-01	4.88E-12	7.07E-12	1.35E-11	2.22E-12	2.38E-07
	Re-188m	NA	1.86E+01	m	M	8.00E-01	9.92E-14	1.42E-13	2.69E-13	5.07E-14	1.28E-07
	Re-189	NA	2.43E+01	h	M	8.00E-01	2.86E-12	4.11E-12	7.84E-12	1.73E-12	2.42E-07
Rhodium (45)	Rh-99	NA	1.60E+01	d	S	5.00E-02	2.21E-12	3.15E-12	5.77E-12	3.33E-12	2.50E-06
	Rh-99m	NA	4.70E+00	h	S	5.00E-02	2.42E-13	3.42E-13	6.03E-13	9.99E-14	3.02E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e		ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Rh-100	NA	2.08E+01	h	S	5.00E-02	2.65E-12	3.74E-12	6.62E-12	1.04E-12	1.38E-05
	Rh-101	NA	3.20E+00	y	S	5.00E-02	2.15E-12	3.01E-12	5.37E-12	1.81E-11	8.84E-07
	Rh-101m	NA	4.34E+00	d	S	5.00E-02	9.40E-13	1.34E-12	2.46E-12	7.14E-13	1.19E-06
	Rh-102	NA	2.90E+00	y	S	5.00E-02	7.70E-12	1.04E-11	1.71E-11	5.99E-11	9.73E-06
	Rh-102m	NA	2.07E+02	d	S	5.00E-02	6.07E-12	8.73E-12	1.66E-11	2.56E-11	2.11E-06
	Rh-103m	007440-16-6	5.61E+01	m	S	5.00E-02	9.40E-15	1.34E-14	2.40E-14	9.14E-15	9.31E-11
	Rh-105	014913-89-4	3.54E+01	h	S	5.00E-02	2.34E-12	3.43E-12	6.73E-12	1.59E-12	3.15E-07
	Rh-106	014234-34-5	2.99E+01	s	-	-	-	-	-	-	9.66E-07
	Rh-106m	NA	1.32E+02	m	S	5.00E-02	5.48E-13	7.73E-13	1.37E-12	2.71E-13	1.37E-05
Rhodium (45)	Rh-107	NA	2.17E+01	m	S	5.00E-02	4.18E-14	5.81E-14	9.51E-14	2.88E-14	1.28E-06
Rubidium (37)	Rb-79	NA	2.29E+01	m	F	1.00E+00	8.36E-14	1.14E-13	1.79E-13	2.37E-14	5.85E-06
	Rb-80	NA	3.40E+01	s	-	-	-	-	-	-	5.56E-06
	Rb-81	NA	4.58E+00	h	F	1.00E+00	1.28E-13	1.74E-13	2.83E-13	4.63E-14	2.59E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Rb-81m	NA	3.20E+01	m	F	1.00E+00	2.05E-14	2.80E-14	4.55E-14	1.10E-14	9.08E-09
	Rb-82	014391-63-0	1.30E+00	m	-	-	-	-	-	-	4.85E-06
	Rb-82m	014391-63-0m	6.20E+00	h	F	1.00E+00	3.51E-13	4.70E-13	7.25E-13	1.35E-13	1.35E-05
	Rb-83	NA	8.62E+01	d	F	1.00E+00	5.70E-12	7.51E-12	1.18E-11	2.32E-12	2.18E-06
	Rb-84	NA	3.28E+01	d	F	1.00E+00	8.81E-12	1.17E-11	1.91E-11	3.59E-12	4.22E-06
	Rb-86	014932-53-7	1.87E+01	d	F	1.00E+00	9.88E-12	1.34E-11	2.37E-11	4.00E-12	4.67E-07
	Rb-87	013982-13-3	4.70E+10	y	F	1.00E+00	5.22E-12	7.07E-12	1.25E-11	2.14E-12	9.11E-11
	Rb-88	014928-36-0	1.78E+01	m	F	1.00E+00	1.40E-13	1.92E-13	3.06E-13	3.17E-14	3.36E-06
	Rb-89	014191-65-2	1.52E+01	m	F	1.00E+00	7.88E-14	1.08E-13	1.70E-13	2.09E-14	1.05E-05
Ruthenium (44)	Ru-94	NA	5.18E+01	m	M	5.00E-02	3.06E-13	4.37E-13	8.03E-13	1.23E-13	2.31E-06
					V	5.00E-02	-	-	-	2.20E-13	-
	Ru-97	015758-35-7	2.90E+00	d	M	5.00E-02	6.36E-13	9.07E-13	1.65E-12	3.36E-13	8.63E-07
					V	5.00E-02	-	-	-	5.44E-13	-

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Ru-103	013968-53-1	3.93E+01	d	M	5.00E-02	3.85E-12	5.55E-12	1.05E-11	8.92E-12	2.04E-06
					V	5.00E-02	-	-	-	5.18E-12	-
	Ru-105	014331-95-4	4.44E+00	h	M	5.00E-02	1.35E-12	1.96E-12	3.77E-12	6.48E-13	3.51E-06
					V	5.00E-02	-	-	-	9.32E-13	-
	Ru-106	013967-48-1	3.68E+02	d	M	5.00E-02	4.22E-11	6.11E-11	1.19E-10	1.02E-10	0
					V	5.00E-02	-	-	-	8.62E-11	-
	Ru-106+D	013967-48-1(+D)	3.68E+02	d	M	5.00E-02	4.22E-11	6.11E-11	1.19E-10	1.02E-10	9.66E-07
Samarium (62)	Sm-141	NA	1.02E+01	m	M	5.00E-04	7.10E-14	9.81E-14	1.59E-13	2.79E-14	6.39E-06
	Sm-141m	NA	2.26E+01	m	M	5.00E-04	1.40E-13	1.95E-13	3.26E-13	6.29E-14	9.04E-06
	Sm-142	NA	7.25E+01	m	M	5.00E-04	5.37E-13	7.70E-13	1.40E-12	2.13E-13	2.99E-07
	Sm-145	NA	3.40E+02	d	M	5.00E-04	1.17E-12	1.70E-12	3.27E-12	4.51E-12	3.83E-08
	Sm-146	NA	1.03E+08	y	M	5.00E-04	4.11E-11	5.25E-11	8.36E-11	7.88E-09	0
	Sm-147	014392-33-7	1.06E+11	y	M	5.00E-04	3.74E-11	4.77E-11	7.59E-11	6.88E-09	0

