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A Radionuclide Decay Data Base—Index and Summary Table

D. C. Kocher

Prepared for the
U.S. Nuclear Regulatory Commission
Division of Safeguards, Fuel Cycle,
and Environmental Research
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ABSTRACT

This report provides an index and summary table for an extensive data base of evaluated radioactive decay data for approximately 500 radionuclides of potential importance in assessing radiological impacts on the general public or occupationally exposed individuals. For each radionuclide, the summary table gives the radionuclide name, half-life, and the average energy per decay for the emitted alpha particles, electrons, and photons.

1. INTRODUCTION

Since 1976, the author has been concerned with the evaluation and compilation of radioactive decay data from the point of view of its application to radiation dosimetry and radiological assessments. The purpose of this work has been to develop a data base of evaluated decay data for a large number of radionuclides for use in various radiological assessment applications by the U. S. Nuclear Regulatory Commission (NRC) and by the Technology Assessments Section of the Health and Safety Research Division at Oak Ridge National Laboratory.

Initially, an evaluated decay data base was prepared for 240 radionuclides of potential importance in routine releases of effluents from nuclear fuel cycle facilities.[1] This data base was used to calculate

dose-rate conversion factors for external exposure to radionuclides dispersed in the environment[2,3] and to calculate dosimetric S factors[4,5] and dose conversion factors[6,7] for internal exposure to inhaled or ingested radionuclides.

Following publication of the data in ref. 1, the data base has been continually expanded and updated. In addition to the radionuclides of interest in the nuclear fuel cycle, the present data base comprises most of the radionuclides occurring naturally in the environment, those of current interest in nuclear medicine and fusion reactor technology, and a selection of additional radionuclides of interest to Committee 2 of the International Commission on Radiological Protection for the estimation of annual limits of intake and derived air concentrations for occupationally exposed individuals. The data base now includes approximately 500 radionuclides. Complete documentation for the current data base is provided in ref. 8, which contains tables of the decay data for each radionuclide, giving the energies and intensities for each of the emitted radiations, and information on decay chains and branching fractions for radionuclides with radioactive progeny. The current data base is available in a simple, computer-readable format from the Radiation Shielding Information Center (RSIC) at Oak Ridge National Laboratory.* The name of the data library at RSIC is NFCLIST, and the code number for the file is DLC62.

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*Mailing address: Radiation Shielding Information Center, Oak Ridge National Laboratory, P. O. Box X, Oak Ridge, TN 37830.

2. INDEX AND SUMMARY TABLE

The purpose of this report, prepared at the request of the NRC, is to provide a summary of the radioactive decay data contained in the current data base in a format not previously used in refs. 1 and 8. Rather than listing separately the energies and intensities for each of the emitted radiations from a given radionuclide, this report presents a summary of the decay data by tabulating the average energies per decay for each of the different types of emitted radiations. This tabulation is given in the Appendix. Each radionuclide is identified by the name and half-life. The average energies of the emitted radiations in MeV per decay are then given for alpha particles, electrons, and photons. In addition to the average energy per decay for all electrons, separate average energies are given for the continuous spectra of beta particles and positrons from beta decay and for discrete Auger and internal conversion electrons. For a given radiation type denoted by m, the average energy $\bar{E}^m$ in MeV per decay is given by

$$\bar{E}^m = \sum_{i=1}^{n_m} f_i^m E_i^m ,$$

where

f_i^m = intensity of the ith radiation of type m in number per decay,

E_i^m = energy of the ith radiation of type m in MeV,

n_m = number of radiations of type m.

The energies and intensities for the individual radiations of a given type are those given in the data tables in ref. 8.

The average energies per decay for the different radiation types from a given radionuclide are potentially quite useful in applications where the energy distribution of the individual radiations is not important. In internal dosimetry, for example, alpha particles and electrons are radiations which are usually regarded as non-penetrating in tissue, so that all such radiations emitted by radionuclides deposited in a given body organ are assumed to be absorbed in that organ. For these radiations, therefore, the dosimetric S factors, which give the dose equivalent to a target organ per unit residence of a radionuclide in a source organ (e.g., in units of rem/μCi-day), are nonzero only for target organs which are the same as the source organs, and the values of the S factors are simply proportional to the average energy per decay divided by the mass of the organ. As another example, the average energies per decay for the different radiation types are useful in problems involving decay heat in a nuclear reactor or energy deposition in materials used to shield a radiation source.

We caution that there are many applications where use of the average energy per decay is not appropriate. In external dosimetry, for example, the absorbed dose in a given body organ from photons and electrons emitted by radionuclides outside the body depends on the energy distribution and not the average energy,[2,3] because the propagation of these radiations through the medium between the source and the location of the exposed individual and then through the body tissues to the body organ is energy dependent. Similarly in internal dosimetry, the dosimetric S factors for photons depend on the propagation of the radiations through body tissues, and, thus, depend on the energy distribution of the emitted photons.

3. REFERENCES

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APPENDIX

AVERAGE ENERGIES PER DECAY

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
H-3	12.28 Y	0.0	0.0057	0.0	0.0	0.0057	0.0
BE-7	53.44 D	0.0	0.0	0.0	0.0	0.0	0.0498
BE-10	1.6E6 Y	0.0	0.2025	0.0	0.0	0.2025	0.0
C-11	20.48 M	0.0	0.0	0.3847	0.0000	0.3847	1.0196
C-14	5.73E3 Y	0.0	0.0495	0.0	0.0	0.0495	0.0
N-13	9.97 M	0.0	0.0	0.4908	0 0000	0.4908	1.0200
N-16	7.13 S	0.0	2.6927	0.0	0.0	2.6927	4.6182
O-15	122.24 S	0.0	0.0	0.7345	0.0	0.7345	1.0210
F-18	109.74 M	0.0	0.0	0.2416	0.0000	0.2415	0.9886
NA-22	2.602 Y	0.0	0.0	0.1941	0.0001	0.1942	2.1925
NA-24	15.00 H	0.0	0.5536	0.0	0.0	0.5536	4.1212
MG-27	9.458 M	0.0	0.7016	0.0	0.0	0.7016	0.8913
MG-28	20.91 H	0.0	0.1520	0.0	0.0090	0.1610	1.3706
AL-26	7.2E5 Y	0.0	0.0	0.4449	0.0002	0.4451	2.0758
AL-28	2.240 M	0.0	1.2423	0.0	0.0	1.2423	1.7789
SI-31	157.3 M	0.0	0.5952	0.0	0.0	0.5952	0.0009
SI-32	3.3E2 Y	0.0	0.0647	0.0	0.0	0.0647	0.0
P-32	14.29 D	0.0	0.6949	0.0	0.0	0.6949	0.0
P-33	25.4 D	0.0	0.0766	0.0	0.0	0.0766	0.0
S-35	87.44 D	0.0	0.0488	0.0	0.0	0.0488	0.0
CL-36	3.01E5 Y	0.0	0.2488	0.0	0.0000	0.2488	0.0000
CL-38	37.21 M	0.0	1.5292	0.0	0.0	1.5292	1.4884
AR-37	35.02 D	0.0	0.0	0.0	0.0019	0.0019	0.0002
AR-39	269 Y	0.0	0.2188	0.0	0.0	0.2188	0.0
AR-41	1.827 H	0.0	0.4640	0.0	0.0	0.4640	1.2836
K-40	1.277E9 Y	0.0	0.4543	0.0	0.0002	0.4545	0.1559
K-42	12.36 H	0.0	1.4303	0.0	0.0	1.4303	0.2760

