§ 835.1302 Emergency exposure situations.

(a) The risk of injury to those individuals involved in rescue and recovery operations shall be minimized.

(b) Operating management shall weigh actual and potential risks against the benefits to be gained.

(c) No individual shall be required to perform a rescue action that might involve substantial personal risk.

(d) Each individual authorized to perform emergency actions likely to result in occupational doses exceeding the values of the limits provided at § 835.202(a) shall be trained in accordance with § 835.901(b) and briefed beforehand on the known or anticipated hazards to which the individual will be subjected.

[58 FR 65485, Dec. 14, 1993, as amended at 63 FR 59687, Nov. 4, 1998]

§ 835.1303 [Reserved]

§ 835.1304 Nuclear accident dosimetry.

(a) Installations possessing sufficient quantities of fissile material to potentially constitute a critical mass, such that the excessive exposure of individuals to radiation from a nuclear accident is possible, shall provide nuclear accident dosimetry for those individuals.

(b) Nuclear accident dosimetry shall include the following:

(1) A method to conduct initial screening of individuals involved in a nuclear accident to determine whether significant exposures to radiation occurred;

(2) Methods and equipment for analysis of biological materials;

(3) A system of fixed nuclear accident dosimeter units; and

(4) Personal nuclear accident dosimeters.

[58 FR 65485, Dec. 14, 1993, as amended at 63 FR 59687, Nov. 4, 1998]

APPENDIX A TO PART 835—DERIVED AIR CONCENTRATIONS (DAC) FOR CONTROLLING RADIATION EXPOSURE TO WORKERS AT DOE FACILITIES

The data presented in appendix A are to be used for controlling individual internal doses in accordance with § 835.209, identifying the need for air monitoring in accordance with § 835.403, and identifying and posting airborne radioactivity areas in accordance with § 835.603(d).

The DAC values are given for individual radionuclides. For known mixtures of radionuclides, determine the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture. If this sum exceeds unity (1), then the DAC has been exceeded. For unknown radionuclides, the most restrictive DAC (lowest value) for those isotopes not known to be absent shall be used. For any single radionuclide not listed in appendix A with decay mode other than alpha emission or spontaneous fission and with radioactive half-life greater than two hours, the DAC value shall be 4 E-11 μCi/mL (1 Bq/m^3). For any single radionuclide not listed in appendix A that decays by alpha emission or spontaneous fission the DAC value shall be 2 E-13 μCi/mL (8 E-03 Bq/m^3).

The DACs for limiting radiation exposures through inhalation of radionuclides by workers are listed in this appendix. The values are based on either a stochastic (committed effective dose) dose limit of 5 rems (0.05 Sv) or a deterministic (organ or tissue) dose limit of 50 rems (0.5 Sv) per year, whichever is more limiting.

NOTE: the 15 rems (0.15 Sv) dose limit for the lens of the eye does not appear as a critical organ dose limit.

The columns in this appendix contain the following information: (1) Radionuclide; (2) inhaled air DAC for type F (fast), type M (moderate), and type S (slow) materials in units of μCi/mL; (3) inhaled air DAC for type F (fast), type M (moderate), and type S (slow) materials in units of Bq/m^3; (4) an indication of whether or not the DAC for each class is controlled by the stochastic (effective dose) or deterministic (organ or tissue) dose. The absorption types (F, M, and S) have been established to describe the absorption type of the materials from the respiratory tract into the blood. The range of half-times for the absorption types correspond to: Type F, 100% at 10 minutes; Type M, 10% at 10 minutes and 90% at 140 days; and Type S 0.1% at 10 minutes and 99.9% at 7000 days. The DACs are listed by radionuclide, in order of increasing atomic mass, and are based on the assumption that the particle size distribution of 5 micrometers AMAD is used. For situations where the particle size distribution is known to differ significantly from 5 micrometers AMAD, appropriate corrections may be made to both the estimated dose to workers and the DACs.

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
H-3 (Water) [2]	2 E−05	2 E−05	2 E−05	7 E+05	7 E+05	7 E+05	St/St/St
H-3 (Elemental) [2].	2 E−01	2 E−01	2 E−01	9 E+09	9 E+09	9 E+09	St/St/St
STCs (Insoluble) [4].	1 E−05	6 E−06	2 E−06	3 E+05	2 E+05	8 E+04	St/St/St
STCs (Soluble)	1 E−05	1 E−05	1 E−05	5 E+05	5 E+05	5 E+05	St/St/St
Be-7	–	1 E−05	1 E−05	–	4 E+05	4 E+05	/St/St
Be-10	–	8 E−08	2 E−08	–	3 E+03	1 E+03	/St/St
C-11 (Vapor) [2]	–	1 E−04	–	–	6 E+06	–	/St/
C-11 (CO) [2]	4 E−04	4 E−04	4 E−04	1 E+07	1 E+07	1 E+07	St/St/St
C-11 (CO_2) [2]	2 E−04	2 E−04	2 E−04	9 E+06	9 E+06	9 E+06	St/St/St
C-14 (Vapor) [2]	–	9 E−07	–	–	3 E+04	–	/St/
C-14 (CO) [2]	7 E−04	7 E−04	7 E−04	2 E+07	2 E+07	2 E+07	St/St/St
C-14 (CO_2) [2]	8 E−05	8 E−05	8 E−05	3 E+06	3 E+06	3 E+06	St/St/St
F-18	4 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Na-22	2 E−07	–	–	1 E+04	–	–	E/ /
Na-24	4 E−07	–	–	1 E+04	–	–	ET/ /
Mg-28	3 E−07	3 E−07	–	1 E+04	1 E+04	–	ET/St/
Al-26	4 E−08	4 E−08	–	1 E+03	1 E+03	–	St/St/
Si-31	9 E−06	5 E−06	5 E−06	3 E+05	1 E+05	1 E+05	ET/St/St
Si-32	1 E−07	5 E−08	1 E−08	5 E+03	2 E+03	3 E+02	St/St/St
P-32	5 E−07	1 E−07	–	1 E+04	7 E+03	–	St/St/
P-33	4 E−06	4 E−07	–	1 E+05	1 E+04	–	St/St/
S-35 (Vapor)	–	4 E−06	–	–	1 E+05	–	/St/
S-35	7 E−06	5 E−07	–	2 E+05	1 E+04	–	St/St/
Cl-36	1 E−06	1 E−07	–	4 E+04	4 E+03	–	St/St/
Cl-38	7 E−06	5 E−06	–	2 E+05	2 E+05	–	ET/ET/
Cl-39	2 E−06	4 E−06	–	1 E+05	1 E+05	–	ET/ET/
K-40	1 E−07	–	–	6 E+03	–	–	St/ /
K-42	2 E−06	–	–	1 E+05	–	–	E/ /
K-43	9 E−07	–	–	3 E+04	–	–	ET/ /
K-44	8 E−06	–	–	2 E+05	–	–	ET/ /
K-45	9 E−06	–	–	3 E+05	–	–	ET/ /
Ca-41	–	2 E−06	–	–	8 E+04	–	/BS/
Ca-45	–	2 E−07	–	–	9 E+03	–	/St/
Ca-47	–	2 E−07	–	–	9 E+03	–	/St/
Sc-43	–	–	2 E−06	–	–	7 E+04	/ /ET
Sc-44m	–	–	2 E−07	–	–	1 E+04	/ /St
Sc-44	–	–	1 E−06	–	–	4 E+04	/ /ET
Sc-46	–	–	1 E−07	–	–	4 E+03	/ /St
Sc-47	–	–	7 E−07	–	–	2 E+04	/ /St
Sc-48	–	–	2 E−07	–	–	1 E+04	/ /ET
Sc-49	–	–	8 E−06	–	–	3 E+05	/ /ET
Ti-44	7 E−09	2 E−08	9 E−09	2 E+02	7 E+02	3 E+02	St/St/St
Ti-45	3 E−06	2 E−06	2 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
V-47	8 E−06	6 E−06	–	3 E+05	2 E+05	–	ET/ET/
V-48	2 E−07	2 E−07	–	9 E+03	7 E+03	–	ET/St/
V-49	1 E−05	2 E−05	–	7 E+05	9 E+05	–	BS/St/
Cr-48	2 E−06	2 E−06	2 E−06	8 E+04	8 E+04	8 E+04	ET/ET/ET
Cr-49	7 E−06	5 E−06	5 E−06	2 E+05	2 E+05	2 E+05	ET/ET/ET
Cr-51	1 E−05	1 E−05	1 E−05	6 E+05	6 E+05	5 E+05	St/St/St
Mn-51	7 E−06	5 E−06	–	2 E+05	2 E+05	–	ET/ET/
Mn-52m	7 E−06	5 E−06	–	2 E+05	2 E+05	–	ET/ET/
Mn-52	2 E−07	2 E−07	–	8 E+03	8 E+03	–	ET/ET/
Mn-53	5 E−06	1 E−05	–	2 E+05	5 E+05	–	BS/St/
Mn-54	5 E−07	4 E−07	–	1 E+04	1 E+04	–	St/St/
Mn-56	2 E−06	2 E−06	–	9 E+04	8 E+04	–	ET/ET/
Fe-52	6 E−07	5 E−07	–	2 E+04	2 E+04	–	ET/E/
Fe-55	6 E−07	1 E−06	–	2 E+04	6 E+04	–	St/St/
Fe-59	1 E−07	1 E−07	–	6 E+03	6 E+03	–	St/St/
Fe-60	1 E−09	4 E−09	–	6 E+01	1 E+02	–	St/St/
Co-55	–	5 E−07	5 E−07	–	2 E+04	2 E+04	/ET/ET
Co-56	–	1 E−07	1 E−07	–	5 E+03	4 E+03	/St/St
Co-57	–	1 E−06	9 E−07	–	5 E+04	3 E+04	/St/St
Co-58m	–	3 E−05	3 E−05	–	1 E+06	1 E+06	/St/St
Co-58	–	4 E−07	3 E−07	–	1 E+04	1 E+04	/St/St
Co-60m	–	4 E−04	4 E−04	–	1 E+07	1 E+07	/St/St
Co-60	–	7 E−08	3 E−08	–	2 E+03	1 E+03	/St/St
Co-61	–	6 E−06	6 E−06	–	2 E+05	2 E+05	/ET/ET
Co-62m	–	7 E−06	6 E−06	–	2 E+05	2 E+05	/ET/ET
Ni-56 (Inorg)	4 E−07	4 E−07	–	1 E+04	1 E+04	–	ET/ET/