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Sm-151	015715-94-3	9.00E+01 y	M	5.00E-04	5.55E-13	8.07E-13	1.59E-12	4.88E-12	3.60E-13
	Sm-153	015766-00-4	4.67E+01 h	M	5.00E-04	4.85E-12	7.10E-12	1.40E-11	2.95E-12	1.06E-07
	Sm-155	NA	2.21E+01 m	M	5.00E-04	4.96E-14	6.88E-14	1.13E-13	3.15E-14	2.81E-07
	Sm-156	NA	9.40E+00 h	M	5.00E-04	1.49E-12	2.18E-12	4.26E-12	9.69E-13	3.79E-07
Scandium (21)	Sc-43	NA	3.89E+00 h	S	1.00E-04	8.18E-13	1.18E-12	2.21E-12	3.81E-13	4.73E-06
	Sc-44	NA	3.93E+00 h	S	1.00E-04	1.56E-12	2.25E-12	4.22E-12	6.44E-13	9.95E-06
	Sc-44m	NA	5.86E+01 h	S	1.00E-04	1.38E-11	2.01E-11	3.89E-11	6.96E-12	1.15E-06
	Sc-46	013967-63-0	8.38E+01 d	S	1.00E-04	6.22E-12	8.88E-12	1.62E-11	2.47E-11	9.63E-06
	Sc-47	014391-96-9	3.35E+00 d	S	1.00E-04	3.49E-12	5.11E-12	1.00E-11	3.05E-12	3.62E-07
Scandium (21)	Sc-48	014391-86-7	4.37E+01 h	S	1.00E-04	7.33E-12	1.05E-11	1.93E-11	3.96E-12	1.62E-05
	Sc-49	NA	5.74E+01 m	S	1.00E-04	2.05E-13	2.92E-13	5.25E-13	1.07E-13	1.90E-08
Selenium (34)	Se-70	NA	4.10E+01 m	F	8.00E-01	2.95E-13	4.11E-13	6.92E-13	7.36E-14	4.22E-06
	Se-73	NA	7.15E+00 h	F	8.00E-01	7.96E-13	1.13E-12	1.99E-12	1.99E-13	4.52E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Se-73m	NA	3.90E+01	m	F	8.00E-01	8.29E-14	1.17E-13	2.02E-13	2.06E-14	1.06E-06
	Se-75	014265-71-5	1.20E+02	d	F	8.00E-01	8.14E-12	1.08E-11	1.67E-11	3.77E-12	1.45E-06
	Se-77m	NA	1.75E+01	s	-	-	-	-	-	-	2.85E-07
	Se-79	NA	6.50E+04	y	F	8.00E-01	7.29E-12	9.69E-12	1.60E-11	3.33E-12	1.10E-11
	Se-81	NA	1.85E+01	m	F	8.00E-01	4.29E-14	5.92E-14	9.58E-14	1.27E-14	4.68E-08
	Se-81m	NA	5.73E+01	m	F	8.00E-01	1.30E-13	1.85E-13	3.24E-13	3.54E-14	3.56E-08
	Se-83	NA	2.25E+01	m	F	8.00E-01	1.02E-13	1.43E-13	2.33E-13	2.72E-14	1.15E-05
Silicon (14)	Si-31	014276-49-4	1.57E+02	m	S	1.00E-02	6.48E-13	9.40E-13	1.81E-12	3.05E-13	1.11E-08
	Si-32	NA	4.50E+02	y	S	1.00E-02	3.44E-12	5.00E-12	9.81E-12	2.93E-10	2.18E-11
Silver (47)	Ag-102	NA	1.29E+01	m	M	5.00E-02	7.25E-14	9.95E-14	1.56E-13	2.56E-14	1.60E-05
	Ag-103	NA	6.57E+01	m	M	5.00E-02	1.20E-13	1.69E-13	2.96E-13	6.07E-14	3.33E-06
	Ag-104	NA	6.92E+01	m	M	5.00E-02	1.65E-13	2.29E-13	3.77E-13	6.25E-14	1.25E-05
	Ag-104m	NA	3.35E+01	m	M	5.00E-02	1.21E-13	1.68E-13	2.81E-13	4.92E-14	5.50E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Ag-105	014928-14-4	4.10E+01	d	M	5.00E-02	1.77E-12	2.49E-12	4.40E-12	2.83E-12	2.15E-06
	Ag-106	NA	2.40E+01	m	M	5.00E-02	5.92E-14	8.21E-14	1.34E-13	2.72E-14	3.08E-06
	Ag-106m	NA	8.41E+00	d	M	5.00E-02	4.81E-12	6.73E-12	1.14E-11	3.54E-12	1.31E-05
	Ag-108	014391-65-2	2.37E+00	m	-	-	-	-	-	-	8.56E-08
	Ag-108m	014391-65-2m	1.27E+02	y	M	5.00E-02	8.14E-12	1.12E-11	1.92E-11	2.67E-11	7.18E-06
	Ag-109m	014378-38-2	3.96E+01	s	-	-	-	-	-	-	7.66E-09
	Ag-110	014391-76-5	2.46E+01	s	-	-	-	-	-	-	1.69E-07
	Ag-110m	014391-76-5m	2.50E+02	d	M	5.00E-02	9.88E-12	1.37E-11	2.37E-11	2.83E-11	1.30E-05
	Ag-111	015760-04-0	7.45E+00	d	M	5.00E-02	8.21E-12	1.21E-11	2.37E-11	6.66E-12	1.09E-07
	Ag-112	NA	3.12E+00	h	M	5.00E-02	1.99E-12	2.90E-12	5.59E-12	7.25E-13	3.23E-06
	Ag-115	NA	2.00E+01	m	M	5.00E-02	1.40E-13	1.98E-13	3.46E-13	6.81E-14	3.44E-06
Sodium (11)	Na-22	013966-32-0	2.60E+00	y	F	1.00E+00	9.62E-12	1.26E-11	1.97E-11	3.89E-12	1.03E-05
	Na-24	013982-04-2	1.50E+01	h	F	1.00E+00	1.23E-12	1.65E-12	2.64E-12	4.74E-13	2.20E-05

