Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Actinium (89)	Ac-223						1.55E-08	3.58E+07	3.58E+07	5.83E+07	1.31E+08				
Actinium (89)	Ac-224	1.53E-11	2.77E-12	5.59E-12	8.03E-12	4.07E-10	6.06E-07	1.15E+04	1.15E+04	1.89E+04	4.24E+04	8.52E+00	2.20E-01		
Actinium (89)	Ac-225	5.18E-10	9.03E-11	1.89E-10	2.71E-10	2.86E-08	4.50E-08	6.36E+02	4.77E+02	2.44E+03	5.23E+03	2.52E-01	6.51E-03		
Actinium (89)	Ac-226	2.00E-10	2.84E-11	6.92E-11	1.01E-10	4.33E-09	4.46E-07	1.46E+03	1.41E+03	2.54E+03	5.71E+03	6.88E-01	1.75E-02		
Actinium (89)	Ac-227	3.81E-10	2.01E-10	2.01E-10	2.45E-10	1.49E-07	3.48E-10	2.53E+00	1.35E+00	1.14E+01	2.10E+01	2.37E-01	7.20E-03		
Actinium (89)	Ac-227+D	1.16E-09	3.45E-10	4.86E-10	6.53E-10	2.09E-07	1.47E-06	1.04E-01	8.31E-02	2.09E-01	4.67E-01	9.80E-02	2.70E-03		
Actinium (89)	Ac-228	5.55E-12	9.10E-13	1.99E-12	2.89E-12	4.92E-11	4.53E-06	7.32E+02	7.31E+02	1.19E+03	2.69E+03	2.39E+01	6.10E-01		
Aluminum (13)	Al-26	4.70E-11	8.18E-12	1.73E-11	2.49E-11	6.92E-11	1.33E-05	8.38E-03	6.28E-03	1.64E-02	3.70E-02	2.75E+00	7.08E-02		
Aluminum (13)	Al-28						9.32E-06	5.84E+04	5.84E+04	9.53E+04	2.14E+05				
Americium (95)	Am-237	1.24E-13	3.12E-14	5.07E-14	7.18E-14	5.77E-14	1.35E-06	1.24E+04	1.23E+04	2.02E+04	4.54E+04	9.39E+02	2.46E+01	3.54E+12	1.77E+11
Americium (95)	Am-238	2.28E-13	5.96E-14	9.62E-14	1.35E-13	9.51E-14	4.02E-06	3.09E+03	3.09E+03	5.05E+03	1.14E+04	4.95E+02	1.31E+01	1.03E+12	5.17E+10
Americium (95)	Am-239	3.89E-12	5.99E-13	1.38E-12	2.01E-12	8.40E-13	6.91E-07	2.47E+03	2.16E+03	4.03E+03	9.07E+03	3.45E+01	8.77E-01	1.36E+09	6.79E+07
Americium (95)	Am-240	6.81E-12	1.27E-12	2.59E-12	3.70E-12	1.41E-12	4.69E-06	8.53E+01	8.21E+01	1.39E+02	3.13E+02	1.84E+01	4.77E-01	3.97E+07	1.98E+06
Americium (95)	Am-241	2.17E-10	9.10E-11	1.04E-10	1.34E-10	2.81E-08	2.76E-08	1.87E+00	1.32E-02	5.67E+00	1.19E+01	4.58E-01	1.32E-02	2.58E+00	1.29E-01
Americium (95)	Am-242	5.14E-12	7.51E-13	1.79E-12	2.62E-12	5.03E-11	3.48E-08	3.57E+04	7.82E+03	5.94E+04	1.34E+05	2.66E+01	6.73E-01	5.79E+08	2.90E+07
Americium (95)	Am-242m	1.29E-10	7.33E-11	7.07E-11	8.77E-11	1.56E-08	1.05E-09	5.63E+00	2.14E-02	2.24E+01	4.13E+01	6.74E-01	2.01E-02	1.30E-01	6.48E-03
Americium (95)	Am-242m+D	2.21E-10	8.95E-11	1.04E-10	1.36E-10	2.81E-08	4.83E-08	1.45E+00	1.37E-02	3.87E+00	8.32E+00	4.58E-01	1.30E-02	8.81E-02	4.40E-03
Americium (95)	Am-243	2.17E-10	9.03E-11	1.03E-10	1.34E-10	2.70E-08	9.47E-08	8.71E-01	1.27E-02	2.06E+00	4.51E+00	4.62E-01	1.32E-02	2.52E+00	1.26E-01
Americium (95)	Am-243+D	2.32E-10	2.15E-12	1.08E-10	1.42E-10	2.70E-08	6.36E-07	1.66E-01	1.11E-02	3.44E-01	7.73E-01	4.41E-01	1.24E-02	2.52E+00	1.26E-01
Americium (95)	Am-244	7.03E-12	1.12E-12	2.52E-12	3.66E-12	3.09E-12	3.58E-06	5.62E+02	5.35E+02	9.17E+02	2.06E+03	1.89E+01	4.82E-01	1.03E+09	5.16E+07
Americium (95)	Am-244m	1.18E-13	3.81E-14	5.11E-14	7.10E-14	1.02E-13	5.09E-09	9.18E+06	5.49E+06	1.50E+07	3.38E+07	9.32E+02	2.48E+01	2.77E+13	1.38E+12
Americium (95)	Am-245	6.11E-13	1.10E-13	2.22E-13	3.22E-13	1.56E-13	1.04E-07	9.52E+04	8.28E+04	1.56E+05	3.50E+05	2.15E+02	5.48E+00	2.84E+11	1.42E+10
Americium (95)	Am-246	2.93E-13	8.47E-14	1.23E-13	1.73E-13	1.31E-13	2.93E-06	1.07E+04	1.06E+04	1.74E+04	3.92E+04	3.87E+02	1.02E+01	5.11E+12	2.55E+11
Americium (95)	Am-246m	1.48E-13	4.96E-14	6.59E-14	9.10E-14	3.96E-14	4.83E-06	1.01E+04	1.01E+04	1.65E+04	3.71E+04	7.23E+02	1.94E+01	2.32E+13	1.16E+12
Antimony (51)	Sb-115	1.16E-13	3.70E-14	5.14E-14	7.10E-14	2.33E-14	3.92E-06	9.78E+03	9.78E+03	1.60E+04	3.59E+04	9.26E+02	2.48E+01		
Antimony (51)	Sb-116	1.07E-13	3.89E-14	4.96E-14	6.81E-14	1.88E-14	1.05E-05	7.35E+03	7.35E+03	1.20E+04	2.70E+04	9.60E+02	2.59E+01		
Antimony (51)	Sb-116m	4.00E-13	1.18E-13	1.76E-13	2.45E-13	8.81E-14	1.47E-05	1.38E+03	1.38E+03	2.24E+03	5.05E+03	2.71E+02	7.20E+00		
Antimony (51)	Sb-117	1.70E-13	3.50E-14	6.59E-14	9.44E-14	4.07E-14	5.78E-07	1.26E+04	1.26E+04	2.05E+04	4.61E+04	7.23E+02	1.87E+01		
Antimony (51)	Sb-118m	1.67E-12	4.07E-13	6.99E-13	9.81E-13	2.64E-13	1.21E-05	3.36E+02	3.36E+02	5.48E+02	1.23E+03	6.81E+01	1.80E+00		
Antimony (51)	Sb-119	1.35E-12	2.01E-13	4.77E-13	6.96E-13	1.74E-13	2.58E-09	1.82E+05	1.57E+05	3.34E+05	7.50E+05	9.98E+01	2.53E+00		
Antimony (51)	Sb-120a	5.44E-14	1.94E-14	2.48E-14	3.42E-14	1.12E-14	1.94E-06	3.95E+04	3.95E+04	6.45E+04	1.45E+05	1.92E+03	5.16E+01		
Antimony (51)	Sb-120b	1.08E-11	2.45E-12	4.44E-12	6.22E-12	3.30E-12	1.15E-05	1.28E+01	1.28E+01	2.09E+01	4.69E+01	1.07E+01	2.84E-01		
Antimony (51)	Sb-122	3.03E-11	4.44E-12	1.06E-11	1.55E-11	5.48E-12	1.97E-06	1.59E+02	1.58E+02	2.60E+02	5.84E+02	4.49E+00	1.14E-01		
Antimony (51)	Sb-124	3.50E-11	6.03E-12	1.29E-11	1.85E-11	2.43E-11	8.89E-06	1.58E+00	1.58E+00	2.58E+00	5.81E+00	3.69E+00	9.53E-02		
Antimony (51)	Sb-124m						1.56E-06	5.04E+05	5.04E+05	8.23E+05	1.85E+06				
Antimony (51)	Sb-124n	3.81E-14	1.20E-14	1.67E-14	2.32E-14	1.15E-14	7.76E-12	3.30E+09	1.76E+09	1.07E+10	2.31E+10	2.85E+03	7.60E+01		
Antimony (51)	Sb-125	1.12E-11	2.38E-12	4.37E-12	6.14E-12	1.66E-11	1.81E-06	4.62E-01	4.61E-01	7.56E-01	1.70E+00	1.09E+01	2.87E-01		
Antimony (51)	Sb-125+D	1.32E-11		5.13E-12	7.21E-12	1.93E-11	1.81E-06	4.62E-01	4.60E-01	7.56E-01	1.70E+00	9.28E+00	2.45E-01		
Antimony (51)	Sb-126	2.93E-11	5.40E-12	1.11E-11	1.59E-11	1.15E-11	1.28E-05	5.33E+00	5.33E+00	8.70E+00	1.96E+01	4.29E+00	1.11E-01		
Antimony (51)	Sb-126m	1.48E-13	5.11E-14	6.66E-14	9.21E-14	3.16E-14	6.94E-06	9.25E+03	9.25E+03	1.51E+04	3.39E+04	7.15E+02	1.91E+01		
Antimony (51)	Sb-127	2.85E-11	4.29E-12	1.01E-11	1.47E-11	7.51E-12	3.07E-06	7.15E+01	7.12E+01	1.17E+02	2.63E+02	4.71E+00	1.20E-01		
Antimony (51)	Sb-128a	1.19E-13	4.44E-14	5.51E-14	7.55E-14	2.12E-14	9.03E-06	1.30E+04	1.30E+04	2.12E+04	4.77E+04	8.64E+02	2.34E+01		
Antimony (51)	Sb-128b	9.21E-12	1.67E-12	3.45E-12	4.96E-12	1.44E-12	1.40E-05	1.61E+02	1.61E+02	2.63E+02	5.91E+02	1.38E+01	3.56E-01		
Antimony (51)	Sb-129	6.11E-12	9.81E-13	2.19E-12	3.19E-12	9.62E-13	6.85E-06	6.86E+02	6.86E+02	1.12E+03	2.52E+03	2.17E+01	5.53E-01		
Antimony (51)	Sb-130	4.77E-13	1.44E-13	2.07E-13	2.88E-13	9.73E-14	1.51E-05	2.02E+03	2.02E+03	3.29E+03	7.41E+03	2.30E+02	6.12E+00		
Antimony (51)	Sb-131	6.48E-13	1.59E-13	2.56E-13	3.59E-13	9.73E-14	9.08E-06	5.84E+03	5.84E+03	9.53E+03	2.14E+04	1.86E+02	4.91E+00		
Argon (18)	Ar-37						0.00E+00								
Argon (18)	Ar-39						5.94E-10	1.95E+02	1.48E+02	3.80E+02	8.55E+02				
Argon (18)	Ar-41						6.39E-06	1.74E+03	1.74E+03	2.84E+03	6.38E+03				
Arsenic (33)	As-69	2.39E-13	7.70E-14	1.05E-13	1.46E-13	4.29E-14	4.43E-06	1.81E+04	1.81E+04	2.95E+04	6.65E+04	4.54E+02	1.21E+01		
Arsenic (33)	As-70	7.40E-13	2.16E-13	3.20E-13	4.48E-13	1.37E-13	1.96E-05	1.18E+03	1.18E+03	1.93E+03	4.34E+03	1.49E+02	3.94E+00		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Arsenic (33)	As-71	6.07E-12	1.09E-12	2.28E-12	3.29E-12	1.52E-12	2.37E-06	1.32E+02	1.31E+02	2.16E+02	4.86E+02	2.09E+01	5.36E-01		
Arsenic (33)	As-72	2.79E-11	4.55E-12	1.02E-11	1.48E-11	4.29E-12	8.21E-06	9.48E+01	9.39E+01	1.55E+02	3.49E+02	4.67E+00	1.19E-01		
Arsenic (33)	As-73	4.40E-12	6.85E-13	1.56E-12	2.28E-12	3.88E-12	5.78E-09	1.01E+03	4.53E+02	2.93E+03	6.58E+03	3.05E+01	7.74E-01		
Arsenic (33)	As-74	1.82E-11	3.17E-12	6.70E-12	9.69E-12	8.44E-12	3.35E-06	1.41E+01	1.39E+01	2.32E+01	5.21E+01	7.11E+00	1.82E-01		
Arsenic (33)	As-76	2.70E-11	4.14E-12	9.66E-12	1.42E-11	4.14E-12	2.01E-06	3.79E+02	3.65E+02	6.27E+02	1.41E+03	4.93E+00	1.24E-01		
Arsenic (33)	As-77	7.03E-12	1.06E-12	2.50E-12	3.67E-12	1.76E-12	3.58E-08	1.21E+04	8.19E+03	2.38E+04	5.35E+04	1.90E+01	4.81E-01		
Arsenic (33)	As-78	1.61E-12	3.59E-13	6.33E-13	9.03E-13	2.69E-13	6.11E-06	2.20E+03	2.20E+03	3.59E+03	8.08E+03	7.52E+01	1.95E+00		
Astatine (85)	At-207	1.66E-12	4.77E-13	6.96E-13	9.51E-13	7.77E-12	6.11E-06	1.85E+03	1.85E+03	3.01E+03	6.78E+03	6.84E+01	1.85E+00		
Astatine (85)	At-211	8.21E-11	2.23E-11	3.37E-11	4.63E-11	3.58E-10	7.94E-08	3.10E+04	3.12E+04	5.60E+04	1.25E+05	1.41E+00	3.81E-02		
Astatine (85)	At-215						8.09E-10	9.04E+14	9.04E+14	1.48E+15	3.32E+15				
Astatine (85)	At-216						3.08E-09	7.92E+13	7.92E+13	1.29E+14	2.91E+14				
Astatine (85)	At-217						1.32E-09	1.72E+12	1.72E+12	2.80E+12	6.30E+12				
Astatine (85)	At-218						3.57E-09	1.02E+10	1.02E+10	1.67E+10	3.76E+10				
Barium (56)	Ba-126	2.24E-12	4.66E-13	8.51E-13	1.22E-12	3.49E-13	5.83E-07	2.17E+04	2.16E+04	3.54E+04	7.96E+04	5.60E+01	1.45E+00		
Barium (56)	Ba-128	4.33E-11	6.92E-12	1.52E-11	2.23E-11	7.22E-12	2.10E-07	1.59E+03	1.41E+03	2.70E+03	6.06E+03	3.13E+00	7.91E-02		
Barium (56)	Ba-131	5.25E-12	1.02E-12	2.00E-12	2.87E-12	2.91E-12	1.77E-06	4.05E+01	4.04E+01	6.61E+01	1.49E+02	2.38E+01	6.15E-01		
Barium (56)	Ba-131m	2.11E-14	6.88E-15	9.25E-15	1.29E-14	1.69E-14	1.67E-07	5.00E+05	5.00E+05	8.16E+05	1.84E+06	5.15E+03	1.37E+02		
Barium (56)	Ba-133	1.39E-11	4.37E-12	6.81E-12	9.44E-12	1.16E-11	1.44E-06	1.75E-01	1.61E-01	3.06E-01	6.89E-01	6.99E+00	1.87E-01		
Barium (56)	Ba-133m	9.07E-12	1.42E-12	3.19E-12	4.66E-12	2.04E-12	1.96E-07	2.64E+03	2.56E+03	4.35E+03	9.77E+03	1.49E+01	3.78E-01		
Barium (56)	Ba-135m	7.29E-12	1.14E-12	2.56E-12	3.74E-12	1.61E-12	1.70E-07	4.13E+03	4.02E+03	6.79E+03	1.53E+04	1.86E+01	4.72E-01		
Barium (56)	Ba-137m						2.69E-06	1.78E+05	1.78E+05	2.90E+05	6.53E+05				
Barium (56)	Ba-139	9.73E-13	2.06E-13	3.70E-13	5.33E-13	1.79E-13	1.65E-07	8.92E+04	8.89E+04	1.46E+05	3.28E+05	1.29E+02	3.31E+00		
Barium (56)	Ba-140	4.18E-11	6.77E-12	1.49E-11	2.17E-11	2.03E-11	7.61E-07	8.67E+01	8.37E+01	1.43E+02	3.21E+02	3.20E+00	8.13E-02		
Barium (56)	Ba-141	5.59E-13	1.22E-13	2.14E-13	3.07E-13	9.69E-14	3.79E-06	1.76E+04	1.76E+04	2.87E+04	6.45E+04	2.23E+02	5.74E+00		
Barium (56)	Ba-142	2.27E-13	5.88E-14	9.29E-14	1.31E-13	4.55E-14	4.85E-06	2.37E+04	2.37E+04	3.87E+04	8.71E+04	5.13E+02	1.35E+01		
Berkelium (97)	Bk-245	9.73E-12	1.45E-12	3.43E-12	5.00E-12	7.22E-12	7.09E-07	2.41E+02	2.41E+02	3.94E+02	8.87E+02	1.39E+01	3.53E-01		
Berkelium (97)	Bk-246	5.25E-12	9.99E-13	2.01E-12	2.88E-12	9.25E-13	4.25E-06	1.09E+02	1.09E+02	1.78E+02	4.00E+02	2.37E+01	6.12E-01		
Berkelium (97)	Bk-247	2.49E-10	1.12E-10	1.24E-10	1.60E-10	3.26E-08	3.09E-07	3.27E-01	2.47E-01	6.80E-01	1.51E+00	3.84E-01	1.10E-02		
Berkelium (97)	Bk-249	2.95E-12	5.99E-13	1.11E-12	1.57E-12	5.14E-11	2.63E-12	6.34E+03	6.61E+03	5.60E+04	1.02E+05	4.29E+01	1.12E+00		
Berkelium (97)	Bk-250	1.54E-12	2.77E-13	5.66E-13	8.18E-13	1.03E-12	4.23E-06	1.49E+03	1.49E+03	2.43E+03	5.48E+03	8.41E+01	2.16E+00		
Beryllium (4)	Be-10	2.02E-11	2.96E-12	7.03E-12	1.02E-11	9.40E-11	7.43E-10	2.48E+01	1.16E+01	1.97E+02	4.10E+02	6.77E+00	1.73E-01		
Beryllium (4)	Be-7	2.02E-13	5.03E-14	8.66E-14	1.20E-13	2.13E-13	2.13E-07	7.46E+01	7.45E+01	1.22E+02	2.74E+02	5.50E+02	1.47E+01		
Bismuth (83)	Bi-200	3.65E-13	9.36E-14	1.52E-13	2.13E-13	7.55E-14	1.06E-05	3.16E+03	3.16E+03	5.16E+03	1.16E+04	3.13E+02	8.28E+00		
Bismuth (83)	Bi-201	1.09E-12	2.26E-13	4.22E-13	6.03E-13	1.90E-13	6.05E-06	1.87E+03	1.86E+03	3.04E+03	6.85E+03	1.13E+02	2.92E+00		
Bismuth (83)	Bi-202	6.18E-13	1.66E-13	2.65E-13	3.69E-13	1.12E-13	1.24E-05	9.81E+02	9.81E+02	1.60E+03	3.60E+03	1.80E+02	4.78E+00		
Bismuth (83)	Bi-203	4.85E-12	1.01E-12	1.92E-12	2.73E-12	8.21E-13	1.16E-05	1.48E+02	1.48E+02	2.42E+02	5.45E+02	2.48E+01	6.46E-01		
Bismuth (83)	Bi-205	8.18E-12	1.79E-12	3.32E-12	4.66E-12	3.24E-12	8.19E-06	6.75E+00	6.72E+00	1.10E+01	2.48E+01	1.43E+01	3.78E-01		
Bismuth (83)	Bi-206	1.98E-11	4.00E-12	7.73E-12	1.10E-11	5.85E-12	1.52E-05	8.91E+00	8.87E+00	1.46E+01	3.28E+01	6.16E+00	1.60E-01		
Bismuth (83)	Bi-207	1.49E-11	2.77E-12	5.66E-12	8.14E-12	2.10E-11	7.08E-06	2.04E-02	1.65E-02	3.84E-02	8.65E-02	8.41E+00	2.17E-01		
Bismuth (83)	Bi-210	2.55E-11	3.74E-12	8.92E-12	1.30E-11	3.17E-10	2.76E-09	4.80E+03	1.34E+03	8.55E+04	1.86E+05	5.34E+00	1.36E-01		
Bismuth (83)	Bi-210m	1.45E-10	2.92E-11	5.51E-11	7.77E-11	1.17E-08	1.01E-06	9.27E-02	4.79E-02	2.16E-01	4.84E-01	8.64E-01	2.27E-02		
Bismuth (83)	Bi-211						1.88E-07	3.03E+06	3.03E+06	4.95E+06	1.11E+07				
Bismuth (83)	Bi-212	1.78E-12	4.40E-13	7.10E-13	9.99E-13	7.77E-11	8.87E-07	2.26E+04	2.24E+04	3.70E+04	8.33E+04	6.71E+01	1.77E+00		
Bismuth (83)	Bi-213	1.28E-12	3.17E-13	5.11E-13	7.18E-13	6.85E-11	5.65E-07	4.71E+04	4.67E+04	7.70E+04	1.73E+05	9.32E+01	2.46E+00		
Bismuth (83)	Bi-214	4.33E-13	1.47E-13	1.92E-13	2.65E-13	2.90E-11	7.48E-06	8.19E+03	8.19E+03	1.34E+04	3.01E+04	2.48E+02	6.66E+00		
Bromine (35)	Br-74	3.19E-13	1.22E-13	1.50E-13	2.05E-13	6.44E-14	2.32E-05	2.08E+03	2.08E+03	3.39E+03	7.63E+03	3.17E+02	8.60E+00		
Bromine (35)	Br-74m	5.29E-13	1.98E-13	2.46E-13	3.36E-13	1.15E-13	2.00E-05	1.47E+03	1.47E+03	2.40E+03	5.39E+03	1.94E+02	5.25E+00		
Bromine (35)	Br-75	3.42E-13	1.22E-13	1.57E-13	2.13E-13	1.13E-13	5.21E-06	2.39E+03	2.38E+03	3.90E+03	8.77E+03	3.03E+02	8.28E+00		
Bromine (35)	Br-76	3.34E-12	9.99E-13	1.45E-12	1.97E-12	1.10E-12	1.30E-05	9.62E+01	9.55E+01	1.57E+02	3.54E+02	3.28E+01	8.95E-01		
Bromine (35)	Br-77	6.51E-13	2.20E-13	3.01E-13	4.03E-13	2.06E-13	1.34E-06	2.69E+02	2.65E+02	4.42E+02	9.94E+02	1.58E+02	4.38E+00		
Bromine (35)	Br-80	1.03E-13	3.85E-14	4.70E-14	6.48E-14	1.80E-14	3.55E-07	1.97E+05	1.95E+05	3.22E+05	7.25E+05	1.01E+03	2.72E+01		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

		Toxicity						Preliminary Remediation Goals (PRG)						Soil to Groundwater	
Element (Atomic Number)	Isotope	Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	DAF=20 (pCi/g)	DAF=1 (pCi/g)
Bromine (35)	Br-80m	6.70E-13	1.97E-13	2.82E-13	3.89E-13	2.43E-13	5.95E-09	3.64E+05	1.38E+05	1.26E+06	2.82E+06	1.69E+02	4.53E+00		
Bromine (35)	Br-82	3.70E-12	1.24E-12	1.71E-12	2.30E-12	1.66E-12	1.24E-05	4.63E+01	4.58E+01	7.58E+01	1.70E+02	2.78E+01	7.67E-01		
Bromine (35)	Br-83	1.94E-13	6.33E-14	8.44E-14	1.16E-13	1.21E-13	3.46E-08	2.32E+05	1.99E+05	4.01E+05	9.02E+05	5.64E+02	1.52E+01		
Bromine (35)	Br-84	3.21E-13	1.19E-13	1.48E-13	2.02E-13	7.18E-14	9.35E-06	4.10E+03	4.09E+03	6.69E+03	1.51E+04	3.22E+02	8.73E+00		