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Ni-56 (Carbonyl).	–	4 E−07	–	–	1 E+04	–	/St/
Ni-57 (Inorg) ...	5 E−07	5 E−07	–	2 E+04	2 E+04	–	ET/ET/
Ni-57 (Carbonyl).	–	7 E−07	–	–	2 E+04	–	/ET/
Ni-59 (Inorg) ...	2 E−06	5 E−06	–	9 E+04	2 E+05	–	St/St/
Ni-59 (Carbonyl).	–	6 E−07	–	–	2 E+04	–	/St/
Ni-63 (Inorg) ...	1 E−06	1 E−06	–	4 E+04	6 E+04	–	St/St/
Ni-63 (Carbonyl).	–	2 E−07	–	–	1 E+04	–	/St/
Ni-65 (Inorg) ...	5 E−06	4 E−06	–	1 E+05	1 E+05	–	ET/ET/
Ni-65 (Carbonyl).	–	8 E−07	–	–	3 E+04	–	/ET/
Ni-66 (Inorg) ...	7 E−07	2 E−07	–	2 E+04	1 E+04	–	St/St/
Ni-66 (Carbonyl).	–	2 E−07	–	–	1 E+04	–	/ET/
Cu-60	5 E−06	4 E−06	4 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Cu-61	3 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Cu-64	4 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/E/E
Cu-67	2 E−06	1 E−06	9 E−07	8 E+04	3 E+04	3 E+04	ET/St/St
Zn-62	–	–	8 E−07	–	–	3 E+04	/ /St
Zn-63	–	–	5 E−06	–	–	2 E+05	/ /ET
Zn-65	–	–	2 E−07	–	–	7 E+03	/ /St
Zn-69m	–	–	1 E−06	–	–	6 E+04	/ /St
Zn-69	–	–	7 E−06	–	–	2 E+05	/ /ET
Zn-71m	–	–	1 E−06	–	–	5 E+04	/ /ET
Zn-72	–	–	3 E−07	–	–	1 E+04	/ /St
Ga-65	1 E−05	9 E−06	–	4 E+05	3 E+05	–	ET/ET/
Ga-66	8 E−07	7 E−07	–	3 E+04	2 E+04	–	ET/St/
Ga-67	3 E−06	2 E−06	–	1 E+05	7 E+04	–	ET/St/
Ga-68	6 E−06	4 E−06	–	2 E+05	1 E+05	–	ET/ET/
Ga-70	1 E−05	1 E−05	–	6 E+05	4 E+05	–	ET/ET/
Ga-72	5 E−07	5 E−07	–	2 E+04	2 E+04	–	ET/ET/
Ga-73	4 E−06	2 E−06	–	1 E+05	1 E+05	–	ET/St/
Ge-66	2 E−06	2 E−06	–	9 E+04	9 E+04	–	ET/ET/
Ge-67	1 E−05	7 E−06	–	3 E+05	2 E+05	–	ET/ET/
Ge-68	6 E−07	7 E−08	–	2 E+04	2 E+03	–	ET/St/
Ge-69	1 E−06	1 E−06	–	3 E+04	3 E+04	–	ET/ET/
Ge-71	5 E−05	5 E−05	–	2 E+06	1 E+06	–	ET/E/
Ge-75	1 E−05	7 E−06	–	4 E+05	2 E+05	–	ET/ET/
Ge-77	1 E−06	1 E−06	–	4 E+04	4 E+04	–	ET/ET/
Ge-78	3 E−06	3 E−06	–	1 E+05	1 E+05	–	ET/ET/
As-69	–	9 E−06	–	–	3 E+05	–	/ET/
As-70	–	2 E−06	–	–	8 E+04	–	/ET/
As-71	–	1 E−06	–	–	4 E+04	–	/St/
As-72	–	4 E−07	–	–	1 E+04	–	/St/
As-73	–	8 E−07	–	–	3 E+04	–	/St/
As-74	–	3 E−07	–	–	1 E+04	–	/St/
As-76	–	6 E−07	–	–	2 E+04	–	/St/
As-77	–	1 E−06	–	–	4 E+04	–	/St/
As-78	–	3 E−06	–	–	1 E+05	–	/ET/
Se-70	2 E−06	2 E−06	–	1 E+05	9 E+04	–	ET/ET/
Se-73m	1 E−05	1 E−05	–	5 E+05	4 E+05	–	ET/ET/
Se-73	1 E−06	1 E−06	–	6 E+04	5 E+04	–	ET/ET/
Se-75	4 E−07	3 E−07	–	1 E+04	1 E+04	–	St/St/
Se-79	3 E−07	1 E−07	–	1 E+04	6 E+03	–	K/St/
Se-81m	1 E−05	6 E−06	–	3 E+05	2 E+05	–	ET/ET/
Se-81	1 E−05	1 E−05	–	6 E+05	4 E+05	–	ET/ET/
Se-83	6 E−06	5 E−06	–	2 E+05	1 E+05	–	ET/ET/
Br-74m	3 E−06	2 E−06	–	1 E+05	1 E+05	–	ET/ET/
Br-74	4 E−06	4 E−06	–	1 E+05	1 E+05	–	ET/ET/
Br-75	4 E−06	3 E−06	–	1 E+05	1 E+05	–	ET/ET/
Br-76	5 E−07	5 E−07	–	2 E+04	2 E+04	–	ET/ET/
Br-77	2 E−06	2 E−06	–	7 E+04	7 E+04	–	ET/ET/
Br-80m	6 E−06	5 E−06	–	2 E+05	2 E+05	–	ET/St/
Br-80	3 E−05	2 E−05	–	1 E+06	7 E+05	–	ET/ET/
Br-82	3 E−07	3 E−07	–	1 E+04	1 E+04	–	ET/ET/
Br-83	9 E−06	6 E−06	–	3 E+05	2 E+05	–	ET/ET/
Br-84	7 E−06	5 E−06	–	2 E+05	2 E+05	–	ET/ET/
Rb-79	8 E−06	–	–	2 E+05	–	–	ET/ /

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Rb-81m	1 E−05	–	–	6 E+05	–	–	ET/ /
Rb-81	2 E−06	–	–	1 E+05	–	–	ET/ /
Rb-82m	8 E−07	–	–	3 E+04	–	–	ET/ /
Rb-83	5 E−07	–	–	2 E+04	–	–	St/ /
Rb-84	3 E−07	–	–	1 E+04	–	–	St/ /
Rb-86	4 E−07	–	–	1 E+04	–	–	St/ /
Rb-87	7 E−07	–	–	2 E+04	–	–	St/ /
Rb-88	1 E−05	–	–	5 E+05	–	–	ET/ /
Rb-89	1 E−05	–	–	3 E+05	–	–	ET/ /
Sr-80	3 E−06	–	2 E−06	1 E+05	–	9 E+04	ET/ /St
Sr-81	7 E−06	–	5 E−06	2 E+05	–	2 E+05	ET/ /ET
Sr-82	1 E−07	–	7 E−08	6 E+03	–	2 E+03	St/ /St
Sr-83	1 E−06	–	9 E−07	3 E+04	–	3 E+04	ET/ /ET
Sr-85m	4 E−05	–	3 E−05	1 E+06	–	1 E+06	ET/ /ET
Sr-85	1 E−06	–	8 E−07	3 E+04	–	3 E+04	St/ /St
Sr-87m	1 E−05	–	9 E−06	4 E+05	–	3 E+05	ET/ /ET
Sr-89	4 E−07	–	1 E−07	1 E+04	–	3 E+03	St/ /St
Sr-90	1 E−08	–	7 E−09	4 E+02	–	2 E+02	BS/ /St
Sr-91	1 E−06	–	9 E−07	5 E+04	–	3 E+04	ET/ /St
Sr-92	2 E−06	–	1 E−06	8 E+04	–	6 E+04	ET/ /St
Y-86m	–	7 E−06	6 E−06	–	2 E+05	2 E+05	/ET/ET
Y-86	–	4 E−07	4 E−07	–	1 E+04	1 E+04	/ET/ET
Y-87	–	9 E−07	8 E−07	–	3 E+04	3 E+04	/ET/ET
Y-88	–	1 E−07	1 E−07	–	6 E+03	6 E+03	/St/St
Y-90m	–	4 E−06	4 E−06	–	1 E+05	1 E+05	/St/St
Y-90	–	3 E−07	3 E−07	–	1 E+04	1 E+04	/St/St
Y-91m	–	2 E−05	2 E−05	–	7 E+05	7 E+05	/ET/ET
Y-91	–	1 E−07	9 E−08	–	4 E+03	3 E+03	/St/St
Y-92	–	2 E−06	2 E−06	–	7 E+04	7 E+04	/St/St
Y-93	–	9 E−07	9 E−07	–	3 E+04	3 E+04	/St/St
Y-94	–	8 E−06	8 E−06	–	3 E+05	3 E+05	/ET/ET
Y-95	–	1 E−05	1 E−05	–	4 E+05	4 E+05	/ET/ET
Zr-86	5 E−07	5 E−07	5 E−07	2 E+04	2 E+04	2 E+04	ET/ET/ET
Zr-88	1 E−07	3 E−07	3 E−07	5 E+03	1 E+04	1 E+04	St/St/St
Zr-89	6 E−07	6 E−07	6 E−07	2 E+04	2 E+04	2 E+04	ET/ET/ET
Zr-93	3 E−09	1 E−08	1 E−07	1 E+02	6 E+02	5 E+03	BS/BS/BS
Zr-95	9 E−08	1 E−07	1 E−07	3 E+03	5 E+03	4 E+03	BS/St/St
Zr-97	7 E−07	4 E−07	4 E−07	2 E+04	1 E+04	1 E+04	ET/St/St
Nb-88	–	5 E−06	5 E−06	–	1 E+05	1 E+05	/ET/ET
Nb-89 (66 min)	–	3 E−06	3 E−06	–	1 E+05	1 E+05	/ET/ET
Nb-89 (122 min).	–	2 E−06	2 E−06	–	1 E+05	1 E+05	/ET/ET
Nb-90	–	3 E−07	3 E−07	–	1 E+04	1 E+04	/ET/ET
Nb-93m	–	1 E−06	6 E−07	–	7 E+04	2 E+04	/St/St
Nb-94	–	7 E−08	2 E−08	–	2 E+03	8 E+02	/St/St
Nb-95m	–	7 E−07	6 E−07	–	2 E+04	2 E+04	/St/St
Nb-95	–	4 E−07	4 E−07	–	1 E+04	1 E+04	/St/St
Nb-96	–	4 E−07	4 E−07	–	1 E+04	1 E+04	/ET/ET
Nb-97	–	5 E−06	5 E−06	–	1 E+05	1 E+05	/ET/ET
Nb-98	–	3 E−06	3 E−06	–	1 E+05	1 E+05	/ET/ET
Mo-90	8 E−07	–	7 E−07	3 E+04	–	2 E+04	ET/ /ET
Mo-93m	1 E−06	–	1 E−06	3 E+04	–	3 E+04	ET/ /ET
Mo-93	2 E−07	–	4 E−07	7 E+03	–	1 E+04	BS/ /St
Mo-99	1 E−06	–	5 E−07	5 E+04	–	1 E+04	E/ /St
Mo-101	8 E−06	–	6 E−06	3 E+05	–	2 E+05	ET/ /ET
Tc-93m	8 E−06	7 E−06	–	3 E+05	2 E+05	–	ET/ET/
Tc-93	3 E−06	3 E−06	–	1 E+05	1 E+05	–	ET/ET/
Tc-94m	5 E−06	4 E−06	–	1 E+05	1 E+05	–	ET/ET/
Tc-94	1 E−06	1 E−06	–	4 E+04	3 E+04	–	ET/ET/
Tc-95m	8 E−07	6 E−07	–	3 E+04	2 E+04	–	ET/St/
Tc-95	1 E−06	1 E−06	–	5 E+04	5 E+04	–	ET/ET/
Tc-96m	2 E−05	2 E−05	–	1 E+06	1 E+06	–	ET/ET/
Tc-96	3 E−07	3 E−07	–	1 E+04	1 E+04	–	ET/ET/
Tc-97m	1 E−06	2 E−07	–	5 E+04	7 E+03	–	St/St/
Tc-97	4 E−06	3 E−06	–	1 E+05	1 E+05	–	ET/St/
Tc-98	3 E−07	9 E−08	–	1 E+04	3 E+03	–	St/St/
Tc-99m	1 E−05	1 E−05	–	5 E+05	4 E+05	–	ET/ET/
Tc-99	1 E−06	1 E−07	–	5 E+04	6 E+03	–	St/St/
Tc-101	1 E−05	1 E−05	–	6 E+05	4 E+05	–	ET/ET/
Tc-104	9 E−06	7 E−06	–	3 E+05	2 E+05	–	ET/ET/
Ru-94	5 E−06	5 E−06	5 E−06	2 E+05	1 E+05	1 E+05	ET/ET/ET