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
K-43	22.6 H	0.0	0.3046	0.0	0.0	0.3046	0.9700
CA-41	1.03E5 Y	0.0	0.0	0.0	0.0023	0.0023	0.0004
CA-45	162.7 D	0.0	0.0772	0.0	0.0	0.0772	0.0000
CA-47	4.536 D	0.0	0.3442	0.0	0.0	0.3442	1.0628
CA-49	8.719 M	0.0	0.8722	0.0	0.0	0.8722	3.1646
SC-44	3.927 H	0.0	0.0	0.5973	0.0002	0.5974	2.1368
SC-46	83.80 D	0.0	0.1120	0.0	0.0	0.1120	2.0095
SC-46M	18.72 S	0.0	0.0	0.0	0.0528	0.0528	0.0896
SC-47	3.422 D	0.0	0.1623	0.0	0.0006	0.1629	0.1084
SC-48	43.67 H	0.0	0.2196	0.0	0.0003	0.2199	3.3491
SC-49	57.4 M	0.0	0.8227	0.0	0.0	0.8227	0.0010
TI-44	47.3 Y	0.0	0.0	0.0	0.0108	0.0108	0.1398
TI-45	3.08 H	0.0	0.0	0.3725	0.0005	0.3729	0.8707
TI-51	5.752 M	0.0	0.8654	0.0	0.0005	0.8659	0.3684
V-48	15.971 D	0.0	0.0	0.1460	0.0017	0.1477	2.9132
V-49	330 D	0.0	0.0	0.0	0.0034	0.0034	0.0009
V-52	3.75 M	0.0	1.0689	0.0	0.0	1.0689	1.4449
CR-49	42.09 M	0.0	0.0	0.5922	0.0059	0.5982	1.0459
CR-51	27.704 D	0.0	0.0	0.0	0.0036	0.0036	0.0326
MN-52	5.591 D	0.0	0.0	0.0710	0.0027	0.0737	3.4557
MN-52M	21.4 M	0.0	0.0	1.1324	0.0001	1.1324	2.4090
MN-53	3.7E6 Y	0.0	0.0	0.0	0.0038	0.0038	0.0014
MN-54	312.7 D	0.0	0.0	0.0	0.0038	0.0038	0.8360
MN-56	2.5785 H	0.0	0.8288	0.0	0.0	0.8288	1.6916
MN-57	1.47 M	0.0	1.1008	0.0	0.0112	1.1120	0.0746
FE-52	8.275 H	0.0	0.0	0.1904	0.0073	0.1977	0.7361
FE-55	2.7 Y	0.0	0.0	0.0	0.0040	0.0040	0.0017

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BE PART	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
FE-59	44.63 D	0.0	0.1.	0.0	0.0	3.1175	1.1885
CO-56	78.76 D	0.0	0.0	0.1200	0.0033	0.1234	3.6093
CO-57	270.9 D	0.0	0.0	0.0	0.0183	0.0183	0.1251
CO-58	70.80 D	0.0	0.0	0.0300	0.0036	0.0336	0.9758
CO-58M	9.15 H	0.0	0.0	0.0	0.0247	0.0247	0.0020
CO-60	5.271 Y	0.0	0.0958	0.0	0.0	0.0958	2.5058
CO-60M	10.47 M	0.0	0.0014	0.0	0.0550	0.0564	0.0066
CO-61	1.650 H	0.0	0.4616	0.0	0.0077	0.4693	0.0907
NI-56	6.10 D	0.0	0.0	0.0	0.0065	0.0065	1.7206
NI-57	36.08 H	0.0	0.0	0.1384	0.0044	0.1428	1.9188
NI-59	7.5E4 Y	0.0	0.0	0.0	0.0043	0.0043	0.0024
NI-63	100.1 Y	0.0	0.0171	0.0	0.0	0.0171	0.0
NI-65	2.520 H	0.0	0.6322	0.0	0.0	0.6322	0.5486
CU-61	3.408 H	0.0	0.0	0.3072	0.0020	0.3092	0.8241
CU-62	9.74 M	0.0	0.0	1.2856	0.0001	1.2857	1.0069
CU-64	12.701 H	0.0	0.0738	0.0497	0.0020	0.1225	0.1905
CU-67	61.88 D	0.0	0.1412	0.0	0.0145	0.1557	0.1154
ZN-62	9.26 H	0.0	0.0	0.0197	0.0110	0.0307	0.4556
ZN-65	244.4 D	0.0	0.0	0.0020	0.0046	0.0066	0.5838
ZN-69	55.6 M	0.0	0.3209	0.0	0.0	0.3209	0.0000
ZN-69M	13.76 H	0.0	0.0	0.0	0.0221	0.0221	0.4164
GA-66	9.40 H	0.0	0.0	0.9608	0.0021	0.9629	2.4847
GA-67	3.261 D	0.0	0.0	0.0	0.0334	0.0334	0.1495
GA-68	68.0 M	0.0	0.0	0.7375	0.0005	0.7380	0.9497
GA-72	14.1 H	0.0	0.4981	0.0	0.0029	0.5009	2.7056
GE-68	288 D	0.0	0.0	0.0	0.0047	0.0047	0.0041
GE-71	11.8 D	0.0	0.0	0.0	0.0048	0.0048	0.0042