Cadmium (48)	Cd-104	4.14E-13	1.02E-13	1.72E-13	2.41E-13	7.66E-14	9.70E-07	2.17E+04	1.74E+04	3.55E+04	8.00E+04	2.77E+02	7.32E+00	5.76E+11	2.88E+10
Cadmium (48)	Cd-107	9.99E-13	1.49E-13	3.50E-13	5.11E-13	3.10E-13	3.48E-08	8.16E+04	5.61E+03	1.47E+05	3.30E+05	1.36E+02	3.45E+00	6.21E+09	3.11E+08
Cadmium (48)	Cd-109	1.14E-11	3.36E-12	5.00E-12	6.70E-12	2.19E-11	8.73E-09	3.32E+01	2.66E-01	3.26E+02	7.25E+02	9.52E+00	2.63E-01	5.69E+02	2.85E+01
Cadmium (48)	Cd-113	3.85E-11	2.18E-11	2.28E-11	2.90E-11	1.12E-10	7.36E-11	5.65E-01	2.80E-03	7.83E+01	1.42E+02	2.09E+00	6.08E-02	1.23E-01	6.14E-03
Cadmium (48)	Cd-113m	5.11E-11	2.63E-11	2.87E-11	3.64E-11	1.30E-10	4.45E-10	8.70E-01	5.26E-03	1.05E+02	1.94E+02	1.66E+00	4.85E-02	3.67E-01	1.83E-02
Cadmium (48)	Cd-115	2.47E-11	3.60E-12	8.66E-12	1.27E-11	5.14E-12	1.01E-06	3.46E+02	2.71E+01	6.13E+02	1.38E+03	5.50E+00	1.39E-01	3.70E+06	1.85E+05
Cadmium (48)	Cd-115m	4.74E-11	7.70E-12	1.70E-11	2.46E-11	2.92E-11	1.13E-07	6.69E+01	7.50E-01	2.72E+02	6.10E+02	2.80E+00	7.17E-02	4.70E+03	2.35E+02
Cadmium (48)	Cd-117	3.81E-12	6.22E-13	1.37E-12	1.99E-12	6.51E-13	5.23E-06	1.56E+03	1.12E+03	2.55E+03	5.73E+03	3.48E+01	8.86E-01	1.08E+10	5.39E+08
Cadmium (48)	Cd-117m	3.26E-12	6.03E-13	1.22E-12	1.76E-12	6.55E-13	1.03E-05	5.86E+02	5.00E+02	9.58E+02	2.16E+03	3.90E+01	1.00E+00	6.65E+09	3.33E+08
Calcium (20)	Ca-41	5.74E-13	3.24E-13	3.53E-13	4.37E-13	2.09E-13	0.00E+00	2.26E+01	3.90E+00	5.49E+03	9.88E+03	1.35E+02	4.04E+00		
Calcium (20)	Ca-45	6.07E-12	1.52E-12	2.47E-12	3.37E-12	9.40E-12	3.96E-11	1.35E+02	3.14E+01	3.74E+04	6.98E+04	1.93E+01	5.23E-01		
Calcium (20)	Ca-47	2.02E-11	3.85E-12	7.55E-12	1.08E-11	7.88E-12	5.24E-06	3.48E+01	3.24E+01	5.82E+01	1.31E+02	6.31E+00	1.63E-01		
Calcium (20)	Ca-49						1.75E-05	7.99E+03	7.99E+03	1.30E+04	2.93E+04				
Californium (98)	Cf-244	2.93E-13	9.03E-14	1.25E-13	1.74E-13	2.96E-11	6.83E-11	5.54E+08	5.07E+08	1.28E+09	2.79E+09	3.81E+02	1.01E+01		
Californium (98)	Cf-246	6.11E-11	8.58E-12	2.11E-11	3.09E-11	1.47E-09	9.25E-11	6.07E+04	5.09E+04	7.92E+05	1.45E+06	2.26E+00	5.71E-02		
Californium (98)	Cf-248	1.18E-10	2.42E-11	4.44E-11	6.22E-11	1.81E-08	4.73E-11	1.40E+02	1.16E+02	1.24E+03	2.28E+03	1.07E+00	2.84E-02		
Californium (98)	Cf-249	2.54E-10	1.14E-10	1.27E-10	1.63E-10	3.40E-08	1.37E-06	8.15E-02	6.13E-02	1.62E-01	3.63E-01	3.75E-01	1.08E-02		
Californium (98)	Cf-250	1.85E-10	7.10E-11	8.62E-11	1.12E-10	2.66E-08	4.48E-11	7.76E+00	5.67E+00	4.26E+01	7.76E+01	5.52E-01	1.57E-02		
Californium (98)	Cf-251	2.67E-10	1.17E-10	1.32E-10	1.70E-10	3.40E-08	3.76E-07	2.70E-01	1.99E-01	5.64E-01	1.26E+00	3.61E-01	1.04E-02		
Californium (98)	Cf-252			6.85E-08	9.30E+08	2.59E-05	8.66E-11	4.25E-17	1.02E-17	3.10E+00	6.97E+00	6.95E-04	1.90E-21		
Californium (98)	Cf-253	1.20E-11	1.96E-12	4.26E-12	6.11E-12	4.22E-09	4.86E-11	2.51E+04	2.11E+04	2.13E+05	4.11E+05	1.12E+01	2.89E-01		
Californium (98)	Cf-254						1.46E-13	9.58E+07	9.58E+07	1.56E+08	3.52E+08				
Carbon (6)	C-11	8.70E-14	3.32E-14	4.07E-14	5.59E-14	2.78E-14	4.45E-06	1.34E+04	1.30E+03	2.19E+04	4.93E+04	1.17E+03	3.16E+01	6.71E+12	3.36E+11
Carbon (6)	C-14	2.79E-12	1.38E-12	1.55E-12	2.00E-12	7.07E-12	7.83E-12	4.56E-01	5.63E-05	1.23E+03	2.24E+03	1.29E+00	8.82E-01	4.01E+01	2.00E+00
Cerium (58)	Ce-134	4.59E-11	6.62E-12	1.59E-11	2.33E-11	6.96E-12	8.24E-09	1.79E+04	9.86E+02	5.09E+04	1.12E+05	2.99E+00	7.57E-02	1.35E+07	6.74E+05
Cerium (58)	Ce-135	1.02E-11	1.78E-12	3.81E-12	5.48E-12	1.75E-12	7.74E-06	1.49E+02	1.48E+02	2.43E+02	5.48E+02	1.25E+01	3.22E-01	9.42E+08	4.71E+07
Cerium (58)	Ce-137	3.64E-13	5.85E-14	1.31E-13	1.91E-13	4.11E-14	4.46E-08	5.06E+04	4.82E+04	8.26E+04	1.86E+05	3.64E+02	9.23E+00	1.05E+11	5.24E+09
Cerium (58)	Ce-137m	9.99E-12	1.42E-12	3.47E-12	5.07E-12	1.94E-12	1.38E-07	4.23E+03	2.98E+03	6.98E+03	1.57E+04	1.37E+01	3.48E-01	2.71E+08	1.35E+07
Cerium (58)	Ce-139	3.70E-12	6.07E-13	1.35E-12	1.95E-12	5.66E-12	4.54E-07	1.35E+01	1.29E+01	2.20E+01	4.96E+01	3.53E+01	9.04E-01	7.51E+04	3.75E+03
Cerium (58)	Ce-143	2.04E-11	2.93E-12	7.10E-12	1.04E-11	3.74E-12	1.09E-06	5.63E+02	5.07E+02	9.22E+02	2.07E+03	6.71E+00	1.70E-01	1.44E+08	7.19E+06
Cerium (58)	Ce-141	1.34E-11	1.89E-12	4.63E-12	6.77E-12	1.14E-11	2.27E-07	1.14E+02	8.46E+01	1.87E+02	4.21E+02	1.03E+01	2.61E-01	3.95E+05	1.97E+04
Cerium (58)	Ce-144	1.02E-10	1.42E-11	3.52E-11	5.18E-11	1.10E-10	5.02E-08	4.46E+01	4.46E+00	9.36E+01	2.09E+02	1.35E+00	3.40E-02	5.64E+02	2.82E+01
Cerium (58)	Ce-144+D	1.02E-10		3.53E-11	5.19E-11	1.10E-10	2.44E-07	1.14E+01	3.45E+00	1.99E+01	4.49E+01	1.35E+00	3.40E-02	5.64E+02	2.82E+01
Cesium (55)	Cs-125	1.29E-13	4.77E-14	5.96E-14	8.18E-14	1.64E-14	2.92E-06	9.28E+03	8.60E+03	1.51E+04	3.41E+04	7.99E+02	2.16E+01	9.61E+12	4.81E+11
Cesium (55)	Cs-126						4.74E-06	1.57E+05	1.57E+05	2.56E+05	5.76E+05				
Cesium (55)	Cs-127	1.38E-13	5.00E-14	6.51E-14	8.73E-14	2.47E-14	1.68E-06	1.93E+03	1.69E+03	3.16E+03	7.11E+03	7.31E+02	2.02E+01	1.27E+11	6.34E+09
Cesium (55)	Cs-128						3.92E-06	7.97E+04	7.97E+04	1.30E+05	2.93E+05				
Cesium (55)	Cs-129	4.00E-13	1.38E-13	1.85E-13	2.48E-13	7.44E-14	1.05E-06	6.03E+02	3.63E+02	9.84E+02	2.21E+03	2.57E+02	7.11E+00	1.69E+09	8.45E+07
Cesium (55)	Cs-130	1.02E-13	3.85E-14	4.74E-14	6.48E-14	1.24E-14	2.22E-06	1.84E+04	1.70E+04	3.00E+04	6.74E+04	1.00E+03	2.72E+01	2.74E+13	1.37E+12
Cesium (55)	Cs-131	4.11E-13	1.37E-13	1.86E-13	2.49E-13	7.51E-14	4.90E-09	1.69E+04	1.25E+02	2.90E+04	6.52E+04	2.56E+02	7.08E+00	3.20E+07	1.60E+06
Cesium (55)	Cs-132	2.89E-12	1.18E-12	1.46E-12	1.91E-12	5.92E-13	3.11E-06	4.20E+01	1.55E+01	6.86E+01	1.54E+02	3.26E+01	9.23E-01	9.12E+06	4.56E+05
Cesium (55)	Cs-134	5.81E-11	4.48E-11	4.22E-11	5.14E-11	1.65E-11	7.10E-06	1.57E-01	7.47E-03	2.59E-01	5.82E-01	1.13E+00	3.43E-02	1.65E+02	8.24E+00
Cesium (55)	Cs-134m	8.84E-14	3.28E-14	4.14E-14	5.55E-14	1.99E-14	5.02E-08	1.39E+05	3.41E+04	2.28E+05	5.12E+05	1.15E+03	3.18E+01	9.25E+11	4.63E+10
Cesium (55)	Cs-135	7.18E-12	4.70E-12	4.74E-12	5.88E-12	1.86E-12	2.36E-11	1.78E+01	5.09E-03	3.63E+02	6.59E+02	1.00E+01	3.00E-01	1.84E+02	9.18E+00
Cesium (55)	Cs-135m	9.10E-14	3.66E-14	4.51E-14	6.07E-14	1.32E-14	7.37E-06	3.12E+03	3.05E+03	5.09E+03	1.15E+04	1.06E+03	2.91E+01	9.16E+12	4.58E+11
Cesium (55)	Cs-136	1.65E-11	7.22E-12	8.66E-12	1.12E-11	3.49E-12	1.00E-05	6.45E+00	1.56E+00	1.05E+01	2.37E+01	5.50E+00	1.57E-01	3.76E+05	1.88E+04
Cesium (55)	Cs-137	4.33E-11	3.17E-11	3.04E-11	3.74E-11	1.19E-11	5.32E-10	3.88E+00	1.23E-03	6.50E+01	1.20E+02	1.57E+00	4.72E-02	5.66E+01	2.83E+00

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Cesium (55)	Cs-137+D	4.33E-11	3.17E-11	3.04E-11	3.74E-11	1.19E-11	2.55E-06	5.97E-02	1.20E-03	1.13E-01	2.53E-01	1.57E+00	4.72E-02	5.66E+01	2.83E+00
Cesium (55)	Cs-138	3.40E-13	1.27E-13	1.58E-13	2.16E-13	4.00E-14	1.19E-05	3.18E+03	3.03E+03	5.19E+03	1.17E+04	3.01E+02	8.17E+00	7.08E+12	3.54E+11
Chlorine (17)	Cl-36	7.66E-12	2.29E-12	3.30E-12	4.44E-12	2.50E-11	1.74E-09	5.65E-02	1.02E-02	1.08E+02	2.35E+02	1.44E+01	3.97E-01		
Chlorine (17)	Cl-38	4.22E-13	1.55E-13	1.93E-13	2.64E-13	9.40E-14	7.93E-06	4.07E+03	3.89E+03	6.74E+03	1.52E+04	2.47E+02	6.68E+00		
Chlorine (17)	Cl-39	3.31E-13	1.21E-13	1.52E-13	2.08E-13	9.36E-14	7.09E-06	3.05E+03	2.93E+03	5.05E+03	1.14E+04	3.13E+02	8.48E+00		
Chromium (24)	Cr-48	1.84E-12	4.07E-13	7.44E-13	1.05E-12	7.51E-13	1.62E-06	5.45E+02	5.45E+02	8.90E+02	2.00E+03	6.40E+01	1.68E+00		
Chromium (24)	Cr-49	3.20E-13	9.10E-14	1.35E-13	1.89E-13	7.36E-14	4.43E-06	6.54E+03	6.54E+03	1.07E+04	2.40E+04	3.53E+02	9.33E+00		
Chromium (24)	Cr-51	4.96E-13	8.88E-14	1.85E-13	2.66E-13	1.67E-13	1.27E-07	2.41E+02	2.41E+02	3.93E+02	8.84E+02	2.57E+02	6.63E+00		
Cobalt (27)	Co-55	1.23E-11	2.38E-12	4.63E-12	6.70E-12	2.07E-12	9.21E-06	1.26E+02	7.59E+00	2.06E+02	4.63E+02	1.03E+01	2.63E-01	6.68E+06	3.34E+05
Cobalt (27)	Co-56	2.56E-11	5.29E-12	1.01E-11	1.43E-11	1.85E-11	1.80E-05	5.96E-01	3.31E-02	9.74E-01	2.19E+00	4.71E+00	1.23E-01	2.62E+02	1.31E+01
Cobalt (27)	Co-57	2.78E-12	4.85E-13	1.04E-12	1.49E-12	2.09E-12	3.55E-07	8.73E+00	9.66E-02	1.44E+01	3.23E+01	4.58E+01	1.18E+00	1.68E+02	8.40E+00
Cobalt (27)	Co-58	7.44E-12	1.57E-12	2.95E-12	4.18E-12	5.99E-12	4.48E-06	2.66E+00	1.27E-01	4.36E+00	9.80E+00	1.61E+01	4.22E-01	1.11E+03	5.56E+01
Cobalt (27)	Co-58m	3.47E-13	5.99E-14	1.26E-13	1.83E-13	6.88E-14	1.00E-12	5.92E+06	5.65E+02	4.33E+08	7.99E+08	3.78E+02	9.64E+00	8.98E+08	4.49E+07
Cobalt (27)	Co-60	4.03E-11	7.33E-12	1.57E-11	2.23E-11	3.58E-11	1.24E-05	3.61E-02	9.01E-04	6.02E-02	1.35E-01	3.03E+00	7.91E-02	2.41E+00	1.21E-01
Cobalt (27)	Co-60m	5.88E-15	2.12E-15	2.66E-15	3.66E-15	3.96E-15	1.86E-08	6.24E+06	1.20E+06	1.02E+07	2.29E+07	1.79E+04	4.82E+02	1.16E+14	5.82E+12
Cobalt (27)	Co-61	6.40E-13	1.32E-13	2.43E-13	3.49E-13	1.43E-13	2.48E-07	4.95E+04	1.59E+03	8.10E+04	1.82E+05	1.96E+02	5.05E+00	1.43E+10	7.16E+08
Cobalt (27)	Co-62m	1.79E-13	6.55E-14	8.25E-14	1.13E-13	3.17E-14	1.35E-05	6.50E+03	5.51E+03	1.06E+04	2.39E+04	5.77E+02	1.56E+01	2.14E+12	1.07E+11
Copper (29)	Cu-60	3.00E-13	1.04E-13	1.37E-13	1.89E-13	5.77E-14	1.93E-05	2.72E+03	2.72E+03	4.44E+03	1.00E+04	3.48E+02	9.33E+00		
Copper (29)	Cu-61	1.20E-12	2.39E-13	4.63E-13	6.70E-13	2.41E-13	3.63E-06	1.64E+03	1.64E+03	2.68E+03	6.03E+03	1.03E+02	2.63E+00		
Copper (29)	Cu-62						4.43E-06	2.83E+04	2.83E+04	4.61E+04	1.04E+05				
Copper (29)	Cu-64	1.72E-12	2.93E-13	6.40E-13	9.32E-13	4.33E-13	8.30E-07	1.92E+03	1.89E+03	3.15E+03	7.08E+03	7.44E+01	1.89E+00		
Copper (29)	Cu-66						4.32E-07	5.53E+05	5.53E+05	9.03E+05	2.03E+06				
Copper (29)	Cu-67	5.29E-12	8.88E-13	1.94E-12	2.83E-12	2.35E-12	3.83E-07	8.38E+02	7.67E+02	1.40E+03	3.15E+03	2.45E+01	6.23E-01		
Curium (96)	Cm-238	8.70E-13	1.65E-13	3.28E-13	4.70E-13	1.35E-11	1.90E-07	4.45E+04	4.40E+04	7.27E+04	1.64E+05	1.45E+02	3.75E+00	1.44E+12	7.21E+10
Curium (96)	Cm-240	9.88E-11	1.53E-11	3.49E-11	5.07E-11	9.51E-09	6.19E-11	2.07E+03	1.23E+02	2.42E+04	4.46E+04	1.36E+00	3.48E-02	1.86E+05	9.29E+03
Curium (96)	Cm-241	1.35E-11	2.15E-12	4.85E-12	7.03E-12	1.01E-10	1.94E-06	1.33E+01	1.31E+01	2.17E+01	4.88E+01	9.82E+00	2.51E-01	9.06E+05	4.53E+04
Curium (96)	Cm-242	1.05E-10	1.87E-11	3.85E-11	5.48E-11	1.51E-08	7.73E-11	3.22E+02	1.89E+01	3.20E+03	5.92E+03	1.24E+00	3.22E-02	4.62E+03	2.31E+02
Curium (96)	Cm-243	2.05E-10	7.84E-11	9.47E-11	1.23E-10	2.69E-08	4.19E-07	3.49E-01	1.27E-01	6.79E-01	1.52E+00	5.03E-01	1.43E-02	3.64E+01	1.82E+00
Curium (96)	Cm-244	1.81E-10	6.88E-11	8.36E-11	1.08E-10	2.53E-08	4.85E-11	6.69E+00	3.04E-01	3.79E+01	6.90E+01	5.70E-01	1.63E-02	4.35E+01	2.17E+00
Curium (96)	Cm-245	2.18E-10	9.14E-11	1.04E-10	1.35E-10	2.77E-08	2.38E-07	4.11E-01	9.22E-02	8.76E-01	1.95E+00	4.58E-01	1.31E-02	7.91E-01	3.96E-02
Curium (96)	Cm-246	2.12E-10	9.03E-11	1.02E-10	1.31E-10	2.77E-08	4.57E-11	3.40E+00	1.29E-01	1.88E+01	3.42E+01	4.67E-01	1.35E-02	8.08E-01	4.04E-02
Curium (96)	Cm-247	2.11E-10	8.58E-11	9.95E-11	1.30E-10	2.50E-08	1.31E-06	8.31E-02	4.28E-02	1.65E-01	3.71E-01	4.79E-01	1.36E-02	8.25E-01	4.13E-02
Curium (96)	Cm-248			9.52E-09	1.23E-08	2.54E-06	3.42E-11	3.89E-01	1.43E-03	4.80E+00	1.08E+01	5.00E-03	1.43E-04	2.59E+01	1.29E+00
Curium (96)	Cm-249	2.18E-13	4.92E-14	8.40E-14	1.20E-13	7.25E-14	8.51E-08	2.23E+05	2.22E+05	3.64E+05	8.19E+05	5.67E+02	1.47E+01	2.83E+13	1.42E+12
Dysprosium (66)	Dy-155	1.35E-12	2.68E-13	5.25E-13	7.47E-13	2.45E-13	2.44E-06	8.33E+02	8.33E+02	1.36E+03	3.06E+03	9.07E+01	2.36E+00		
Dysprosium (66)	Dy-157	5.62E-13	1.21E-13	2.26E-13	3.20E-13	8.33E-14	1.32E-06	1.90E+03	1.90E+03	3.10E+03	6.98E+03	2.11E+02	5.51E+00		
Dysprosium (66)	Dy-159	1.47E-12	2.37E-13	5.29E-13	7.70E-13	1.28E-12	3.19E-08	1.83E+02	1.83E+02	3.00E+02	6.76E+02	9.00E+01	2.29E+00		
Dysprosium (66)	Dy-165	1.15E-12	1.95E-13	4.14E-13	6.03E-13	2.10E-13	9.49E-08	9.17E+04	9.17E+04	1.50E+05	3.37E+05	1.15E+02	2.92E+00		
Dysprosium (66)	Dy-166	3.22E-11	4.48E-12	1.11E-11	1.63E-11	8.36E-12	6.02E-08	3.85E+03	3.86E+03	6.69E+03	1.50E+04	4.29E+00	1.08E-01		
Einsteinium (99)	Es-250	1.44E-13	3.55E-14	5.96E-14	8.36E-14	5.07E-13	1.69E-06	5.73E+03	5.73E+03	9.34E+03	2.10E+04	7.99E+02	2.11E+01		
Einsteinium (99)	Es-251	2.89E-12	4.33E-13	1.02E-12	1.49E-12	6.40E-12	2.55E-07	2.41E+03	2.41E+03	3.94E+03	8.86E+03	4.67E+01	1.18E+00		
Einsteinium (99)	Es-253	1.01E-10	1.44E-11	3.49E-11	5.11E-11	8.84E-09	1.25E-09	2.67E+03	2.77E+03	2.12E+04	4.19E+04	1.36E+00	3.45E-02		
Einsteinium (99)	Es-254	1.50E-10	2.82E-11	5.51E-11	7.81E-11	1.85E-08	8.55E-09	1.03E+02	1.06E+02	4.05E+02	8.52E+02	8.64E-01	2.26E-02		
Einsteinium (99)	Es-254m	7.88E-11	1.11E-11	2.73E-11	4.00E-11	1.53E-09	2.10E-06	2.45E+02	2.45E+02	4.02E+02	9.03E+02	1.74E+00	4.41E-02		
Erbium (68)	Er-161	8.10E-13	1.65E-13	3.15E-13	4.51E-13	1.34E-13	4.09E-06	1.53E+03	1.53E+03	2.50E+03	5.63E+03	1.51E+02	3.91E+00		
Erbium (68)	Er-165	2.42E-13	4.18E-14	8.95E-14	1.30E-13	3.13E-14	3.05E-08	6.40E+04	6.40E+04	1.05E+05	2.35E+05	5.32E+02	1.36E+01		
Erbium (68)	Er-169	7.36E-12	1.02E-12	2.53E-12	3.70E-12	3.85E-12	9.10E-11	8.09E+04	8.41E+04	6.86E+05	1.35E+06	1.88E+01	4.77E-01		
Erbium (68)	Er-171	5.74E-12	8.70E-13	2.02E-12	2.96E-12	9.40E-13	1.42E-06	1.90E+03	1.90E+03	3.10E+03	6.99E+03	2.36E+01	5.96E-01		
Erbium (68)	Er-172	1.70E-11	2.55E-12	5.99E-12	8.77E-12	4.74E-12	2.20E-06	1.87E+02	1.87E+02	3.06E+02	6.88E+02	7.95E+00	2.01E-01		
Europium (63)	Eu-145	6.77E-12	1.46E-12	2.73E-12	3.85E-12	1.81E-12	6.95E-06	2.05E+01	2.05E+01	3.35E+01	7.53E+01	1.74E+01	4.58E-01		
Europium (63)	Eu-146	1.12E-11	2.45E-12	4.55E-12	6.40E-12	2.59E-12	1.16E-05	1.58E+01	1.58E+01	2.58E+01	5.81E+01	1.05E+01	2.76E-01		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Europium (63)	Eu-147	5.37E-12	9.69E-13	2.02E-12	2.90E-12	3.85E-12	2.04E-06	1.73E+01	1.73E+01	2.82E+01	6.35E+01	2.36E+01	6.08E-01		
Europium (63)	Eu-148	1.04E-11	2.38E-12	4.29E-12	6.03E-12	9.92E-12	9.84E-06	1.58E+00	1.58E+00	2.58E+00	5.80E+00	1.11E+01	2.92E-01		
Europium (63)	Eu-149	1.40E-12	2.34E-13	5.14E-13	7.40E-13	1.07E-12	1.42E-07	6.39E+01	6.39E+01	1.04E+02	2.35E+02	9.26E+01	2.38E+00		
Europium (63)	Eu-150a	6.88E-12	9.81E-13	2.38E-12	3.50E-12	1.03E-12	1.95E-07	8.22E+03	8.20E+03	1.35E+04	3.03E+04	2.00E+01	5.04E-01		