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Ru-97	2 E−06	2 E−06	2 E−06	8 E+04	8 E+04	8 E+04	ET/ET/ET
Ru-103	8 E−07	2 E−07	2 E−07	3 E+04	1 E+04	9 E+03	St/St/St
Ru-105	2 E−06	2 E−06	2 E−06	9 E+04	8 E+04	8 E+04	ET/ET/ET
Ru-106	5 E−08	3 E−08	1 E−08	2 E+03	1 E+03	5 E+02	St/St/St
Rh-99m	3 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Rh-99	8 E−07	6 E−07	6 E−07	3 E+04	2 E+04	2 E+04	ET/St/St
Rh-100	5 E−07	5 E−07	5 E−07	1 E+04	1 E+04	1 E+04	ET/ET/ET
Rh-101m	1 E−06	1 E−06	1 E−06	6 E+04	6 E+04	6 E+04	ET/ET/ET
Rh-101	3 E−07	3 E−07	1 E−07	1 E+04	1 E+04	6 E+03	St/St/St
Rh-102m	2 E−07	2 E−07	1 E−07	1 E+04	7 E+03	4 E+03	St/St/St
Rh-102	6 E−08	1 E−07	6 E−08	2 E+03	4 E+03	2 E+03	St/St/St
Rh-103m	4 E−04	2 E−04	2 E−04	1 E+07	8 E+06	8 E+06	St/St/St
Rh-105	3 E−06	1 E−06	1 E−06	1 E+05	5 E+04	4 E+04	ET/St/St
Rh-106m	1 E−06	1 E−06	1 E−06	6 E+04	5 E+04	5 E+04	ET/ET/ET
Rh-107	1 E−05	9 E−06	9 E−06	5 E+05	3 E+05	3 E+05	ET/ET/ET
Pd-100	5 E−07	5 E−07	5 E−07	2 E+04	2 E+04	2 E+04	ET/ET/ET
Pd-101	3 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Pd-103	4 E−06	1 E−06	1 E−06	1 E+05	6 E+04	7 E+04	E/St/St
Pd-107	1 E−05	1 E−05	1 E−06	5 E+05	4 E+05	7 E+04	K/St/St
Pd-109	2 E−06	1 E−06	1 E−06	9 E+04	4 E+04	4 E+04	St/St/St
Ag-102	9 E−06	7 E−06	7 E−06	3 E+05	2 E+05	2 E+05	ET/ET/ET
Ag-103	8 E−06	7 E−06	7 E−06	3 E+05	2 E+05	2 E+05	ET/ET/ET
Ag-104m	8 E−06	6 E−06	6 E−06	2 E+05	2 E+05	2 E+05	ET/ET/ET
Ag-104	3 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Ag-105	7 E−07	8 E−07	7 E−07	2 E+04	2 E+04	2 E+04	St/St/St
Ag-106m	2 E−07	2 E−07	2 E−07	9 E+03	9 E+03	9 E+03	ET/ET/ET
Ag-106	1 E−05	1 E−05	1 E−05	5 E+05	4 E+05	4 E+05	ET/ET/ET
Ag-108m	7 E−08	1 E−07	2 E−08	2 E+03	4 E+03	1 E+03	St/St/St
Ag-110m	8 E−08	9 E−08	7 E−08	3 E+03	3 E+03	2 E+03	St/St/St
Ag-111	9 E−07	3 E−07	3 E−07	3 E+04	1 E+04	1 E+04	St/St/St
Ag-112	4 E−06	2 E−06	2 E−06	1 E+05	8 E+04	8 E+04	E/St/St
Ag-115	1 E−05	8 E−06	8 E−06	4 E+05	3 E+05	3 E+05	ET/ET/ET
Cd-104	4 E−06	4 E−06	4 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Cd-107	5 E−06	5 E−06	4 E−06	2 E+05	1 E+05	1 E+05	ET/ET/ET
Cd-109	2 E−08	9 E−08	1 E−07	9 E+02	3 E+03	4 E+03	K/K/St
Cd-113m	1 E−09	6 E−09	1 E−08	6 E+01	2 E+02	6 E+02	K/K/K
Cd-113	1 E−09	5 E−09	1 E−08	5 E+01	2 E+02	5 E+02	K/K/K
Cd-115m	3 E−08	1 E−07	1 E−07	1 E+03	3 E+03	3 E+03	K/St/St
Cd-115	9 E−07	4 E−07	4 E−07	3 E+04	1 E+04	1 E+04	K/St/St
Cd-117m	1 E−06	1 E−06	1 E−06	4 E+04	4 E+04	4 E+04	ET/ET/ET
Cd-117	2 E−06	2 E−06	2 E−06	8 E+04	7 E+04	7 E+04	ET/ET/ET
In-109	4 E−06	4 E−06	–	1 E+05	1 E+05	–	ET/ET/
In-110 (69 min)	5 E−06	4 E−06	–	1 E+05	1 E+05	–	ET/ET/
In-110 (5 h)	9 E−07	9 E−07	–	3 E+04	3 E+04	–	ET/ET/
In-111	1 E−06	1 E−06	–	5 E+04	5 E+04	–	ET/ET/
In-112	2 E−05	1 E−05	–	9 E+05	6 E+05	–	ET/ET/
In-113m	1 E−05	1 E−05	–	4 E+05	3 E+05	–	ET/ET/
In-114m	5 E−08	9 E−08	–	1 E+03	3 E+03	–	St/St/
In-115m	6 E−06	5 E−06	–	2 E+05	2 E+05	–	ET/ET/
In-115	1 E−09	5 E−09	–	4 E+01	1 E+02	–	St/St/
In-116m	4 E−06	3 E−06	–	1 E+05	1 E+05	–	ET/ET/
In-117m	5 E−06	4 E−06	–	2 E+05	1 E+05	–	ET/ET/
In-117	7 E−06	5 E−06	–	2 E+05	2 E+05	–	ET/ET/
In-119m	1 E−05	1 E−05	–	6 E+05	4 E+05	–	ET/ET/
Sn-110	1 E−06	1 E−06	–	6 E+04	6 E+04	–	ET/ET/
Sn-111	1 E−05	1 E−05	–	6 E+05	5 E+05	–	ET/ET/
Sn-113	7 E−07	2 E−07	–	2 E+04	1 E+04	–	St/St/
Sn-117m	8 E−07	2 E−07	–	3 E+04	9 E+03	–	BS/St/
Sn-119m	1 E−06	3 E−07	–	5 E+04	1 E+04	–	St/St/
Sn-121m	5 E−07	1 E−07	–	2 E+04	6 E+03	–	St/St/
Sn-121	4 E−06	2 E−06	–	1 E+05	7 E+04	–	ET/St/
Sn-123m	1 E−05	7 E−06	–	4 E+05	2 E+05	–	ET/ET/
Sn-123	3 E−07	1 E−07	–	1 E+04	3 E+03	–	St/St/
Sn-125	4 E−07	2 E−07	–	1 E+04	7 E+03	–	St/St/
Sn-126	4 E−08	3 E−08	–	1 E+03	1 E+03	–	St/St/
Sn-127	2 E−06	2 E−06	–	9 E+04	7 E+04	–	ET/ET/
Sn-128	2 E−06	2 E−06	–	1 E+05	8 E+04	–	ET/ET/
Sb-115	1 E−05	1 E−05	–	5 E+05	4 E+05	–	ET/ET/
Sb-116m	3 E−06	2 E−06	–	1 E+05	1 E+05	–	ET/ET/
Sb-116	1 E−05	1 E−05	–	4 E+05	3 E+05	–	ET/ET/
Sb-117	1 E−05	1 E−05	–	4 E+05	3 E+05	–	ET/ET/