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Strontium (38)	Sr-80	NA	1.00E+02	m	M	3.00E-01	1.09E-12	1.55E-12	2.83E-12	4.51E-13	5.08E-11
	Sr-81	NA	2.55E+01	m	M	3.00E-01	1.71E-13	2.39E-13	4.03E-13	8.07E-14	5.97E-06
	Sr-82	014809-50-8	2.50E+01	d	M	3.00E-01	3.13E-11	4.48E-11	8.47E-11	3.69E-11	5.00E-11
	Sr-83	NA	3.24E+01	h	M	3.00E-01	2.21E-12	3.17E-12	5.85E-12	1.26E-12	3.60E-06
	Sr-85	013967-73-2	6.48E+01	d	M	3.00E-01	2.26E-12	3.11E-12	5.03E-12	2.56E-12	2.20E-06
	Sr-85m	013967-73-2m	6.95E+01	m	M	3.00E-01	1.67E-14	2.31E-14	3.74E-14	8.32E-15	8.21E-07
	Sr-87m	NA	2.81E+00	h	M	3.00E-01	1.07E-13	1.51E-13	2.69E-13	5.62E-14	1.33E-06
	Sr-89	014158-27-1	5.05E+01	d	M	3.00E-01	1.28E-11	1.84E-11	3.47E-11	2.34E-11	7.19E-09
	Sr-90	010098-97-2	2.91E+01	y	M	3.00E-01	5.59E-11	6.88E-11	9.18E-11	1.05E-10	4.82E-10
Strontium (38)	Sr-90+D	010098-97-2(+D)	2.91E+01	y	M	3.00E-01	7.40E-11	9.53E-11	1.44E-10	1.13E-10	1.96E-08
	Sr-91	014331-91-0	9.50E+00	h	M	3.00E-01	3.22E-12	4.66E-12	8.81E-12	1.70E-12	3.30E-06
	Sr-92	014928-29-1	2.71E+00	h	M	3.00E-01	2.25E-12	3.26E-12	6.18E-12	1.03E-12	6.69E-06
Sulfur (16)	S-35 ⁿ	015117-53-0	8.74E+01	d	M	1.00E+00	5.1400e-13	3.70000e-12	1.24000e-12	5.03E-12	8.77E-12

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
				V	0.8	-	-	-	2.90E-12	-	
Tantalum (73)	Ta-172	NA	3.68E+01	m	S	1.00E-03	1.14E-13	1.59E-13	2.64E-13	7.22E-14	7.04E-06
	Ta-173	NA	3.65E+00	h	S	1.00E-03	9.03E-13	1.31E-12	2.49E-12	4.44E-13	2.38E-06
	Ta-174	NA	1.20E+00	h	S	1.00E-03	1.62E-13	2.30E-13	4.11E-13	1.11E-13	2.55E-06
	Ta-175	NA	1.05E+01	h	S	1.00E-03	8.70E-13	1.24E-12	2.25E-12	4.37E-13	4.16E-06
	Ta-176	NA	8.08E+00	h	S	1.00E-03	1.25E-12	1.78E-12	3.18E-12	5.96E-13	1.06E-05
	Ta-177	NA	5.66E+01	h	S	1.00E-03	5.88E-13	8.58E-13	1.65E-12	4.44E-13	1.20E-07
	Ta-178a	NA	9.31E+00	m	-	-	-	-	-	-	3.29E-07
	Ta-178b	NA	2.20E+00	h	S	1.00E-03	2.49E-13	3.53E-13	6.29E-13	1.79E-13	3.78E-06
	Ta-179	NA	6.65E+02	d	S	1.00E-03	3.44E-13	5.00E-13	9.51E-13	2.05E-12	3.62E-08
	Ta-180	NA	1.00E+13	y	S	1.00E-03	4.44E-12	6.44E-12	1.23E-11	7.25E-11	2.03E-06
	Ta-180m	NA	8.10E+00	h	S	1.00E-03	3.03E-13	4.40E-13	8.58E-13	1.86E-13	6.13E-08
	Ta-182	013982-00-8	1.15E+02	d	S	1.00E-03	7.96E-12	1.15E-11	2.19E-11	3.74E-11	6.04E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Technetium (43)	Ta-182m	013982-00-8m	1.58E+01	m	S	1.00E-03	1.99E-14	2.76E-14	4.44E-14	3.41E-14	7.38E-07
	Ta-183	NA	5.10E+00	d	S	1.00E-03	8.33E-12	1.22E-11	2.38E-11	8.81E-12	9.40E-07
	Ta-184	NA	8.70E+00	h	S	1.00E-03	3.53E-12	5.11E-12	9.81E-12	1.73E-12	7.02E-06
	Ta-185	NA	4.90E+01	m	S	1.00E-03	1.57E-13	2.22E-13	3.92E-13	1.18E-13	6.24E-07
	Ta-186	NA	1.05E+01	m	S	1.00E-03	5.51E-14	7.55E-14	1.19E-13	2.69E-14	6.69E-06
	Tc-93	NA	2.75E+00	h	M	5.00E-01	1.59E-13	2.20E-13	3.55E-13	6.36E-14	7.31E-06
	Tc-93m	NA	4.35E+01	m	M	5.00E-01	6.81E-14	9.44E-14	1.55E-13	3.17E-14	3.62E-06
	Tc-94	NA	2.93E+02	m	M	5.00E-01	6.36E-13	8.88E-13	1.48E-12	2.80E-13	1.24E-05
	Tc-94m	NA	5.20E+01	m	M	5.00E-01	2.36E-13	3.32E-13	5.74E-13	1.03E-13	8.70E-06
	Tc-95	014809-56-4	2.00E+01	h	M	5.00E-01	5.77E-13	8.03E-13	1.35E-12	2.63E-13	3.63E-06
	Tc-95m	014809-56-4m	6.10E+01	d	M	5.00E-01	1.80E-12	2.51E-12	4.29E-12	3.40E-12	2.93E-06
	Tc-96	014808-44-7	4.28E+00	d	M	5.00E-01	3.42E-12	4.74E-12	7.81E-12	2.00E-12	1.16E-05
	Tc-96m	014808-44-7m	5.15E+01	m	M	5.00E-01	3.59E-14	5.00E-14	8.36E-14	2.05E-14	2.13E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	y	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Tc-97	015759-35-0	2.60E+06	y	M	5.00E-01	2.70E-13	3.89E-13	7.40E-13	8.51E-13	2.94E-10
	Tc-97m	015759-35-0m	8.70E+01	d	M	5.00E-01	2.38E-12	3.44E-12	6.62E-12	1.12E-11	1.04E-09
	Tc-98	NA	4.20E+06	y	M	5.00E-01	7.10E-12	1.01E-11	1.83E-11	3.01E-11	6.45E-06
	Tc-99	014133-76-7	2.13E+05	y	M	5.00E-01	2.75E-12	4.00E-12	7.66E-12	1.41E-11	8.14E-11
	Tc-99m	014133-76-7m	6.02E+00	h	M	5.00E-01	7.96E-14	1.14E-13	2.03E-13	5.70E-14	3.93E-07
	Tc-101	NA	1.42E+01	m	M	5.00E-01	3.06E-14	4.22E-14	6.81E-14	1.85E-14	1.37E-06
	Tc-104	NA	1.82E+01	m	M	5.00E-01	1.38E-13	1.90E-13	3.09E-13	5.33E-14	9.75E-06
Tellurium (52)	Te-116	NA	2.49E+00	h	M	3.00E-01	6.73E-13	9.62E-13	1.75E-12	3.20E-13	1.34E-07
					V	3.00E-01	-	-	-	2.76E-13	-
	Te-121	NA	1.70E+01	d	M	3.00E-01	1.46E-12	2.01E-12	3.40E-12	1.30E-12	2.46E-06
V					3.00E-01	-	-	-	1.82E-13	-	
	Te-121m	NA	1.54E+02	d	M	3.00E-01	6.40E-12	8.51E-12	1.42E-11	1.44E-11	7.83E-07
					V	3.00E-01	-	-	-	1.43E-12	-