Europium (63)	Eu-150b	1.08E-11	2.43E-12	4.33E-12	6.07E-12	1.12E-10	6.49E-06	2.29E-02	1.88E-02	4.29E-02	9.65E-02	1.10E+01	2.91E-01		
Europium (63)	Eu-152	1.62E-11	2.96E-12	6.07E-12	8.70E-12	9.10E-11	5.30E-06	4.16E-02	3.76E-02	7.37E-02	1.66E-01	7.84E+00	2.03E-01		
Europium (63)	Eu-152m	8.51E-12	1.25E-12	2.98E-12	4.37E-12	1.12E-12	1.33E-06	1.64E+03	1.64E+03	2.67E+03	6.02E+03	1.60E+01	4.04E-01		
Europium (63)	Eu-154	2.85E-11	4.74E-12	1.03E-11	1.49E-11	1.15E-10	5.83E-06	4.99E-02	4.72E-02	8.57E-02	1.93E-01	4.62E+00	1.18E-01		
Europium (63)	Eu-155	5.40E-12	8.07E-13	1.90E-12	2.77E-12	1.48E-11	1.24E-07	3.80E+00	3.74E+00	6.34E+00	1.43E+01	2.51E+01	6.37E-01		
Europium (63)	Eu-156	3.56E-11	5.44E-12	1.27E-11	1.84E-11	1.37E-11	6.62E-06	8.41E+00	8.40E+00	1.37E+01	3.09E+01	3.75E+00	9.59E-02		
Europium (63)	Eu-157	1.06E-11	1.54E-12	3.70E-12	5.40E-12	1.57E-12	9.60E-07	1.39E+03	1.39E+03	2.27E+03	5.11E+03	1.29E+01	3.27E-01		
Europium (63)	Eu-158	5.22E-13	1.39E-13	2.14E-13	3.01E-13	1.10E-13	5.06E-06	5.25E+03	5.25E+03	8.57E+03	1.93E+04	2.23E+02	5.86E+00		
Fermium (100)	Fm-252	4.92E-11	6.92E-12	1.69E-11	2.48E-11	1.03E-09	5.09E-11	1.28E+05	1.34E+05	1.59E+06	2.90E+06	2.82E+00	7.11E-02		
Fermium (100)	Fm-253	1.48E-11	2.13E-12	5.14E-12	7.51E-12	1.28E-09	2.24E-07	1.25E+03	1.25E+03	2.05E+03	4.62E+03	9.26E+00	2.35E-01		
Fermium (100)	Fm-254	6.07E-12	9.58E-13	2.15E-12	3.13E-12	1.98E-10	1.23E-10	6.42E+06	6.66E+06	4.19E+07	8.41E+07	2.21E+01	5.63E-01		
Fermium (100)	Fm-255	4.77E-11	6.73E-12	1.65E-11	2.42E-11	8.84E-10	3.85E-09	9.57E+04	9.83E+04	3.52E+05	7.58E+05	2.89E+00	7.29E-02		
Fermium (100)	Fm-257	1.23E-10	2.05E-11	4.40E-11	6.29E-11	2.04E-08	3.06E-07	2.59E+01	2.60E+01	4.43E+01	9.94E+01	1.08E+00	2.80E-02		
Fluorine (9)	F-18	2.00E-13	7.88E-14	9.73E-14	1.30E-13	1.21E-13	4.45E-06	2.49E+03	2.49E+03	4.06E+03	9.14E+03	4.89E+02	1.36E+01		
Francium (87)	Fr-219						1.44E-08	2.42E+11	2.42E+11	3.95E+11	8.88E+11				
Francium (87)	Fr-220						3.25E-08	8.21E+07	8.21E+07	1.34E+08	3.02E+08				
Francium (87)	Fr-221						1.11E-07	2.29E+06	2.29E+06	3.73E+06	8.40E+06				
Francium (87)	Fr-222	3.43E-12	1.07E-12	1.48E-12	2.02E-12	2.42E-11	1.14E-08	7.12E+06	7.14E+06	1.20E+07	2.69E+07	3.22E+01	8.73E-01		
Francium (87)	Fr-223	1.78E-11	4.85E-12	7.29E-12	1.00E-11	3.06E-12	1.40E-07	3.92E+05	3.93E+05	6.49E+05	1.46E+06	6.53E+00	1.76E-01		
Gadolinium (64)	Gd-145	1.99E-13	6.59E-14	8.92E-14	1.23E-13	3.63E-14	1.13E-05	4.71E+03	4.71E+03	7.69E+03	1.73E+04	5.34E+02	1.43E+01		
Gadolinium (64)	Gd-146	1.39E-11	2.26E-12	5.03E-12	7.29E-12	2.27E-11	5.56E-07	3.14E+01	3.13E+01	5.14E+01	1.16E+02	9.47E+00	2.42E-01		
Gadolinium (64)	Gd-147	6.33E-12	1.25E-12	2.46E-12	3.50E-12	1.34E-12	5.87E-06	9.08E+01	9.08E+01	1.48E+02	3.34E+02	1.94E+01	5.04E-01		
Gadolinium (64)	Gd-148	9.07E-11	3.37E-11	4.22E-11	5.51E-11	1.26E-08	0.00E+00	7.84E+00	3.87E+00	5.48E+01	9.97E+01	1.13E+00	3.20E-02		
Gadolinium (64)	Gd-149	6.03E-12	1.02E-12	2.23E-12	3.22E-12	2.76E-12	1.59E-06	5.66E+01	5.66E+01	9.24E+01	2.08E+02	2.14E+01	5.48E-01		
Gadolinium (64)	Gd-151	3.20E-12	4.85E-13	1.14E-12	1.65E-12	2.92E-12	1.20E-07	5.85E+01	5.84E+01	9.59E+01	2.16E+02	4.18E+01	1.07E+00		
Gadolinium (64)	Gd-152	6.29E-11	2.40E-11	2.97E-11	3.85E-11	9.10E-09	0.00E+00	1.01E+01	4.80E+00	7.02E+01	1.28E+02	1.60E+00	4.58E-02		
Gadolinium (64)	Gd-153	4.26E-12	6.66E-13	1.52E-12	2.22E-12	6.55E-12	1.62E-07	2.15E+01	2.15E+01	3.52E+01	7.92E+01	3.13E+01	7.94E-01		
Gadolinium (64)	Gd-159	9.21E-12	1.31E-12	3.19E-12	4.66E-12	1.46E-12	1.74E-07	6.22E+03	6.20E+03	1.02E+04	2.30E+04	1.49E+01	3.78E-01		
Gallium (31)	Ga-65	1.39E-13	4.96E-14	6.33E-14	8.73E-14	2.84E-14	5.04E-06	1.59E+04	1.59E+04	2.60E+04	5.84E+04	7.52E+02	2.02E+01		
Gallium (31)	Ga-66	1.80E-11	2.81E-12	6.40E-12	9.32E-12	2.18E-12	1.26E-05	1.72E+02	1.72E+02	2.80E+02	6.30E+02	7.44E+00	1.89E-01		
Gallium (31)	Ga-67	2.89E-12	4.59E-13	1.04E-12	1.51E-12	9.55E-13	5.36E-07	4.84E+02	4.84E+02	7.90E+02	1.78E+03	4.58E+01	1.17E+00		
Gallium (31)	Ga-68	7.18E-13	1.66E-13	2.83E-13	4.03E-13	1.28E-13	4.17E-06	4.30E+03	4.30E+03	7.02E+03	1.58E+04	1.68E+02	4.38E+00		
Gallium (31)	Ga-70	1.19E-13	3.96E-14	5.22E-14	7.22E-14	2.92E-14	4.39E-08	1.31E+06	1.31E+06	2.14E+06	4.81E+06	9.12E+02	2.44E+01		
Gallium (31)	Ga-72	1.53E-11	2.54E-12	5.59E-12	8.07E-12	2.17E-12	1.37E-05	1.05E+02	1.05E+02	1.72E+02	3.86E+02	8.52E+00	2.19E-01		
Gallium (31)	Ga-73	3.92E-12	6.07E-13	1.39E-12	2.03E-12	6.14E-13	1.25E-06	3.31E+03	3.31E+03	5.40E+03	1.22E+04	3.43E+01	8.69E-01		
Germanium (32)	Ge-66	7.99E-13	2.58E-13	3.70E-13	4.88E-13	2.50E-13	2.86E-06	3.12E+03	3.11E+03	5.11E+03	1.15E+04	1.29E+02	3.61E+00		
Germanium (32)	Ge-67	2.28E-13	8.62E-14	1.06E-13	1.45E-13	4.59E-14	6.24E-06	1.04E+04	1.04E+04	1.70E+04	3.84E+04	4.49E+02	1.22E+01		
Germanium (32)	Ge-68	1.85E-11	3.48E-12	6.96E-12	9.88E-12	4.88E-11	4.69E-13	3.25E+01	7.98E+00	1.12E+04	2.01E+04	6.84E+00	1.79E-01		
Germanium (32)	Ge-69	2.35E-12	5.99E-13	9.84E-13	1.35E-12	8.81E-13	4.02E-06	1.29E+02	1.28E+02	2.11E+02	4.75E+02	4.84E+01	1.31E+00		
Germanium (32)	Ge-71	1.73E-13	3.19E-14	6.48E-14	9.18E-14	5.18E-14	4.74E-13	8.53E+04	2.10E+04	2.66E+07	4.90E+07	7.35E+02	1.92E+01		
Germanium (32)	Ge-75	1.85E-13	6.92E-14	8.66E-14	1.17E-13	8.44E-14	1.38E-07	1.06E+05	1.03E+05	1.74E+05	3.92E+05	5.50E+02	1.51E+01		
Germanium (32)	Ge-77	2.81E-12	7.92E-13	1.22E-12	1.65E-12	1.15E-12	4.82E-06	3.72E+02	3.68E+02	6.09E+02	1.37E+03	3.90E+01	1.07E+00		
Germanium (32)	Ge-78	6.22E-13	2.43E-13	3.09E-13	4.03E-13	2.48E-13	1.10E-06	1.27E+04	1.26E+04	2.08E+04	4.68E+04	1.54E+02	4.38E+00		
Gold (79)	Au-193	2.05E-12	3.26E-13	7.36E-13	1.07E-12	4.55E-13	4.30E-07	2.65E+03	2.61E+03	4.36E+03	9.80E+03	6.47E+01	1.65E+00		
Gold (79)	Au-194	4.22E-12	8.70E-13	1.66E-12	2.36E-12	7.92E-13	4.93E-06	1.04E+02	1.04E+02	1.70E+02	3.83E+02	2.87E+01	7.47E-01		
Gold (79)	Au-195	4.22E-12	6.48E-13	1.50E-12	2.19E-12	6.48E-12	1.38E-07	3.22E+01	2.91E+01	5.47E+01	1.23E+02	3.17E+01	8.05E-01		
Gold (79)	Au-195m						7.37E-07	3.25E+06	3.25E+06	5.31E+06	1.19E+07				

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Gold (79)	Au-198	1.78E-11	2.66E-12	6.29E-12	9.18E-12	4.00E-12	1.70E-06	1.82E+02	1.75E+02	3.01E+02	6.77E+02	7.57E+00	1.92E-01		
Gold (79)	Au-198m	2.09E-11	3.20E-12	7.44E-12	1.08E-11	7.77E-12	1.89E-06	1.92E+02	1.85E+02	3.18E+02	7.15E+02	6.40E+00	1.63E-01		
Gold (79)	Au-199	7.92E-12	1.16E-12	2.78E-12	4.07E-12	3.12E-12	2.79E-07	9.32E+02	8.49E+02	1.58E+03	3.55E+03	1.71E+01	4.33E-01		
Gold (79)	Au-200	3.85E-13	9.92E-14	1.55E-13	2.20E-13	8.55E-14	1.30E-06	1.94E+04	1.93E+04	3.16E+04	7.11E+04	3.07E+02	8.02E+00		
Gold (79)	Au-200m	1.48E-11	2.50E-12	5.44E-12	7.88E-12	2.81E-12	9.04E-06	1.20E+02	1.19E+02	1.96E+02	4.41E+02	8.75E+00	2.24E-01		
Gold (79)	Au-201	1.01E-13	3.19E-14	4.33E-14	6.03E-14	3.30E-14	2.29E-07	2.02E+05	2.01E+05	3.29E+05	7.40E+05	1.10E+03	2.92E+01		
Hafnium (72)	Hf-170	5.81E-12	1.05E-12	2.19E-12	3.14E-12	1.20E-12	2.04E-06	6.22E+02	6.22E+02	1.02E+03	2.29E+03	2.17E+01	5.62E-01		
Hafnium (72)	Hf-172	1.37E-11	2.35E-12	4.96E-12	7.14E-12	6.92E-11	1.62E-07	7.57E+00	7.57E+00	1.25E+01	2.81E+01	9.60E+00	2.47E-01		
Hafnium (72)	Hf-173	2.85E-12	5.00E-13	1.06E-12	1.52E-12	5.92E-13	1.34E-06	6.32E+02	6.32E+02	1.03E+03	2.32E+03	4.49E+01	1.16E+00		
Hafnium (72)	Hf-175	5.29E-12	9.21E-13	1.96E-12	2.83E-12	4.29E-12	1.35E-06	8.95E+00	8.95E+00	1.46E+01	3.29E+01	2.43E+01	6.23E-01		
Hafnium (72)	Hf-177m	4.74E-13	1.33E-13	2.01E-13	2.81E-13	1.81E-13	8.58E-06	2.76E+03	2.76E+03	4.51E+03	1.02E+04	2.37E+02	6.28E+00		
Hafnium (72)	Hf-178m	3.89E-11	8.40E-12	1.51E-11	2.13E-11	3.70E-10	9.57E-06	1.60E-02	1.32E-02	2.98E-02	6.70E-02	3.15E+00	8.28E-02		
Hafnium (72)	Hf-179m	1.81E-11	2.94E-12	6.55E-12	9.51E-12	1.38E-11	3.42E-06	9.86E+00	9.86E+00	1.61E+01	3.62E+01	7.27E+00	1.85E-01		
Hafnium (72)	Hf-180m	1.89E-12	3.56E-13	7.18E-13	1.03E-12	4.14E-13	3.93E-06	9.40E+02	9.40E+02	1.53E+03	3.45E+03	6.63E+01	1.71E+00		
Hafnium (72)	Hf-181	1.79E-11	2.75E-12	6.36E-12	9.25E-12	1.76E-11	2.24E-06	8.90E+00	8.90E+00	1.45E+01	3.27E+01	7.49E+00	1.91E-01		
Hafnium (72)	Hf-182	1.27E-11	3.74E-12	5.37E-12	7.25E-12	3.41E-10	9.10E-07	1.22E-01	9.18E-02	2.40E-01	5.40E-01	8.87E+00	2.43E-01		
Hafnium (72)	Hf-182m	2.70E-13	6.99E-14	1.11E-13	1.57E-13	1.04E-13	3.83E-06	5.18E+03	5.18E+03	8.45E+03	1.90E+04	4.29E+02	1.12E+01		
Hafnium (72)	Hf-183	6.25E-13	1.31E-13	2.39E-13	3.42E-13	1.65E-13	3.30E-06	5.77E+03	5.77E+03	9.42E+03	2.12E+04	1.99E+02	5.16E+00		
Hafnium (72)	Hf-184	8.18E-12	1.26E-12	2.91E-12	4.26E-12	1.38E-12	8.64E-07	5.70E+03	5.70E+03	9.31E+03	2.10E+04	1.64E+01	4.14E-01		
Holmium (67)	Ho-155	2.63E-13	6.25E-14	1.05E-13	1.49E-13	5.29E-14	1.52E-06	1.67E+04	1.67E+04	2.73E+04	6.14E+04	4.54E+02	1.18E+01		
Holmium (67)	Ho-157	3.49E-14	1.07E-14	1.54E-14	2.13E-14	7.36E-15	1.84E-06	5.26E+04	5.26E+04	8.58E+04	1.93E+05	3.09E+03	8.28E+01		
Holmium (67)	Ho-159	3.96E-14	1.28E-14	1.78E-14	2.46E-14	1.22E-14	1.16E-06	3.18E+04	3.18E+04	5.20E+04	1.17E+05	2.68E+03	7.17E+01		
Holmium (67)	Ho-161	1.33E-13	2.48E-14	4.96E-14	7.14E-14	1.98E-14	5.52E-08	1.47E+05	1.47E+05	2.40E+05	5.41E+05	9.60E+02	2.47E+01		
Holmium (67)	Ho-162	1.29E-14	4.66E-15	5.96E-15	8.18E-15	5.40E-15	6.02E-07	1.35E+05	1.35E+05	2.20E+05	4.96E+05	7.99E+03	2.16E+02		
Holmium (67)	Ho-162m	1.81E-13	4.55E-14	7.47E-14	1.05E-13	5.18E-14	2.46E-06	7.29E+03	7.29E+03	1.19E+04	2.68E+04	6.37E+02	1.68E+01		
Holmium (67)	Ho-164	4.11E-14	1.26E-14	1.75E-14	2.45E-14	1.65E-14	2.78E-08	1.51E+06	1.51E+06	2.47E+06	5.55E+06	2.72E+03	7.20E+01		
Holmium (67)	Ho-164m	1.05E-13	2.50E-14	4.14E-14	5.88E-14	3.48E-14	3.63E-08	8.95E+05	8.95E+05	1.46E+06	3.29E+06	1.15E+03	3.00E+01		
Holmium (67)	Ho-166	2.67E-11	3.74E-12	9.21E-12	1.35E-11	3.85E-12	1.18E-07	6.19E+03	6.07E+03	1.04E+04	2.35E+04	5.17E+00	1.31E-01		
Holmium (67)	Ho-166m	2.10E-11	4.29E-12	8.03E-12	1.14E-11	3.09E-10	7.69E-06	1.46E-02	1.10E-02	2.86E-02	6.44E-02	5.93E+00	1.55E-01		
Holmium (67)	Ho-167	9.95E-13	1.73E-13	3.64E-13	5.25E-13	2.25E-13	1.45E-06	4.52E+03	4.52E+03	7.38E+03	1.66E+04	1.31E+02	3.36E+00		
Hydrogen (1)	H-3 (vapor)	9.25E-14		5.07E-14	6.51E-14	5.62E-14	0.00E+00					1.44E+02		1.65E+02	8.25E+00
Hydrogen (1)	H-3 (organic)	2.20E-13		1.12E-13	1.44E-13	1.99E-13		2.28E+00	1.60E-01	1.42E+00	3.20E+00		1.22E+01		
Indium (49)	In-109	6.25E-13	1.32E-13	2.46E-13	3.50E-13	1.11E-13	2.90E-06	1.67E+03	1.67E+03	2.72E+03	6.13E+03	1.94E+02	5.04E+00		
Indium (49)	In-110a	7.03E-13	1.68E-13	2.81E-13	4.00E-13	1.17E-13	7.13E-06	2.47E+03	2.47E+03	4.04E+03	9.09E+03	1.69E+02	4.41E+00		
Indium (49)	In-110b	1.77E-12	4.51E-13	7.59E-13	1.05E-12	2.65E-13	1.41E-05	2.94E+02	2.94E+02	4.80E+02	1.08E+03	6.27E+01	1.68E+00		
Indium (49)	In-111	3.40E-12	6.25E-13	1.29E-12	1.85E-12	8.03E-13	1.42E-06	2.11E+02	2.11E+02	3.44E+02	7.73E+02	3.69E+01	9.53E-01		
Indium (49)	In-112	3.70E-14	1.33E-14	1.68E-14	2.32E-14	1.10E-14	1.15E-06	7.36E+04	7.36E+04	1.20E+05	2.70E+05	2.83E+03	7.60E+01		
Indium (49)	In-113m	2.47E-13	5.11E-14	9.47E-14	1.35E-13	5.18E-14	1.05E-06	1.17E+04	1.17E+04	1.90E+04	4.28E+04	5.03E+02	1.31E+01		
Indium (49)	In-114						1.35E-08	7.54E+07	7.54E+07	1.23E+08	2.77E+08				
Indium (49)	In-114m	7.03E-11	1.07E-11	2.48E-11	3.60E-11	3.00E-11	3.57E-07	4.63E+01	4.54E+01	7.79E+01	1.75E+02	1.92E+00	4.90E-02		
Indium (49)	In-115	5.85E-11	3.19E-11	3.38E-11	4.33E-11	4.03E-10	2.70E-10	9.73E+00	4.14E+00	5.14E+01	9.37E+01	1.41E+00	4.07E-02		
Indium (49)	In-115m	1.24E-12	1.96E-13	4.40E-13	6.40E-13	2.15E-13	6.27E-07	7.21E+03	7.21E+03	1.18E+04	2.65E+04	1.08E+02	2.76E+00		
Indium (49)	In-116m	3.77E-13	1.07E-13	1.62E-13	2.26E-13	8.77E-14	1.23E-05	1.83E+03	1.83E+03	2.98E+03	6.71E+03	2.94E+02	7.80E+00		
Indium (49)	In-117	1.67E-13	4.74E-14	7.03E-14	9.84E-14	5.59E-14	2.90E-06	9.60E+03	9.60E+03	1.57E+04	3.52E+04	6.77E+02	1.79E+01		
Indium (49)	In-117m	1.22E-12	2.17E-13	4.44E-13	6.44E-13	2.33E-13	3.35E-07	3.11E+04	3.11E+04	5.08E+04	1.14E+05	1.07E+02	2.74E+00		
Indium (49)	In-119						3.54E-06	1.43E+05	1.43E+05	2.34E+05	5.27E+05				
Indium (49)	In-119m	1.70E-13	5.85E-14	7.55E-14	1.04E-13	3.34E-14	5.63E-08	1.20E+06	1.20E+06	1.96E+06	4.42E+06	6.31E+02	1.70E+01		
Iodine (53)	I-120	2.33E-12	5.66E-13	9.03E-13	2.46E-12	3.89E-13	1.33E-05	1.13E+03	4.13E+02	1.85E+03	4.16E+03	5.27E+01	7.17E-01	4.41E+09	2.21E+08
Iodine (53)	I-120m	1.20E-12	3.53E-13	5.03E-13	1.30E-12	1.98E-13	2.55E-05	9.02E+02	6.09E+02	1.47E+03	3.31E+03	9.47E+01	1.36E+00	1.85E+10	9.26E+08
Iodine (53)	I-121	5.59E-13	1.44E-13	2.27E-13	6.03E-13	9.81E-14	1.63E-06	5.88E+03	1.31E+03	9.60E+03	2.16E+04	2.10E+02	2.92E+00	7.12E+09	3.56E+08
Iodine (53)	I-122						4.17E-06	8.08E+04	8.08E+04	1.32E+05	2.97E+05				

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Iodine (53)	I-123	1.96E-12	3.77E-13	6.96E-13	2.05E-12	3.03E-13	5.10E-07	3.01E+03	7.77E+01	4.93E+03	1.11E+04	6.84E+01	8.60E-01	5.99E+07	3.00E+06
Iodine (53)	I-124	1.16E-10	2.18E-11	4.14E-11	1.22E-10	1.76E-11	5.10E-06	3.92E+01	1.75E-01	6.48E+01	1.46E+02	1.15E+00	1.45E-02	1.74E+04	8.72E+02
Iodine (53)	I-125	5.55E-11	1.70E-11	2.54E-11	6.29E-11	1.06E-11	7.24E-09	3.28E+02	2.38E-02	2.46E+03	5.25E+03	1.87E+00	2.80E-02	1.37E+02	6.87E+00
Iodine (53)	I-126	2.31E-10	3.24E-11	8.73E-11	2.48E-10	3.70E-11	1.96E-06	3.10E+01	2.79E-02	5.41E+01	1.22E+02	5.45E-01	7.11E-03	8.55E+02	4.27E+01
Iodine (53)	I-128	1.89E-13	6.14E-14	8.14E-14	2.06E-13	3.04E-14	3.74E-07	1.30E+05	2.11E+04	2.13E+05	4.79E+05	5.85E+02	8.56E+00	5.14E+11	2.57E+10
Iodine (53)	I-129	2.71E-10	1.14E-10	1.48E-10	3.22E-10	6.07E-11	6.10E-09	5.96E-01	2.76E-05	1.09E+01	2.08E+01	3.22E-01	5.48E-03	4.60E-03	2.30E-04
Iodine (53)	I-130	1.80E-11	3.41E-12	6.36E-12	1.88E-11	2.76E-12	9.67E-06	1.69E+02	8.77E+00	2.77E+02	6.22E+02	7.49E+00	9.38E-02	7.43E+06	3.71E+05
Iodine (53)	I-131	1.26E-10	2.43E-11	4.55E-11	1.34E-10	1.95E-11	1.59E-06	6.32E+01	8.33E-02	1.08E+02	2.43E+02	1.05E+00	1.32E-02	4.29E+03	2.14E+02
Iodine (53)	I-132	2.22E-12	5.07E-13	8.44E-13	2.34E-12	3.74E-13	1.06E-05	8.33E+02	2.71E+02	1.36E+03	3.06E+03	5.64E+01	7.54E-01	1.63E+09	8.14E+07