Radionuclide	Absorption type 3			Absorption type 3			Stochastic or organ or tissue 1
	μCi/mL			Bq/m 3			
	F	M	S	F	M	S	(F/M/S)
Sb-118m	1 E−06	1 E−06	–	4 E+04	4 E+04	–	ET/ET/
Sb-119	6 E−06	6 E−06	–	2 E+05	2 E+05	–	ET/ET/
Sb-120 (16 min).	2 E−05	2 E−05	–	1 E+06	7 E+05	–	ET/ET/
Sb-120 (6 d)	3 E−07	3 E−07	–	1 E+04	1 E+04	–	ET/ET/
Sb-122	8 E−07	4 E−07	–	3 E+04	1 E+04	–	St/St/
Sb-124m	4 E−05	3 E−05	–	1 E+06	1 E+06	–	ET/ET/
Sb-124	2 E−07	1 E−07	–	1 E+04	4 E+03	–	St/St/
Sb-125	2 E−07	1 E−07	–	7 E+03	6 E+03	–	BS/St/
Sb-126m	1 E−05	7 E−06	–	3 E+05	2 E+05	–	ET/ET/
Sb-126	2 E−07	1 E−07	–	9 E+03	6 E+03	–	ET/St/
Sb-127	7 E−07	3 E−07	–	2 E+04	1 E+04	–	E/St/
Sb-128 (9 h)	5 E−07	5 E−07	–	2 E+04	2 E+04	–	ET/ET/
Sb-128 (10 min).	1 E−05	9 E−06	–	4 E+05	3 E+05	–	ET/ET/
Sb-129	1 E−06	1 E−06	–	6 E+04	5 E+04	–	ET/ET/
Sb-130	3 E−06	2 E−06	–	1 E+05	1 E+05	–	ET/ET/
Sb-131	6 E−06	4 E−06	–	2 E+05	1 E+05	–	ET/ET/
Te-116 (Vapor)	–	6 E−06	–	–	2 E+05	–	/St /
Te-116	2 E−06	2 E−06	–	8 E+04	7 E+04	–	ET/ET/
Te-121m (Vapor).	–	4 E−08	–	–	1 E+03	–	/BS/
Te-121m	1 E−07	1 E−07	–	4 E+03	5 E+03	–	BS/St/
Te-121 (Vapor)	–	1 E−06	–	–	4 E+04	–	/St /
Te-121	1 E−06	1 E−06	–	3 E+04	3 E+04	–	ET/ET/
Te-123m (Vapor).	–	5 E−08	–	–	2 E+03	–	/BS/
Te-123m	1 E−07	1 E−07	–	4 E+03	6 E+03	–	BS/St/
Te-123 (Vapor)	–	1 E−08	–	–	4 E+02	–	/BS/
Te-123	2 E−08	5 E−08	–	1 E+03	1 E+03	–	BS/BS/
Te-125m (Vapor).	–	1 E−07	–	–	3 E+03	–	/BS/
Te-125m	2 E−07	1 E−07	–	9 E+03	7 E+03	–	BS/St/
Te-127m (Vapor).	–	6 E−08	–	–	2 E+03	–	/BS/
Te-127m	1 E−07	9 E−08	–	5 E+03	3 E+03	–	BS/St/
Te-127 (Vapor)	–	7 E−06	–	–	2 E+05	–	/St/
Te-127	5 E−06	3 E−06	–	2 E+05	1 E+05	–	ET/St/
Te-129m (Vapor).	–	1 E−07	–	–	5 E+03	–	/St/
Te-129m	3 E−07	1 E−07	–	1 E+04	3 E+03	–	St/St/
Te-129 (Vapor)	–	1 E−05	–	–	5 E+05	–	/St/
Te-129	1 E−05	7 E−06	–	4 E+05	2 E+05	–	ET/ET/
Te-131m (Vapor).	–	1 E−07	–	–	5 E+03	–	/T/
Te-131m	3 E−07	3 E−07	–	1 E+04	1 E+04	–	T/St/
Te-131 (Vapor)	–	6 E−06	–	–	2 E+05	–	/T/
Te-131	1 E−05	7 E−06	–	4 E+05	2 E+05	–	ET/ET/
Te-132 (Vapor)	–	7 E−08	–	–	2 E+03	–	/T/
Te-132	1 E−07	1 E−07	–	6 E+03	6 E+03	–	T/St/
Te-133m (Vapor).	–	1 E−06	–	–	6 E+04	–	/T/
Te-133m	3 E−06	2 E−06	–	1 E+05	1 E+05	–	T/ET/
Te-133 (Vapor)	–	7 E−06	–	–	2 E+05	–	/T/
Te-133	1 E−05	9 E−06	–	4 E+05	3 E+05	–	ET/ET/
Te-134 (Vapor)	–	6 E−06	–	–	2 E+05	–	/St/
Te-134	3 E−06	2 E−06	–	1 E+05	1 E+05	–	ET/ET/
I-120m (Methyl).	4 E−06	–	–	1 E+05	–	–	T/ /
I-120m (Vapor)	–	3 E−06	–	–	1 E+05	–	/St /
I-120m	2 E−06	–	–	8 E+04	–	–	ET/ /
I-120 (Methyl)	1 E−06	–	–	6 E+04	–	–	T/ /
I-120 (Vapor)	–	1 E−06	–	–	5 E+04	–	/T/
I-120	2 E−06	–	–	1 E+05	–	–	E/ /
I-121 (Methyl)	5 E−06	–	–	2 E+05	–	–	T/ /
I-121 (Vapor)	–	4 E−06	–	–	1 E+05	–	/T/
I-121	8 E−06	–	–	3 E+05	–	–	T/ /
I-123 (Methyl)	1 E−06	–	–	7 E+04	–	–	T/ /
I-123 (Vapor)	–	1 E−06	–	–	5 E+04	–	/T/
I-123	2 E−06	–	–	1 E+05	–	–	T/ /
I-124 (Methyl)	3 E−08	–	–	1 E+03	–	–	T/ /

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
I-124 (Vapor) ..	–	2 E−08	–	–	9 E+02	–	/T/
I-124	4 E−08	–	–	1 E+03	–	–	T/ /
I-125 (Methyl)	2 E−08	–	–	9 E+02	–	–	T/ /
I-125 (Vapor) ..	–	2 E−08	–	–	7 E+02	–	/T/
I-125	3 E−08	–	–	1 E+03	–	–	T/ /
I-126 (Methyl)	1 E−08	–	–	5 E+02	–	–	T/ /
I-126 (Vapor) ..	–	1 E−08	–	–	4 E+02	–	/T/
I-126	2 E−08	–	–	7 E+02	–	–	T/ /
I-128 (Methyl)	3 E−05	–	–	1 E+06	–	–	T/ /
I-128 (Vapor) ..	–	8 E−06	–	–	3 E+05	–	/St/
I-128	1 E−05	–	–	6 E+05	–	–	ET/ /
I-129 (Methyl)	3 E−09	–	–	1 E+02	–	–	T/ /
I-129 (Vapor) ..	–	2 E−09	–	–	1 E+02	–	/T/
I-129	5 E−09	–	–	2 E+02	–	–	T/ /
I-130 (Methyl)	2 E−07	–	–	7 E+03	–	–	T/ /
I-130 (Vapor) ..	–	1 E−07	–	–	6 E+03	–	/T/
I-130	3 E−07	–	–	1 E+04	–	–	T/ /
I-131 (Methyl)	1 E−08	–	–	6 E+02	–	–	T/ /
I-131 (Vapor) ..	–	1 E−08	–	–	5 E+02	–	/T/
I-131	2 E−08	–	–	9 E+02	–	–	T/ /
I-132m (Methyl).	1 E−06	–	–	7 E+04	–	–	T/ /
I-132m (Vapor)	–	1 E−06	–	–	6 E+04	–	/T/
I-132m	3 E−06	–	–	1 E+05	–	–	T/ /
I-132 (Methyl)	1 E−06	–	–	6 E+04	–	–	T/ /
I-132 (Vapor) ..	–	1 E−06	–	–	5 E+04	–	/T/
I-132	2 E−06	–	–	7 E+04	–	–	T/ /
I-133 (Methyl)	9 E−08	–	–	3 E+03	–	–	T/ /
I-133 (Vapor) ..	–	7 E−08	–	–	2 E+03	–	/T/
I-133	1 E−07	–	–	5 E+03	–	–	T/ /
I-134 (Methyl)	8 E−06	–	–	2 E+05	–	–	T/ /
I-134 (Vapor) ..	–	3 E−06	–	–	1 E+05	–	/St/
I-134	3 E−06	–	–	1 E+05	–	–	ET/ /
I-135 (Methyl)	4 E−07	–	–	1 E+04	–	–	T/ /
I-135 (Vapor) ..	–	3 E−07	–	–	1 E+04	–	/T/
I-135	6 E−07	–	–	2 E+04	–	–	T/ /
Cs-125	1 E−05	–	–	4 E+05	–	–	ET/ /
Cs-127	4 E−06	–	–	1 E+05	–	–	ET/ /
Cs-129	2 E−06	–	–	9 E+04	–	–	ET/ /
Cs-130	1 E−05	–	–	6 E+05	–	–	ET/ /
Cs-131	7 E−06	–	–	2 E+05	–	–	ET/ /
Cs-132	9 E−07	–	–	3 E+04	–	–	ET/ /
Cs-134m	8 E−06	–	–	2 E+05	–	–	ET/ /
Cs-134	5 E−08	–	–	2 E+03	–	–	St/ /
Cs-135m	8 E−06	–	–	2 E+05	–	–	ET/ /
Cs-135	5 E−07	–	–	2 E+04	–	–	St/ /
Cs-136	2 E−07	–	–	1 E+04	–	–	E/ /
Cs-137	8 E−08	–	–	3 E+03	–	–	St/ /
Cs-138	5 E−06	–	–	2 E+05	–	–	ET/ /
Ba-126	4 E−06	–	–	1 E+05	–	–	ET/ /
Ba-128	4 E−07	–	–	1 E+04	–	–	St/ /
Ba-131m	4 E−05	–	–	1 E+06	–	–	ET/ /
Ba-131	1 E−06	–	–	4 E+04	–	–	ET/ /
Ba-133m	2 E−06	–	–	7 E+04	–	–	St/ /
Ba-133	3 E−07	–	–	1 E+04	–	–	St/ /
Ba-135m	2 E−06	–	–	9 E+04	–	–	St/ /
Ba-139	1 E−05	–	–	3 E+05	–	–	St/ /
Ba-140	3 E−07	–	–	1 E+04	–	–	St/ /
Ba-141	1 E−05	–	–	4 E+05	–	–	ET/ /
Ba-142	9 E−06	–	–	3 E+05	–	–	ET/ /
La-131	1 E−05	8 E−06	–	4 E+05	3 E+05	–	ET/ET/
La-132	1 E−06	1 E−06	–	5 E+04	5 E+04	–	ET/ET/
La-135	1 E−05	1 E−05	–	4 E+05	4 E+05	–	ET/ET/
La-137	4 E−08	2 E−07	–	1 E+03	8 E+03	–	L/L/
La-138	3 E−09	1 E−08	–	1 E+02	4 E+02	–	St/St/
La-140	4 E−07	3 E−07	–	1 E+04	1 E+04	–	ET/St/
La-141	5 E−06	2 E−06	–	1 E+05	9 E+04	–	St/St/
La-142	2 E−06	2 E−06	–	9 E+04	8 E+04	–	ET/ET/
La-143	1 E−05	1 E−05	–	6 E+05	4 E+05	–	ET/ET/
Ce-134	–	3 E−07	3 E−07	–	1 E+04	1 E+04	/St/St
Ce-135	–	5 E−07	5 E−07	–	2 E+04	2 E+04	/ET/ET