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Te-123	NA	NA	1.00E+13 y	M	3.00E-01	4.11E-12	5.11E-12	6.77E-12	2.50E-12	2.73E-09
				V	3.00E-01	-	-	-	1.19E-11	-
Te-123m	NA	NA	1.20E+02 d	M	3.00E-01	4.14E-12	5.66E-12	1.02E-11	1.36E-11	4.48E-07
				V	3.00E-01	-	-	-	6.48E-12	-
Te-125m	014390-73-9	NA	5.80E+01 d	M	3.00E-01	3.33E-12	4.70E-12	8.92E-12	1.17E-11	6.95E-09
				V	3.00E-01	-	-	-	3.77E-12	-
Te-127	013981-49-2	NA	9.35E+00 h	M	3.00E-01	1.00E-12	1.48E-12	2.87E-12	6.11E-13	2.10E-08
				V	3.00E-01	-	-	-	3.42E-13	-
Te-127m	013981-49-2m	NA	1.09E+02 d	M	3.00E-01	8.62E-12	1.20E-11	2.25E-11	2.58E-11	2.73E-09
				V	3.00E-01	-	-	-	1.21E-11	-
Te-129	014269-71-7	NA	6.96E+01 m	M	3.00E-01	1.71E-13	2.44E-13	4.40E-13	9.95E-14	2.45E-07
				V	3.00E-01	-	-	-	1.13E-13	-
Te-129m	014269-71-7m	NA	3.36E+01 d	M	3.00E-01	1.53E-11	2.20E-11	4.26E-11	2.49E-11	1.38E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
				V	3.00E-01	-	-	-	1.35E-11	-	
	Te-131	014683-12-6	2.50E+01	m	M	3.00E-01	2.17E-13	3.05E-13	5.62E-13	6.40E-14	1.79E-06
				V	3.00E-01	-	-	-	2.45E-13	-	
	Te-131m	014683-12-6m	3.00E+01	h	M	3.00E-01	8.25E-12	1.19E-11	2.28E-11	4.22E-12	6.61E-06
				V	3.00E-01	-	-	-	9.58E-12	-	
	Te-132	014234-28-7	7.82E+01	h	M	3.00E-01	1.70E-11	2.44E-11	4.77E-11	9.32E-12	7.83E-07
				V	3.00E-01	-	-	-	2.14E-11	-	
	Te-133	NA	1.25E+01	m	M	3.00E-01	1.92E-13	2.73E-13	5.29E-13	4.92E-14	4.29E-06
				V	3.00E-01	-	-	-	2.16E-13	-	
	Te-133m	NA	5.54E+01	m	M	3.00E-01	8.73E-13	1.24E-12	2.42E-12	2.64E-13	1.09E-05
				V	3.00E-01	-	-	-	8.77E-13	-	
	Te-134	NA	4.18E+01	m	M	3.00E-01	3.01E-13	4.18E-13	7.51E-13	1.60E-13	3.78E-06
				V	3.00E-01	-	-	-	3.13E-13	-	