Iodine (53)	I-132m	1.70E-12	3.40E-13	6.11E-13	1.78E-12	2.70E-13	1.40E-06	1.04E+04	8.03E+02	1.70E+04	3.82E+04	7.79E+01	9.91E-01	6.12E+09	3.06E+08
Iodine (53)	I-133	4.26E-11	7.25E-12	1.44E-11	4.40E-11	6.25E-12	2.72E-06	3.56E+02	2.34E+00	5.86E+02	1.32E+03	3.31E+00	4.01E-02	1.17E+06	5.83E+04
Iodine (53)	I-134	5.96E-13	1.76E-13	2.50E-13	6.44E-13	1.02E-13	1.24E-05	1.87E+03	1.26E+03	3.05E+03	6.86E+03	1.90E+02	2.74E+00	3.78E+10	1.89E+09
Iodine (53)	I-135	8.62E-12	1.64E-12	3.05E-12	8.99E-12	1.34E-12	7.83E-06	3.92E+02	3.32E+01	6.41E+02	1.44E+03	1.56E+01	1.96E-01	5.45E+07	2.73E+06
Iridium (77)	Ir-182	2.33E-13	6.92E-14	9.95E-14	1.39E-13	5.03E-14	5.85E-06	1.39E+04	1.39E+04	2.27E+04	5.10E+04	4.79E+02	1.27E+01		
Iridium (77)	Ir-184	1.67E-12	3.38E-13	6.44E-13	9.21E-13	3.30E-13	8.66E-06	7.77E+02	7.77E+02	1.27E+03	2.85E+03	7.39E+01	1.91E+00		
Iridium (77)	Ir-185	3.61E-12	6.03E-13	1.32E-12	1.91E-12	7.25E-13	2.69E-06	5.39E+02	5.38E+02	8.80E+02	1.98E+03	3.61E+01	9.23E-01		
Iridium (77)	Ir-186a	5.44E-12	1.04E-12	2.08E-12	2.98E-12	1.06E-12	7.40E-06	1.74E+02	1.74E+02	2.84E+02	6.38E+02	2.29E+01	5.92E-01		
Iridium (77)	Ir-186b	5.07E-13	1.12E-13	2.00E-13	2.84E-13	1.11E-13	4.22E-06	2.75E+03	2.75E+03	4.49E+03	1.01E+04	2.38E+02	6.21E+00		
Iridium (77)	Ir-187	1.57E-12	2.71E-13	5.77E-13	8.33E-13	2.87E-13	1.42E-06	1.36E+03	1.36E+03	2.22E+03	5.00E+03	8.25E+01	2.12E+00		
Iridium (77)	Ir-188	6.40E-12	1.30E-12	2.52E-12	3.58E-12	1.38E-12	7.68E-06	6.37E+01	6.37E+01	1.04E+02	2.34E+02	1.89E+01	4.93E-01		
Iridium (77)	Ir-189	4.29E-12	6.44E-13	1.51E-12	2.21E-12	2.33E-12	1.69E-07	3.72E+02	3.62E+02	6.14E+02	1.38E+03	3.15E+01	7.98E-01		
Iridium (77)	Ir-190	1.50E-11	2.72E-12	5.66E-12	8.10E-12	8.81E-12	5.99E-06	1.17E+01	1.16E+01	1.91E+01	4.29E+01	8.41E+00	2.18E-01		
Iridium (77)	Ir-190m	8.44E-14	1.59E-14	3.17E-14	4.55E-14	3.89E-14	8.69E-13	3.93E+08	1.22E+08	9.79E+09	1.88E+10	1.50E+03	3.88E+01		
Iridium (77)	Ir-190n	1.07E-12	2.33E-13	4.26E-13	6.03E-13	2.14E-13	6.48E-06	1.01E+03	1.01E+03	1.65E+03	3.71E+03	1.12E+02	2.92E+00		
Iridium (77)	Ir-191m						1.58E-07	9.37E+07	9.37E+07	1.53E+08	3.44E+08				
Iridium (77)	Ir-192	2.04E-11	3.30E-12	7.36E-12	1.07E-11	2.41E-11	3.40E-06	3.36E+00	3.33E+00	5.49E+00	1.24E+01	6.47E+00	1.65E-01		
Iridium (77)	Ir-192m	2.16E-12	6.77E-13	9.81E-13	1.32E-12	1.02E-10	5.39E-07	2.16E-01	1.63E-01	4.20E-01	9.45E-01	4.85E+01	1.34E+00		
Iridium (77)	Ir-194	2.49E-11	3.52E-12	8.62E-12	1.26E-11	3.40E-12	4.09E-07	2.51E+03	2.37E+03	4.22E+03	9.49E+03	5.52E+00	1.40E-01		
Iridium (77)	Ir-194m	2.29E-11	4.55E-12	8.88E-12	1.26E-11	4.59E-11	1.01E-05	4.90E-01	4.88E-01	8.00E-01	1.80E+00	5.36E+00	1.40E-01		
Iridium (77)	Ir-195	1.10E-12	1.85E-13	3.96E-13	5.77E-13	2.39E-13	1.12E-07	7.22E+04	7.14E+04	1.18E+05	2.66E+05	1.20E+02	3.06E+00		
Iridium (77)	Ir-195m	2.89E-12	4.63E-13	1.03E-12	1.50E-12	5.96E-13	1.58E-06	3.38E+03	3.37E+03	5.52E+03	1.24E+04	4.62E+01	1.18E+00		
Iron (26)	Fe-52	1.94E-11	3.29E-12	7.07E-12	1.03E-11	2.73E-12	3.07E-06	7.99E+02	1.99E+02	1.30E+03	2.93E+03	6.74E+00	1.71E-01	2.15E+08	1.08E+07
Iron (26)	Fe-55	2.09E-12	5.18E-13	8.62E-13	1.16E-12	7.99E-13	0.00E+00	2.69E+03	8.21E-01	2.21E+04	3.97E+04	5.52E+01	1.52E+00	1.02E+03	5.08E+01
Iron (26)	Fe-59	2.07E-11	4.07E-12	7.88E-12	1.11E-11	1.33E-11	5.83E-06	3.26E+00	1.20E+00	5.32E+00	1.20E+01	6.04E+00	1.59E-01	1.16E+04	5.80E+02
Iron (26)	Fe-60	3.53E-10	1.28E-10	1.80E-10	2.39E-10	1.84E-10	6.38E-12	2.03E+00	3.88E-04	1.39E+01	2.50E+01	2.65E-01	7.38E-03	1.75E-02	8.73E-04
Krypton (36)	Kr-74						4.90E-06	2.16E+04	2.16E+04	3.53E+04	7.94E+04				
Krypton (36)	Kr-76						1.73E-06	7.94E+02	7.94E+02	1.30E+03	2.91E+03				
Krypton (36)	Kr-77						4.22E-06	3.87E+03	3.87E+03	6.31E+03	1.42E+04				
Krypton (36)	Kr-79						1.08E-06	5.38E+02	5.38E+02	8.77E+02	1.97E+03				
Krypton (36)	Kr-81						2.18E-08	5.12E+00	3.84E+00	1.00E+01	2.26E+01				
Krypton (36)	Kr-81m						4.60E-07	1.22E+07	1.22E+07	2.00E+07	4.49E+07				
Krypton (36)	Kr-83m						1.34E-11	8.29E+08	8.29E+08	1.35E+09	3.04E+09				
Krypton (36)	Kr-85						1.05E-08	2.41E+01	2.23E+01	4.20E+01	9.45E+01				
Krypton (36)	Kr-85m						5.46E-07	8.31E+03	8.31E+03	1.36E+04	3.05E+04				
Krypton (36)	Kr-87						4.00E-06	3.99E+03	3.99E+03	6.52E+03	1.47E+04				
Krypton (36)	Kr-88						1.02E-05	7.01E+02	7.01E+02	1.14E+03	2.58E+03				
Lanthanum (57)	La-131	2.28E-13	5.74E-14	9.32E-14	1.31E-13	5.48E-14	2.76E-06	7.49E+03	7.49E+03	1.22E+04	2.75E+04	5.11E+02	1.35E+01		
Lanthanum (57)	La-132	4.85E-12	8.44E-13	1.78E-12	2.58E-12	6.25E-13	9.52E-06	4.45E+02	4.45E+02	7.26E+02	1.63E+03	2.68E+01	6.84E-01		
Lanthanum (57)	La-134						3.05E-06	5.99E+04	5.99E+04	9.78E+04	2.20E+05				
Lanthanum (57)	La-135	3.96E-13	6.70E-14	1.46E-13	2.11E-13	5.03E-14	5.21E-08	2.00E+04	1.99E+04	3.26E+04	7.34E+04	3.26E+02	8.36E+00		
Lanthanum (57)	La-137	9.44E-13	1.67E-13	3.48E-13	5.00E-13	1.39E-11	6.75E-09	1.61E+01	1.18E+01	3.23E+01	7.26E+01	1.37E+02	3.53E+00		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Lanthanum (57)	La-138	8.81E-12	2.03E-12	3.53E-12	4.96E-12	3.05E-10	6.07E-06	1.84E-02	1.38E-02	3.60E-02	8.10E-02	1.35E+01	3.56E-01		
Lanthanum (57)	La-140	3.05E-11	4.85E-12	1.10E-11	1.59E-11	4.77E-12	1.15E-05	4.38E+01	4.38E+01	7.15E+01	1.61E+02	4.33E+00	1.11E-01		
Lanthanum (57)	La-141	5.37E-12	8.18E-13	1.88E-12	2.74E-12	7.44E-13	2.37E-07	2.17E+04	2.16E+04	3.56E+04	8.01E+04	2.53E+01	6.44E-01		
Lanthanum (57)	La-142	1.48E-12	3.23E-13	5.77E-13	8.21E-13	2.42E-13	1.44E-05	9.15E+02	9.15E+02	1.49E+03	3.36E+03	8.25E+01	2.15E+00		
Lanthanum (57)	La-143	3.14E-13	8.03E-14	1.26E-13	1.78E-13	5.66E-14	5.11E-07	1.68E+05	1.68E+05	2.74E+05	6.17E+05	3.78E+02	9.91E+00		
Lead (82)	Pb-195m	1.20E-13	4.18E-14	5.48E-14	7.55E-14	4.37E-14	6.90E-06	1.12E+04	1.11E+04	1.82E+04	4.11E+04	8.69E+02	2.34E+01	5.15E+13	2.58E+12
Lead (82)	Pb-198	6.18E-13	1.62E-13	2.60E-13	3.63E-13	1.43E-13	1.62E-06	5.23E+03	4.55E+03	8.53E+03	1.92E+04	1.83E+02	4.86E+00	1.31E+11	6.54E+09
Lead (82)	Pb-199	3.28E-13	9.29E-14	1.42E-13	1.97E-13	7.44E-14	6.87E-06	1.97E+03	1.93E+03	3.22E+03	7.24E+03	3.35E+02	8.95E+00	6.13E+11	3.06E+10
Lead (82)	Pb-200	4.03E-12	8.70E-13	1.58E-12	2.24E-12	1.16E-12	5.97E-07	1.58E+03	4.54E+02	2.58E+03	5.81E+03	3.01E+01	7.87E-01	2.68E+08	1.34E+07
Lead (82)	Pb-201	1.47E-12	3.41E-13	5.92E-13	8.36E-13	3.50E-13	3.18E-06	6.80E+02	5.79E+02	1.11E+03	2.50E+03	8.04E+01	2.11E+00	3.74E+09	1.87E+08
Lead (82)	Pb-202	3.74E-11	1.74E-11	2.22E-11	2.93E-11	1.43E-11	3.09E-12	9.48E+00	4.31E-03	1.02E+02	1.84E+02	2.15E+00	6.02E-02	2.66E-01	1.33E-02
Lead (82)	Pb-202m	9.84E-13	2.65E-13	4.18E-13	5.85E-13	2.25E-13	9.32E-06	6.02E+02	5.78E+02	9.83E+02	2.21E+03	1.14E+02	3.01E+00	3.58E+10	1.79E+09
Lead (82)	Pb-203	2.65E-12	5.59E-13	1.02E-12	1.46E-12	7.55E-13	1.09E-06	3.58E+02	1.90E+02	5.84E+02	1.31E+03	4.67E+01	1.21E+00	7.07E+07	3.54E+06
Lead (82)	Pb-205	1.26E-12	4.92E-13	6.33E-13	8.25E-13	6.44E-13	3.50E-12	3.07E+02	1.53E-01	3.42E+03	6.22E+03	7.52E+01	2.14E+00	9.33E+00	4.66E-01
Lead (82)	Pb-209	6.55E-13	1.22E-13	2.41E-13	3.49E-13	1.90E-13	5.37E-10	8.85E+06	2.70E+04	1.85E+07	4.13E+07	1.98E+02	5.05E+00	7.69E+10	3.85E+09
Lead (82)	Pb-210	1.84E-09	5.99E-10	8.81E-10	1.18E-09	2.77E-09	1.41E-09	3.28E-01	1.87E-04	4.19E+00	7.56E+00	5.41E-02	1.49E-03	1.58E-02	7.92E-04
Lead (82)	Pb-210+D	2.66E-09	2.04E-09	1.27E-09	3.44E-09	1.39E-08	4.21E-09	1.50E-01	6.42E-05	1.23E+00	2.22E+00	3.75E-02	5.13E-04	1.10E-02	5.50E-04
Lead (82)	Pb-211	1.04E-12	2.63E-13	4.11E-13	5.81E-13	3.70E-11	2.29E-07	1.47E+05	5.50E+04	2.41E+05	5.41E+05	1.16E+02	3.04E+00	1.32E+12	6.58E+10
Lead (82)	Pb-212	6.70E-11	1.31E-11	2.50E-11	3.54E-11	5.77E-10	5.09E-07	3.64E+03	8.00E+01	6.13E+03	1.38E+04	1.90E+00	4.98E-02	6.97E+07	3.49E+06
Lead (82)	Pb-214	8.51E-13	2.21E-13	3.44E-13	4.85E-13	3.63E-11	9.82E-07	4.63E+04	3.49E+04	7.56E+04	1.70E+05	1.38E+02	3.64E+00	2.85E+12	1.43E+11
Lutetium (71)	Lu-169	5.03E-12	9.69E-13	1.94E-12	2.77E-12	1.33E-12	4.73E-06	1.26E+02	1.26E+02	2.06E+02	4.63E+02	2.45E+01	6.37E-01		
Lutetium (71)	Lu-170	1.06E-11	2.11E-12	4.14E-12	5.88E-12	2.25E-12	1.26E-05	3.36E+01	3.36E+01	5.48E+01	1.23E+02	1.15E+01	3.00E-01		
Lutetium (71)	Lu-171	8.84E-12	1.52E-12	3.27E-12	4.70E-12	3.50E-12	2.90E-06	3.55E+01	3.55E+01	5.80E+01	1.30E+02	1.46E+01	3.75E-01		
Lutetium (71)	Lu-172	1.47E-11	2.75E-12	5.59E-12	8.03E-12	6.03E-12	8.70E-06	1.45E+01	1.45E+01	2.37E+01	5.33E+01	8.52E+00	2.20E-01		
Lutetium (71)	Lu-173	3.74E-12	6.03E-13	1.35E-12	1.96E-12	8.70E-12	2.92E-07	5.79E+00	5.79E+00	9.46E+00	2.13E+01	3.53E+01	9.00E-01		
Lutetium (71)	Lu-174	4.11E-12	6.44E-13	1.46E-12	2.12E-12	1.42E-11	4.26E-07	1.65E+00	1.64E+00	2.70E+00	6.07E+00	3.26E+01	8.32E-01		
Lutetium (71)	Lu-174m	9.73E-12	1.39E-12	3.38E-12	4.96E-12	1.51E-11	9.88E-08	5.95E+01	5.96E+01	9.83E+01	2.21E+02	1.41E+01	3.56E-01		
Lutetium (71)	Lu-176	2.60E-11	4.11E-12	9.29E-12	1.35E-11	1.41E-10	1.83E-06	6.08E-02	4.56E-02	1.19E-01	2.69E-01	5.13E+00	1.31E-01		
Lutetium (71)	Lu-176m	2.43E-12	3.74E-13	8.55E-13	1.25E-12	4.55E-13	2.78E-08	1.96E+05	1.96E+05	3.24E+05	7.28E+05	5.57E+01	1.41E+00		
Lutetium (71)	Lu-177	1.02E-11	1.43E-12	3.53E-12	5.18E-12	4.66E-12	1.14E-07	1.09E+03	1.09E+03	1.80E+03	4.06E+03	1.35E+01	3.40E-01		
Lutetium (71)	Lu-177m	2.60E-11	4.14E-12	9.36E-12	1.36E-11	5.70E-11	3.63E-06	1.45E+00	1.45E+00	2.36E+00	5.32E+00	5.09E+00	1.30E-01		
Lutetium (71)	Lu-178	2.02E-13	6.25E-14	8.62E-14	1.20E-13	5.29E-14	6.76E-07	6.35E+04	6.35E+04	1.04E+05	2.33E+05	5.52E+02	1.47E+01		
Lutetium (71)	Lu-178m	1.59E-13	5.37E-14	7.10E-14	9.84E-14	5.85E-14	4.26E-06	1.26E+04	1.26E+04	2.06E+04	4.63E+04	6.71E+02	1.79E+01		
Lutetium (71)	Lu-179	3.21E-12	4.81E-13	1.12E-12	1.64E-12	5.14E-13	1.19E-07	3.71E+04	3.71E+04	6.07E+04	1.37E+05	4.25E+01	1.08E+00		
Magnesium (12)	Mg-28	3.06E-11	5.22E-12	1.14E-11	1.65E-11	5.14E-12	6.56E-06	1.48E+02	1.48E+02	2.42E+02	5.44E+02	4.18E+00	1.07E-01		
Manganese (25)	Mn-51	5.11E-13	1.37E-13	2.09E-13	2.95E-13	9.55E-14	4.37E-06	6.04E+03	5.62E+03	9.85E+03	2.22E+04	2.28E+02	5.98E+00	1.30E+12	6.50E+10
Manganese (25)	Mn-52	1.58E-11	3.60E-12	6.44E-12	9.07E-12	4.40E-12	1.67E-05	9.03E+00	5.67E+00	1.48E+01	3.33E+01	7.39E+00	1.94E-01	1.39E+06	6.95E+04
Manganese (25)	Mn-52m	2.82E-13	9.66E-14	1.27E-13	1.75E-13	5.07E-14	1.15E-05	5.02E+03	4.94E+03	8.20E+03	1.84E+04	3.75E+02	1.01E+01	1.03E+13	5.13E+11
Manganese (25)	Mn-53	4.37E-13	6.99E-14	1.56E-13	2.25E-13	2.17E-13	0.00E+00	7.14E+01	3.37E-01	2.54E+04	4.58E+04	3.05E+02	7.84E+00	3.11E+01	1.56E+00
Manganese (25)	Mn-54	5.14E-12	1.48E-12	2.28E-12	3.11E-12	5.88E-12	3.89E-06	6.92E-01	3.69E-01	1.13E+00	2.55E+00	2.09E+01	5.67E-01	7.42E+02	3.71E+01
Manganese (25)	Mn-56	2.78E-12	5.11E-13	1.03E-12	1.48E-12	4.14E-13	8.44E-06	9.32E+02	7.82E+02	1.52E+03	3.43E+03	4.62E+01	1.19E+00	2.35E+10	1.17E+09
Mendelevium (101)	Md-257	1.67E-12	2.59E-13	5.88E-13	8.58E-13	7.70E-11	3.62E-07	1.08E+04	1.08E+04	1.76E+04	3.96E+04	8.10E+01	2.06E+00		
Mendelevium (101)	Md-258	1.23E-10	1.95E-11	4.33E-11	6.25E-11	1.68E-08	1.31E-09	8.24E+02	8.56E+02	6.27E+03	1.23E+04	1.10E+00	2.82E-02		
Mercury (80)	Hg-193	1.14E-12	1.87E-13	4.11E-13	5.99E-13	2.53E-13	5.55E-07	1.04E+04	1.01E+04	1.71E+04	3.84E+04	1.16E+02	2.94E+00		
Mercury (80)	Hg-193m	5.37E-12	9.10E-13	1.97E-12	2.84E-12	9.40E-13	4.54E-06	4.01E+02	3.94E+02	6.58E+02	1.48E+03	2.42E+01	6.21E-01		
Mercury (80)	Hg-194	1.55E-10	2.00E-12	8.07E-11	1.06E-10	2.88E-11	5.04E-12	1.27E-01	2.33E-02	8.99E+02	1.62E+03	5.90E-01	1.66E-02		
Mercury (80)	Hg-195	1.41E-12	2.27E-13	5.07E-13	7.36E-13	2.84E-13	7.34E-07	2.77E+03	2.70E+03	4.56E+03	1.03E+04	9.39E+01	2.40E+00		
Mercury (80)	Hg-195m	9.55E-12	1.42E-12	3.36E-12	4.92E-12	2.33E-12	7.68E-07	6.02E+02	5.18E+02	1.04E+03	2.33E+03	1.42E+01	3.58E-01		
Mercury (80)	Hg-197	4.07E-12	5.99E-13	1.43E-12	2.09E-12	1.25E-12	1.14E-07	2.40E+03	1.68E+03	4.53E+03	1.02E+04	3.33E+01	8.44E-01		
Mercury (80)	Hg-197m	8.62E-12	1.24E-12	3.00E-12	4.40E-12	2.28E-12	2.50E-07	2.96E+03	2.10E+03	5.57E+03	1.25E+04	1.59E+01	4.01E-01		
Mercury (80)	Hg-199m	1.63E-13	4.44E-14	6.70E-14	9.44E-14	6.33E-14	5.77E-07	4.95E+04	4.93E+04	8.09E+04	1.82E+05	7.11E+02	1.87E+01		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Mercury (80)	Hg-203	1.27E-11	1.35E-12	5.70E-12	7.62E-12	8.95E-12	9.21E-07	1.84E+01	1.52E+01	3.22E+01	7.24E+01	8.35E+00	2.31E-01		
Molybdenum (42)	Mo-101	1.48E-13	5.59E-14	6.88E-14	9.44E-14	4.33E-14	6.62E-06	1.26E+04	1.26E+04	2.06E+04	4.63E+04	6.92E+02	1.87E+01		
Molybdenum (42)	Mo-90	1.39E-12	5.03E-13	6.59E-13	8.73E-13	1.24E-12	3.41E-06	1.05E+03	1.05E+03	1.71E+03	3.86E+03	7.23E+01	2.02E+00		
Molybdenum (42)	Mo-93	5.29E-12	3.38E-12	3.35E-12	4.18E-12	1.27E-12	2.17E-10	8.58E+00	1.05E+00	3.46E+02	6.69E+02	1.42E+01	4.22E-01		
Molybdenum (42)	Mo-93m	6.62E-13	2.51E-13	3.20E-13	4.26E-13	4.33E-13	1.09E-05	2.72E+02	2.72E+02	4.44E+02	9.99E+02	1.49E+02	4.14E+00		
Molybdenum (42)	Mo-99	3.50E-12	1.18E-12	1.60E-12	2.11E-12	4.29E-12	6.64E-07	4.59E+02	4.37E+02	7.56E+02	1.70E+03	2.98E+01	8.36E-01		
Neodymium (60)	Nd-136	6.70E-13	1.64E-13	2.70E-13	3.81E-13	1.34E-13	1.01E-06	2.38E+04	2.38E+04	3.89E+04	8.74E+04	1.76E+02	4.63E+00		
Neodymium (60)	Nd-138	9.69E-12	1.49E-12	3.42E-12	5.00E-12	1.24E-12	6.73E-08	5.85E+04	5.70E+04	9.75E+04	2.19E+05	1.39E+01	3.53E-01		
Neodymium (60)	Nd-139	1.21E-13	3.11E-14	4.96E-14	6.96E-14	2.37E-14	1.72E-06	2.39E+04	2.39E+04	3.89E+04	8.76E+04	9.60E+02	2.53E+01		
Neodymium (60)	Nd-139m	2.86E-12	5.37E-13	1.08E-12	1.56E-12	4.96E-13	7.13E-06	5.18E+02	5.18E+02	8.46E+02	1.90E+03	4.41E+01	1.13E+00		
Neodymium (60)	Nd-141	8.07E-14	1.61E-14	3.09E-14	4.40E-14	1.34E-14	2.28E-07	3.58E+04	3.58E+04	5.84E+04	1.31E+05	1.54E+03	4.01E+01		
Neodymium (60)	Nd-141m						3.48E-06	3.37E+05	3.37E+05	5.50E+05	1.24E+06				
Neodymium (60)	Nd-147	2.01E-11	2.86E-12	6.96E-12	1.02E-11	9.36E-12	4.87E-07	1.57E+02	1.56E+02	2.58E+02	5.80E+02	6.84E+00	1.73E-01		
Neodymium (60)	Nd-149	1.51E-12	2.58E-13	5.44E-13	7.92E-13	3.19E-13	1.49E-06	7.88E+03	7.88E+03	1.29E+04	2.89E+04	8.75E+01	2.23E+00		