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Ce-137m	–	1 E−06	9 E−07	–	3 E+04	3 E+04	/St/St
Ce-137	–	1 E−05	1 E−05	–	7 E+05	7 E+05	/ET/ET
Ce-139	–	4 E−07	4 E−07	–	1 E+04	1 E+04	/St/St
Ce-141	–	2 E−07	1 E−07	–	7 E+03	6 E+03	/St/St
Ce-143	–	5 E−07	5 E−07	–	2 E+04	2 E+04	/St/St
Ce-144	–	2 E−08	1 E−08	–	9 E+02	7 E+02	/St/St
Pr-136	–	1 E−05	1 E−05	–	3 E+05	3 E+05	/ET/ET
Pr-137	–	9 E−06	9 E−06	–	3 E+05	3 E+05	/ET/ET
Pr-138m	–	2 E−06	2 E−06	–	7 E+04	7 E+04	/ET/ET
Pr-139	–	1 E−05	1 E−05	–	5 E+05	5 E+05	/ET/ET
Pr-142m	–	6 E−05	5 E−05	–	2 E+06	2 E+06	/St/St
Pr-142	–	8 E−07	7 E−07	–	2 E+04	2 E+04	/St/St
Pr-143	–	2 E−07	2 E−07	–	1 E+04	9 E+03	/St/St
Pr-144	–	1 E−05	1 E−05	–	4 E+05	4 E+05	/ET/ET
Pr-145	–	2 E−06	2 E−06	–	8 E+04	8 E+04	/St/St
Pr-147	–	9 E−06	9 E−06	–	3 E+05	3 E+05	/ET/ET
Nd-136	–	4 E−06	4 E−06	–	1 E+05	1 E+05	/ET/ET
Nd-138	–	1 E−06	1 E−06	–	5 E+04	5 E+04	/St/St
Nd-139m	–	1 E−06	1 E−06	–	5 E+04	5 E+04	/ET/ET
Nd-139	–	1 E−05	1 E−05	–	6 E+05	6 E+05	/ET/ET
Nd-141	–	3 E−05	3 E−05	–	1 E+06	1 E+06	/ET/ET
Nd-147	–	2 E−07	2 E−07	–	1 E+04	9 E+03	/St/St
Nd-149	–	4 E−06	4 E−06	–	1 E+05	1 E+05	/ET/ET
Nd-151	–	9 E−06	9 E−06	–	3 E+05	3 E+05	/ET/ET
Pm-141	–	1 E−05	1 E−05	–	4 E+05	4 E+05	/ET/ET
Pm-143	–	5 E−07	6 E−07	–	2 E+04	2 E+04	/St/St
Pm-144	–	1 E−07	1 E−07	–	3 E+03	5 E+03	/St/St
Pm-145	–	1 E−07	4 E−07	–	5 E+03	1 E+04	/BS/St
Pm-146	–	4 E−08	6 E−08	–	1 E+03	2 E+03	/St/St
Pm-147	–	1 E−07	1 E−07	–	4 E+03	6 E+03	/BS/St
Pm-148m	–	1 E−07	1 E−07	–	5 E+03	4 E+03	/St/St
Pm-148	–	2 E−07	2 E−07	–	9 E+03	9 E+03	/St/St
Pm-149	–	7 E−07	6 E−07	–	2 E+04	2 E+04	/St/St
Pm-150	–	2 E−06	2 E−06	–	8 E+04	8 E+04	/ET/ET
Pm-151	–	9 E−07	8 E−07	–	3 E+04	3 E+04	/St/St
Sm-141m	–	5 E−06	–	–	2 E+05	–	/ET/
Sm-141	–	1 E−05	–	–	4 E+05	–	/ET/
Sm-142	–	4 E−06	–	–	1 E+05	–	/ET/
Sm-145	–	4 E−07	–	–	1 E+04	–	/BS/
Sm-146	–	2 E−11	–	–	1 E+00	–	/BS/
Sm-147	–	2 E−11	–	–	1 E+00	–	/BS/
Sm-151	–	7 E−08	–	–	2 E+03	–	/BS/
Sm-153	–	8 E−07	–	–	3 E+04	–	/St/
Sm-155	–	1 E−05	–	–	3 E+05	–	/ET/
Sm-156	–	2 E−06	–	–	7 E+04	–	/St/
Eu-145	–	5 E−07	–	–	2 E+04	–	/ET/
Eu-146	–	3 E−07	–	–	1 E+04	–	/ET/
Eu-147	–	5 E−07	–	–	2 E+04	–	/St/
Eu-148	–	2 E−07	–	–	9 E+03	–	/St/
Eu-149	–	2 E−06	–	–	9 E+04	–	/St/
Eu-150 (12 h)	–	2 E−06	–	–	7 E+04	–	/St/
Eu-150 (34 yr)	–	1 E−08	–	–	6 E+02	–	/St/
Eu-152m	–	1 E−06	–	–	6 E+04	–	/St/
Eu-152	–	2 E−08	–	–	7 E+02	–	/St/
Eu-154	–	1 E−08	–	–	5 E+02	–	/St/
Eu-155	–	7 E−08	–	–	2 E+03	–	/BS/
Eu-156	–	1 E−07	–	–	6 E+03	–	/St/
Eu-157	–	1 E−06	–	–	4 E+04	–	/St/
Eu-158	–	5 E−6	–	–	1 E+05	–	/ET/
Gd-145	9 E−06	7 E−06	–	3 E+05	2 E+05	–	ET/ET/
Gd-146	1 E−07	1 E−07	–	4 E+03	4 E+03	–	St/St/
Gd-147	7 E−07	6 E−07	–	2 E+04	2 E+04	–	ET/ET/
Gd-148	5 E−12	2 E−11	–	2 E−01	9 E−01	–	BS/BS/
Gd-149	1 E−06	7 E−07	–	4 E+04	2 E+04	–	St/St/
Gd-151	2 E−07	8 E−07	–	9 E+03	3 E+04	–	BS/St/
Gd-152	7 E−12	3 E−11	–	2 E−01	1 E+00	–	BS/BS/
Gd-153	9 E−08	4 E−07	–	3 E+03	1 E+04	–	BS/St/
Gd-159	3 E−06	1 E−06	–	1 E+05	5 E+04	–	St/St/
Tb-147	–	2 E−06	–	–	1 E+05	–	/ET/
Tb-149	–	1 E−07	–	–	6 E+03	–	/St/
Tb-150	–	2 E−06	–	–	8 E+04	–	/ET/

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Tb-151	–	1 E−06	–	–	4 E+04	–	/ET/
Tb-153	–	2 E−06	–	–	8 E+04	–	/St/
Tb-154	–	5 E−07	–	–	2 E+04	–	/ET/
Tb-155	–	2 E−06	–	–	8 E+04	–	/St/
Tb-156m (24 h)	–	2 E−06	–	–	9 E+04	–	/St/
Tb-156m (5 h)	–	4 E−06	–	–	1 E+05	–	/St/
Tb-156	–	4 E−07	–	–	1 E+04	–	/E/
Tb-157	–	2 E−07	–	–	8 E+03	–	/BS/
Tb-158	–	1 E−08	–	–	6 E+02	–	/BS/
Tb-160	–	1 E−07	–	–	3 E+03	–	/St/
Tb-161	–	4 E−07	–	–	1 E+04	–	/St/
Dy-155	–	2 E−06	–	–	1 E+05	–	/ET/
Dy-157	–	5 E−06	–	–	1 E+05	–	/ET/
Dy-159	–	2 E−06	–	–	8 E+04	–	/BS/
Dy-165	–	6 E−06	–	–	2 E+05	–	/ET/
Dy-166	–	3 E−07	–	–	1 E+04	–	/St/
Ho-155	–	1 E−05	–	–	4 E+05	–	/ET/
Ho-157	–	2 E−05	–	–	1 E+06	–	/ET/
Ho-159	–	2 E−05	–	–	9 E+05	–	/ET/
Ho-161	–	3 E−05	–	–	1 E+06	–	/ET/
Ho-162m	–	9 E−06	–	–	3 E+05	–	/ET/
Ho-162	–	5 E−05	–	–	2 E+06	–	/ET/
Ho-164m	–	3 E−05	–	–	1 E+06	–	/St/
Ho-164	–	2 E−05	–	–	8 E+05	–	/ET/
Ho-166m	–	7 E−09	–	–	2 E+02	–	/St/
Ho-166	–	6 E−07	–	–	2 E+04	–	/St/
Ho-167	–	4 E−06	–	–	1 E+05	–	/ET/
Er-161	–	3 E−06	–	–	1 E+05	–	/ET/
Er-165	–	2 E−05	–	–	1 E+06	–	/ET/
Er-169	–	6 E−07	–	–	2 E+04	–	/St/
Er-171	–	1 E−06	–	–	6 E+04	–	/St/
Er-172	–	4 E−07	–	–	1 E+04	–	/St/
Tm-162	–	9 E−06	–	–	3E+05	–	/ET/
Tm-166	–	1 E−06	–	–	4 E+04	–	/ET/
Tm-167	–	5 E−07	–	–	2 E+04	–	/St/
Tm-170	–	1 E−07	–	–	4 E+03	–	/St/
Tm-171	–	2 E−07	–	–	9 E+03	–	/BS/
Tm-172	–	4 E−07	–	–	1 E+04	–	/St/
Tm-173	–	2 E−06	–	–	8 E+04	–	/St/
Tm-175	–	8 E−06	–	–	2 E+05	–	/ET/
Yb-162	–	1 E−05	1 E−05	–	5 E+05	5 E+05	/ET/ET
Yb-166	–	6 E−07	5 E−07	–	2 E+04	2 E+04	/St/St
Yb-167	–	3 E−05	3 E−05	–	1 E+06	1 E+06	/ET/ET
Yb-169	–	2 E−07	2 E−07	–	9 E+03	8 E+03	/St/St
Yb-175	–	8 E−07	8 E−07	–	3 E+04	2 E+04	/St/St
Yb-177	–	6 E−06	5 E−06	–	2 E+05	2 E+05	/ET/ET
Yb-178	–	5 E−06	5 E−06	–	1 E+05	1 E+05	/ET/E
Lu-169	–	9 E−07	9 E−07	–	3 E+04	3 E+04	/ET/ET
Lu-170	–	4 E−07	4 E−07	–	1 E+04	1 E+04	/ET/ET
Lu-171	–	6 E−07	6 E−07	–	2 E+04	2 E+04	/St/St
Lu-172	–	3 E−07	3 E−07	–	1 E+04	1 E+04	/St/St
Lu-173	–	2 E−07	4 E−07	–	8 E+03	1 E+04	/BS/St
Lu-174m	–	2 E−07	2 E−07	–	7 E+03	8 E+03	/BS/St
Lu-174	–	9 E−08	2 E−07	–	3 E+03	8 E+03	/BS/St
Lu-176m	–	3 E−06	3 E−06	–	1 E+05	1 E+05	/St/St
Lu-176	–	3 E−09	1 E−08	–	1 E+02	6 E+02	/BS/St
Lu-177m	–	5 E−08	4 E−08	–	2 E+03	1 E+03	/St/St
Lu-177	–	5 E−07	5 E−07	–	2 E+04	1 E+04	/St/St
Lu-178m	–	4 E−06	4 E−06	–	1 E+05	1 E+05	/ET/ET
Lu-178	–	8 E−06	8 E−06	–	3 E+05	3 E+05	/ET/ET
Lu-179	–	3 E−06	3 E−06	–	1 E+05	1 E+05	/St/St
Hf-170	1 E−06	1 E−06	–	4 E+04	4 E+04	–	ET/ET/
Hf-172	6 E−09	3 E−08	–	2 E+02	1 E+03	–	BS/BS/
Hf-173	2 E−06	2 E−06	–	9 E+04	8 E+04	–	ET/ET/
Hf-175	5 E−07	6 E−07	–	2 E+04	2 E+04	–	BS/St/
Hf-177m	2 E−06	1 E−06	–	9 E+04	6 E+04	–	ET/ET/
Hf-178m	8 E−10	4 E−09	–	3 E+01	1 E+02	–	BS/BS/
Hf-179m	2 E−07	1 E−07	–	8 E+03	6 E+03	–	BS/St/
Hf-180m	2 E−06	1 E−06	–	7 E+04	6 E+04	–	ET/ET/
Hf-181	1 E−07	1 E−07	–	4 E+03	5 E+03	–	BS/St/
Hf-182m	5 E−06	4 E−06	–	2 E+05	1 E+05	–	ET/ET/