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e		ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Terbium (65)	Tb-147	NA	1.65E+00	h	M	5.00E-04	5.33E-13	7.59E-13	1.37E-12	2.26E-13	7.30E-06
	Tb-149	NA	4.15E+00	h	M	5.00E-04	1.08E-12	1.56E-12	2.90E-12	1.65E-11	7.60E-06
	Tb-150	NA	3.27E+00	h	M	5.00E-04	1.08E-12	1.56E-12	2.92E-12	3.88E-13	7.79E-06
	Tb-151	NA	1.76E+01	h	M	5.00E-04	1.49E-12	2.13E-12	3.92E-12	7.73E-13	3.65E-06
	Tb-153	NA	2.34E+00	d	M	5.00E-04	1.28E-12	1.86E-12	3.54E-12	8.18E-13	7.24E-07
	Tb-154	NA	2.14E+01	h	M	5.00E-04	2.57E-12	3.64E-12	6.51E-12	1.14E-12	1.18E-05
	Tb-155	NA	5.32E+00	d	M	5.00E-04	1.08E-12	1.56E-12	2.97E-12	8.99E-13	3.26E-07
Terbium (65)	Tb-156	NA	5.34E+00	d	M	5.00E-04	4.96E-12	7.10E-12	1.30E-11	4.22E-12	8.37E-06
	Tb-156m	NA	2.44E+01	h	M	5.00E-04	8.44E-13	1.22E-12	2.29E-12	8.47E-13	2.16E-08
	Tb-156n	NA	5.00E+00	h	M	5.00E-04	4.03E-13	5.85E-13	1.11E-12	3.77E-13	4.06E-09
	Tb-157	NA	1.50E+02	y	M	5.00E-04	1.86E-13	2.70E-13	5.29E-13	1.46E-12	1.63E-09
	Tb-158	015759-55-4	1.50E+02	y	M	5.00E-04	4.88E-12	6.99E-12	1.32E-11	8.29E-11	3.57E-06
	Tb-160	013981-29-8	7.23E+01	d	M	5.00E-04	8.70E-12	1.27E-11	2.42E-11	2.45E-11	5.23E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					External Exposure (Risk/y per pCi/g)
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure	
	Tl-207	NA	4.77E+00	m	-	-	-	-	-	-	1.52E-08
	Tl-208	014913-50-9	3.07E+00	m	-	-	-	-	-	-	1.76E-05
	Tl-209	015690-73-0	2.20E+00	m	-	-	-	-	-	-	9.83e-06
Thorium (90)	Th-226	NA	3.09E+01	m	S	5.00E-04	6.66E-13	9.32E-13	1.58E-12	1.56E-10	2.36E-08
	Th-227	015623-47-9	1.87E+01	d	S	5.00E-04	4.74E-11	6.92E-11	1.37E-10	3.51E-08	3.78E-07
	Th-228	014274-82-9	1.91E+00	y	S	5.00E-04	1.07E-10	1.48E-10	2.89E-10	1.32E-07	5.59E-09
	Th-228+D	0147274-82-9(+D)	1.91E+00	y	S	5.00E-04	3.00E-10	4.22E-10	8.09E-10	1.43E-07	7.76E-06
	Th-229	015594-54-4	7.34E+03	y	S	5.00E-04	2.24E-10	2.90E-10	4.96E-10	1.75E-07	2.25E-07
	Th-229+D	015594-54-4(+D)	7.34E+03	y	S	5.00E-04	5.28E-10	7.16E-10	1.29E-09	2.25E-07	1.17E-06
	Th-230	014269-63-7	7.70E+04	y	S	5.00E-04	9.10E-11	1.19E-10	2.02E-10	2.85E-08	8.19E-10
	Th-231	014932-40-2	2.55E+01	h	S	5.00E-04	2.21E-12	3.24E-12	6.36E-12	1.52E-12	2.45E-08
	Th-232	007440-29-1	1.41E+10	y	S	5.00E-04	1.01E-10	1.33E-10	2.31E-10	4.33E-08	3.42E-10
	Th-234	015065-10-8	2.41E+01	d	S	5.00E-04	2.31E-11	3.40E-11	6.70E-11	3.07E-11	1.63E-08

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Thulium (69)	Tm-162	NA	2.17E+01	m	M	5.00E-04	5.66E-14	7.77E-14	1.24E-13	2.72E-14	8.69E-06
	Tm-166	NA	7.70E+00	h	M	5.00E-04	1.12E-12	1.59E-12	2.86E-12	5.14E-13	8.98E-06
	Tm-167	NA	9.24E+00	d	M	5.00E-04	3.46E-12	5.07E-12	9.88E-12	4.37E-12	3.97E-07
	Tm-170	013981-30-1	1.29E+02	d	M	5.00E-04	8.92E-12	1.31E-11	2.59E-11	2.43E-11	1.01E-08
	Tm-171	014333-45-0	1.92E+00	y	M	5.00E-04	6.99E-13	1.02E-12	2.02E-12	3.33E-12	6.97E-10
	Tm-172	NA	6.36E+01	h	M	5.00E-04	1.08E-11	1.57E-11	3.09E-11	5.62E-12	2.35E-06
	Tm-173	NA	8.24E+00	h	M	5.00E-04	1.72E-12	2.52E-12	4.88E-12	7.73E-13	1.62E-06
Thulium (69)	Tm-175	NA	1.52E+01	m	M	5.00E-04	5.22E-14	7.25E-14	1.19E-13	3.26E-14	4.78E-06
Tin (50)	Sn-110	NA	4.00E+00	h	M	2.00E-02	1.87E-12	2.71E-12	5.18E-12	6.70E-13	1.13E-06
	Sn-111	NA	3.53E+01	m	M	2.00E-02	5.51E-14	7.70E-14	1.32E-13	2.83E-14	2.29E-06
	Sn-113	013966-06-8	1.15E+02	d	M	2.00E-02	4.33E-12	6.33E-12	1.22E-11	1.00E-11	2.02E-08
	Sn-117m	NA	1.36E+01	d	M	2.00E-02	4.37E-12	6.40E-12	1.25E-11	8.84E-12	4.69E-07
	Sn-119m	NA	2.93E+02	d	M	2.00E-02	2.21E-12	3.24E-12	6.36E-12	7.81E-12	1.20E-09