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
GE-77	11.30 H	0.0	0.6449	0.0	0.0078	0.6528	1.0648
AS-72	26.0 H	0.0	0.0	1.0274	0.0065	1.0339	1.7841
AS-73	80.30 D	0.0	0.0	0.0	0.0600	0.0600	0.0158
AS-74	17.77 D	0.0	0.1375	0.1296	0.0018	0.2688	0.7671
AS-76	26.32 H	0.0	1.0648	0.0	0.0	1.0648	0.4300
AS-77	38.8 H	0.0	0.2284	0.0	0.0	0.2284	0.0086
SE-73	7.15 H	0.0	0.0	0.3709	0.0194	0.3902	1.0959
SE-75	119.78 D	0.0	0.0	0.0	0.0134	0.0134	0.3924
SE-79	6.5E4 Y	0.0	0.0522	0.0	0.0	0.0522	0.0
BR-77	57.04 H	0.0	0.0	0.0011	0.0070	0.0081	0.3208
BR-80	17.4 M	0.0	0.7181	0.0081	0.0003	0.7265	0.0750
BR-80M	4.42 H	0.0	0.0	0.0	0.0612	0.0612	0.0241
BR-82	35.30 H	0.0	0.1361	0.0	0.0	0.1361	1.6452
BR-83	2.39 H	0.0	0.3201	0.0	0.0	0.3201	0.0074
BR-84	31.80 M	0.0	1.2492	0.0	0.0	1.2492	1.7874
BR-85	172 S	0.0	1.0026	0.0	0.0	1.0026	0.0660
KR-79	35.04 H	0.0	0.0	0.0186	0.0050	0.0236	0.2579
KR-81	2.1E5 Y	0.0	0.0	0.0	0.0047	0.0047	0.0161
KR-83M	1.83 H	0.0	0.0	0.0	0.0382	0.0382	0.0026
KR-85	10.72 Y	0.0	0.2505	0.0	0.0	0.2505	0.0022
KR-85M	4.48 H	0.0	0.2290	0.0	0.0263	0.2553	0.1577
KR-87	76.3 M	0.0	1.3229	0.0	0.0007	1.3235	0.7931
KR-88	2.84 H	0.0	0.3597	0.0	0.0051	0.3648	1.0545
KR-89	3.16 M	0.0	1.3507	0.0	0.0113	1.3620	1.8344
KR-90	32.32 S	0.0	1.3040	0.0	0.0111	1.3151	1.2715
RB-81	4.58 H	0.0	0.0	0.1485	0.0607	0.2090	0.6122
RB-82	1.25 M	0.0	0.0	1.4081	0.0002	1.4083	1.0948

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
RB-83	86.2 D	0.0	0.0	0.0	0.0070	0.0070	0.5054
RB-84	32.9 D	0.0	0.0132	0.1484	0.0034	0.1651	0.9001
RB-86	18.66 D	0.0	0.6674	0.0	0.0	0.6674	0.0945
RB-87	4.73E10 Y	0.0	0.0788	0.0	0.0	0.0788	0.0
RB-88	17.8 M	0.0	2.0711	0.0	0.0	2.0711	0.6364
RB-89	15.44 M	0.0	1.0202	0.0	0.0	1.0202	2.0683
RB-90	157 S	0.0	1.9598	0.0	0.0	1.9598	2.1641
RB-90M	258 S	0.0	1.3862	0.0	0.0020	1.3882	3.2734
SR-82	25.0 D	0.0	0.0	0.0	0.0051	0.0051	0.0079
SR-85	64.84 D	0.0	0.0	0.0	0.0082	0.0082	0.5184
SR-85M	67.66 M	0.0	0.0	0.0	0.0124	0.0124	0.2167
SR-87M	2.805 H	0.0	0.0	0.0	0.0660	0.0660	0.3209
SR-89	50.55 D	0.0	0.5829	0.0	0.0	0.5829	0.0001
SR-90	28.6 Y	0.0	0.1958	0.0	0.0	0.1958	0.0
SR-91	9.5 H	0.0	0.6531	0.0	0.0	0.6531	0.6867
SR-92	2.71 H	0.0	0.1999	0.0	0.0	0.1999	1.3391
SR-93	7.3 M	0.0	0.8918	0.0	0.0282	0.9200	2.2370
Y-86	14.74 H	0.0	0.0	0.2231	0.0034	0.2265	3.5910
Y-87	80.3 H	0.0	0.0	0.0003	0.0062	0.0066	0.4657
Y-88	106.60 D	0.0	0.0	0.0008	0.0051	0.0059	2.6919
Y-90	64.1 H	0.0	0.9347	0.0	0.0	0.9347	0.0
Y-90M	3.19 H	0.0	0.0	0.0	0.0467	0.0467	0.6353
Y-91	58.51 D	0.0	0.6023	0.0	0.0	0.6023	0.0036
Y-91M	49.71 M	0.0	0.0	0.0	0.0269	0.0269	0.5306
Y-92	3.54 H	0.0	1.4449	0.0	0.0	1.4449	0.2516
Y-93	10.1 H	0.0	1.1731	0.0	0.0004	1.1734	0.0891
ZR-86	16.5 H	0.0	0.0	0.0	0.0303	0.0303	0.2943