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Hf-182	5 E−10	2 E−09	–	2 E+01	9 E+01	–	BS/BS/
Hf-183	6 E−06	4 E−06	–	2 E+05	1 E+05	–	ET/ET/
Hf-184	1 E−06	1 E−06	–	5 E+04	4 E+04	–	ET/St/
Ta-172	–	5 E−06	5 E−06	–	1 E+05	1 E+05	/ET/ET
Ta-173	–	3 E−06	3 E−06	–	1 E+05	1 E+05	/E/E
Ta-174	–	5 E−06	5 E−06	–	2 E+05	2 E+05	/ET/ET
Ta-175	–	1 E−06	1 E−06	–	6 E+04	6 E+04	/ET/ET
Ta-176	–	1 E−06	1 E−06	–	3 E+04	3 E+04	/ET/ET
Ta-177	–	4 E−06	4 E−06	–	1 E+05	1 E+05	/St/St
Ta-178	–	3 E−06	3 E−06	–	1 E+05	1 E+05	/ET/ET
Ta-179	–	4 E−06	1 E−06	–	1 E+05	7 E+04	/St/St
Ta-180m	–	9 E−06	9 E−06	–	3 E+05	3 E+05	/St/St
Ta-180	–	1 E−07	4 E−08	–	4 E+03	1 E+03	/St/St
Ta-182m	–	6 E−06	6 E−06	–	2 E+05	2 E+05	/ET/ET
Ta-182	–	9 E−08	7 E−08	–	3 E+03	2 E+03	/St/St
Ta-183	–	3 E−07	2 E−07	–	1 E+04	1 E+04	/St/St
Ta-184	–	8 E−07	8 E−07	–	3 E+04	3 E+04	/ET/ET
Ta-185	–	5 E−06	5 E−06	–	2 E+05	1 E+05	/ET/ET
Ta-186	–	7 E−06	7 E−06	–	2 E+05	2 E+05	/ET/ET
W-176	3 E−06	–	–	1 E+05	–	–	ET/ /
W-177	5 E−06	–	–	2 E+05	–	–	ET/ /
W-178	3 E−06	–	–	1 E+05	–	–	ET/ /
W-179	1 E−04	–	–	5 E+06	–	–	ET/ /
W-181	1 E−05	–	–	4 E+05	–	–	ET/ /
W-185	2 E−06	–	–	9 E+04	–	–	St/ /
W-187	1 E−06	–	–	5 E+04	–	–	ET/ /
W-188	6 E−07	–	–	2 E+04	–	–	St/ /
Re-177	1 E−05	1 E−05	–	6 E+05	4 E+05	–	ET/ET/
Re-178	1 E−05	1 E−05	–	5 E+05	3 E+05	–	ET/ET/
Re-181	1 E−06	1 E−06	–	5 E+04	4 E+04	–	ET/ET/
Re-182 (64 h)	4 E−07	3 E−07	–	1 E+04	1 E+04	–	ET/St/
Re-182 (12 h)	1 E−06	1 E−06	–	4 E+04	4 E+04	–	ET/ET/
Re-184m	6 E−07	1 E−07	–	2 E+04	4 E+03	–	St/St/
Re-184	7 E−07	3 E−07	–	2 E+04	1 E+04	–	ET/St/
Re-186m	4 E−7	7 E−08	–	1 E+04	2 E+03	–	St/St/
Re-186	7 E−07	4 E−07	–	2 E+04	1 E+04	–	St/St/
Re-187	2 E−04	1 E−04	–	8 E+06	4 E+06	–	St/St/
Re-188m	3 E−05	2 E−05	–	1 E+06	1 E+06	–	St/St/
Re-188	8 E−07	7 E−07	–	3 E+04	2 E+04	–	St/St/
Re-189	1 E−06	9 E−07	–	4 E+04	3 E+04	–	St/St/
Os-180	1 E−05	1 E−05	1 E−05	5 E+05	3 E+05	3 E+05	ET/ET/ET
Os-181	3 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Os-182	1 E−06	9 E−07	9 E−07	3 E+04	3 E+04	3 E+04	ET/ET/ET
Os-185	4 E−07	5 E−07	5 E−07	1 E+04	2 E+04	1 E+04	St/St/St
Os-189m	1 E−04	7 E−05	7 E−05	4 E+06	2 E+06	2 E+06	St/St/St
Os-191m	1 E−05	4 E−06	4 E−06	5 E+05	1 E+05	1 E+05	St/St/St
Os-191	1 E−06	4 E−07	3 E−07	5 E+04	1 E+04	1 E+04	St/St/St
Os-193	2 E−06	8 E−07	8 E−07	7 E+04	3 E+04	3 E+04	St/St/St
Os-194	4 E−08	4 E−08	1 E−08	1 E+03	1 E+03	4 E+02	St/St/St
Ir-182	9 E−06	7 E−06	7 E−06	3 E+05	2 E+05	2 E+05	ET/ET/ET
Ir-184	1 E−06	1 E−06	1 E−06	7 E+04	6 E+04	7 E+04	ET/ET/ET
Ir-185	2 E−06	1 E−06	1 E−06	7 E+04	7 E+04	7 E+04	ET/ET/ET
Ir-186 (16 h)	8 E−07	7 E−07	7 E−07	2 E+04	2 E+04	2 E+04	ET/ET/ET
Ir-186 (2 h)	5 E−06	4 E−06	4 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Ir-187	4 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/ET/ET
Ir-188	6 E−07	6 E−07	6 E−07	2 E+04	2 E+04	2 E+04	ET/ET/ET
Ir-189	3 E−06	1 E−06	1 E−06	1 E+05	5 E+04	4 E+04	St/St/St
Ir-190m (3 h)	2 E−06	2 E−06	2 E−06	8 E+04	8 E+04	7 E+04	ET/ET/ET
Ir-190m (1 h)	9 E−05	5 E−05	5 E−05	3 E+06	2 E+06	1 E+06	ET/St/St
Ir-190	4 E−07	2 E−07	2 E−07	1 E+04	9 E+03	8 E+03	ET/St/St
Ir-192m	1 E−07	1 E−07	2 E−08	3 E+03	6 E+03	1 E+03	St/St/St
Ir-192	2 E−07	1 E−07	1 E−07	9 E+03	5 E+03	4 E+03	St/St/St
Ir-194m	8 E−08	8 E−08	6 E−08	3 E+03	3 E+03	2 E+03	St/St/St
Ir-194	1 E−06	7 E−07	7 E−07	5 E+04	2 E+04	2 E+04	St/St/St
Ir-195m	2 E−06	2 E−06	2 E−06	9 E+04	7 E+04	7 E+04	ET/ET/ET
Ir-195	7 E−06	5 E−06	4 E−06	2 E+05	1 E+05	1 E+05	ET/ET/ET
Pt-186	3 E−06	–	–	1 E+05	–	–	ET/ /
Pt-188	8 E−07	–	–	3 E+04	–	–	E/ /
Pt-189	3 E−06	–	–	1 E+05	–	–	ET/ /
Pt-191	1 E−06	–	–	7 E+04	–	–	ET/ /
Pt-193m	2 E−06	–	–	8 E+04	–	–	ET/ /