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Sn-121	014683-06-8	2.71E+01	h	M	2.00E-02	1.50E-12	2.20E-12	4.33E-12	1.02E-12	1.30E-10
	Sn-121m	014683-06-8m	5.50E+01	y	M	2.00E-02	2.34E-12	3.41E-12	6.66E-12	1.54E-11	8.85E-10
	Sn-123	NA	1.29E+02	d	M	2.00E-02	1.40E-11	2.05E-11	4.03E-11	3.03E-11	3.88E-08
	Sn-123m	NA	4.01E+01	m	M	2.00E-02	7.96E-14	1.12E-13	1.94E-13	5.62E-14	4.62E-07
	Sn-125	014683-08-0	9.64E+00	d	M	2.00E-02	2.01E-11	2.95E-11	5.81E-11	1.41E-11	1.53E-06
	Sn-126	015832-50-5	1.00E+05	y	M	2.00E-02	2.56E-11	3.69E-11	7.07E-11	9.95E-11	9.96E-08
	Sn-127	NA	2.10E+00	h	M	2.00E-02	8.25E-13	1.19E-12	2.22E-12	4.40E-13	9.25E-06
	Sn-128	NA	5.91E+01	m	M	2.00E-02	4.33E-13	6.14E-13	1.09E-12	2.29E-13	2.62E-06
Titanium (22)	Ti-44	NA	4.73E+01	y	S	1.00E-02	2.56E-11	3.64E-11	6.73E-11	3.41E-10	2.39E-07
	Ti-45	NA	3.08E+00	h	S	1.00E-02	6.44E-13	9.32E-13	1.75E-12	3.09E-13	3.79E-06
Tungsten (74)	W-176	NA	2.30E+00	h	F	3.00E-01	4.11E-13	5.88E-13	1.05E-12	1.24E-13	3.20E-07
	W-177	NA	1.35E+02	m	F	3.00E-01	2.01E-13	2.84E-13	5.00E-13	5.99E-14	3.63E-06
	W-178	NA	2.17E+01	d	F	3.00E-01	1.21E-12	1.75E-12	3.33E-12	3.85E-13	1.59E-08

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	m	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
Uranium (92)	W-179	NA	3.75E+01	m	F	3.00E-01	7.22E-15	1.01E-14	1.68E-14	1.83E-15	6.01E-08
	W-181	015749-46-9	1.21E+02	d	F	3.00E-01	3.96E-13	5.70E-13	1.07E-12	1.35E-13	4.86E-08
	W-185	014932-41-3	7.51E+01	d	F	3.00E-01	2.93E-12	4.29E-12	8.36E-12	9.36E-13	2.92E-10
	W-187	014983-48-3	2.39E+01	h	F	3.00E-01	3.67E-12	5.37E-12	1.03E-11	1.11E-12	2.04E-06
	W-188	NA	6.94E+01	d	F	3.00E-01	1.40E-11	2.05E-11	4.00E-11	4.63E-12	7.02E-09
	U-230	NA	2.08E+01	d	M	2.00E-02	2.09E-10	2.98E-10	5.66E-10	4.55E-08	3.07E-09
	U-231	NA	4.20E+00	d	M	2.00E-02	1.75E-12	2.56E-12	5.00E-12	1.80E-12	1.60E-07
	U-232	014158-29-3	7.20E+01	y	M	2.00E-02	2.92E-10	3.85E-10	5.74E-10	1.95E-08	5.98E-10
	U-233	013968-55-3	1.59E+05	y	M	2.00E-02	7.18E-11	9.69E-11	1.60E-10	1.16E-08	9.82E-10
	U-234	013966-29-5	2.45E+05	y	M	2.00E-02	7.07E-11	9.55E-11	1.58E-10	1.14E-08	2.52E-10
	U-235	015117-96-1	7.04E+08	y	M	2.00E-02	6.96E-11	9.44E-11	1.57E-10	1.01E-08	5.18E-07
	U-235+D	015117-96-1(+D)	7.04E+08	y	M	2.00E-02	7.18E-11	9.76E-11	1.63E-10	1.01E-08	5.43E-07
	U-236	013982-70-2	2.34E+07	y	M	2.00E-02	6.70E-11	9.03E-11	1.49E-10	1.05E-08	1.25E-10

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)					
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)	
	Xe-127	013994-19-9	3.64E+01	d	-	-	-	-	-	9.52E-07	
	Xe-129m	013965-99-6	8.00E+00	d	-	-	-	-	-	4.25E-08	
	Xe-131m	014683-11-5	1.19E+01	d	-	-	-	-	-	1.41E-08	
	Xe-133	014932-42-4	5.25E+00	d	-	-	-	-	-	6.62E-08	
	Xe-133m	014932-42-4m	2.19E+00	d	-	-	-	-	-	9.25E-08	
	Xe-135	014995-62-1	9.09E+00	h	-	-	-	-	-	9.70E-07	
	Xe-135m	014995-62-1m	1.53E+01	m	-	-	-	-	-	1.86E-06	
	Xe-138	015751-81-2	1.42E+01	m	-	-	-	-	-	5.62E-06	
Ytterbium (70)	Yb-162	NA	1.89E+01	m	S	5.00E-04	5.22E-14	7.29E-14	1.21E-13	3.00E-14	3.26E-07
	Yb-166	NA	5.67E+01	h	S	5.00E-04	4.37E-12	6.29E-12	1.17E-11	2.89E-12	9.46E-08
	Yb-167	NA	1.75E+01	m	S	5.00E-04	1.56E-14	2.18E-14	3.70E-14	1.71E-14	6.21E-07
	Yb-169	NA	3.20E+01	d	S	5.00E-04	4.00E-12	5.85E-12	1.12E-11	1.08E-11	7.75E-07
	Yb-175	NA	4.19E+00	d	S	5.00E-04	2.87E-12	4.22E-12	8.29E-12	2.95E-12	1.54E-07