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
ZR-88	83.4 D	0.0	0.0	0.0	0.0154	0.0154	0.3920
ZR-89	78.43 H	0.0	0.0	0.0910	0.0104	0.1014	1.0803
ZR-93	1.53E6 Y	0.0	0.0195	0.0	0.0	0.0195	0.0
ZR-95	64.02 D	0.0	0.1161	0.0	0.0	0.1161	0.7349
ZR-97	16.90 H	0.0	0.6974	0.0	0.0	0.6974	0.1806
NB-90	14.60 H	0.0	0.0	0.3515	0.0455	0.3968	4.1594
NB-91	1E4 Y	0.0	0.0	0.0002	0.0052	0.0053	0.0119
NB-91M	61 D	0.0	0.0	0.0	0.0915	0.0915	0.0515
NB-92	3.6E7 Y	0.0	0.0	0.0	0.0066	0.0066	1.5034
NB-92M	10.15 D	0.0	0.0	0.0	0.0052	0.0052	0.9678
NB-93M	14.6 Y	0.0	0.0	0.0	0.0283	0.0283	0.0019
NB-94	2.03E4 Y	0.0	0.1458	0.0	0.0011	0.1469	1.5738
NB-94M	6.26 M	0.0	0.0021	0.0	0.0329	0.0350	0.0114
NB-95	35.06 D	0.0	0.0434	0.0	0.0010	0.0444	0.7644
NB-95M	86.6 H	0.0	0.0241	0.0	0.1564	0.1805	0.0663
NB-96	23.35 H	0.0	0.2487	0.0	0.0026	0.2513	2.4724
NB-97	72.1 M	0.0	0.4662	0.0	0.0011	0.4674	0.6648
NB-97M	60 S	0.0	0.0	0.0	0.0144	0.0144	0.7284
MO-91	15.49 M	0.0	0.0	1.4532	0.0005	1.4535	0.9780
MO-93	3.5E3 Y	0.0	0.0	0.0	0.0051	0.0051	0.0107
MO-99	66.02 H	0.0	0.3954	0.0	0.0028	0.3962	0.1550
MO-101	14.61 M	0.0	0.5172	0.0	0.0242	0.5413	1.4971
TC-95	20.0 H	0.0	0.0	0.0	0.0061	0.0061	0.7965
TC-95M	61 D	0.0	0.0	0.0015	0.0127	0.0142	0.6751
TC-96	4.28 D	0.0	0.0	0.0	0.0061	0.0061	2.5061
TC-96M	51.5 M	0.0	0.0	0.0	0.0266	0.0266	0.0479
TC-97	2.6E6 Y	0.0	0.0	0.0	0.0052	0.0052	0.0118

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
TC-97M	89 D	0.0	0.0	0.0	0.0861	0.0861	0.0096
TC-98	4.2E6 Y	0.0	0.1180	0.0	0.0025	0.1205	1.3948
TC-99	2.13E5 Y	0.0	0.0846	0.0	0.0	0.0846	0.0000
TC-99M	6.02 H	0.0	0.0	0.0	0.0156	0.0156	0.1266
TC-101	14.2 M	0.0	0.4690	0.0	0.0047	0.4738	0.3427
RU-97	2.9 D	0.0	0.0	0.0	0.0120	0.0120	0.2406
RU-103	39.35 D	0.0	0.0675	0.0	0.0022	0.0697	0.4838
RU-105	4.44 H	0.0	0.4026	0.0	0.0009	0.4035	0.7842
RU-106	368.2 D	0.0	0.0100	0.0	0.0	0.0100	0.0
RH-103M	56.119 M	0.0	0.0	0.0	0.0371	0.0371	0.0017
RH-105	35.36 H	0.0	0.1522	0.0	0.0009	0.1531	0.0776
RH-105M	45 S	0.0	0.0	0.0	0.1026	0.1026	0.0350
RH-106	29.92 S	0.0	1.4120	0.0	0.0	1.4120	0.2073
PD-103	16.961 D	0.0	0.0	0.0	0.0050	0.0050	0.0145
PD-107	6.5E6 Y	0.0	0.0093	0.0	0.0	0.0093	0.0
PD-109	13.455 H	0.0	0.3607	0.0	0.0	0.3607	0.0007
AG-106M	8.46 D	0.0	0.0	0.0	0.0080	0.0080	2.8092
AG-108	2.37 M	0.0	0.6094	0.0009	0.0001	0.6104	0.0177
AG-108M	127 Y	0.0	0.0	0.0	0.0142	0.0142	1.6196
AG-109M	39.6 S	0.0	0.0	0.0	0.0757	0.0757	0.0113
AG-110	24.37 S	0.0	1.1815	0.0	0.0000	1.1815	0.0306
AG-110M	249.85 D	0.0	0.0655	0.0	0.0029	0.0684	2.7337
AG-111	7.46 D	0.0	0.3500	0.0	0.0003	0.3503	0.0264
CD-109	464 D	0.0	0.0	0.0	0.0047	0.0047	0.0149
CD-111M	48.7 M	0.0	0.0	0.0	0.1082	0.1082	0.2871
CD-113	9.3E15 Y	0.0	0.0933	0.0	0.0	0.0933	0.0
CD-113M	13.7 Y	0.0	0.1854	0.0	0.0	0.1854	0.0

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
CD-115	53.46 H	0.0	0.3123	0.0	0.0010	0.3133	0.2043
CD-115M	44.6 D	0.0	0.6062	0.0	0.0	0.6062	0.0219
CD-117	2.49 H	0.0	0.4258	0.0	0.0082	0.4340	1.0929
CD-117M	3.36 H	0.0	0.2024	0.0	0.0009	0.2034	2.0368
IN-111	2.83 D	0.0	0.0	0.0	0.0335	0.0335	0.4050
IN-113M	1.658 H	0.0	0.0	0.0	0.1308	0.1308	0.2602
IN-114	71.9 S	0.0	0.7716	0.0	0.0000	0.7715	0.0319
IN-114M	49.51 D	0.0	0.0	0.0	0.1422	0.1422	0.0972
IN-115	4.6E15 Y	0.0	0.1520	0.0	0.0	0.1520	0.0
IN-115M	4.36 H	0.0	0.0105	0.0	0.1576	0.1681	0.1657
IN-116M	54.15 M	0.0	0.2984	0.0	0.0024	0.3007	2.4588
IN-117	43.8 M	0.0	0.2453	0.0	0.0210	0.2663	0.6894
IN-117M	116.5 M	0.0	0.3463	0.0	0.0856	0.4319	0.0919
SN-113	115.1 D	0.0	0.0	0.0	0.0050	0.0050	0.0251
SN-117M	13.60 D	0.0	0.0	0.0	0.1555	0.1555	0.1575
SN-119M	293.0 D	0.0	0.0	0.0	0.0757	0.0757	0.0114
SN-123	129.2 D	0.0	0.5205	0.0	0.0	0.5205	0.0069
SN-125	9.64 D	0.0	0.8072	0.0	0.0	0.8072	0.3031
SN-126	1.0E5 Y	0.0	0.0700	0.0	0.0519	0.1219	0.0566
SB-117	2.80 H	0.0	0.0	0.0044	0.0235	0.0279	0.1851
SB-122	2.70 D	0.0	0.5607	0.0	0.0020	0.5627	0.4438
SB-124	60.20 D	0.0	0.3778	0.0	0.0024	0.3801	1.8689
SB-125	2.77 Y	0.0	0.0864	0.0	0.0112	0.0976	0.4326
SB-126	12.4 D	0.0	0.2904	0.0	0.0089	0.2993	2.7551
SB-126M	19.0 M	0.0	0.5821	0.0	0.0103	0.5924	1.5726
SB-127	3.85 D	0.0	0.3110	0.0	0.0042	0.3152	0.6619
SB-129	4.40 H	0.0	0.3576	0.0	0.0006	0.3582	1.4298