Neodymium (60)	Nd-151	1.83E-13	4.63E-14	7.36E-14	1.04E-13	3.92E-14	4.10E-06	2.40E+04	2.40E+04	3.91E+04	8.80E+04	6.47E+02	1.70E+01		
Neon (10)	Ne-19						4.47E-06	9.51E+05	9.51E+05	1.55E+06	3.49E+06				
Neptunium (93)	Np-232	4.14E-14	1.57E-14	1.97E-14	2.70E-14	3.17E-14	5.25E-06	1.58E+04	1.56E+04	2.58E+04	5.80E+04	2.42E+03	6.53E+01	8.01E+12	4.01E+11
Neptunium (93)	Np-233	1.14E-14	3.58E-15	5.03E-15	6.99E-15	2.49E-15	2.29E-07	1.47E+05	1.38E+05	2.40E+05	5.40E+05	9.47E+03	2.52E+02	5.18E+12	2.59E+11
Neptunium (93)	Np-234	8.77E-12	1.72E-12	3.40E-12	4.85E-12	1.86E-12	7.06E-06	2.72E+01	1.13E+01	4.45E+01	1.00E+02	1.40E+01	3.64E-01	2.50E+05	1.25E+04
Neptunium (93)	Np-235	9.99E-13	1.42E-13	3.46E-13	5.07E-13	1.15E-12	2.13E-09	8.57E+02	2.06E+00	1.62E+03	3.65E+03	1.38E+02	3.48E+00	3.03E+02	1.52E+01
Neptunium (93)	Np-236a	2.56E-11	7.18E-12	1.05E-11	1.44E-11	9.77E-10	3.25E-07	3.33E-01	2.81E-03	6.70E-01	1.51E+00	4.54E+00	1.22E-01	2.72E-02	1.36E-03
Neptunium (93)	Np-236b	3.19E-12	4.74E-13	1.11E-12	1.63E-12	8.07E-12	1.34E-07	6.68E+03	2.60E+02	1.10E+04	2.47E+04	4.29E+01	1.08E+00	1.69E+07	8.43E+05
Neptunium (93)	Np-237	1.46E-10	4.70E-11	6.18E-11	8.29E-11	1.77E-08	5.36E-08	1.00E+00	4.93E-04	3.66E+00	8.04E+00	7.71E-01	2.13E-02	9.00E-02	4.50E-03
Neptunium (93)	Np-237+D	1.62E-10	4.92E-11	6.74E-11	9.10E-11	1.77E-08	7.97E-07	1.30E-01	4.48E-04	2.72E-01	6.11E-01	7.07E-01	1.94E-02	9.00E-02	4.50E-03
Neptunium (93)	Np-238	1.52E-11	2.33E-12	5.40E-12	7.88E-12	4.18E-12	2.62E-06	1.52E+02	2.13E+01	2.49E+02	5.60E+02	8.82E+00	2.24E-01	6.78E+05	3.39E+04
Neptunium (93)	Np-239	1.47E-11	2.15E-12	5.14E-12	7.51E-12	4.00E-12	5.41E-07	6.57E+02	2.26E+01	1.08E+03	2.43E+03	9.26E+00	2.35E-01	5.75E+05	2.87E+04
Neptunium (93)	Np-240	5.55E-13	1.37E-13	2.23E-13	3.16E-13	1.95E-13	5.80E-06	3.23E+03	2.91E+03	5.28E+03	1.19E+04	2.14E+02	5.58E+00	3.62E+10	1.81E+09
Neptunium (93)	Np-240m						1.51E-06	1.09E+05	1.09E+05	1.78E+05	4.01E+05				
Nickel (28)	Ni-56	6.70E-12	1.64E-12	2.83E-12	3.96E-12	2.88E-12	7.74E-06	1.79E+01	1.71E+01	2.93E+01	6.58E+01	1.68E+01	4.45E-01	1.78E+07	8.91E+05
Nickel (28)	Ni-57	1.02E-11	1.89E-12	3.89E-12	5.55E-12	1.78E-12	9.43E-06	5.96E+01	5.64E+01	9.74E+01	2.19E+02	1.22E+01	3.18E-01	2.13E+08	1.07E+07
Nickel (28)	Ni-59	7.33E-13	1.44E-13	2.74E-13	3.89E-13	4.66E-13	0.00E+00	2.08E+02	2.15E+00	1.23E+04	2.22E+04	1.74E+02	4.53E+00	2.05E+02	1.03E+01
Nickel (28)	Ni-63	1.79E-12	3.50E-13	6.70E-13	9.51E-13	1.64E-12	0.00E+00	9.48E+01	1.01E+00	5.55E+03	9.99E+03	7.11E+01	1.85E+00	3.80E+01	1.90E+00
Nickel (28)	Ni-65	1.92E-12	3.34E-13	6.96E-13	1.01E-12	3.03E-13	2.74E-06	2.94E+03	2.84E+03	4.80E+03	1.08E+04	6.84E+01	1.75E+00	2.44E+11	1.22E+10
Nickel (28)	Ni-66	5.77E-11	8.18E-12	2.00E-11	2.94E-11	8.99E-12	2.67E-11	9.12E+03	1.26E+02	5.88E+05	1.06E+06	2.38E+00	6.00E-02	1.81E+07	9.06E+05
Niobium (41)	Nb-88	2.45E-13	8.92E-14	1.13E-13	1.55E-13	4.51E-14	1.89E-05	4.51E+03	4.51E+03	7.36E+03	1.66E+04	4.21E+02	1.14E+01		
Niobium (41)	Nb-89a	1.01E-12	2.35E-13	4.00E-13	5.66E-13	1.74E-13	8.48E-06	2.18E+03	2.18E+03	3.55E+03	8.00E+03	1.19E+02	3.12E+00		
Niobium (41)	Nb-89b	2.82E-12	5.22E-13	1.04E-12	1.51E-12	4.07E-13	6.64E-06	1.50E+03	1.50E+03	2.46E+03	5.53E+03	4.58E+01	1.17E+00		
Niobium (41)	Nb-90	1.52E-11	2.75E-12	5.70E-12	8.21E-12	2.27E-12	2.13E-05	6.53E+01	6.53E+01	1.07E+02	2.40E+02	8.35E+00	2.15E-01		
Niobium (41)	Nb-93m	2.31E-12	3.32E-13	8.03E-13	1.17E-12	1.90E-12	3.83E-11	3.50E+02	1.37E+02	4.88E+03	9.73E+03	5.93E+01	1.51E+00		
Niobium (41)	Nb-94	2.05E-11	3.89E-12	7.77E-12	1.11E-11	3.77E-11	7.29E-06	1.53E-02	1.15E-02	3.00E-02	6.75E-02	6.13E+00	1.59E-01		
Niobium (41)	Nb-95	6.36E-12	1.23E-12	2.45E-12	3.50E-12	5.44E-12	3.53E-06	6.81E+00	6.81E+00	1.11E+01	2.50E+01	1.94E+01	5.04E-01		
Niobium (41)	Nb-95m	1.05E-11	1.50E-12	3.66E-12	5.37E-12	3.27E-12	2.32E-07	1.00E+03	9.84E+02	1.65E+03	3.71E+03	1.30E+01	3.28E-01		
Niobium (41)	Nb-96	1.35E-11	2.41E-12	5.03E-12	7.25E-12	2.28E-12	1.15E-05	7.55E+01	7.54E+01	1.23E+02	2.77E+02	9.47E+00	2.43E-01		
Niobium (41)	Nb-97	5.00E-13	1.14E-13	1.96E-13	2.79E-13	1.07E-13	2.97E-06	5.69E+03	5.69E+03	9.29E+03	2.09E+04	2.43E+02	6.32E+00		
Niobium (41)	Nb-97m						3.34E-06	3.65E+05	3.65E+05	5.96E+05	1.34E+06				
Niobium (41)	Nb-98	6.73E-13	1.81E-13	2.80E-13	3.92E-13	1.23E-13	1.16E-05	2.04E+03	2.04E+03	3.33E+03	7.49E+03	1.70E+02	4.50E+00		
Nitrogen (7)	N-13						4.45E-06	2.75E+04	2.75E+04	4.48E+04	1.01E+05				
Osmium (76)	Os-180	7.92E-14	2.72E-14	3.63E-14	5.00E-14	2.62E-14	1.08E-07	5.13E+05	5.13E+05	8.37E+05	1.88E+06	1.31E+03	3.53E+01		
Osmium (76)	Os-181	9.21E-13	1.83E-13	3.54E-13	5.07E-13	1.95E-13	5.41E-06	2.15E+03	2.15E+03	3.50E+03	7.88E+03	1.35E+02	3.48E+00		
Osmium (76)	Os-182	6.92E-12	1.23E-12	2.59E-12	3.74E-12	1.45E-12	1.63E-06	5.66E+02	5.66E+02	9.25E+02	2.08E+03	1.84E+01	4.72E-01		
Osmium (76)	Os-185	4.77E-12	1.04E-12	1.92E-12	2.70E-12	6.14E-12	3.11E-06	2.90E+00	2.90E+00	4.73E+00	1.06E+01	2.48E+01	6.53E-01		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Osmium (76)	Os-189m	2.94E-13	4.29E-14	1.02E-13	1.50E-13	3.44E-14	7.20E-13	8.05E+07	8.40E+07	9.22E+08	1.70E+09	4.67E+02	1.18E+01		
Osmium (76)	Os-190m						6.76E-06	1.82E+04	1.82E+04	2.97E+04	6.69E+04				
Osmium (76)	Os-191	1.05E-11	1.50E-12	3.64E-12	5.33E-12	7.10E-12	1.66E-07	3.28E+02	3.28E+02	5.40E+02	1.21E+03	1.31E+01	3.31E-01		
Osmium (76)	Os-191m	1.76E-12	2.51E-13	6.11E-13	8.95E-13	6.36E-13	1.05E-08	1.45E+05	1.46E+05	2.42E+05	5.45E+05	7.79E+01	1.97E+00		
Osmium (76)	Os-193	1.53E-11	2.16E-12	5.29E-12	7.77E-12	2.71E-12	2.69E-07	2.50E+03	2.50E+03	4.10E+03	9.23E+03	9.00E+00	2.27E-01		
Osmium (76)	Os-194	4.37E-11	6.55E-12	1.53E-11	2.23E-11	2.55E-10	6.57E-10	5.87E+01	5.96E+01	4.56E+02	9.01E+02	3.11E+00	7.91E-02		
Oxygen (8)	O-15						4.46E-06	1.34E+05	1.34E+05	2.19E+05	4.94E+05				
Palladium (46)	Pd-100	1.05E-11	1.99E-12	4.03E-12	5.77E-12	3.10E-12	2.22E-07	9.87E+02	8.43E+02	1.71E+03	3.85E+03	1.18E+01	3.06E-01		
Palladium (46)	Pd-101	1.12E-12	2.03E-13	4.22E-13	6.07E-13	1.97E-13	1.38E-06	1.78E+03	1.77E+03	2.91E+03	6.54E+03	1.13E+02	2.91E+00		
Palladium (46)	Pd-103	3.61E-12	5.07E-13	1.25E-12	1.84E-12	1.77E-12	1.15E-09	8.67E+03	2.67E+03	6.70E+04	1.49E+05	3.81E+01	9.59E-01		
Palladium (46)	Pd-107	7.25E-13	1.01E-13	2.50E-13	3.67E-13	1.69E-12	0.00E+00	1.22E+02	2.40E+01	1.76E+04	3.16E+04	1.90E+02	4.81E+00		
Palladium (46)	Pd-109	1.01E-11	1.43E-12	3.50E-12	5.14E-12	1.85E-12	1.27E-08	5.94E+04	2.46E+04	1.92E+05	4.31E+05	1.36E+01	3.43E-01		
Phosphorus (15)	P-30						4.50E-06	1.08E+05	1.08E+05	1.77E+05	3.98E+05				
Phosphorus (15)	P-32	2.21E-11	5.37E-12	8.95E-12	1.23E-11	1.22E-11	9.41E-09	2.07E+02	5.15E+01	9.59E+03	2.12E+04	5.32E+00	1.43E-01		
Phosphorus (15)	P-33	2.47E-12	5.62E-13	9.81E-13	1.36E-12	5.11E-12	3.72E-11	1.09E+03	2.64E+02	5.11E+05	9.90E+05	4.85E+01	1.30E+00		
Platinum (78)	Pt-186	1.03E-12	1.97E-13	3.92E-13	5.62E-13	8.25E-14	3.20E-06	3.17E+03	3.17E+03	5.18E+03	1.17E+04	1.21E+02	3.14E+00		
Platinum (78)	Pt-188	1.03E-11	1.74E-12	3.77E-12	5.44E-12	1.88E-12	6.02E-07	1.38E+02	1.38E+02	2.25E+02	5.06E+02	1.26E+01	3.24E-01		
Platinum (78)	Pt-189	1.61E-12	2.76E-13	5.92E-13	8.55E-13	1.32E-13	1.17E-06	1.59E+03	1.59E+03	2.60E+03	5.85E+03	8.04E+01	2.06E+00		
Platinum (78)	Pt-191	4.85E-12	7.88E-13	1.76E-12	2.55E-12	4.63E-13	9.78E-07	3.09E+02	3.09E+02	5.04E+02	1.14E+03	2.71E+01	6.92E-01		
Platinum (78)	Pt-193	6.14E-13	8.51E-14	2.11E-13	3.09E-13	1.11E-13	2.78E-12	1.53E+03	1.27E+03	1.95E+04	3.67E+04	2.26E+02	5.71E+00		
Platinum (78)	Pt-193m	8.81E-12	1.23E-12	3.03E-12	4.44E-12	7.73E-13	1.68E-08	1.08E+04	1.09E+04	1.88E+04	4.23E+04	1.57E+01	3.97E-01		
Platinum (78)	Pt-195m	1.19E-11	1.69E-12	4.11E-12	6.03E-12	1.05E-12	1.26E-07	1.65E+03	1.65E+03	2.72E+03	6.12E+03	1.16E+01	2.92E-01		
Platinum (78)	Pt-197	7.59E-12	1.07E-12	2.62E-12	3.85E-12	5.22E-13	5.63E-08	1.94E+04	1.94E+04	3.21E+04	7.22E+04	1.82E+01	4.58E-01		
Platinum (78)	Pt-197m	1.12E-12	1.81E-13	4.00E-13	5.81E-13	8.66E-14	2.38E-07	5.42E+04	5.42E+04	8.85E+04	1.99E+05	1.19E+02	3.04E+00		
Platinum (78)	Pt-199	2.18E-13	5.66E-14	8.84E-14	1.25E-13	2.48E-14	8.69E-07	4.55E+04	4.55E+04	7.43E+04	1.67E+05	5.39E+02	1.41E+01		
Platinum (78)	Pt-200	2.23E-11	3.16E-12	7.73E-12	1.13E-11	1.48E-12	1.58E-07	1.01E+04	1.01E+04	1.67E+04	3.77E+04	6.16E+00	1.56E-01		
Plutonium (94)	Pu-234	2.39E-12	3.85E-13	8.58E-13	1.25E-12	6.85E-11	1.61E-07	1.43E+04	8.89E+03	2.34E+04	5.26E+04	5.55E+01	1.41E+00	2.47E+09	1.24E+08
Plutonium (94)	Pu-235	9.73E-15	3.24E-15	4.37E-15	6.03E-15	2.39E-15	2.37E-07	2.03E+05	2.03E+05	3.32E+05	7.47E+05	1.09E+04	2.92E+02	2.11E+14	1.06E+13
Plutonium (94)	Pu-236	1.74E-10	5.55E-11	7.47E-11	9.92E-11	2.28E-08	1.19E-10	3.03E+01	1.04E-01	1.81E+02	3.31E+02	6.37E-01	1.78E-02	3.53E+00	1.77E-01
Plutonium (94)	Pu-237	1.62E-12	2.53E-13	5.77E-13	8.40E-13	1.27E-12	1.12E-07	1.66E+02	1.05E+02	2.72E+02	6.12E+02	8.25E+01	2.10E+00	2.41E+05	1.20E+04
Plutonium (94)	Pu-238	2.72E-10	1.17E-10	1.31E-10	1.69E-10	3.36E-08	7.22E-11	2.97E+00	7.31E-03	1.60E+01	2.91E+01	3.64E-01	1.04E-02	1.75E+00	8.76E-02
Plutonium (94)	Pu-239	2.76E-10	1.21E-10	1.35E-10	1.74E-10	3.33E-08	2.00E-10	2.59E+00	6.09E-03	1.40E+01	2.54E+01	3.53E-01	1.01E-02	1.56E+00	7.80E-02
Plutonium (94)	Pu-240	2.77E-10	1.21E-10	1.35E-10	1.74E-10	3.33E-08	6.98E-11	2.60E+00	6.10E-03	1.41E+01	2.56E+01	3.53E-01	1.01E-02	1.56E+00	7.81E-02
Plutonium (94)	Pu-241	3.29E-12	1.73E-12	1.76E-12	2.28E-12	3.34E-10	4.11E-12	4.06E+02	1.05E+00	1.69E+03	3.06E+03	2.71E+01	7.74E-01	1.00E+01	5.02E-01
Plutonium (94)	Pu-242	2.63E-10	1.15E-10	1.28E-10	1.65E-10	3.13E-08	6.25E-11	2.73E+00	6.42E-03	1.48E+01	2.69E+01	3.72E-01	1.07E-02	1.56E+00	7.80E-02
Plutonium (94)	Pu-243	1.34E-12	2.06E-13	4.74E-13	6.92E-13	2.94E-13	5.50E-08	7.42E+04	3.73E+04	1.21E+05	2.73E+05	1.00E+02	2.55E+00	1.41E+10	7.04E+08
Plutonium (94)	Pu-244	2.94E-10	1.15E-10	1.37E-10	1.80E-10	2.93E-08	3.01E-11	2.45E+00	5.88E-03	1.49E+01	2.70E+01	3.48E-01	9.80E-03	1.56E+00	7.80E-02
Plutonium (94)	Pu-244+D	3.14E-10		1.44E-10	1.90E-10	2.93E-08	1.51E-06	7.16E-02	5.06E-03	1.45E-01	3.25E-01	3.31E-01	9.28E-03	1.56E+00	7.80E-02
Plutonium (94)	Pu-245	1.28E-11	1.89E-12	4.48E-12	6.55E-12	2.07E-12	1.77E-06	1.09E+03	8.46E+02	1.78E+03	4.01E+03	1.06E+01	2.69E-01	3.33E+08	1.66E+07
Plutonium (94)	Pu-246	4.92E-11	7.40E-12	1.73E-11	2.53E-11	1.73E-11	4.04E-07	1.89E+02	3.23E+01	3.13E+02	7.04E+02	2.75E+00	6.97E-02	1.39E+05	6.94E+03
Polonium (84)	Po-203	3.92E-13	9.77E-14	1.63E-13	1.88E-13	7.73E-14	7.65E-06	4.34E+03	4.34E+03	7.09E+03	1.59E+04	2.92E+02	9.38E+00		
Polonium (84)	Po-205	4.26E-13	1.12E-13	1.81E-13	2.41E-13	1.72E-13	7.36E-06	1.53E+03	1.53E+03	2.50E+03	5.63E+03	2.63E+02	7.32E+00		
Polonium (84)	Po-207	1.28E-12	2.86E-13	5.18E-13	5.55E-13	1.99E-13	6.08E-06	5.73E+02	5.73E+02	9.35E+02	2.10E+03	9.19E+01	3.18E+00		
Polonium (84)	Po-210	7.96E-10	2.96E-10	3.77E-10	2.25E-09	1.08E-08	3.95E-11	3.79E+01	1.94E+01	2.73E+02	4.93E+02	1.26E-01	7.84E-04		
Polonium (84)	Po-211						3.58E-08	3.96E+09	3.96E+09	6.46E+09	1.45E+10				
Polonium (84)	Po-212						0.00E+00								
Polonium (84)	Po-213						0.00E+00								
Polonium (84)	Po-214						3.86E-10	1.16E+15	1.16E+15	1.89E+15	4.24E+15				
Polonium (84)	Po-215						7.48E-10	5.49E+13	5.49E+13	8.97E+13	2.02E+14				
Polonium (84)	Po-216						7.87E-11	6.20E+12	6.20E+12	1.01E+13	2.28E+13				
Polonium (84)	Po-218						4.26E-11	9.38E+09	9.38E+09	1.53E+10	3.45E+10				

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Potassium (19)	K-38						1.61E-05	9.91E+03	9.91E+03	1.62E+04	3.64E+04				
Potassium (19)	K-40	6.18E-11	1.51E-11	2.47E-11	3.43E-11	1.03E-11	7.97E-07	1.08E-01	4.45E-02	2.73E-01	6.15E-01	1.93E+00	5.14E-02		
Potassium (19)	K-42	3.06E-12	8.40E-13	1.26E-12	1.74E-12	4.33E-13	1.46E-06	1.11E+03	1.08E+03	1.83E+03	4.12E+03	3.78E+01	1.01E+00		
Potassium (19)	K-43	1.81E-12	5.48E-13	7.88E-13	1.07E-12	3.09E-13	4.23E-06	2.12E+02	2.11E+02	3.47E+02	7.80E+02	6.04E+01	1.65E+00		
Potassium (19)	K-44	3.00E-13	1.13E-13	1.39E-13	1.91E-13	3.39E-14	1.19E-05	4.64E+03	4.63E+03	7.56E+03	1.70E+04	3.43E+02	9.23E+00		
Potassium (19)	K-45	1.93E-13	7.29E-14	8.95E-14	1.22E-13	2.33E-14	9.53E-06	6.40E+03	6.39E+03	1.04E+04	2.35E+04	5.32E+02	1.45E+01		
Praseodymium (59)	Pr-136	1.27E-13	4.66E-14	5.88E-14	8.07E-14	2.15E-14	9.74E-06	9.55E+03	9.55E+03	1.56E+04	3.51E+04	8.10E+02	2.19E+01		
Praseodymium (59)	Pr-137	3.22E-13	6.99E-14	1.25E-13	1.78E-13	5.55E-14	2.14E-06	7.44E+03	7.44E+03	1.21E+04	2.73E+04	3.81E+02	9.91E+00		
Praseodymium (59)	Pr-138						3.57E-06	2.36E+05	2.36E+05	3.84E+05	8.65E+05				
Praseodymium (59)	Pr-138m	1.03E-12	2.41E-13	4.18E-13	5.92E-13	1.76E-13	1.13E-05	8.56E+02	8.56E+02	1.40E+03	3.14E+03	1.14E+02	2.98E+00		
Praseodymium (59)	Pr-139	4.03E-13	6.85E-14	1.47E-13	2.12E-13	6.96E-14	4.41E-07	1.02E+04	1.02E+04	1.67E+04	3.75E+04	3.24E+02	8.32E+00		
Praseodymium (59)	Pr-142	2.49E-11	3.50E-12	8.58E-12	1.26E-11	3.38E-12	3.14E-07	3.34E+03	3.31E+03	5.52E+03	1.24E+04	5.55E+00	1.40E-01		
Praseodymium (59)	Pr-142m	3.20E-13	4.48E-14	1.10E-13	1.62E-13	4.33E-14	0.00E+00	1.55E+09	9.00E+08	2.47E+10	4.45E+10	4.33E+02	1.09E+01		
Praseodymium (59)	Pr-143	2.29E-11	3.19E-12	7.92E-12	1.16E-11	9.73E-12	1.63E-09	1.13E+04	7.53E+03	5.02E+04	1.08E+05	6.01E+00	1.52E-01		
Praseodymium (59)	Pr-144	1.82E-13	6.33E-14	8.10E-14	1.12E-13	3.58E-14	1.94E-07	3.63E+05	3.63E+05	5.93E+05	1.33E+06	5.88E+02	1.57E+01		
Praseodymium (59)	Pr-144m						8.73E-09	1.94E+07	1.94E+07	3.17E+07	7.12E+07				
Praseodymium (59)	Pr-145	6.59E-12	9.66E-13	2.29E-12	3.36E-12	9.25E-13	6.95E-08	4.81E+04	4.76E+04	7.96E+04	1.79E+05	2.08E+01	5.25E-01		
Praseodymium (59)	Pr-147	1.32E-13	4.40E-14	5.85E-14	8.10E-14	3.59E-14	3.78E-06	2.37E+04	2.37E+04	3.87E+04	8.71E+04	8.14E+02	2.18E+01		
Promethium (61)	Pm-141	1.52E-13	4.96E-14	6.66E-14	9.25E-14	2.85E-14	3.33E-06	1.75E+04	1.75E+04	2.86E+04	6.43E+04	7.15E+02	1.91E+01		
Promethium (61)	Pm-142						3.86E-06	4.68E+05	4.68E+05	7.64E+05	1.72E+06				