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Pt-193	2 E−05	–	–	7 E+05	–	–	ET/ /
Pt-195m	1 E−06	–	–	5 E+04	–	–	ET/ /
Pt-197m	7 E−06	–	–	2 E+05	–	–	ET/ /
Pt-197	3 E−06	–	–	1 E+05	–	–	ET/ /
Pt-199	1 E−05	–	–	4 E+05	–	–	ET/ /
Pt-200	1 E−06	–	–	5 E+04	–	–	St/ /
Au-193	4 E−06	3 E−06	3 E−06	1 E+05	1 E+05	1 E+05	ET/E/St
Au-194	9 E−07	9 E−07	9 E−07	3 E+04	3 E+04	3 E+04	ET/ET/ET
Au-195	3 E−06	7 E−07	4 E−07	1 E+05	2 E+04	1 E+04	ET/St/St
Au-198m	6 E−07	2 E−07	2 E−07	2 E+04	1 E+04	1 E+04	ET/St/St
Au-198	1 E−06	5 E−07	5 E−07	4 E+04	2 E+04	1 E+04	ET/St/St
Au-199	2 E−06	8 E−07	7 E−07	7 E+04	3 E+04	2 E+04	ET/St/St
Au-200m	5 E−07	4 E−07	4 E−07	1 E+04	1 E+04	1 E+04	ET/ET/ET
Au-200	1 E−05	7 E−06	7 E−06	4 E+05	2 E+05	2 E+05	ET/ET/ET
Au-201	1 E−05	1 E−05	9 E−06	5 E+05	3 E+05	3 E+05	ET/ET/ET
Hg-193m (Org)	1 E−06	–	–	4 E+04	–	–	ET/ /
Hg-193m	1 E−06	1 E−06	–	4 E+04	4 E+04	–	ET/ET/
Hg-193m (Vapor).	–	1 E−07	–	–	6 E+03	–	/St/
Hg-193 (Org)	5 E−06	–	–	1 E+05	–	–	ET/ /
Hg-193	5 E−06	4 E−06	–	1 E+05	1 E+05	–	ET/ET/
Hg-193 (Vapor)	–	5 E−07	–	–	1 E+04	–	/St/
Hg-194 (Org)	2 E−08	–	–	1 E+03	–	–	St/ /
Hg-194	3 E−08	1 E−07	–	1 E+03	3 E+03	–	St/St/
Hg-194 (Vapor)	–	1 E−08	–	–	5 E+02	–	/St/
Hg-195m (Org)	1 E−06	–	–	5 E+04	–	–	ET/ /
Hg-195m	1 E−06	8 E−07	–	5 E+04	3 E+04	–	ET/St/
Hg-195m (Vapor).	–	6 E−08	–	–	2 E+03	–	/St/
Hg-195 (Org)	6 E−06	–	–	2 E+05	–	–	ET/ /
Hg-195	6 E−06	6 E−06	–	2 E+05	2 E+05	–	ET/ET/
Hg-195 (Vapor)	–	4 E−07	–	–	1 E+04	–	/St/
Hg-197m (Org)	1 E−06	–	–	5 E+04	–	–	ET/ /
Hg-197m	1 E−06	8 E−07	–	5 E+04	3 E+04	–	ET/St/
Hg-197m (Vapor).	–	9 E−08	–	–	3 E+03	–	/St/
Hg-197 (Org)	4 E−06	–	–	1 E+05	–	–	ET/ /
Hg-197	4 E−06	2 E−06	–	1 E+05	7 E+04	–	ET/St/
Hg-197 (Vapor)	–	1 E−07	–	–	4 E+03	–	/St/
Hg-199m (Org)	8 E−06	–	–	3 E+05	–	–	ET/ /
Hg-199m	8 E−06	5 E−06	–	3 E+05	1 E+05	–	ET/ET/
Hg-199m (Vapor).	–	3 E−06	–	–	1 E+05	–	/St/
Hg-203 (Org)	7 E−07	–	–	2 E+04	–	–	St/ /
Hg-203	9 E−07	2 E−07	–	3 E+04	1 E+04	–	St/St/
Hg-203 (Vapor)	–	8 E−08	–	–	2 E+03	–	/St/
Tl-194m	5 E−06	–	–	2 E+05	–	–	ET/ /
Tl-194	2 E−05	–	–	8 E+05	–	–	ET/ /
Tl-195	6 E−06	–	–	2 E+05	–	–	ET/ /
Tl-197	8 E−06	–	–	2 E+05	–	–	ET/ /
Tl-198m	2 E−06	–	–	9 E+04	–	–	ET/ /
Tl-198	1 E−06	–	–	5 E+04	–	–	ET/ /
Tl-199	5 E−06	–	–	2 E+05	–	–	ET/ /
Tl-200	8 E−07	–	–	3 E+04	–	–	ET/ /
Tl-201	4 E−06	–	–	1 E+05	–	–	ET/ /
Tl-202	1 E−06	–	–	5 E+04	–	–	ET/ /
Tl-204	9 E−07	–	–	3 E+04	–	–	St/ /
Pb-195m	7 E−06	–	–	2 E+05	–	–	ET/ /
Pb-198	2 E−06	–	–	9 E+04	–	–	ET/ /
Pb-199	4 E−06	–	–	1 E+05	–	–	ET/ /
Pb-200	1 E−06	–	–	4 E+04	–	–	ET/ /
Pb-201	2 E−06	–	–	7 E+04	–	–	ET/ /
Pb-202m	1 E−06	–	–	6 E+04	–	–	ET/ /
Pb-202	4 E−08	–	–	1 E+03	–	–	St/ /
Pb-203	2 E−06	–	–	7 E+04	–	–	ET/ /
Pb-205	9 E−07	–	–	3 E+04	–	–	BS/ /
Pb-209	9 E−06	–	–	3 E+05	–	–	ET/ /
Pb-210	1 E−10	–	–	5 E+00	–	–	BS/ /
Pb-211	4 E−08	–	–	1 E+03	–	–	ET/ /
Pb-212	5 E−09	–	–	2 E+02	–	–	ET/ /
Pb-214	4 E−08	–	–	1 E+03	–	–	ET/ /

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Bi-200	5 E−06	4 E−06	–	2 E+05	1 E+05	–	ET/ET/
Bi-201	3 E−06	2 E−06	–	1 E+05	1 E+05	–	ET/ET/
Bi-202	2 E−06	2 E−06	–	9 E+04	9 E+04	–	ET/ET/
Bi-203	7 E−07	7 E−07	–	2 E+04	2 E+04	–	ET/ET/
Bi-205	4 E−07	4 E−07	–	1 E+04	1 E+04	–	ET/ET/
Bi-206	2 E−07	2 E−07	–	9 E+03	8 E+03	–	ET/ET/
Bi-207	4 E−07	1 E−07	–	1 E+04	6 E+03	–	ET/St/
Bi-210m	3 E−09	2 E−10	–	1 E+02	9 E+00	–	K/St/
Bi-210	1 E−07	9 E−09	–	6 E+03	3 E+02	–	K/St/
Bi-212	1 E−08	8 E−09	–	4 E+02	3 E+02	–	ET/ET/
Bi-213	1 E−08	7 E−09	–	4 E+02	2 E+02	–	ET/ET/
Bi-214	1 E−08	1 E−08	–	6 E+02	4 E+02	–	ET/ET/
Po-203	5 E−06	4 E−06	–	1 E+05	1 E+05	–	ET/ET/
Po-205	4 E−06	3 E−06	–	1 E+05	1 E+05	–	ET/ET/
Po-207	1 E−06	1 E−06	–	7 E+04	6 E+04	–	ET/ET/
Po-210	7 E−10	2 E−10	–	2 E+01	9 E+00	–	K/St/
At-207	1 E−06	2 E−07	–	4 E+04	1 E+04	–	St/St/
At-211	7 E−09	5 E−09	–	2 E+02	1 E+02	–	ET/St/
Rn-220 [5]	1 E−08	–	–	6 E+02	–	–	–
Rn-222 [5]	8 E−08	–	–	3 E+03	–	–	–
Fr-222	1 E−08	–	–	3 E+02	–	–	ET/ /
Fr-223	4 E−07	–	–	1 E+04	–	–	St/ /
Ra-223	–	9 E−11	–	–	3 E+00	–	/St/
Ra-224	–	2 E−10	–	–	8 E+00	–	/St/
Ra-225	–	1 E−10	–	–	4 E+00	–	/St/
Ra-226	–	2 E−10	–	–	9 E+00	–	/St/
Ra-227	–	8 E−07	–	–	3 E+04	–	/BS/
Ra-228	–	1 E−10	–	–	5 E+00	–	/BS/
Ac-224	1 E−08	6 E−09	5 E−09	6 E+02	2 E+02	2 E+02	BS/St/St
Ac-225	2 E−10	9 E−11	8 E−11	7 E+00	3 E+00	3 E+00	BS/St/St
Ac-226	1 E−09	6 E−10	5 E−10	4 E+01	2 E+01	2 E+01	ET/St/St
Ac-227	2 E−13	1 E−12	1 E−11	1 E−02	5 E−02	4 E−01	BS/BS/St
Ac-228	6 E−09	3 E−08	4 E−08	2 E+02	1 E+03	1 E+03	BS/BS/St
Th-226	–	4 E−09	4 E−09	–	1 E+02	1 E+02	/ET/ET
Th-227	–	9 E−11	7 E−11	–	3 E+00	2 E+00	/St/St
Th-228	–	2 E−11	2 E−11	–	7 E−01	8 E−01	/BS/St
Th-229	–	2 E−12	1 E−11	–	7 E−02	4 E−01	/BS/St
Th-230	–	3 E−12	4 E−11	–	1 E−01	1 E+00	/BS/BS
Th-231	–	1 E−06	1 E−06	–	5 E+04	5 E+04	/St/St
Th-232	–	3 E−12	4 E−11	–	1 E−01	1 E+00	/BS/BS
Th-234	–	1 E−07	9 E−08	–	3 E+03	3 E+03	/St/St
Pa-227	–	4 E−09	4 E−09	–	1 E+02	1 E+02	/ET/ET
Pa-228	–	1 E−08	1 E−08	–	3 E+02	4 E+02	/BS/St
Pa-230	–	1 E−09	9 E−10	–	4 E+01	3 E+01	/St/St
Pa-231	–	1 E−12	1 E−11	–	4 E−02	4 E−01	/BS/BS
Pa-232	–	1 E−08	1 E−07	–	6 E+02	7 E+03	/BS/BS
Pa-233	–	2 E−07	1 E−07	–	7 E+03	6 E+03	/St/St
Pa-234	–	7 E−07	7 E−07	–	2 E+04	2 E+04	/ET/ET
U-230	6 E−10	5 E−11	4 E−11	2 E+01	2 E+00	1 E+00	K/St/St
U-231	2 E−06	1 E−06	1 E−06	8 E+04	4 E+04	4 E+04	ET/St/St
U-232	5 E−11	1 E−10	2 E−11	2 E+00	4 E+00	7 E−01	BS/St/ET
U-233	4 E−10	2 E−10	7 E−11	1 E+01	9 E+00	2 E+00	BS/St/ET
U-234	5 E−10	2 E−10	7 E−11	1 E+01	9 E+00	2 E+00	BS/St/ET
U-235	5 E−10	3 E−10	8 E−11	1 E+01	1 E+01	3 E+00	BS/St/ET
U-236	5 E−10	2 E−10	7 E−11	1 E+01	1 E+01	2 E+00	BS/St/ET
U-237	1 E−06	3 E−07	3 E−07	4 E+04	1 E+04	1 E+04	ET/St/St
U-238	5 E−10	3 E−10	8 E−11	2 E+01	1 E+01	3 E+00	BS/St/ET
U-239	1 E−05	9 E−06	9 E−06	5 E+05	3 E+05	3 E+05	ET/ET/ET
U-240	1 E−06	7 E−07	6 E−07	5 E+04	2 E+04	2 E+04	ET/St/St
Np-232	–	3 E−06	–	–	1 E+05	–	/BS/
Np-233	–	7 E−05	–	–	2 E+06	–	/ET/
Np-234	–	5 E−07	–	–	2 E+04	–	/ET/
Np-235	–	1 E−06	–	–	4 E+04	–	/BS/
Np-236 (1 E+05 yr).	–	4 E−11	–	–	1 E+00	–	/BS/
Np-236 (22 h)	–	5 E−08	–	–	1 E+03	–	/BS/
Np-237	–	8 E−12	–	–	3 E−01	–	/BS/
Np-238	–	1 E−07	–	–	4 E+03	–	/BS/
Np-239	–	5 E−07	–	–	1 E+04	–	/St/
Np-240	–	2 E−06	–	–	8 E+04	–	/ET/
Pu-234	–	3 E−08	3 E−08	–	1 E+03	1 E+03	/St/St