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
TE-121	16.8 D	0.0	0.0	0.0	0.0080	0.0080	0.5773
TE-121M	154 D	0.0	0.0	0.0	0.0781	0.0781	0.2174
TE-123	1E13 Y	0.0	0.0	0.0	0.0040	0.0040	0.0131
TE-123M	119.7 D	0.0	0.0	0.0	0.0978	0.0978	0.1480
TE-125M	58 D	0.0	0.0	0.0	0.1244	0.1244	0.0350
TE-127	9.35 H	0.0	0.2229	0.0	0.0	0.2229	0.0048
TE-127M	109 D	0.0	0.0046	0.0	0.0750	0.0796	0.0112
TE-129	69.6 M	0.0	0.5245	0.0	0.0213	0.5458	0.0577
TE-129M	33.6 D	0.0	0.2119	0.0	0.0575	0.2692	0.0394
TE-131	25.0 M	0.0	0.6966	0.0	0.0219	0.7186	0.4204
TE-131M	30 H	0.0	0.1445	0.0	0.0454	0.1899	1.4263
TE-132	78.2 H	0.0	0.0594	0.0	0.0390	0.0984	0.2307
TE-133	12.45 M	0.0	0.8148	0.0	0.0085	0.8233	0.9286
TE-133M	55.4 M	0.0	0.6742	0.0	0.0355	0.7094	2.2181
TE-134	41.8 M	0.0	0.1116	0.0	0.0349	0.1465	0.8738
I-122	3.62 M	0.0	0.0	1.0366	0.0018	1.0384	0.9734
I-123	13.13 H	0.0	0.0	0.0	0.0265	0.0265	0.1729
I-124	4.18 D	0.0	0.0	0.1933	0.0053	0.1986	1.0642
I-125	60.14 D	0.0	0.0	0.0	0.0172	0.0172	0.0415
I-126	12.93 D	0.0	0.1234	0.0044	0.0055	0.1338	0.4656
I-128	24.99 M	0.0	0.7602	0.0	0.0009	0.7610	0.0758
I-129	1.57E7 Y	0.0	0.0409	0.0	0.0134	0.0543	0.0246
I-130	12.36 H	0.0	0.2774	0.0	0.0088	0.2862	2.1387
I-131	8.040 D	0.0	0.1815	0.0	0.0090	0.1904	0.3811
I-132	2.30 H	0.0	0.4861	0.0	0.0043	0.4904	2.2913
I-133	20.8 H	0.0	0.4069	0.0	0.0030	0.4099	0.6067
I-134	52.6 M	0.0	0.6030	0.0	0.0047	0.6077	2.6253

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
I-135	6.61 H	0.0	0.3683	0.0	0.0006	0.3689	1.5751
I-136	83 S	0.0	2.0222	0.0	0.0	2.0222	2.5334
XE-122	20.1 H	0.0	0.0	0.0	0.0082	0.0082	0.0766
XE-123	2.14 H	0.0	0.0	0.1483	0.0354	0.1837	0.6298
XE-125	16.8 H	0.0	0.0	0.0016	0.0306	0.0323	0.2688
XE-127	36.406 D	0.0	0.0	0.0	0.0301	0.0301	0.2790
XE-129M	8.89 D	0.0	0.0	0.0	0.1814	0.1814	0.0516
XE-131M	11.84 D	0.0	0.0	0.0	0.1422	0.1422	0.0201
XE-133	5.245 D	0.0	0.1004	0.0	0.0351	0.1355	0.0453
XE-133M	2.19 D	0.0	0.0	0.0	0.1902	0.1902	0.0415
XE-135	9.11 H	0.0	0.3028	0.0	0.0153	0.3182	0.2479
XE-135M	15.36 M	0.0	0.0	0.0	0.0958	0.0958	0.4307
XE-137	3.83 M	0.0	1.7672	0.0	0.0015	1.7687	0.1877
XE-138	14.13 M	0.0	0.6149	0.0	0.0166	0.6315	1.1258
CS-126	1.64 M	0.0	0.0	1.3427	0.0031	1.3457	1.1272
CS-129	32.06 H	0.0	0.0	0.0	0.0141	0.0141	0.2836
CS-131	9.688 D	0.0	0.0	0.0	0.0050	0.0050	0.0229
CS-132	6.475 D	0.0	0.0046	0.0007	0.0071	0.0125	0.7158
CS-134	2.062 Y	0.0	0.1568	0.0	0.0052	0.1620	1.5551
CS-134M	2.90 H	0.0	0.0	0.0	0.1081	0.1081	0.0272
CS-135	2.3E6 Y	0.0	0.0563	0.0	0.0	0.0563	0.0
CS-136	13.16 D	0.0	0.1001	0.0	0.0329	0.1329	2.1681
CS-137	30.17 Y	0.0	0.1708	0.0	0.0	0.1708	0.0
CS-138	32.2 M	0.0	1.2198	0.0	0.0029	1.2227	2.3610
CS-139	9.40 M	0.0	1.6535	0.0	0.0	1.6535	0.3062
BA-131	11.8 D	0.0	0.0	0.0	0.0418	0.0418	0.4735
BA-133	10.5 Y	0.0	0.0	0.0	0.0502	0.0502	0.3922