Promethium (61)	Pm-143	2.20E-12	4.59E-13	8.73E-13	1.24E-12	5.37E-12	1.33E-06	2.40E+00	2.40E+00	3.92E+00	8.82E+00	5.45E+01	1.42E+00		
Promethium (61)	Pm-144	8.10E-12	1.86E-12	3.34E-12	4.66E-12	2.76E-11	6.90E-06	3.38E-01	3.38E-01	5.52E-01	1.24E+00	1.43E+01	3.78E-01		
Promethium (61)	Pm-145	1.54E-12	2.54E-13	5.59E-13	8.07E-13	6.59E-12	1.61E-08	1.16E+01	1.00E+01	2.12E+01	4.78E+01	8.52E+01	2.19E+00		
Promethium (61)	Pm-146	1.12E-11	2.00E-12	4.18E-12	5.99E-12	5.40E-11	3.29E-06	1.30E-01	1.28E-01	2.17E-01	4.89E-01	1.14E+01	2.94E-01		
Promethium (61)	Pm-147	4.88E-12	6.92E-13	1.69E-12	2.48E-12	1.61E-11	3.21E-11	1.03E+03	6.69E+02	1.23E+04	2.35E+04	2.82E+01	7.11E-01		
Promethium (61)	Pm-148	4.96E-11	7.07E-12	1.72E-11	2.52E-11	1.05E-11	2.80E-06	5.61E+01	5.60E+01	9.19E+01	2.07E+02	2.77E+00	7.00E-02		
Promethium (61)	Pm-148m	2.13E-11	3.85E-12	7.99E-12	1.15E-11	2.12E-11	8.98E-06	2.28E+00	2.28E+00	3.73E+00	8.38E+00	5.96E+00	1.53E-01		
Promethium (61)	Pm-149	1.93E-11	2.69E-12	6.66E-12	9.77E-12	3.66E-12	4.60E-08	7.77E+03	7.49E+03	1.35E+04	3.03E+04	7.15E+00	1.81E-01		
Promethium (61)	Pm-150	2.94E-12	5.25E-13	1.08E-12	1.56E-12	4.63E-13	6.87E-06	1.10E+03	1.10E+03	1.80E+03	4.05E+03	4.41E+01	1.13E+00		
Promethium (61)	Pm-151	1.28E-11	1.88E-12	4.51E-12	6.59E-12	2.36E-12	1.27E-06	5.62E+02	5.62E+02	9.19E+02	2.07E+03	1.06E+01	2.68E-01		
Protactinium (91)	Pa-227	2.38E-12	6.48E-13	9.69E-13	1.37E-12	2.12E-10	4.37E-08	7.18E+05	7.03E+05	1.19E+06	2.67E+06	4.91E+01	1.29E+00		
Protactinium (91)	Pa-228	9.84E-12	1.68E-12	3.60E-12	5.18E-12	2.33E-10	5.10E-06	1.81E+02	1.81E+02	2.96E+02	6.65E+02	1.32E+01	3.40E-01		
Protactinium (91)	Pa-230	1.02E-11	1.80E-12	3.77E-12	5.40E-12	2.58E-09	2.86E-06	1.70E+01	1.70E+01	2.78E+01	6.25E+01	1.26E+01	3.27E-01		
Protactinium (91)	Pa-231	3.74E-10	1.54E-10	1.73E-10	2.26E-10	4.55E-08	1.39E-07	4.61E-01	2.10E-01	1.38E+00	3.01E+00	2.75E-01	7.80E-03		
Protactinium (91)	Pa-232	9.55E-12	1.59E-12	3.48E-12	5.03E-12	6.81E-12	4.29E-06	1.51E+02	1.50E+02	2.46E+02	5.53E+02	1.37E+01	3.51E-01		
Protactinium (91)	Pa-233	1.59E-11	2.34E-12	5.55E-12	8.14E-12	1.42E-11	7.43E-07	4.20E+01	4.17E+01	6.88E+01	1.55E+02	8.58E+00	2.17E-01		
Protactinium (91)	Pa-234	7.03E-12	1.20E-12	2.56E-12	3.70E-12	1.46E-12	8.71E-06	3.48E+02	3.48E+02	5.68E+02	1.28E+03	1.86E+01	4.77E-01		
Protactinium (91)	Pa-234m						6.87E-08	1.52E+07	1.52E+07	2.48E+07	5.57E+07				
Radium (88)	Ra-222						3.71E-08	5.19E+07	5.19E+07	8.47E+07	1.91E+08				
Radium (88)	Ra-223	6.44E-10	1.23E-10	2.38E-10	3.39E-10	2.50E-08	4.34E-07	8.99E+01	8.97E-01	2.70E+02	6.01E+02	2.00E-01	5.20E-03	5.67E+03	2.84E+02
Radium (88)	Ra-224	4.51E-10	8.44E-11	1.67E-10	2.38E-10	9.99E-09	3.72E-08	7.41E+02	4.00E+00	7.91E+03	1.69E+04	9.50E-04	7.41E-03	7.84E+04	3.92E+03
Radium (88)	Ra-225	2.72E-10	7.44E-11	1.14E-10	1.54E-10	2.10E-08	5.91E-09	3.16E+02	1.53E+00	6.05E+03	1.19E+04	4.18E-01	1.15E-02	7.03E+03	3.51E+02
Radium (88)	Ra-226	7.29E-10	2.95E-10	3.85E-10	5.14E-10	1.15E-08	2.29E-08	1.93E-01	6.76E-04	3.70E+00	7.22E+00	8.23E-04	3.43E-03	3.22E-01	1.61E-02
Radium (88)	Ra-226+D	7.30E-10	2.95E-10	3.86E-10	5.15E-10	1.16E-08	8.49E-06	1.24E-02	6.32E-04	2.58E-02	5.79E-02	8.16E-04	3.42E-03	3.22E-01	1.61E-02
Radium (88)	Ra-227	2.48E-13	7.44E-14	1.05E-13	1.46E-13	3.13E-13	6.22E-07	4.64E+04	4.39E+04	7.58E+04	1.71E+05	4.54E+02	1.21E+01	1.95E+12	9.73E+10
Radium (88)	Ra-228	2.28E-09	6.70E-10	1.04E-09	1.43E-09	5.18E-09	0.00E+00	2.60E-01	1.17E-03	8.40E+00	1.51E+01	4.58E-02	1.23E-03	1.19E+00	5.94E-02
Radium (88)	Ra-228+D	2.29E-09	6.70E-10	1.04E-09	1.43E-09	5.23E-09	4.53E-06	6.77E-02	1.16E-03	1.50E-01	3.36E-01	4.58E-02	1.23E-03	1.19E+00	5.94E-02
Radon (86)	Rn-218						3.39E-09	6.16E+11	6.16E+11	1.01E+12	2.26E+12				
Radon (86)	Rn-219						2.25E-07	8.21E+07	8.21E+07	1.34E+08	3.01E+08				
Radon (86)	Rn-220						1.70E-09	7.74E+08	7.74E+08	1.26E+09	2.84E+09				
Radon (86)	Rn-222						1.74E-09	1.27E+05	1.27E+05	2.08E+05	4.68E+05			2.38E+03	1.19E+02

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Radon (86)	Rn-222+D					7.57E-12		5.45E+09	5.30E+09	2.67E+09	6.01E+09	1.26E+00		2.38E+03	1.19E+02
Rhenium (75)	Re-177	1.05E-13	3.28E-14	4.55E-14	6.33E-14	2.97E-14	2.62E-06	3.32E+04	3.32E+04	5.42E+04	1.22E+05	1.05E+03	2.79E+01		
Rhenium (75)	Re-178	9.32E-14	3.37E-14	4.26E-14	5.85E-14	2.33E-14	5.65E-06	1.63E+04	1.63E+04	2.67E+04	6.00E+04	1.12E+03	3.01E+01		
Rhenium (75)	Re-180						5.29E-06	9.48E+04	9.48E+04	1.55E+05	3.48E+05				
Rhenium (75)	Re-181	3.64E-12	7.96E-13	1.41E-12	2.00E-12	7.96E-13	3.18E-06	3.19E+02	3.19E+02	5.21E+02	1.17E+03	3.38E+01	8.82E-01		
Rhenium (75)	Re-182a	2.16E-12	5.22E-13	8.70E-13	1.22E-12	5.51E-13	5.37E-06	2.98E+02	2.98E+02	4.86E+02	1.09E+03	5.47E+01	1.45E+00		
Rhenium (75)	Re-182b	1.26E-11	2.86E-12	4.96E-12	6.99E-12	4.44E-12	8.22E-06	3.86E+01	3.86E+01	6.30E+01	1.42E+02	9.60E+00	2.52E-01		
Rhenium (75)	Re-184	7.66E-12	1.94E-12	3.16E-12	4.40E-12	6.73E-12	3.93E-06	5.67E+00	5.67E+00	9.25E+00	2.08E+01	1.51E+01	4.01E-01		
Rhenium (75)	Re-184m	1.27E-11	2.78E-12	4.88E-12	6.96E-12	2.26E-11	1.52E-06	3.37E+00	3.37E+00	5.51E+00	1.24E+01	9.76E+00	2.53E-01		
Rhenium (75)	Re-186	1.53E-11	2.84E-12	5.59E-12	8.03E-12	4.26E-12	5.49E-08	3.93E+03	3.94E+03	6.62E+03	1.49E+04	8.52E+00	2.20E-01		
Rhenium (75)	Re-186m	1.95E-11	4.03E-12	7.33E-12	1.05E-11	4.18E-11	1.75E-08	5.51E+00	4.16E+00	1.21E+01	2.71E+01	6.50E+00	1.68E-01		
Rhenium (75)	Re-187	4.81E-14	9.47E-15	1.79E-14	2.56E-14	2.51E-14	0.00E+00	1.65E+04	1.29E+04	1.88E+05	3.38E+05	2.66E+03	6.89E+01		
Rhenium (75)	Re-188	1.35E-11	2.52E-12	4.88E-12	7.07E-12	2.22E-12	2.38E-07	4.98E+03	4.98E+03	8.18E+03	1.84E+04	9.76E+00	2.49E-01		
Rhenium (75)	Re-188m	2.69E-13	5.29E-14	9.92E-14	1.42E-13	5.07E-14	1.28E-07	5.12E+05	5.12E+05	8.36E+05	1.88E+06	4.80E+02	1.24E+01		
Rhenium (75)	Re-189	7.84E-12	1.47E-12	2.86E-12	4.11E-12	1.73E-12	2.42E-07	3.44E+03	3.44E+03	5.63E+03	1.27E+04	1.67E+01	4.29E-01		
Rhodium (45)	Rh-100	6.62E-12	1.42E-12	2.65E-12	3.74E-12	1.04E-12	1.38E-05	7.07E+01	7.06E+01	1.16E+02	2.60E+02	1.80E+01	4.72E-01		
Rhodium (45)	Rh-101	5.37E-12	1.22E-12	2.15E-12	3.01E-12	1.81E-11	8.84E-07	8.12E-01	7.87E-01	1.34E+00	3.02E+00	2.21E+01	5.86E-01		
Rhodium (45)	Rh-101m	2.46E-12	4.63E-13	9.40E-13	1.34E-12	7.14E-13	1.19E-06	1.63E+02	1.62E+02	2.67E+02	6.02E+02	5.07E+01	1.32E+00		
Rhodium (45)	Rh-102	1.71E-11	5.22E-12	7.70E-12	1.04E-11	5.99E-11	9.73E-06	8.20E-02	8.11E-02	1.34E-01	3.03E-01	6.18E+00	1.70E-01		
Rhodium (45)	Rh-102m	1.66E-11	2.85E-12	6.07E-12	8.73E-12	2.56E-11	2.11E-06	1.91E+00	1.84E+00	3.16E+00	7.12E+00	7.84E+00	2.02E-01		
Rhodium (45)	Rh-103m	2.40E-14	5.66E-15	9.40E-15	1.34E-14	9.14E-15	9.31E-11	1.61E+08	8.44E+07	3.78E+08	8.49E+08	5.07E+03	1.32E+02		
Rhodium (45)	Rh-105	6.73E-12	9.66E-13	2.34E-12	3.43E-12	1.59E-12	3.15E-07	1.76E+03	1.61E+03	2.97E+03	6.69E+03	2.04E+01	5.14E-01		
Rhodium (45)	Rh-106						9.66E-07	2.53E+06	2.53E+06	4.13E+06	9.30E+06				
Rhodium (45)	Rh-106m	1.37E-12	3.09E-13	5.48E-13	7.73E-13	2.71E-13	1.37E-05	6.74E+02	6.74E+02	1.10E+03	2.48E+03	8.69E+01	2.28E+00		
Rhodium (45)	Rh-107	9.51E-14	3.19E-14	4.18E-14	5.81E-14	2.88E-14	1.28E-06	4.39E+04	4.39E+04	7.16E+04	1.61E+05	1.14E+03	3.04E+01		
Rhodium (45)	Rh-99	5.77E-12	1.10E-12	2.21E-12	3.15E-12	3.33E-12	2.50E-06	2.11E+01	2.08E+01	3.45E+01	7.77E+01	2.15E+01	5.60E-01		
Rhodium (45)	Rh-99m	6.03E-13	1.32E-13	2.42E-13	3.42E-13	9.99E-14	3.02E-06	1.43E+03	1.43E+03	2.34E+03	5.26E+03	1.97E+02	5.16E+00		
Rubidium (37)	Rb-79	1.79E-13	6.77E-14	8.36E-14	1.14E-13	2.37E-14	5.85E-06	9.10E+03	9.10E+03	1.49E+04	3.34E+04	5.70E+02	1.55E+01		
Rubidium (37)	Rb-80						5.56E-06	3.87E+05	3.87E+05	6.31E+05	1.42E+06				
Rubidium (37)	Rb-81	2.83E-13	9.69E-14	1.28E-13	1.74E-13	4.63E-14	2.59E-06	1.71E+03	1.71E+03	2.80E+03	6.29E+03	3.72E+02	1.01E+01		
Rubidium (37)	Rb-81m	4.55E-14	1.57E-14	2.05E-14	2.80E-14	1.10E-14	9.08E-09	4.16E+06	4.04E+06	6.85E+06	1.54E+07	2.32E+03	6.30E+01		
Rubidium (37)	Rb-82						4.85E-06	1.93E+05	1.93E+05	3.16E+05	7.10E+05				
Rubidium (37)	Rb-82m	7.25E-13	2.75E-13	3.51E-13	4.70E-13	1.35E-13	1.35E-05	2.43E+02	2.43E+02	3.96E+02	8.91E+02	1.36E+02	3.75E+00		
Rubidium (37)	Rb-83	1.18E-11	4.40E-12	5.70E-12	7.51E-12	2.32E-12	2.18E-06	4.46E+00	4.32E+00	7.35E+00	1.65E+01	8.35E+00	2.35E-01		
Rubidium (37)	Rb-84	1.91E-11	6.55E-12	8.81E-12	1.17E-11	3.59E-12	4.22E-06	6.06E+00	5.92E+00	9.98E+00	2.25E+01	5.41E+00	1.51E-01		
Rubidium (37)	Rb-86	2.37E-11	6.59E-12	9.88E-12	1.34E-11	4.00E-12	4.67E-07	8.89E+01	7.17E+01	1.58E+02	3.55E+02	4.82E+00	1.32E-01		
Rubidium (37)	Rb-87	1.25E-11	3.43E-12	5.22E-12	7.07E-12	2.14E-12	9.11E-11	5.01E+00	9.64E-01	4.26E+02	7.95E+02	9.12E+00	2.49E-01		
Rubidium (37)	Rb-88	3.06E-13	1.14E-13	1.40E-13	1.92E-13	3.17E-14	3.36E-06	2.04E+04	2.04E+04	3.33E+04	7.48E+04	3.40E+02	9.19E+00		
Rubidium (37)	Rb-89	1.70E-13	6.40E-14	7.88E-14	1.08E-13	2.09E-14	1.05E-05	7.64E+03	7.64E+03	1.25E+04	2.80E+04	6.04E+02	1.63E+01		
Ruthenium (44)	Ru-103	1.05E-11	1.76E-12	3.85E-12	5.55E-12	8.92E-12	2.04E-06	1.05E+01	6.81E+00	1.72E+01	3.88E+01	1.24E+01	3.18E-01	4.80E+04	2.40E+03
Ruthenium (44)	Ru-105	3.77E-12	6.07E-13	1.35E-12	1.96E-12	6.48E-13	3.51E-06	1.30E+03	1.17E+03	2.13E+03	4.79E+03	3.53E+01	9.00E-01	6.17E+09	3.09E+08
Ruthenium (44)	Ru-106	1.19E-10	1.84E-11	4.22E-11	6.11E-11	1.02E-10	0.00E+00	4.00E+01	1.86E-01	1.66E+03	2.99E+03	1.13E+00	2.89E-02	6.43E+01	3.22E+00
Ruthenium (44)	Ru-106+D	1.19E-10		4.22E-11	6.11E-11	1.02E-10	9.66E-07	2.25E+00	1.72E-01	3.89E+00	8.74E+00	1.13E+00	2.89E-02	6.43E+01	3.22E+00
Ruthenium (44)	Ru-94	8.03E-13	1.61E-13	3.06E-13	4.37E-13	1.23E-13	2.31E-06	1.02E+04	9.81E+03	1.66E+04	3.74E+04	1.56E+02	4.04E+00	7.20E+11	3.60E+10
Ruthenium (44)	Ru-97	1.65E-12	3.15E-13	6.36E-13	9.07E-13	3.36E-13	8.63E-07	3.38E+02	2.79E+02	5.52E+02	1.24E+03	7.49E+01	1.94E+00	5.33E+07	2.67E+06
Samarium (62)	Sm-141	1.59E-13	5.37E-14	7.10E-14	9.81E-14	2.79E-14	6.39E-06	1.87E+04	1.87E+04	3.05E+04	6.87E+04	6.71E+02	1.80E+01		
Samarium (62)	Sm-141m	3.26E-13	9.81E-14	1.40E-13	1.95E-13	6.29E-14	9.04E-06	5.97E+03	5.97E+03	9.74E+03	2.19E+04	3.40E+02	9.04E+00		
Samarium (62)	Sm-142	1.40E-12	3.05E-13	5.37E-13	7.70E-13	2.13E-13	2.99E-07	5.62E+04	5.62E+04	9.18E+04	2.06E+05	8.87E+01	2.29E+00		
Samarium (62)	Sm-145	3.27E-12	5.11E-13	1.17E-12	1.70E-12	4.51E-12	3.83E-08	6.41E+01	6.36E+01	1.06E+02	2.38E+02	4.07E+01	1.04E+00		
Samarium (62)	Sm-146	8.36E-11	3.49E-11	4.11E-11	5.25E-11	7.88E-09	0.00E+00	7.58E+00	3.57E+00	4.93E+01	8.93E+01	1.16E+00	3.36E-02		
Samarium (62)	Sm-147	7.59E-11	3.17E-11	3.74E-11	4.77E-11	6.88E-09	0.00E+00	8.35E+00	3.93E+00	5.44E+01	9.85E+01	1.27E+00	3.70E-02		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Samarium (62)	Sm-151	1.59E-12	2.35E-13	5.55E-13	8.07E-13	4.88E-12	3.60E-13	4.65E+02	2.42E+02	8.19E+03	1.48E+04	8.58E+01	2.19E+00		
Samarium (62)	Sm-153	1.40E-11	1.97E-12	4.85E-12	7.10E-12	2.95E-12	1.06E-07	4.02E+03	3.97E+03	6.68E+03	1.50E+04	9.82E+00	2.48E-01		
Samarium (62)	Sm-155	1.13E-13	3.74E-14	4.96E-14	6.88E-14	3.15E-14	2.81E-07	1.96E+05	1.96E+05	3.20E+05	7.21E+05	9.60E+02	2.56E+01		
Samarium (62)	Sm-156	4.26E-12	6.29E-13	1.49E-12	2.18E-12	9.69E-13	3.79E-07	5.69E+03	5.69E+03	9.31E+03	2.09E+04	3.20E+01	8.09E-01		
Scandium (21)	Sc-43	2.21E-12	3.96E-13	8.18E-13	1.18E-12	3.81E-13	4.73E-06	1.10E+03	1.10E+03	1.80E+03	4.05E+03	5.82E+01	1.49E+00		
Scandium (21)	Sc-44	4.22E-12	7.51E-13	1.56E-12	2.25E-12	6.44E-13	9.95E-06	5.20E+02	5.20E+02	8.48E+02	1.91E+03	3.05E+01	7.84E-01		
Scandium (21)	Sc-44m	3.89E-11	6.03E-12	1.38E-11	2.01E-11	6.96E-12	1.15E-06	3.00E+02	2.99E+02	4.92E+02	1.11E+03	3.45E+00	8.77E-02		
Scandium (21)	Sc-46	1.62E-11	3.07E-12	6.22E-12	8.88E-12	2.47E-11	9.63E-06	1.05E+00	1.05E+00	1.71E+00	3.85E+00	7.66E+00	1.99E-01		
Scandium (21)	Sc-47	1.00E-11	1.44E-12	3.49E-12	5.11E-12	3.05E-12	3.62E-07	6.95E+02	6.94E+02	1.14E+03	2.56E+03	1.36E+01	3.45E-01		
Scandium (21)	Sc-48	1.93E-11	3.59E-12	7.33E-12	1.05E-11	3.96E-12	1.62E-05	2.87E+01	2.87E+01	4.68E+01	1.05E+02	6.50E+00	1.68E-01		
Scandium (21)	Sc-49	5.25E-13	1.22E-13	2.05E-13	2.92E-13	1.07E-13	1.90E-08	1.11E+06	1.11E+06	1.82E+06	4.10E+06	2.32E+02	6.04E+00		
Selenium (34)	Se-70	6.92E-13	1.95E-13	2.95E-13	4.11E-13	7.36E-14	4.22E-06	7.04E+03	7.00E+03	1.15E+04	2.59E+04	1.61E+02	4.29E+00		
Selenium (34)	Se-73	1.99E-12	4.48E-13	7.96E-13	1.13E-12	1.99E-13	4.52E-06	6.28E+02	6.19E+02	1.03E+03	2.31E+03	5.98E+01	1.56E+00		
Selenium (34)	Se-73m	2.02E-13	5.07E-14	8.29E-14	1.17E-13	2.06E-14	1.06E-06	2.95E+04	2.93E+04	4.81E+04	1.08E+05	5.74E+02	1.51E+01		
Selenium (34)	Se-75	1.67E-11	6.25E-12	8.14E-12	1.08E-11	3.77E-12	1.45E-06	4.78E+00	3.27E+00	7.94E+00	1.79E+01	5.85E+00	1.63E-01		
Selenium (34)	Se-77m						2.85E-07	1.47E+07	1.47E+07	2.39E+07	5.39E+07				
Selenium (34)	Se-79	1.60E-11	5.29E-12	7.29E-12	9.69E-12	3.33E-12	1.10E-11	4.69E+00	1.32E-01	3.30E+02	5.97E+02	6.53E+00	1.82E-01		
Selenium (34)	Se-81	9.58E-14	3.36E-14	4.29E-14	5.92E-14	1.27E-14	4.68E-08	1.40E+06	1.30E+06	2.30E+06	5.17E+06	1.11E+03	2.98E+01		
Selenium (34)	Se-81m	3.24E-13	8.07E-14	1.30E-13	1.85E-13	3.54E-14	3.56E-08	5.90E+05	4.46E+05	9.75E+05	2.19E+06	3.66E+02	9.53E+00		
Selenium (34)	Se-83	2.33E-13	7.33E-14	1.02E-13	1.43E-13	2.72E-14	1.15E-05	4.71E+03	4.71E+03	7.69E+03	1.73E+04	4.67E+02	1.23E+01		
Silicon (14)	Si-31	1.81E-12	2.97E-13	6.48E-13	9.40E-13	3.05E-13	1.11E-08	6.84E+05	6.85E+05	1.14E+06	2.56E+06	7.35E+01	1.88E+00		
Silicon (14)	Si-32	9.81E-12	1.50E-12	3.44E-12	5.00E-12	2.93E-10	2.18E-11	8.14E+01	6.41E+01	1.05E+03	1.95E+03	1.38E+01	3.53E-01		
Silver (47)	Ag-102	1.56E-13	5.74E-14	7.25E-14	9.95E-14	2.56E-14	1.60E-05	5.91E+03	5.88E+03	9.64E+03	2.17E+04	6.57E+02	1.77E+01	2.73E+13	1.37E+12
Silver (47)	Ag-103	2.96E-13	7.22E-14	1.20E-13	1.69E-13	6.07E-14	3.33E-06	5.57E+03	5.39E+03	9.09E+03	2.05E+04	3.97E+02	1.04E+01	6.37E+11	3.18E+10
Silver (47)	Ag-104	3.77E-13	1.10E-13	1.65E-13	2.29E-13	6.25E-14	1.25E-05	1.41E+03	1.39E+03	2.30E+03	5.17E+03	2.89E+02	7.70E+00	4.17E+11	2.09E+10
Silver (47)	Ag-104m	2.81E-13	8.29E-14	1.21E-13	1.68E-13	4.92E-14	5.50E-06	6.62E+03	6.48E+03	1.08E+04	2.43E+04	3.94E+02	1.05E+01	2.43E+12	1.21E+11