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	h	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Yb-177	NA	1.90E+00	h	S	5.00E-04	3.46E-13	5.03E-13	9.51E-13	2.29E-13	8.35E-07
	Yb-178	NA	7.40E+01	m	S	5.00E-04	3.89E-13	5.59E-13	1.06E-12	2.38E-13	1.44E-07
Yttrium (39)	Y-86	NA	1.47E+01	h	S	1.00E-04	4.07E-12	5.81E-12	1.05E-11	1.58E-12	1.73E-05
	Y-86m	NA	4.80E+01	m	S	1.00E-04	2.35E-13	3.35E-13	6.11E-13	9.29E-14	8.35E-07
	Y-87	NA	8.03E+01	h	S	1.00E-04	2.58E-12	3.70E-12	6.92E-12	1.49E-12	1.94E-06
	Y-88	NA	1.07E+02	d	S	1.00E-04	4.18E-12	5.85E-12	9.92E-12	1.70E-11	1.37E-05
	Y-90	010098-91-6	6.40E+01	h	S	1.00E-04	1.81E-11	2.65E-11	5.25E-11	8.40E-12	1.91E-08
	Y-90m	NA	3.19E+00	h	S	1.00E-04	1.04E-12	1.51E-12	2.95E-12	4.81E-13	2.58E-06
	Y-91	014234-24-3	5.85E+01	d	S	1.00E-04	1.60E-11	2.35E-11	4.66E-11	3.36E-11	2.51E-08
	Y-91m	014234-24-3m	4.97E+01	m	S	1.00E-04	3.52E-14	4.96E-14	8.51E-14	3.01E-14	2.34E-06
	Y-92	015751-59-4	3.54E+00	h	S	1.00E-04	2.48E-12	3.61E-12	7.03E-12	9.32E-13	1.26E-06
	Y-93	014981-70-5	1.01E+01	h	S	1.00E-04	7.18E-12	1.05E-11	2.08E-11	2.64E-12	4.60E-07
	Y-94	NA	1.91E+01	m	S	1.00E-04	1.37E-13	1.90E-13	3.08E-13	5.51E-14	5.45E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e		ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient) Lifetime Excess Total Cancer Risk Per Unit Intake or Exposure				
							Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Y-95	NA	1.07E+01	m	S	1.00E-04	7.25E-14	9.99E-14	1.59E-13	2.92E-14	4.80E-06
Zinc (30)	Zn-62	NA	9.26E+00	h	M	5.00E-01	4.96E-12	7.25E-12	1.34E-11	2.65E-12	1.87E-06
	Zn-63	NA	3.81E+01	m	M	5.00E-01	1.61E-13	2.26E-13	3.77E-13	7.55E-14	4.87E-06
	Zn-65	013982-39-3	2.44E+02	d	M	5.00E-01	1.17E-11	1.54E-11	2.45E-11	5.81E-12	2.81E-06
	Zn-69	013982-23-5	5.70E+01	m	M	5.00E-01	7.22E-14	1.03E-13	1.79E-13	6.11E-14	1.67E-09
	Zn-69m	013982-23-5m	1.38E+01	h	M	5.00E-01	1.86E-12	2.73E-12	5.07E-12	1.28E-12	1.77E-06
	Zn-71m	NA	3.92E+00	h	M	5.00E-01	9.66E-13	1.39E-12	2.50E-12	5.33E-13	6.84E-06
Zinc (30)	Zn-72	NA	4.65E+01	h	M	5.00E-01	6.59E-12	9.44E-12	1.71E-11	5.48E-12	4.68E-07
Zirconium (40)	Zr-86	NA	1.65E+01	h	M	1.00E-02	3.85E-12	5.55E-12	1.02E-11	1.56E-12	1.04E-06
	Zr-88	NA	8.34E+01	d	M	1.00E-02	1.58E-12	2.18E-12	3.74E-12	8.95E-12	1.65E-06
	Zr-89	NA	7.84E+01	h	M	1.00E-02	3.60E-12	5.18E-12	9.58E-12	1.92E-12	5.38E-06
	Zr-93	015751-77-6	1.53E+06	y	M	1.00E-02	1.11E-12	1.44E-12	2.12E-12	7.29E-12	0
	Zr-95	013967-71-0	6.40E+01	d	M	1.00E-02	4.59E-12	6.59E-12	1.23E-11	1.65E-11	3.40E-06

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

Element (Atomic Number)	Isotope ^c	CASRN ^d	Radioactive Half-Life ^e	ICRP Lung Type ^f	GI Absorption Fraction (f ₁) ^g	Slope Factor (Morbidity Risk Coefficient)				
						Water Ingestion (Risk/pCi)	Food Ingestion (Risk/pCi)	Soil Ingestion (Risk/pCi)	Inhalation (Risk/pCi)	External Exposure (Risk/y per pCi/g)
	Zr-97	014928-30-4	1.69E+01 h	M	1.00E-02	1.25E-11	1.83E-11	3.57E-11	4.81E-12	8.62e-07

ENDNOTES:

- Risk coefficients for this radionuclide and pathway not specified in *Federal Guidance Report No. 13*.