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
BA-133M	38.9 H	0.0	0.0	0.0	0.2169	0.2169	0.0681
BA-135M	28.7 H	0.0	0.0	0.0	0.2056	0.2056	0.0611
BA-137M	2.552 M	0.0	0.0	0.0	0.0637	0.0637	0.5978
BA-139	83.1 M	0.0	0.8966	0.0	0.0058	0.9024	0.0353
BA-140	12.789 D	0.0	0.2712	0.0	0.0327	0.3039	0.1910
BA-141	18.27 M	0.0	0.8436	0.0	0.0143	0.8579	0.8908
BA-142	10.70 M	0.0	0.4506	0.0	0.0196	0.4703	0.9051
LA-140	40.22 H	0.0	0.5275	0.0	0.0052	0.5326	2.3163
LA-141	3.94 H	0.0	0.9483	0.0	0.0	0.9483	0.0427
LA-142	95.4 M	0.0	0.8457	0.0	0.0015	0.8472	2.7189
CE-139	137.66 D	0.0	0.0	0.0	0.0315	0.0315	0.1609
CE-141	32.50 D	0.0	0.1447	0.0	0.0252	0.1698	0.0769
CE-143	33.0 H	0.0	0.4097	0.0	0.0272	0.4369	0.2734
CE-144	284.3 D	0.0	0.0833	0.0	0.0093	0.0925	0.0193
PR-142	19.13 H	0.0	0.8087	0.0	0.0	0.8087	0.0584
PR-143	13.56 D	0.0	0.3156	0.0	0.0	0.3156	0.0000
PR-144	17.28 M	0.0	1.2072	0.0	0.0	1.2072	0.0319
PR-144M	7.2 M	0.0	0.0	0.0	0.0449	0.0449	0.0118
ND-147	10.98 D	0.0	0.2335	0.0	0.0345	0.2680	0.1407
ND-149	1.73 H	0.0	0.4472	0.0	0.0428	0.4900	0.3819
PM-143	265 D	0.0	0.0	0.0	0.0061	0.0061	0.3140
PM-144	363 D	0.0	0.0	0.0	0.0132	0.0132	1.5550
PM-145	17.7 Y	0.0	0.0	0.0	0.0122	0.0122	0.0321
PM-146	2020 D	0.0	0.0896	0.0	0.0081	0.0977	0.7551
PM-147	2.6234 Y	0.0	0.0620	0.0	0.0	0.0620	0.0000
PM-148	5.37 D	0.0	0.7257	0.0	0.0009	0.7266	0.5743
PM-148M	41.3 D	0.0	0.1454	0.0	0.0186	0.1640	1.9913

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
PM-147	55.08 H	0.0	0.3642	0.0	0.0006	0.3648	0.0116
PM-151	28.40 H	0.0	0.2823	0.0	0.0218	0.3041	0.3362
SM-147	1.069E11 Y	2.2476	0.0	0.0	0.0	0.0	0.0
SM-151	90 Y	0.0	0.0196	0.0	0.0001	0.0198	0.0000
SM-153	46.7 H	0.0	0.2234	0.0	0.0428	0.2661	0.0616
EU-152	13.6 Y	0.0	0.0857	0.0	0.0403	0.1260	1.1525
EU-152M	9.32 H	0.0	0.4849	0.0	0.0099	0.4948	0.3156
EU-154	8.8 Y	0.0	0.2252	0.0	0.0485	0.2737	1.2532
EU-155	4.96 Y	0.0	0.0454	0.0	0.0163	0.0618	0.0606
EU-156	15.19 D	0.0	0.3888	0.0	0.0247	0.4135	1.3453
GD-152	1.1E14 Y	2.1496	0.0	0.0	0.0	0.0	0.0
GD-153	241.6 D	0.0	0.0	0.0	0.0419	0.0419	0.1105
GD-159	18.56 H	0.0	0.3119	0.0	0.0038	0.3156	0.0404
GD-162	9.7 M	0.0	0.3200	0.0	0.0150	0.3350	0.4258
TB-157	150 Y	0.0	0.0	0.0	0.0031	0.0031	0.0050
TB-160	72.3 D	0.0	0.2259	0.0	0.0453	0.2712	1.0817
TB-162	7.76 M	0.0	0.4770	0.0	0.0422	0.5192	1.0960
DY-157	8.06 H	0.0	0.0	0.0	0.0105	0.0105	0.3516
DY-165	2.334 H	0.0	0.4400	0.0	0.0065	0.4465	0.0257
DY-166	81.6 H	0.0	0.1184	0.0	0.0391	0.1576	0.0400
HO-166	26.80 H	0.0	0.6677	0.0	0.0274	0.6950	0.0292
HO-166M	1.20E3 Y	0.0	0.0404	0.0	0.0040	0.1443	1.5970
ER-169	9.40 D	0.0	0.0994	0.0	0.0027	0.1021	0.0000
ER-171	7.52 H	0.0	0.3584	0.0	0.0547	0.4131	0.3725
TM-170	128.6 D	0.0	0.3155	0.0	0.0141	0.3293	0.0054
TM-171	1.92 Y	0.0	0.0248	0.0	0.0007	0.0255	0.0007
YB-169	31.97 D	0.0	0.0	0.0	0.1124	0.1124	0.3111

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
YB-175	4.19 D	0.0	0.1257	0.0	0.0042	0.1298	0.0395
LU-177	6.71 D	0.0	0.1331	0.0	0.0138	0.1469	0.0350
LU-177M	160.10 D	0.0	0.0318	0.0	0.2281	0.2598	0.9925
HF-181	42.39 D	0.0	0.1186	0.0	0.0757	0.1943	0.5441
TA-182	114.74 D	0.0	0.1240	0.0	0.0756	0.1995	1.2974
W-181	120.95 D	0.0	0.0	0.0	0.0080	0.0080	0.0403
W-185	75.1 D	0.0	0.1268	0.0	0.0	0.1268	0.0000
W-187	23.83 H	0.0	0.2561	0.0	0.0232	0.2893	0.4762
W-188	69.4 D	0.0	0.0990	0.0	0.0002	0.0991	0.0018
RE-182	64.0 H	0.0	0.0	0.0	0.2349	0.2349	1.7542
RE-182M	12.7 H	0.0	0.0	0.0144	0.0669	0.0814	1.1988
RE-183	70 D	0.0	0.0	0.0	0.0962	0.0962	0.1562
RE-184	38.0 D	0.0	0.0	0.0	0.0489	0.0489	0.8915
RE-184M	169 D	0.0	0.0	0.0	0.1303	0.1303	0.3895
RE-186	90.64 H	0.0	0.3250	0.0	0.0150	0.3403	0.0207
RE-187	4.7E10 Y	0.0	0.0007	0.0	0.0	0.0007	0.0
RE-188	16.98 H	0.0	0.7644	0.0	0.0152	0.7796	0.0580
OS-185	93.6 D	0.0	0.0	0.0	0.0124	0.0124	0.7068
OS-186	2.0E15 Y	2.7564	0.0	0.0	0.0	0.0	0.0
OS-190M	9.9 M	0.0	0.0	0.0	0.1101	0.1101	1.5884
OS-191	15.4 D	0.0	0.0367	0.0	0.0887	0.1254	0.0743
OS-191M	13.03 H	0.0	0.0	0.0	0.0631	0.0631	0.0066
OS-193	30.0 H	0.0	0.3450	0.0	0.0277	0.3727	0.0677
IR-190	11.78 D	0.0	0.0	0.0	0.0601	0.0601	1.4005
IR-190M	1.2 H	0.0	0.0	0.0	0.0193	0.0193	0.0021
IR-190M	3.2 H	0.0	0.0	0.0	0.0115	0.0115	0.0488
IR-192	74.02 D	0.0	0.1728	0.0	0.0422	0.2149	0.8184