Silver (47)	Ag-105	4.40E-12	9.77E-13	1.77E-12	2.49E-12	2.83E-12	2.15E-06	9.56E+00	5.37E+00	1.57E+01	3.53E+01	2.69E+01	7.08E-01	5.35E+04	2.67E+03
Silver (47)	Ag-106	1.34E-13	4.44E-14	5.92E-14	8.21E-14	2.72E-14	3.08E-06	1.65E+04	1.62E+04	2.69E+04	6.06E+04	8.04E+02	2.15E+01	9.67E+12	4.84E+11
Silver (47)	Ag-106m	1.14E-11	2.82E-12	4.81E-12	6.73E-12	3.54E-12	1.31E-05	7.67E+00	5.69E+00	1.25E+01	2.82E+01	9.90E+00	2.62E-01	4.67E+05	2.34E+04
Silver (47)	Ag-108						8.56E-08	6.01E+06	6.01E+06	9.81E+06	2.21E+07				
Silver (47)	Ag-108m	1.92E-11	5.07E-12	8.14E-12	1.12E-11	2.67E-11	7.18E-06	1.68E-02	6.29E-03	3.25E-02	7.32E-02	5.85E+00	1.57E-01	3.99E-01	1.99E-02
Silver (47)	Ag-109m						7.66E-09	2.41E+08	2.41E+08	3.94E+08	8.85E+08				
Silver (47)	Ag-110						1.69E-07	1.76E+07	1.76E+07	2.87E+07	6.46E+07				
Silver (47)	Ag-110m	2.37E-11	5.96E-12	9.88E-12	1.37E-11	2.83E-11	1.30E-05	2.60E-01	1.52E-01	4.25E-01	9.56E-01	4.82E+00	1.29E-01	1.58E+02	7.92E+00
Silver (47)	Ag-111	2.37E-11	3.36E-12	8.21E-12	1.21E-11	6.66E-12	1.09E-07	7.44E+02	1.36E+01	1.69E+03	3.81E+03	5.80E+00	1.46E-01	3.49E+05	1.75E+04
Silver (47)	Ag-112	5.59E-12	9.10E-13	1.99E-12	2.90E-12	7.25E-13	3.23E-06	2.01E+03	1.25E+03	3.29E+03	7.40E+03	2.39E+01	6.08E-01	4.73E+09	2.36E+08
Silver (47)	Ag-115	3.46E-13	8.92E-14	1.40E-13	1.98E-13	6.81E-14	3.44E-06	1.77E+04	1.71E+04	2.89E+04	6.51E+04	3.40E+02	8.91E+00	5.89E+12	2.94E+11
Sodium (11)	Na-22	1.97E-11	7.47E-12	9.62E-12	1.26E-11	3.89E-12	1.03E-05	8.65E-02	8.52E-02	1.42E-01	3.18E-01	4.95E+00	1.40E-01		
Sodium (11)	Na-24	2.64E-12	9.29E-13	1.23E-12	1.65E-12	4.74E-13	2.20E-05	6.16E+01	6.15E+01	1.00E+02	2.26E+02	3.87E+01	1.07E+00		
Strontium (38)	Sr-80	2.83E-12	6.11E-13	1.09E-12	1.55E-12	4.51E-13	5.08E-11	1.13E+06	8.03E+03	1.58E+08	3.09E+08	4.37E+01	1.14E+00	1.25E+10	6.26E+08
Strontium (38)	Sr-81	4.03E-13	1.17E-13	1.71E-13	2.39E-13	8.07E-14	5.97E-06	8.01E+03	7.71E+03	1.31E+04	2.94E+04	2.78E+02	7.38E+00	1.23E+12	6.14E+10
Strontium (38)	Sr-82	8.47E-11	1.57E-11	3.13E-11	4.48E-11	3.69E-11	5.00E-11	1.09E+02	7.71E-01	2.79E+04	5.05E+04	1.52E+00	3.94E-02	3.36E+03	1.68E+02
Strontium (38)	Sr-83	5.85E-12	1.14E-12	2.21E-12	3.17E-12	1.26E-12	3.60E-06	1.73E+02	9.35E+01	2.84E+02	6.40E+02	2.15E+01	5.56E-01	1.63E+07	8.17E+05
Strontium (38)	Sr-85	5.03E-12	1.42E-12	2.26E-12	3.11E-12	2.56E-12	2.20E-06	5.88E+00	2.49E+00	9.69E+00	2.18E+01	2.11E+01	5.67E-01	6.93E+03	3.47E+02
Strontium (38)	Sr-85m	3.74E-14	1.14E-14	1.67E-14	2.31E-14	8.32E-15	8.21E-07	2.14E+04	2.08E+04	3.49E+04	7.85E+04	2.85E+03	7.63E+01	1.69E+12	8.46E+10
Strontium (38)	Sr-87m	2.69E-13	6.03E-14	1.07E-13	1.51E-13	5.62E-14	1.33E-06	5.43E+03	4.89E+03	8.87E+03	2.00E+04	4.45E+02	1.17E+01	4.49E+10	2.24E+09
Strontium (38)	Sr-89	3.47E-11	6.48E-12	1.28E-11	1.84E-11	2.34E-11	7.19E-09	1.24E+02	9.29E-01	3.43E+03	7.52E+03	3.72E+00	9.59E-02	2.02E+03	1.01E+02
Strontium (38)	Sr-90	9.18E-11	5.18E-11	5.59E-11	6.88E-11	1.05E-10	4.82E-10	3.31E-01	1.92E-03	4.23E+01	7.73E+01	8.52E-01	2.56E-02	2.69E-01	1.34E-02
Strontium (38)	Sr-90+D	1.44E-10	5.92E-11	7.40E-11	9.53E-11	1.13E-10	1.96E-08	2.31E-01	1.39E-03	1.08E+01	2.27E+01	6.44E-01	1.85E-02	2.69E-01	1.34E-02
Strontium (38)	Sr-91	8.81E-12	1.57E-12	3.22E-12	4.66E-12	1.70E-12	3.30E-06	6.42E+02	2.72E+02	1.06E+03	2.38E+03	1.48E+01	3.78E-01	1.30E+08	6.52E+06
Strontium (38)	Sr-92	6.18E-12	1.07E-12	2.25E-12	3.26E-12	1.03E-12	6.69E-06	1.12E+03	7.58E+02	1.83E+03	4.11E+03	2.12E+01	5.41E-01	2.29E+09	1.15E+08

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Sulfur (16)	S-35	1.24E-12	3.27E-13	5.14E-13	3.70E-12	5.03E-12	8.77E-12	1.96E+02	4.71E+01	3.22E+05	6.02E+05	9.26E+01	4.77E-01		
Tantalum (73)	Ta-172	2.64E-13	7.96E-14	1.14E-13	1.59E-13	7.22E-14	7.04E-06	4.71E+03	4.71E+03	7.68E+03	1.73E+04	4.18E+02	1.11E+01		
Tantalum (73)	Ta-173	2.49E-12	4.22E-13	9.03E-13	1.31E-12	4.44E-13	2.38E-06	2.34E+03	2.34E+03	3.82E+03	8.59E+03	5.27E+01	1.35E+00		
Tantalum (73)	Ta-174	4.11E-13	9.47E-14	1.62E-13	2.30E-13	1.11E-13	2.55E-06	6.64E+03	6.64E+03	1.08E+04	2.44E+04	2.94E+02	7.67E+00		
Tantalum (73)	Ta-175	2.25E-12	4.37E-13	8.70E-13	1.24E-12	4.37E-13	4.16E-06	4.65E+02	4.65E+02	7.59E+02	1.71E+03	5.47E+01	1.42E+00		
Tantalum (73)	Ta-176	3.18E-12	6.55E-13	1.25E-12	1.78E-12	5.96E-13	1.06E-05	2.37E+02	2.37E+02	3.87E+02	8.71E+02	3.81E+01	9.91E-01		
Tantalum (73)	Ta-177	1.65E-12	2.58E-13	5.88E-13	8.58E-13	4.44E-13	1.20E-07	2.98E+03	2.95E+03	4.88E+03	1.10E+04	8.10E+01	2.06E+00		
Tantalum (73)	Ta-178a						3.29E-07	3.98E+05	3.98E+05	6.50E+05	1.46E+06				
Tantalum (73)	Ta-178b	6.29E-13	1.38E-13	2.49E-13	3.53E-13	1.79E-13	3.78E-06	2.44E+03	2.44E+03	3.99E+03	8.97E+03	1.91E+02	5.00E+00		
Tantalum (73)	Ta-179	9.51E-13	1.54E-13	3.44E-13	5.00E-13	2.05E-12	3.62E-08	3.48E+01	3.42E+01	5.74E+01	1.29E+02	1.38E+02	3.53E+00		
Tantalum (73)	Ta-180	1.23E-11	1.99E-12	4.44E-12	6.44E-12	7.25E-11	2.03E-06	5.48E-02	4.09E-02	1.08E-01	2.42E-01	1.07E+01	2.74E-01		
Tantalum (73)	Ta-180m	8.58E-13	1.31E-13	3.03E-13	4.40E-13	1.86E-13	6.13E-08	4.07E+04	4.03E+04	6.68E+04	1.50E+05	1.57E+02	4.01E+00		
Tantalum (73)	Ta-182	2.19E-11	3.59E-12	7.96E-12	1.15E-11	3.74E-11	6.04E-06	1.22E+00	1.21E+00	1.99E+00	4.47E+00	5.98E+00	1.53E-01		
Tantalum (73)	Ta-182m	4.44E-14	1.54E-14	1.99E-14	2.76E-14	3.41E-14	7.38E-07	1.05E+05	1.05E+05	1.71E+05	3.84E+05	2.39E+03	6.39E+01		
Tantalum (73)	Ta-183	2.38E-11	3.44E-12	8.33E-12	1.22E-11	8.81E-12	9.40E-07	1.75E+02	1.72E+02	2.88E+02	6.48E+02	5.72E+00	1.45E-01		
Tantalum (73)	Ta-184	9.81E-12	1.58E-12	3.53E-12	5.11E-12	1.73E-12	7.02E-06	3.33E+02	3.32E+02	5.43E+02	1.22E+03	1.35E+01	3.45E-01		
Tantalum (73)	Ta-185	3.92E-13	9.88E-14	1.57E-13	2.22E-13	1.18E-13	6.24E-07	3.99E+04	3.98E+04	6.51E+04	1.46E+05	3.03E+02	7.94E+00		
Tantalum (73)	Ta-186	1.19E-13	4.44E-14	5.51E-14	7.55E-14	2.69E-14	6.69E-06	1.74E+04	1.74E+04	2.83E+04	6.37E+04	8.64E+02	2.34E+01		
Technetium (43)	Tc-101	6.81E-14	2.42E-14	3.06E-14	4.22E-14	1.85E-14	1.37E-06	6.25E+04	5.62E+04	1.02E+05	2.30E+05	1.56E+03	4.18E+01	3.82E+12	1.91E+11
Technetium (43)	Tc-104	3.09E-13	1.07E-13	1.38E-13	1.90E-13	5.33E-14	9.75E-06	6.86E+03	6.40E+03	1.12E+04	2.52E+04	3.45E+02	9.28E+00	5.15E+11	2.57E+10
Technetium (43)	Tc-93	3.55E-13	1.04E-13	1.59E-13	2.20E-13	6.36E-14	7.31E-06	1.01E+03	9.08E+02	1.65E+03	3.71E+03	2.99E+02	8.02E+00	5.44E+09	2.72E+08
Technetium (43)	Tc-93m	1.55E-13	4.51E-14	6.81E-14	9.44E-14	3.17E-14	3.62E-06	7.72E+03	7.05E+03	1.26E+04	2.84E+04	6.99E+02	1.87E+01	1.83E+11	9.13E+09
Technetium (43)	Tc-94	1.48E-12	3.92E-13	6.36E-13	8.88E-13	2.80E-13	1.24E-05	3.33E+02	2.64E+02	5.48E+02	1.23E+03	7.49E+01	1.99E+00	4.31E+08	2.16E+07
Technetium (43)	Tc-94m	5.74E-13	1.55E-13	2.36E-13	3.32E-13	1.03E-13	8.70E-06	2.68E+03	2.36E+03	4.40E+03	9.89E+03	2.02E+02	5.31E+00	3.69E+10	1.84E+09
Technetium (43)	Tc-95	1.35E-12	3.50E-13	5.77E-13	8.03E-13	2.63E-13	3.63E-06	2.73E+02	1.53E+02	4.57E+02	1.03E+03	8.25E+01	2.20E+00	2.83E+07	1.42E+06
Technetium (43)	Tc-95m	4.29E-12	1.10E-12	1.80E-12	2.51E-12	3.40E-12	2.93E-06	4.32E+00	1.12E+00	7.73E+00	1.74E+01	2.65E+01	7.03E-01	1.69E+03	8.47E+01
Technetium (43)	Tc-96	7.81E-12	2.15E-12	3.42E-12	4.74E-12	2.00E-12	1.16E-05	1.63E+01	6.73E+00	2.78E+01	6.26E+01	1.39E+01	3.72E-01	1.81E+05	9.06E+03
Technetium (43)	Tc-96m	8.36E-14	2.27E-14	3.59E-14	5.00E-14	2.05E-14	2.13E-07	1.08E+05	5.91E+04	1.81E+05	4.08E+05	1.33E+03	3.53E+01	2.47E+11	1.24E+10
Technetium (43)	Tc-97	7.40E-13	1.34E-13	2.70E-13	3.89E-13	8.51E-13	2.94E-10	2.56E+00	5.73E-02	7.04E+02	1.56E+03	1.76E+02	4.53E+00	7.30E-01	3.65E-02
Technetium (43)	Tc-97m	6.62E-12	1.14E-12	2.38E-12	3.44E-12	1.12E-11	1.04E-09	2.53E+01	7.54E-01	1.35E+04	2.94E+04	2.00E+01	5.13E-01	6.30E+02	3.15E+01
Technetium (43)	Tc-98	1.83E-11	3.92E-12	7.10E-12	1.01E-11	3.01E-11	6.45E-06	1.47E-02	1.89E-03	3.39E-02	7.62E-02	6.71E+00	1.75E-01	2.78E-02	1.39E-03
Technetium (43)	Tc-99	7.66E-12	1.32E-12	2.75E-12	4.00E-12	1.41E-11	8.14E-11	2.50E-01	5.57E-03	8.96E+02	1.73E+03	1.73E+01	4.41E-01	3.73E+00	1.86E-01
Technetium (43)	Tc-99m	2.03E-13	4.37E-14	7.96E-14	1.14E-13	5.70E-14	3.93E-07	8.32E+03	4.11E+03	1.40E+04	3.15E+04	5.98E+02	1.55E+01	2.27E+09	1.13E+08
Tellurium (52)	Te-116	1.75E-12	3.48E-13	6.73E-13	9.62E-13	3.20E-13	1.34E-07	5.55E+04	3.61E+04	9.93E+04	2.24E+05	7.08E+01	1.83E+00		
Tellurium (52)	Te-121	3.40E-12	9.07E-13	1.46E-12	2.01E-12	1.30E-12	2.46E-06	2.00E+01	1.88E+01	3.30E+01	7.43E+01	3.26E+01	8.77E-01		
Tellurium (52)	Te-121m	1.42E-11	4.51E-12	6.40E-12	8.51E-12	1.44E-11	7.83E-07	6.12E+00	3.44E+00	1.14E+01	2.58E+01	7.44E+00	2.07E-01		
Tellurium (52)	Te-123	6.77E-12	4.07E-12	4.11E-12	5.11E-12	2.50E-12	2.73E-09	1.55E+00	1.71E-01	6.76E+01	1.47E+02	1.16E+01	3.45E-01		
Tellurium (52)	Te-123m	1.02E-11	2.46E-12	4.14E-12	5.66E-12	1.36E-11	4.48E-07	1.34E+01	7.13E+00	2.57E+01	5.78E+01	1.15E+01	3.12E-01		
Tellurium (52)	Te-125m	8.92E-12	1.70E-12	3.33E-12	4.70E-12	1.17E-11	6.95E-09	2.06E+02	3.20E+01	3.33E+03	7.43E+03	1.43E+01	3.75E-01		
Tellurium (52)	Te-127	2.87E-12	4.22E-13	1.00E-12	1.48E-12	6.11E-13	2.10E-08	5.28E+04	1.34E+04	1.68E+05	3.79E+05	4.76E+01	1.19E+00		
Tellurium (52)	Te-127m	2.25E-11	4.77E-12	8.62E-12	1.20E-11	2.58E-11	2.73E-09	4.68E+01	6.76E+00	3.82E+03	8.23E+03	5.52E+00	1.47E-01		
Tellurium (52)	Te-129	4.40E-13	9.88E-14	1.71E-13	2.44E-13	9.95E-14	2.45E-07	7.05E+04	6.53E+04	1.17E+05	2.62E+05	2.78E+02	7.23E+00		
Tellurium (52)	Te-129m	4.26E-11	7.18E-12	1.53E-11	2.20E-11	2.49E-11	1.38E-07	5.76E+01	1.12E+01	2.96E+02	6.65E+02	3.11E+00	8.02E-02		
Tellurium (52)	Te-131	5.62E-13	1.31E-13	2.17E-13	3.05E-13	6.40E-14	1.79E-06	2.72E+04	2.68E+04	4.45E+04	1.00E+05	2.19E+02	5.78E+00		
Tellurium (52)	Te-131m	2.28E-11	4.00E-12	8.25E-12	1.19E-11	4.22E-12	6.61E-06	1.00E+02	8.74E+01	1.67E+02	3.76E+02	5.77E+00	1.48E-01		
Tellurium (52)	Te-132	4.77E-11	8.25E-12	1.70E-11	2.44E-11	9.32E-12	7.83E-07	2.33E+02	8.34E+01	5.41E+02	1.22E+03	2.80E+00	7.23E-02		
Tellurium (52)	Te-133	5.29E-13	1.11E-13	1.92E-13	2.73E-13	4.92E-14	4.29E-06	2.27E+04	2.26E+04	3.71E+04	8.35E+04	2.48E+02	6.46E+00		
Tellurium (52)	Te-133m	2.42E-12	4.74E-13	8.73E-13	1.24E-12	2.64E-13	1.09E-05	2.02E+03	2.00E+03	3.29E+03	7.41E+03	5.45E+01	1.42E+00		
Tellurium (52)	Te-134	7.51E-13	1.89E-13	3.01E-13	4.18E-13	1.60E-13	3.78E-06	7.70E+03	7.64E+03	1.26E+04	2.83E+04	1.58E+02	4.22E+00		
Terbium (65)	Tb-147	1.37E-12	2.88E-13	5.33E-13	7.59E-13	2.26E-13	7.30E-06	1.69E+03	1.69E+03	2.75E+03	6.19E+03	8.93E+01	2.32E+00		
Terbium (65)	Tb-149	2.90E-12	5.25E-13	1.08E-12	1.56E-12	1.65E-11	7.60E-06	6.44E+02	6.44E+02	1.05E+03	2.37E+03	4.41E+01	1.13E+00		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Terbium (65)	Tb-150	2.92E-12	5.25E-13	1.08E-12	1.56E-12	3.88E-13	7.79E-06	7.98E+02	7.98E+02	1.30E+03	2.93E+03	4.41E+01	1.13E+00		
Terbium (65)	Tb-151	3.92E-12	7.25E-13	1.49E-12	2.13E-12	7.73E-13	3.65E-06	3.16E+02	3.16E+02	5.16E+02	1.16E+03	3.20E+01	8.28E-01		
Terbium (65)	Tb-153	3.54E-12	5.77E-13	1.28E-12	1.86E-12	8.18E-13	7.24E-07	4.99E+02	4.99E+02	8.15E+02	1.83E+03	3.72E+01	9.48E-01		
Terbium (65)	Tb-154	6.51E-12	1.34E-12	2.57E-12	3.64E-12	1.14E-12	1.18E-05	8.05E+01	8.05E+01	1.31E+02	2.95E+02	1.85E+01	4.85E-01		
Terbium (65)	Tb-155	2.97E-12	4.81E-13	1.08E-12	1.56E-12	8.99E-13	3.26E-07	4.87E+02	4.87E+02	7.96E+02	1.79E+03	4.41E+01	1.13E+00		
Terbium (65)	Tb-156	1.30E-11	2.46E-12	4.96E-12	7.10E-12	4.22E-12	8.37E-06	1.89E+01	1.89E+01	3.09E+01	6.95E+01	9.60E+00	2.48E-01		
Terbium (65)	Tb-156m	2.29E-12	3.92E-13	8.44E-13	1.22E-12	8.47E-13	2.16E-08	3.79E+04	3.75E+04	6.28E+04	1.41E+05	5.64E+01	1.45E+00		
Terbium (65)	Tb-156n	1.11E-12	1.82E-13	4.03E-13	5.85E-13	3.77E-13	4.06E-09	9.56E+05	9.34E+05	1.62E+06	3.65E+06	1.18E+02	3.01E+00		
Terbium (65)	Tb-157	5.29E-13	7.99E-14	1.86E-13	2.70E-13	1.46E-12	1.63E-09	6.95E+01	5.19E+01	1.41E+02	3.17E+02	2.56E+02	6.53E+00		
Terbium (65)	Tb-158	1.32E-11	2.38E-12	4.88E-12	6.99E-12	8.29E-11	3.57E-06	3.34E-02	2.56E-02	6.48E-02	1.46E-01	9.76E+00	2.52E-01		
Terbium (65)	Tb-160	2.42E-11	3.85E-12	8.70E-12	1.27E-11	2.45E-11	5.23E-06	2.24E+00	2.24E+00	3.65E+00	8.22E+00	5.47E+00	1.39E-01		
Terbium (65)	Tb-161	1.38E-11	1.95E-12	4.77E-12	7.03E-12	5.03E-12	3.44E-08	3.33E+03	3.23E+03	5.77E+03	1.30E+04	9.98E+00	2.51E-01		
Thallium (81)	Tl-194	3.68E-14	1.48E-14	1.81E-14	2.45E-14	5.11E-15	3.25E-06	1.14E+04	1.14E+04	1.86E+04	4.17E+04	2.63E+03	7.20E+01		
Thallium (81)	Tl-194m	1.63E-13	6.36E-14	7.81E-14	1.06E-13	2.50E-14	1.01E-05	3.68E+03	3.68E+03	6.01E+03	1.35E+04	6.10E+02	1.66E+01		
Thallium (81)	Tl-195	1.36E-13	5.00E-14	6.40E-14	8.70E-14	2.08E-14	6.02E-06	2.91E+03	2.91E+03	4.75E+03	1.07E+04	7.44E+02	2.03E+01		
Thallium (81)	Tl-197	1.41E-13	4.51E-14	6.25E-14	8.55E-14	2.39E-14	1.65E-06	4.33E+03	4.33E+03	7.08E+03	1.59E+04	7.62E+02	2.06E+01		
Thallium (81)	Tl-198	4.26E-13	1.61E-13	2.06E-13	2.75E-13	7.92E-14	9.67E-06	3.96E+02	3.96E+02	6.47E+02	1.46E+03	2.31E+02	6.41E+00		
Thallium (81)	Tl-198m	2.76E-13	1.01E-13	1.30E-13	1.75E-13	4.92E-14	5.04E-06	2.16E+03	2.15E+03	3.52E+03	7.92E+03	3.66E+02	1.01E+01		
Thallium (81)	Tl-199	1.64E-13	5.33E-14	7.36E-14	9.99E-14	2.89E-14	8.56E-07	3.20E+03	3.19E+03	5.22E+03	1.17E+04	6.47E+02	1.77E+01		
Thallium (81)	Tl-200	1.31E-12	4.55E-13	6.14E-13	8.21E-13	2.52E-13	5.93E-06	1.31E+02	1.31E+02	2.14E+02	4.82E+02	7.76E+01	2.15E+00		
Thallium (81)	Tl-201	8.81E-13	2.23E-13	3.61E-13	5.00E-13	1.49E-13	1.88E-07	1.46E+03	1.41E+03	2.42E+03	5.44E+03	1.32E+02	3.53E+00		
Thallium (81)	Tl-202	3.28E-12	1.05E-12	1.49E-12	2.01E-12	6.14E-13	1.83E-06	3.77E+01	3.72E+01	6.19E+01	1.39E+02	3.20E+01	8.77E-01		
Thallium (81)	Tl-204	1.54E-11	3.16E-12	5.85E-12	8.25E-12	2.45E-12	2.76E-09	1.48E+01	3.90E+00	3.21E+02	7.01E+02	8.14E+00	2.14E-01		
Thallium (81)	Tl-206						6.05E-09	4.80E+07	4.80E+07	7.83E+07	1.76E+08				
Thallium (81)	Tl-207						1.52E-08	1.68E+07	1.68E+07	2.74E+07	6.17E+07				
Thallium (81)	Tl-208						1.76E-05	2.26E+04	2.26E+04	3.68E+04	8.28E+04				
Thallium (81)	Tl-209						9.83E-06	5.64E+04	5.64E+04	9.20E+04	2.07E+05				