Radionuclide	Absorption type [3]			Absorption type [3]			Stochastic or organ or tissue [1]
	μCi/mL			Bq/m [3]			
	F	M	S	F	M	S	(F/M/S)
Pu-235	–	9 E−05	8 E−05	–	3 E+06	3 E+06	/ET/ET
Pu-236	–	1 E−11	7 E−11	–	6 E−01	2 E+00	/BS/St
Pu-237	–	1 E−06	1 E−06	–	7 E+04	6 E+04	/St/St
Pu-238	–	6 E−12	5 E−11	–	2 E−01	1 E+00	/BS/St
Pu-239	–	5 E−12	6 E−11	–	2 E−01	2 E+00	/BS/BS
Pu-240	–	5 E−12	6 E−11	–	2 E−01	2 E+00	/BS/BS
Pu-241	–	2 E−10	2 E−09	–	1 E+01	1 E+02	/BS/BS
Pu-242	–	5 E−12	6 E−11	–	2 E−01	2 E+00	/BS/BS
Pu-243	–	5 E−06	5 E−06	–	1 E+05	1 E+05	/E/E
Pu-244	–	5 E−12	6 E−11	–	2 E−01	2 E+00	/BS/BS
Pu-245	–	9 E−07	8 E−07	–	3 E+04	3 E+04	/St/St
Pu-246	–	8 E−08	8 E−08	–	3 E+03	2 E+03	/St/St
Am-237	–	8 E−06	–	–	3 E+05	–	/ET/
Am-238	–	2 E−06	–	–	9 E+04	–	/BS/
Am-239	–	1 E−06	–	–	6 E+04	–	/ET/
Am-240	–	7 E−07	–	–	2 E+04	–	/ET/
Am-241	–	5 E−12	–	–	1 E−01	–	/BS/
Am-242m	–	5 E−12	–	–	1 E−01	–	/BS/
Am-242	–	4 E−08	–	–	1 E+03	–	/St/
Am-243	–	5 E−12	–	–	1 E−01	–	/BS/
Am-244m	–	3 E−06	–	–	1 E+05	–	/BS/
Am-244	–	1 E−07	–	–	5 E+03	–	/BS/
Am-245	–	5 E−06	–	–	2 E+05	–	/ET/
Am-246m	–	6 E−06	–	–	2 E+05	–	/ET/
Am-246	–	2 E−06	–	–	9 E+04	–	/ET/
Cm-238	–	1 E−07	–	–	4 E+03	–	/St/
Cm-240	–	2 E−10	–	–	7 E+00	–	/St/
Cm-241	–	2 E−08	–	–	8 E+02	–	/St/
Cm-242	–	1 E−10	–	–	5 E+00	–	/St/
Cm-243	–	7 E−12	–	–	2 E−01	–	/BS/
Cm-244	–	9 E−12	–	–	3 E−01	–	/BS/
Cm-245	–	5 E−12	–	–	1 E−01	–	/BS/
Cm-246	–	5 E−12	–	–	1 E−01	–	/BS/
Cm-247	–	5 E−12	–	–	2 E−01	–	/BS/
Cm-248	–	1 E−12	–	–	5 E−02	–	/BS/
Cm-249	–	8 E−06	–	–	3 E+05	–	/ET/
Cm-250	–	2 E−13	–	–	8 E−03	–	/BS/
Bk-245	–	3 E−07	–	–	1 E+04	–	/St/
Bk-246	–	8 E−07	–	–	3 E+04	–	/ET/
Bk-247	–	3 E−12	–	–	1 E−01	–	/BS/
Bk-249	–	1 E−09	–	–	5 E+01	–	/BS/
Bk-250	–	2 E−07	–	–	9 E+03	–	/BS/
Cf-244	–	1 E−08	–	–	5 E+02	–	/ET/
Cf-246	–	1 E−09	–	–	5 E+01	–	/St/
Cf-248	–	5 E−11	–	–	2 E+00	–	/BS/
Cf-249	–	3 E−12	–	–	1 E−01	–	/BS/
Cf-250	–	7 E−12	–	–	2 E−01	–	/BS/
Cf-251	–	3 E−12	–	–	1 E−01	–	/BS/
Cf-252	–	1 E−11	–	–	6 E−01	–	/BS/
Cf-253	–	5 E−10	–	–	2 E+01	–	/St/
Cf-254	–	2 E−11	–	–	8 E−01	–	/BS/
Es-250	–	4 E−07	–	–	1 E+04	–	/BS/
Es-251	–	3 E−07	–	–	1 E+04	–	/St/
Es-253	–	2 E−10	–	–	9 E+00	–	/St/
Es-254m	–	1 E−09	–	–	5 E+01	–	/St/
Es-254	–	6 E−11	–	–	2 E+00	–	/BS/
Fm-252	–	2 E−09	–	–	8 E+01	–	/St/
Fm-253	–	1 E−09	–	–	6 E+01	–	/St/
Fm-254	–	6 E−09	–	–	2 E+02	–	/ET/
Fm-255	–	2 E−09	–	–	8 E+01	–	/St/
Fm-257	–	1 E−10	–	–	4 E+00	–	/St/
Md-257	–	2 E−08	–	–	1 E+03	–	/St/
Md-258	–	1 E−10	–	–	4 E+00	–	/St/

FOOTNOTES FOR APPENDIX A

[1] A determination of whether the DACs are controlled by stochastic (St) or deterministic (organ or tissue) dose, or if they both give the same result (E), for each absorption type, is given in this column. The

key to the organ notation for deterministic dose is: BS = Bone surface, ET = Extrathoracic, K = Kidney, L = Liver, and T = Thyroid. A blank indicates that no calculations were performed for the absorption type shown.

[2]The ICRP identifies these materials as soluble or reactive gases and vapors or highly soluble or reactive gases and vapors. For tritiated water, the inhalation DAC values allow for an additional 50% absorption through the skin, as described in ICRP Publication No. 68, Dose Coefficients for Intakes of Radionuclides by Workers. For elemental tritium, the DAC values include a factor that irradiation from gas within the lungs might increase the dose by 20%.

[3]A dash indicates no values given for this data category.

[4]DAC values derived using hafnium tritide particle and are based on ''observed activity'' (i.e, only radiation emitted from the particle is considered). DAC values derived using methodology found in Radiological Control Programs for Special Tritium Compounds, DOE–HDBK–1184–2004.

[5]These values are appropriate for protection from radon combined with its short-lived decay products and are based on information given in ICRP Publication 65: Protection Against Radon-222 at Home and at Work and in DOE–STD–1121–98: Internal Dosimetry. The values given are for 100% equilibrium concentration conditions of the short-lived radon decay products with the parent. To allow for an actual measured equilibrium concentration or a demonstrated equilibrium concentration, the values given in this table should be multiplied by the ratio (100%/actual %) or (100%/demonstrated %), respectively. Alternatively, the DAC values for Rn-220 and Rn-222 may be replaced by 2.5 working level (WL) and 0.83 WL, respectively, for appropriate limiting of decay product concentrations. A WL is any combination of short-lived radon decay products, in one liter of air without regard to the degree of equilibrium, that will result in the ultimate emission of 1.3 E+05 MeV of alpha energy.

[72 FR 31927, June 8, 2007]

APPENDIX B TO PART 835 [RESERVED]

APPENDIX C TO PART 835—DERIVED AIR CONCENTRATION (DAC) FOR WORKERS FROM EXTERNAL EXPOSURE DURING IMMERSION IN A CLOUD OF AIRBORNE RADIOACTIVE MATERIAL

a. The data presented in appendix C are to be used for controlling occupational exposures in accordance with §835.209, identifying the need for air monitoring in accordance with §835.403 and identifying the need for posting of airborne radioactivity areas in accordance with §835.603(d).

b. The air immersion DAC values shown in this appendix are based on a stochastic dose limit of 5 rems (0.05 Sv) per year. Four columns of information are presented: (1) Radionuclide; (2) half-life in units of seconds (s), minutes (min), hours (h), days (d), or years (yr); (3) air immersion DAC in units of μCi/mL; and (4) air immersion DAC in units of Bq/m3. The data are listed by radionuclide in order of increasing atomic mass. The air immersion DACs were calculated for a continuous, nonshielded exposure via immersion in a semi-infinite cloud of airborne radioactive material. The DACs listed in this appendix may be modified to allow for submersion in a cloud of finite dimensions.

c. The DAC values are given for individual radionuclides. For known mixtures of radionuclides, determine the sum of the ratio of the observed concentration of a particular radionuclide and its corresponding DAC for all radionuclides in the mixture. If this sum exceeds unity (1), then the DAC has been exceeded. For unknown radionuclides, the most restrictive DAC (lowest value) for those isotopes not known to be absent shall be used.

AIR IMMERSION DAC

Radionuclide	Half-life	(μCi/mL)	(Bq/m^3)
Ar-37	35.02 d	3E+00	1E+11
Ar-39	269 yr	1E–03	5E+07
Ar-41	1.827 h	3E–06	1E+05
Kr-74	11.5 min	3E–06	1E+05
Kr-76	14.8 h	1E–05	3E+05
Kr-77	74.7 min	4E–06	1E+05
Kr-79	35.04 h	1E–05	6E+05
Kr-81	2.1E+05 yr	7E–04	2E+07
Kr-83m	1.83 h	7E–02	2E+09
Kr-85	10.72 yr	7E–04	2E+07
Kr-85m	4.48 h	2E–05	1E+06
Kr-87	76.3 min	4E–06	1E+05
Kr-88	2.84 h	1E–06	7E+04
Xe-120	40.0 min	1E–05	4E+05
Xe-121	40.1 min	2E–06	8E+04
Xe-122	20.1 h	8E–05	3E+06
Xe-123	2.14 h	6E–06	2E+05
Xe-125	16.8 h	1E–05	6E+05
Xe-127	36.406 d	1E–05	6E+05
Xe-129m	8.89 d	2E–04	7E+06
Xe-131m	11.84 d	5E–04	1E+07
Xe-133	5.245 d	1E–04	5E+06
Xe-133m	2.19 d	1E–04	5E+06
Xe-135	9.11 h	1E–05	6E+05
Xe-135m	15.36 min	1E–05	3E+05
Xe-138	14.13 min	3E–06	1E+05

For any single radionuclide not listed above with decay mode other than alpha emission or spontaneous fission and with radioactive half-life less than two hours, the DAC value shall be 6 E–06 μCi/mL (2 E+04 Bq/m^3).

[72 FR 31940, June 8, 2007, as amended at 76 FR 20489, Apr. 13, 2011]