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
IR-193M	11.9 D	0.0	0.0	0.0	0.0732	0.0732	0.0024
IR-194	19.15 H	0.0	0.8077	0.0	0.0029	0.8106	0.0911
IR-194M	171 D	0.0	0.0697	0.0	0.0834	0.1531	2.3373
PT-191	2.71 D	0.0	0.0	0.0	0.0619	0.0619	0.3914
PT-193	50 Y	0.0	0.0	0.0	0.0032	0.0032	0.0021
PT-193M	4.33 D	0.0	0.0	0.0	0.1282	0.1282	0.0128
PT-195M	4.02 D	0.0	0.0	0.0	0.1698	0.1698	0.0756
PT-197	18.3 H	0.0	0.1964	0.0	0.0552	0.2516	0.0248
PT-197M	94.4 M	0.0	0.0073	0.0	0.3064	0.3138	0.0841
AU-194	39.5 H	0.0	0.0	0.0105	0.0221	0.0325	1.0797
AU-195	183 D	0.0	0.0	0.0	0.0423	0.0423	0.0858
AU-195M	30.6 S	0.0	0.0	0.0	0.1102	0.1102	0.2015
AU-196	6.183 D	0.0	0.0049	0.0	0.0270	0.0319	0.4746
AU-198	2.696 D	0.0	0.3115	0.0	0.0151	0.3266	0.4051
AU-199	3.139 D	0.0	0.0856	0.0	0.0560	0.1416	0.0893
HG-197	64.14 H	0.0	0.0	0.0	0.0601	0.0601	0.0705
HG-197M	23.8 H	0.0	0.0	0.0	0.2076	0.2076	0.0941
HG-203	46.60 D	0.0	0.0577	0.0	0.0492	0.1069	0.2287
TL-200	26.1 H	0.0	0.0	0.0019	0.0286	0.0305	1.3181
TL-201	73.06 H	0.0	0.0	0.0	0.0357	0.0357	0.0934
TL-202	12.23 D	0.0	0.0	0.0	0.0183	0.0183	0.4682
TL-204	3.779 Y	0.0	0.2376	0.0	0.0001	0.2378	0.0011
TL-207	4.77 M	0.0	0.4933	0.0	0.0	0.4933	0.0022
TL-208	3.053 M	0.0	0.5549	0.0	0.0341	0.5890	3.3696
TL-209	2.20 M	0.0	0.6590	0.0	0.0287	0.6877	2.1179
TL-210	1.30 M	0.0	0.6586	0.0	0.0576	0.7162	2.7600
PB-203	52.02 H	0.0	0.0	0.0	0.0557	0.0557	0.3045

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
PB-204M	66.9 M	0.0	0.0	0.0	0.0989	0.0989	2.0848
PB-205	1.51E7 Y	0.0	0.0	0.0	0.0026	0.0026	0.0023
PB-209	3.253 H	0.0	0.1976	0.0	0.0	0.1976	0.0
PB-210	22.26 Y	0.0	0.0065	0.0	0.0279	0.0344	0.0045
PB-211	36.1 M	0.0	0.4529	0.0	0.0016	0.4545	0.0509
PB-212	10.643 H	0.0	0.0996	0.0	0.0735	0.1731	0.1481
PB-214	26.8 M	0.0	0.2195	0.0	0.0697	0.2893	0.2492
BI-206	6.243 D	0.0	0.0	0.0	0.1197	0.1197	1.2780
BI-207	33.4 Y	0.0	0.0	0.0	0.1098	0.1098	1.5385
BI-208	3.68E5 Y	0.0	0.0	0.0	0.0084	0.0084	2.6452
BI-210	5.013 D	0.0	0.3890	0.0	0.0	0.3890	0.0
BI-211	2.13 M	6.5492	0.0005	0.0	0.0093	0.0098	0.0475
BI-212	60.55 M	2.1734	0.4598	0.0	0.0088	0.4685	0.1841
BI-213	45.65 M	0.1263	0.4199	0.0	0.0192	0.4391	0.1393
BI-214	19.9 M	0.0	0.6319	0.0	0.0119	0.6437	1.5099
PO-209	102 Y	4.8676	0.0	0.0	0.0010	0.0010	0.0035
PO-210	138.378 D	5.3045	0.0	0.0	0.0	0.0	0.0000
PO-211	0.516 S	7.4426	0.0	0.0	0.0	0.0	0.0078
PO-212	2.98E-7 S	8.7849	0.0	0.0	0.0	0.0	0.0
PO-213	4.2E-6 S	8.3770	0.0	0.0	0.0	0.0	0.0000
PO-214	1.637E-4 S	7.6870	0.0	0.0	0.0	0.0	0.0001
PO-215	1.778E-3 S	7.3862	0.0	0.0	0.0	0.0	0.0001
PO-216	0.146 S	6.7785	0.0	0.0	0.0	0.0	0.0000
PO-218	3.05 M	6.0013	0.0	0.0	0.0	0.0	0.0
AT-211	7.214 H	2.4465	0.0	0.0	0.0030	0.0030	0.0391
AT-217	0.0323 S	7.0657	0.0	0.0	0.0	0.0	0.0002
RN-218	0.035 S	7.1322	0.0	0.0	0.0	0.0	0.0008