a) EPA classifies all radionuclides as Group A (known human) carcinogens. Radionuclide risk coefficients, or slope factors, are calculated by EPA's Office of Radiation and Indoor Air (ORIA) to assist *HEAST* users with risk-related evaluations and decision-making at various stages of the remediation process. Most values presented in this tabulation are taken from *Federal Guidance Report No. 13* (EPA 402-R-99-001). (Risk estimates for the soil ingestion pathway are not addressed in *Federal Guidance Report No. 13*, but have been computed using similar methods.) Ingestion and inhalation slope factors are central estimates in a linear model of the age-averaged, lifetime attributable radiation cancer incidence (fatal and nonfatal cancer) risk per unit of activity inhaled or ingested, expressed as risk/picocurie (pCi). Ingestion values are tabulated separately for ingestion of tap water, dietary intakes (food), and incidental soil ingestion. Inhalation values for particulates represent the indicated ICRP lung absorption type, based on the guidelines described in the *User's Guide*; where appropriate, separate values are tabulated for inhalation of the radionuclide in vapor or gas form. External exposure slope factors are central estimates of the lifetime attributable radiation cancer incidence risk for each year of exposure to external radiation from photon-emitting radionuclides uniformly distributed in a thick layer of soil (expressed as risk/year per pCi/g of soil). If required, slope factors in Table 4 can be converted into the International System (SI) units of becquerels (1 Bq = 1 nuclear transformation per second) by dividing each inhalation, ingestion, or external exposure value by 0.037. Users can calculate cancer risks using slope factors expressed in either customary units or SI units with equivalent results provided that they also use air, water and soil concentration values in the same system of units. For a discussion on the derivation of radionuclide slope factors and guidance on their use, refer to the *User's Guide* section on radionuclide carcinogenicity.

b) The curie (Ci), the customary unit of activity is equal to 3.7×10^{10} nuclear transformations per second. 1 picocurie (pCi) = 10^{-12} Ci. The International System (SI) unit of activity is the Becquerel (1 Bq = 1 nuclear transformation per second).

c) For each radionuclide listed, slope factors correspond to the risks per unit intake or exposure for that radionuclide only, except when marked with a "+D" to indicate that the risks from associated short-lived radioactive decay products (i.e., those decay

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

products with radioactive half-lives less than or equal to 6 months) are also included. Refer to Exhibit 1 in the *User's Guide* section on radionuclide carcinogenicity for guidance on determining slope factors for partial or complete radioactive decay chains.

- d) Chemical Abstract Service Reference Number (CASRN). For risk calculations involving decay chains, a CASRN should be reported for the parent radionuclide and each chain member. For radionuclides not included in the 1995 *HEAST* tabulation, CASRN numbers have not yet been assigned and are designated as “NA” (except metastable forms of isotopes with previously assigned numbers, which are designated with a trailing “m”).
- e) Radioactive half-life: s = second, m = minute, d = day, y = year. For those radionuclides with decay products (+D), half-lives are listed for the parent radionuclide.
- f) Lung absorption type recommended by the International Commission on Radiological Protection (ICRP): F = fast (particulate), M = medium (particulate), S = slow (particulate), V = vapor, G = gas.
- g) Gastrointestinal (GI) absorption fractions (f_1) are the fractional amounts of each radionuclide absorbed across the GI tract into the bloodstream. Lung absorption types and GI absorption fractions are provided for reference only. Do not use these factors to adjust inhalation or ingestion slope factors. See the *User's Guide* for instructions.
- h) For isotopes of carbon, two inhalation entries are provided: the value in the first line represents inhalation of carbon in particulate aerosols (with default ICRP lung absorption type M), while the value in the next line represents inhalation of carbon dioxide gas. Values for inhalation of carbon monoxide gas would be lower than the corresponding carbon dioxide values by a factor of 2 for C-11 and 6 for C-14.
- i) For tritium, two sets of values are provided for ingestion and inhalation pathways. The values in the first line represent ingestion of H-3 in the form of tritiated water and inhalation of tritiated water vapor, while values in the second line represent ingestion of organically bound tritium and inhalation of H-3 in particulate form (with default ICRP lung absorption type M). The corresponding value for inhalation of H-3 in organically bound gas would be greater than the value for tritiated water vapor by a factor of 2.3, while the value for inhalation of elemental hydrogen gas would be lower by a factor of 10,000.
- j) For radioisotopes of iodine, the values listed for food ingestion represent ingestion of milk; corresponding values for ingestion of nondairy foods would be lower by a factor of approximately 2. Inhalation values are provided both for inhalation of particulate aerosols (with default ICRP lung absorption type F) and inhalation of vapor. Corresponding values for inhalation of methyl iodide vapor are also provided in *Federal Guidance Report 13*, and are slightly lower than the vapor entries in each case.

Radionuclide Table: Radionuclide Carcinogenicity – Slope Factors ^a
(Federal Guidance Report No. 13 Morbidity Risk Coefficients, in Units of Picocuries) ^b

- k) For radioisotopes of mercury, *Federal Guidance Report No. 13* provides values for inhalation of organic particulates, inorganic particulates and vapors. The inhalation value presented in the first line represents the maximum of the organic or inorganic particulate values (these values are very similar in most cases), and the value in the second line represents inhalation of the radionuclide in vapor form. For ingestion, *Federal Guidance Report No. 13* provides values for inorganic compounds, organic compounds, and methyl mercury for each isotope. The ingestion values reported in Table 4 for each isotope represent the maximum of these three forms.
- l) For radioisotopes of polonium, *Federal Guidance Report No. 13* provides values for ingestion of organic ($f_1=0.5$) and inorganic ($f_1=0.1$) compounds. For purposes of this tabulation, polonium is assumed to be ingested in organic form in foods and in inorganic form in water and soil.
- m) To derive the inhalation slope factor for Rn-222+D, EPA's Office of Radiation and Indoor Air (ORIA) uses a risk model based on radon decay product exposure and the following exposure assumptions: inhalation rate of $1.78E+04$ L/day (Federal Guidance Report 13, p. 139); 40% equilibrium for decay products; and a risk coefficient of $5.38E-04$ fatal lung cancers per working level month (WLM) (see EPA 402-R-03-003, *Assessment of Risks from Radon in Homes*).
- n) For radioisotopes of sulfur, *Federal Guidance Report No. 13* provides values for ingestion of both organic and inorganic compounds. For the purpose of this tabulation, sulfur is assumed to be ingested in organic form in foods and in inorganic form for ingestion of water and soil. The first inhalation value represents inhalation of inorganic particulates (with default ICRP lung absorption type M), while the second value represents inhalation of carbon disulfide vapor; *Federal Guidance Report No. 13* also provides a value for inhalation of sulfur dioxide vapor, at approximately 17% of the value for carbon disulfide.