Thorium (90)	Th-226	1.58E-12	4.77E-13	6.66E-13	9.32E-13	1.56E-10	2.36E-08	1.65E+06	4.59E+05	2.72E+06	6.12E+06	7.15E+01	1.89E+00	3.61E+12	1.81E+11
Thorium (90)	Th-227	1.37E-10	2.03E-11	4.74E-11	6.92E-11	3.51E-08	3.78E-07	1.13E+02	9.05E+00	1.94E+02	4.35E+02	1.00E+00	2.55E-02	6.68E+04	3.34E+03
Thorium (90)	Th-228	2.89E-10	6.40E-11	1.07E-10	1.48E-10	1.32E-07	5.59E-09	2.42E+01	1.23E-01	1.25E+02	2.51E+02	4.45E-01	1.19E-02	6.60E+01	3.30E+00
Thorium (90)	Th-228+D	8.09E-10	1.62E-10	3.00E-10	4.22E-10	1.43E-07	7.76E-06	1.54E-01	3.38E-02	2.55E-01	5.73E-01	1.59E-01	4.18E-03	6.60E+01	3.30E+00
Thorium (90)	Th-229	4.96E-10	1.97E-10	2.24E-10	2.90E-10	1.75E-07	2.25E-07	3.70E-01	4.28E-03	8.67E-01	1.90E+00	2.13E-01	6.08E-03	6.07E+00	3.03E-01
Thorium (90)	Th-229+D	1.29E-09	3.63E-10	5.28E-10	7.16E-10	2.25E-07	1.17E-06	8.16E-02	1.71E-03	1.79E-01	4.00E-01	9.02E-02	2.46E-03	6.07E+00	3.03E-01
Thorium (90)	Th-230	2.02E-10	7.73E-11	9.10E-11	1.19E-10	2.85E-08	8.19E-10	3.49E+00	1.05E-02	2.02E+01	3.72E+01	5.23E-01	1.48E-02	6.06E+00	3.03E-01
Thorium (90)	Th-231	6.36E-12	9.14E-13	2.21E-12	3.24E-12	1.52E-12	2.45E-08	3.13E+04	3.31E+03	5.28E+04	1.19E+05	2.15E+01	5.44E-01	4.44E+08	2.22E+07
Thorium (90)	Th-232	2.31E-10	8.47E-11	1.01E-10	1.33E-10	4.33E-08	3.42E-10	3.10E+00	9.42E-03	1.90E+01	3.48E+01	4.71E-01	1.33E-02	6.06E+00	3.03E-01
Thorium (90)	Th-234	6.70E-11	9.51E-12	2.31E-11	3.40E-11	3.07E-11	1.63E-08	1.33E+03	1.53E+01	3.28E+03	7.26E+03	2.06E+00	5.19E-02	8.26E+04	4.13E+03
Thulium (69)	Tm-162	1.24E-13	4.29E-14	5.66E-14	7.77E-14	2.72E-14	8.69E-06	6.46E+03	6.46E+03	1.06E+04	2.37E+04	8.41E+02	2.27E+01		
Thulium (69)	Tm-166	2.86E-12	5.85E-13	1.12E-12	1.59E-12	5.14E-13	8.98E-06	2.94E+02	2.94E+02	4.80E+02	1.08E+03	4.25E+01	1.11E+00		
Thulium (69)	Tm-167	9.88E-12	1.44E-12	3.46E-12	5.07E-12	4.37E-12	3.97E-07	2.30E+02	2.30E+02	3.76E+02	8.47E+02	1.38E+01	3.48E-01		
Thulium (69)	Tm-170	2.59E-11	3.61E-12	8.92E-12	1.31E-11	2.43E-11	1.01E-08	4.78E+02	4.83E+02	1.02E+03	2.26E+03	5.34E+00	1.35E-01		
Thulium (69)	Tm-171	2.02E-12	2.85E-13	6.99E-13	1.02E-12	3.33E-12	6.97E-10	1.23E+03	1.25E+03	2.69E+03	5.99E+03	6.81E+01	1.73E+00		
Thulium (69)	Tm-172	3.09E-11	4.44E-12	1.08E-11	1.57E-11	5.62E-12	2.35E-06	1.36E+02	1.36E+02	2.22E+02	4.99E+02	4.41E+00	1.12E-01		
Thulium (69)	Tm-173	4.88E-12	7.44E-13	1.72E-12	2.52E-12	7.73E-13	1.62E-06	1.52E+03	1.52E+03	2.48E+03	5.59E+03	2.77E+01	7.00E-01		
Thulium (69)	Tm-175	1.19E-13	3.85E-14	5.22E-14	7.25E-14	3.26E-14	4.78E-06	1.68E+04	1.68E+04	2.74E+04	6.16E+04	9.12E+02	2.43E+01		
Tin (50)	Sn-110	5.18E-12	8.36E-13	1.87E-12	2.71E-12	6.70E-13	1.13E-06	4.49E+03	4.49E+03	7.34E+03	1.65E+04	2.55E+01	6.51E-01		
Tin (50)	Sn-111	1.32E-13	3.61E-14	5.51E-14	7.70E-14	2.83E-14	2.29E-06	1.51E+04	1.51E+04	2.46E+04	5.54E+04	8.64E+02	2.29E+01		
Tin (50)	Sn-113	1.22E-11	1.86E-12	4.33E-12	6.33E-12	1.00E-11	2.02E-08	3.31E+02	3.16E+02	5.88E+02	1.32E+03	1.10E+01	2.79E-01		
Tin (50)	Sn-117m	1.25E-11	1.83E-12	4.37E-12	6.40E-12	8.84E-12	4.69E-07	1.32E+02	1.32E+02	2.17E+02	4.87E+02	1.09E+01	2.76E-01		
Tin (50)	Sn-119m	6.36E-12	9.14E-13	2.21E-12	3.24E-12	7.81E-12	1.20E-09	1.27E+03	1.03E+03	3.59E+03	7.91E+03	2.15E+01	5.44E-01		
Tin (50)	Sn-121	4.33E-12	6.11E-13	1.50E-12	2.20E-12	1.02E-12	1.30E-10	8.71E+05	6.13E+05	5.97E+06	1.23E+07	3.17E+01	8.02E-01		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Soil Ingestion Slope Factor-Adult (risk/pCi)	Water Ingestion Slope Factor (risk/pCi)	Food Ingestion Slope Factor (risk/pCi)	Inhalation Slope Factor (risk/pCi)	External Exposure Slope Factor (risk/y per pCi/g)	PRG: Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Tin (50)	Sn-121m	6.66E-12	9.99E-13	2.34E-12	3.41E-12	1.54E-11	8.85E-10	6.66E+01	4.14E+01	2.53E+02	5.52E+02	2.04E+01	5.17E-01		
Tin (50)	Sn-123	4.03E-11	5.70E-12	1.40E-11	2.05E-11	3.03E-11	3.88E-08	1.44E+02	1.34E+02	2.71E+02	6.07E+02	3.40E+00	8.60E-02		
Tin (50)	Sn-123m	1.94E-13	5.33E-14	7.96E-14	1.12E-13	5.62E-14	4.62E-07	6.58E+04	6.58E+04	1.07E+05	2.42E+05	5.98E+02	1.57E+01		
Tin (50)	Sn-125	5.81E-11	8.25E-12	2.01E-11	2.95E-11	1.41E-11	1.53E-06	5.70E+01	5.69E+01	9.36E+01	2.11E+02	2.37E+00	5.98E-02		
Tin (50)	Sn-126	7.07E-11	1.17E-11	2.56E-11	3.69E-11	9.95E-11	9.96E-08	1.00E+00	7.11E-01	2.16E+00	4.85E+00	1.86E+00	4.78E-02		
Tin (50)	Sn-127	2.22E-12	4.11E-13	8.25E-13	1.19E-12	4.40E-13	9.25E-06	1.05E+03	1.05E+03	1.71E+03	3.84E+03	5.77E+01	1.48E+00		
Tin (50)	Sn-128	1.09E-12	2.57E-13	4.33E-13	6.14E-13	2.29E-13	2.62E-06	7.87E+03	7.87E+03	1.28E+04	2.89E+04	1.10E+02	2.87E+00		
Titanium (22)	Ti-44	6.73E-11	1.34E-11	2.56E-11	3.64E-11	3.41E-10	2.39E-07	5.55E-01	4.46E-01	1.08E+00	2.44E+00	1.86E+00	4.85E-02		
Titanium (22)	Ti-45	1.75E-12	3.12E-13	6.44E-13	9.32E-13	3.09E-13	3.79E-06	1.74E+03	1.74E+03	2.84E+03	6.39E+03	7.39E+01	1.89E+00		
Tungsten (74)	W-176	1.05E-12	2.13E-13	4.11E-13	5.88E-13	1.24E-13	3.20E-07	2.76E+04	2.75E+04	4.50E+04	1.01E+05	1.16E+02	3.00E+00		
Tungsten (74)	W-177	5.00E-13	1.13E-13	2.01E-13	2.84E-13	5.99E-14	3.63E-06	2.49E+03	2.49E+03	4.06E+03	9.13E+03	2.37E+02	6.21E+00		
Tungsten (74)	W-178	3.33E-12	5.37E-13	1.21E-12	1.75E-12	3.85E-13	1.59E-08	2.29E+03	2.03E+03	3.99E+03	8.96E+03	3.94E+01	1.01E+00		
Tungsten (74)	W-179	1.68E-14	5.00E-15	7.22E-15	1.01E-14	1.83E-15	6.01E-08	5.41E+05	5.41E+05	8.83E+05	1.99E+06	6.60E+03	1.75E+02		
Tungsten (74)	W-181	1.07E-12	1.83E-13	3.96E-13	5.70E-13	1.35E-13	4.86E-08	1.43E+02	1.41E+02	2.35E+02	5.28E+02	1.20E+02	3.09E+00		
Tungsten (74)	W-185	8.36E-12	1.21E-12	2.93E-12	4.29E-12	9.36E-13	2.92E-10	3.54E+03	1.32E+03	4.17E+04	8.66E+04	1.63E+01	4.11E-01		
Tungsten (74)	W-187	1.03E-11	1.59E-12	3.67E-12	5.37E-12	1.11E-12	2.04E-06	4.16E+02	4.15E+02	6.80E+02	1.53E+03	1.30E+01	3.28E-01		
Tungsten (74)	W-188	4.00E-11	5.77E-12	1.40E-11	2.05E-11	4.63E-12	7.02E-09	5.85E+02	2.62E+02	2.58E+03	5.67E+03	3.40E+00	8.60E-02		
Uranium (92)	U-230	5.66E-10	1.04E-10	2.09E-10	2.98E-10	4.55E-08	3.07E-09	4.09E+02	2.91E-01	3.99E+03	7.52E+03	2.28E-01	5.92E-03	3.58E+12	1.79E+11
Uranium (92)	U-231	5.00E-12	7.40E-13	1.75E-12	2.56E-12	1.80E-12	1.60E-07	1.25E+03	1.48E+02	2.05E+03	4.62E+03	2.72E+01	6.89E-01	8.74E+13	4.37E+12
Uranium (92)	U-232	5.74E-10	2.45E-10	2.92E-10	3.85E-10	1.95E-08	5.98E-10	1.25E+00	5.59E-04	7.92E+00	1.43E+01	1.63E-01	4.58E-03	8.86E+06	4.43E+05
Uranium (92)	U-233	1.60E-10	5.22E-11	7.18E-11	9.69E-11	1.16E-08	9.82E-10	3.86E+00	1.84E-03	2.87E+01	5.34E+01	6.63E-01	1.82E-02	3.47E+03	1.74E+02
Uranium (92)	U-234	1.58E-10	5.11E-11	7.07E-11	9.55E-11	1.14E-08	2.52E-10	4.01E+00	1.87E-03	3.24E+01	5.92E+01	6.74E-01	1.85E-02	2.24E+03	1.12E+02
Uranium (92)	U-235	1.57E-10	4.92E-11	6.96E-11	9.44E-11	1.01E-08	5.18E-07	2.05E-01	1.87E-03	4.17E-01	9.35E-01	6.84E-01	1.87E-02	7.77E-01	3.89E-02
Uranium (92)	U-235+D	1.63E-10	5.03E-11	7.18E-11	9.76E-11	1.01E-08	5.43E-07	1.95E-01	1.81E-03	3.98E-01	8.92E-01	6.63E-01	1.81E-02	7.77E-01	3.89E-02
Uranium (92)	U-236	1.49E-10	4.85E-11	6.70E-11	9.03E-11	1.05E-08	1.25E-10	4.27E+00	1.98E-03	3.48E+01	6.33E+01	7.11E-01	1.95E-02	2.33E+01	1.16E+00
Uranium (92)	U-237	1.39E-11	2.05E-12	4.88E-12	7.14E-12	6.44E-12	3.76E-07	3.31E+02	3.37E+01	5.44E+02	1.22E+03	9.76E+00	2.47E-01	3.30E+13	1.65E+12
Uranium (92)	U-238	1.43E-10	4.66E-11	6.40E-11	8.66E-11	9.32E-09	4.99E-11	4.46E+00	2.06E-03	3.68E+01	6.67E+01	7.44E-01	2.04E-02	1.21E-01	6.04E-03
Uranium (92)	U-238+D	2.10E-10	5.62E-11	8.71E-11	1.21E-10	9.35E-09	1.14E-07	7.42E-01	1.47E-03	1.80E+00	4.00E+00	5.47E-01	1.46E-02	1.21E-01	6.04E-03
Uranium (92)	U-239	1.90E-13	4.40E-14	7.40E-14	1.06E-13	5.70E-14	1.21E-07	4.29E+05	3.04E+05	7.00E+05	1.57E+06	6.44E+02	1.66E+01	5.59E+18	2.80E+17
Uranium (92)	U-240	2.02E-11	2.96E-12	7.03E-12	1.03E-11	2.96E-12	7.33E-10	3.48E+05	2.98E+02	2.14E+06	4.45E+06	6.77E+00	1.71E-01	4.30E+15	2.15E+14
Vanadium (23)	V-47	2.92E-13	8.88E-14	1.25E-13	1.74E-13	5.96E-14	4.36E-06	8.58E+03	8.58E+03	1.40E+04	3.15E+04	3.81E+02	1.01E+01		
Vanadium (23)	V-48	2.13E-11	4.11E-12	8.21E-12	1.17E-11	9.29E-12	1.40E-05	3.73E+00	3.73E+00	6.09E+00	1.37E+01	5.80E+00	1.51E-01		
Vanadium (23)	V-49	3.53E-13	5.00E-14	1.22E-13	1.79E-13	1.47E-13	0.00E+00	5.17E+04	5.39E+04	6.81E+05	1.23E+06	3.90E+02	9.85E+00		
Xenon (54)	Xe-120						1.70E-06	1.79E+04	1.79E+04	2.93E+04	6.58E+04				
Xenon (54)	Xe-121						8.73E-06	3.48E+03	3.48E+03	5.68E+03	1.28E+04				
Xenon (54)	Xe-122						1.83E-07	5.52E+03	5.52E+03	9.01E+03	2.03E+04				
Xenon (54)	Xe-123						2.72E-06	3.59E+03	3.59E+03	5.86E+03	1.32E+04				
Xenon (54)	Xe-125						9.38E-07	1.27E+03	1.27E+03	2.08E+03	4.68E+03				
Xenon (54)	Xe-127						9.52E-07	2.44E+01	2.44E+01	3.99E+01	8.97E+01				
Xenon (54)	Xe-129m						4.25E-08	2.49E+03	2.49E+03	4.06E+03	9.14E+03				
Xenon (54)	Xe-131m						1.41E-08	5.05E+03	5.05E+03	8.23E+03	1.85E+04				
Xenon (54)	Xe-133						6.62E-08	2.44E+03	2.44E+03	3.98E+03	8.94E+03				
Xenon (54)	Xe-133m						9.25E-08	4.18E+03	4.18E+03	6.82E+03	1.53E+04				
Xenon (54)	Xe-135						9.70E-07	2.30E+03	2.30E+03	3.76E+03	8.46E+03				
Xenon (54)	Xe-135m						1.86E-06	4.28E+04	4.28E+04	6.99E+04	1.57E+05				
Xenon (54)	Xe-138						5.62E-06	1.53E+04	1.53E+04	2.49E+04	5.61E+04				
Ytterbium (70)	Yb-162	1.21E-13	3.62E-14	5.22E-14	7.29E-14	3.00E-14	3.26E-07	1.98E+05	1.98E+05	3.23E+05	7.27E+05	9.12E+02	2.42E+01		
Ytterbium (70)	Yb-166	1.17E-11	2.08E-12	4.37E-12	6.29E-12	2.89E-12	9.46E-08	3.72E+03	3.73E+03	6.17E+03	1.39E+04	1.09E+01	2.80E-01		
Ytterbium (70)	Yb-167	3.70E-14	1.04E-14	1.56E-14	2.18E-14	1.71E-14	6.21E-07	1.12E+05	1.12E+05	1.83E+05	4.12E+05	3.05E+03	8.09E+01		
Ytterbium (70)	Yb-169	1.12E-11	1.73E-12	4.00E-12	5.85E-12	1.08E-11	7.75E-07	3.41E+01	3.41E+01	5.57E+01	1.25E+02	1.19E+01	3.01E-01		
Ytterbium (70)	Yb-175	8.29E-12	1.17E-12	2.87E-12	4.22E-12	2.95E-12	1.54E-07	1.30E+03	1.30E+03	2.14E+03	4.81E+03	1.66E+01	4.18E-01		

Radionuclide Toxicity and Preliminary Remediation Goals for Superfund

Element (Atomic Number)	Isotope	Toxicity: Soil Ingestion Slope Factor (risk/pCi)	Toxicity: Soil Ingestion Slope Factor-Adult (risk/pCi)	Toxicity: Water Ingestion Slope Factor (risk/pCi)	Toxicity: Food Ingestion Slope Factor (risk/pCi)	Toxicity: Inhalation Slope Factor (risk/pCi)	Toxicity: External Exposure Slope Factor (risk/y per pCi/g)	Preliminary Remediation Goals (PRG): Residential Soil (pCi/g)	Agricultural Soil (pCi/g)	Outdoor Worker Soil (pCi/g)	Indoor Worker Soil (pCi/g)	Tap Water (pCi/L)	Fish Ingestion (pCi/g)	Soil to Groundwater: DAF=20 (pCi/g)	DAF=1 (pCi/g)
Ytterbium (70)	Yb-177	9.51E-13	1.69E-13	3.46E-13	5.03E-13	2.29E-13	8.35E-07	1.28E+04	1.28E+04	2.09E+04	4.70E+04	1.38E+02	3.51E+00		
Ytterbium (70)	Yb-178	1.06E-12	1.92E-13	3.89E-13	5.59E-13	2.38E-13	1.44E-07	1.14E+05	1.14E+05	1.87E+05	4.20E+05	1.22E+02	3.16E+00		
Yttrium (39)	Y-86	1.05E-11	2.03E-12	4.07E-12	5.81E-12	1.58E-12	1.73E-05	7.99E+01	7.99E+01	1.30E+02	2.93E+02	1.17E+01	3.04E-01		
Yttrium (39)	Y-86m	6.11E-13	1.18E-13	2.35E-13	3.35E-13	9.29E-14	8.35E-07	3.04E+04	3.04E+04	4.96E+04	1.12E+05	2.03E+02	5.26E+00		
Yttrium (39)	Y-87	6.92E-12	1.21E-12	2.58E-12	3.70E-12	1.49E-12	1.94E-06	1.30E+02	1.30E+02	2.13E+02	4.79E+02	1.85E+01	4.77E-01		
Yttrium (39)	Y-88	9.92E-12	2.40E-12	4.18E-12	5.85E-12	1.70E-11	1.37E-05	5.77E-01	5.77E-01	9.42E-01	2.12E+00	1.14E+01	3.01E-01		
Yttrium (39)	Y-90	5.25E-11	7.29E-12	1.81E-11	2.65E-11	8.40E-12	1.91E-08	1.14E+04	9.63E+03	2.59E+04	5.77E+04	2.63E+00	6.66E-02		
Yttrium (39)	Y-90m	2.95E-12	4.40E-13	1.04E-12	1.51E-12	4.81E-13	2.58E-06	2.47E+03	2.47E+03	4.03E+03	9.06E+03	4.58E+01	1.17E+00		
Yttrium (39)	Y-91	4.66E-11	6.48E-12	1.60E-11	2.35E-11	3.36E-11	2.51E-08	4.39E+02	3.87E+02	9.12E+02	2.04E+03	2.98E+00	7.50E-02		
Yttrium (39)	Y-91m	8.51E-14	2.15E-14	3.52E-14	4.96E-14	3.01E-14	2.34E-06	1.05E+04	1.05E+04	1.71E+04	3.85E+04	1.35E+03	3.56E+01		
Yttrium (39)	Y-92	7.03E-12	1.10E-12	2.48E-12	3.61E-12	9.32E-13	1.26E-06	4.55E+03	4.55E+03	7.43E+03	1.67E+04	1.92E+01	4.89E-01		
Yttrium (39)	Y-93	2.08E-11	2.96E-12	7.18E-12	1.05E-11	2.64E-12	4.60E-07	4.34E+03	4.32E+03	7.13E+03	1.60E+04	6.63E+00	1.68E-01		
Yttrium (39)	Y-94	3.08E-13	1.06E-13	1.37E-13	1.90E-13	5.51E-14	5.45E-06	1.17E+04	1.17E+04	1.91E+04	4.30E+04	3.48E+02	9.28E+00		
Yttrium (39)	Y-95	1.59E-13	5.85E-14	7.25E-14	9.99E-14	2.92E-14	4.80E-06	2.37E+04	2.37E+04	3.87E+04	8.72E+04	6.57E+02	1.77E+01		
Zinc (30)	Zn-62	1.34E-11	2.25E-12	4.96E-12	7.25E-12	2.65E-12	1.87E-06	1.13E+03	4.04E+00	1.91E+03	4.31E+03	9.60E+00	2.43E-01	2.23E+07	1.11E+06
Zinc (30)	Zn-63	3.77E-13	1.13E-13	1.61E-13	2.26E-13	7.55E-14	4.87E-06	6.57E+03	1.47E+03	1.07E+04	2.41E+04	2.96E+02	7.80E+00	1.46E+11	7.30E+09
Zinc (30)	Zn-65	2.45E-11	8.95E-12	1.17E-11	1.54E-11	5.81E-12	2.81E-06	1.18E+00	3.01E-03	2.01E+00	4.53E+00	4.07E+00	1.15E-01	5.60E+01	2.80E+00
Zinc (30)	Zn-69	1.79E-13	4.51E-14	7.22E-14	1.03E-13	6.11E-14	1.67E-09	8.19E+06	2.78E+03	2.08E+07	4.68E+07	6.60E+02	1.71E+01	1.45E+11	7.27E+09
Zinc (30)	Zn-69m	5.07E-12	8.33E-13	1.86E-12	2.73E-12	1.28E-12	1.77E-06	8.20E+02	7.15E+00	1.36E+03	3.05E+03	2.56E+01	6.46E-01	2.68E+07	1.34E+06
Zinc (30)	Zn-71m	2.50E-12	4.92E-13	9.66E-13	1.39E-12	5.33E-13	6.84E-06	7.56E+02	4.68E+01	1.24E+03	2.78E+03	4.93E+01	1.27E+00	6.38E+08	3.19E+07
Zinc (30)	Zn-72	1.71E-11	3.34E-12	6.59E-12	9.44E-12	5.48E-12	4.68E-07	7.88E+02	6.19E-01	1.52E+03	3.42E+03	7.23E+00	1.87E-01	6.65E+05	3.33E+04
Zirconium (40)	Zr-86	1.02E-11	1.86E-12	3.85E-12	5.55E-12	1.56E-12	1.04E-06	1.18E+03	1.18E+03	1.93E+03	4.35E+03	1.24E+01	3.18E-01		
Zirconium (40)	Zr-88	3.74E-12	9.36E-13	1.58E-12	2.18E-12	8.95E-12	1.65E-06	6.15E+00	6.15E+00	1.00E+01	2.26E+01	3.01E+01	8.09E-01		
Zirconium (40)	Zr-89	9.58E-12	1.72E-12	3.60E-12	5.18E-12	1.92E-12	5.38E-06	4.82E+01	4.82E+01	7.86E+01	1.77E+02	1.32E+01	3.40E-01		
Zirconium (40)	Zr-93	2.12E-12	9.81E-13	1.11E-12	1.44E-12	7.29E-12	0.00E+00	3.38E+02	2.00E+02	1.81E+03	3.26E+03	4.29E+01	1.22E+00		
Zirconium (40)	Zr-95	1.23E-11	2.16E-12	4.59E-12	6.59E-12	1.65E-11	3.40E-06	3.89E+00	3.89E+00	6.35E+00	1.43E+01	1.04E+01	2.68E-01		