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
RN-219	3.96 S	6.7687	0.0	0.0	0.0062	0.0062	0.0573
RN-220	55.61 S	6.2878	0.0	0.0	0.0	0.0	0.0005
RN-222	3.8235 D	5.4892	0.0	0.0	0.0	0.0	0.0004
FR-221	4.8 M	6.3542	0.0	0.0	0.0093	0.0093	0.0309
FR-223	21.8 M	0.0	0.3417	0.0	0.0388	0.3805	0.0542
RA-222	38.0 S	6.5436	0.0	0.0	0.0007	0.0007	0.0092
RA-223	11.434 D	5.6931	0.0	0.0	0.0710	0.0710	0.1354
RA-224	3.62 D	5.6749	0.0	0.0	0.0022	0.0022	0.0100
RA-225	14.8 D	0.0	0.0936	0.0	0.0112	0.1048	0.0144
RA-226	1600 Y	4.7795	0.0	0.0	0.0035	0.0035	0.0067
RA-228	5.75 Y	0.0	0.0099	0.0	0.0017	0.0116	0.0000
AC-225	10.0 D	5.7947	0.0	0.0	0.0218	0.0218	0.0157
AC-227	21.773 Y	0.0671	0.0095	0.0	0.0028	0.0123	0.0003
AC-228	6.13 H	0.0	0.3650	0.0	0.0642	0.4292	0.9269
TH-226	30.9 M	6.3077	0.0	0.0	0.0196	0.0196	0.0085
TH-227	18.718 D	5.9022	0.0	0.0	0.0386	0.0386	0.1096
TH-228	1.9132 Y	5.3993	0.0	0.0	0.0190	0.0190	0.0031
TH-229	7.34E3 Y	4.8622	0.0	0.0	0.0997	0.0997	0.0948
TH-230	7.7E4 Y	4.6768	0.0	0.0	0.0129	0.0129	0.0014
TH-231	25.52 H	0.0	0.0800	0.0	0.0749	0.1549	0.0235
TH-232	1.405E10 Y	4.0045	0.0	0.0	0.0109	0.0109	0.0012
TH-233	22.3 M	0.0	0.4016	0.0	0.0121	0.4137	0.0352
TH-234	24.10 D	0.0	0.0434	0.0	0.0145	0.0579	0.0091
PA-230	17.4 D	0.0	0.0140	0.0	0.0399	0.0539	0.6617
PA-231	3.276E4 Y	5.3808	0.0	0.0	0.0355	0.0355	0.0372
PA-233	27.0 D	0.0	0.0586	0.0	0.1334	0.1919	0.2176
PA-234	6.70 H	0.0	0.2230	0.0	0.2745	0.4975	1.9660

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
PA-234M	1.17 M	0.0	0.8204	0.0	0.0030	0.8234	0.0114
U-230	20.8 D	5.8674	0.0	0.0	0.0193	0.0193	0.0026
U-231	4.2 D	0.0	0.0	0.0	0.0575	0.0575	0.0820
U-232	72 Y	5.3065	0.0	0.0	0.0144	0.0144	0.0018
U-233	1.592E5 Y	4.8134	0.0	0.0	0.0030	0.0030	0.0007
U-234	2.445E5 Y	4.7630	0.0	0.0	0.0113	0.0113	0.0015
U-235	7.038E8 Y	4.3784	0.0	0.0	0.0420	0.0420	0.1525
U-236	2.3415E7 Y	4.4925	0.0	0.0	0.0096	0.0096	0.0014
U-237	6.75 D	0.0	0.0563	0.0	0.1163	0.1826	0.1440
U-238	4.468E9 Y	4.1940	0.0	0.0	0.0085	0.0085	0.0012
U-239	23.40 M	0.0	0.3965	0.0	.0118	0.4083	0.0498
U-240	14.1 H	0.0	0.1250	0.0	0.0285	0.1535	0.0067
NP-235	396.1 D	0.0	0.0	0.0	0.0030	0.0030	0.0068
NP-236	1.15E6 Y	0.0	0.0079	0.0	0.1889	0.1968	0.1442
NP-236M	22.5 H	0.0	0.0746	0.0	0.0079	0.0825	0.0535
NP-237	2.14E6 Y	4.7594	0.0	0.0	0.0624	0.0624	0.0330
NP-238	2.117 D	0.0	0.2247	0.0	0.0297	0.2544	0.5541
NP-239	2.355 D	0.0	0.1151	0.0	0.1282	0.2433	0.1721
NP-240	65 M	0.0	0.2410	0.0	0.1903	0.4313	1.1631
NP-240M	7.4 M	0.0	0.5900	0.0	0.0252	0.6152	0.3337
PU-236	2.851 Y	5.7592	0.0	0.0	0.0106	0.0106	0.0018
PU-237	45.3 D	0.0	0.0	0.0	0.0086	0.0086	0.0536
PU-238	87.75 Y	5.4871	0.0	0.0	0.0083	0.0083	0.0016
PU-239	24131 Y	5.1480	0.0	0.0	0.0049	0.0049	0.0007
PU-240	6537 Y	5.1544	0.0	0.0	0.0083	0.0083	0.0015
PU-241	14.4 Y	0.0	0.0052	0.0	0.0	0.0052	0.0
PU-242	3.758E5 Y	4.9149	0.0	0.0	0.0068	0.0068	0.0013

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
PU-243	4.956 H	0.0	0.1604	0.0	0.0099	0.1703	0.0249
PU-244	8.26E7 Y	4.5913	0.0	0.0	0.0058	0.0058	0.0011
PU-245	10.57 H	0.0	0.2412	0.0	0.0789	0.3201	0.4183
PU-246	10.85 D	0.0	0.0542	0.0	0.0	0.0542	0.1003
AM-241	432.2 Y	5.4776	0.0	0.0	0.0294	0.0294	0.0281
AM-242	16.02 H	0.0	0.1592	0.0	0.0145	0.1737	0.0178
AM-242M	152 Y	0.0249	0.0	0.0	0.0360	0.0360	0.0047
AM-243	7.38E3 Y	5.2645	0.0	0.0	0.0253	0.0253	0.0583
AM-244	10.1 H	0.0	0.1096	0.0	0.2113	0.3209	0.8129
AM-245	122.4 M	0.0	0.2601	0.0	0.0258	0.2859	0.0321
AM-246	25.0 M	0.0	0.4285	0.0	0.0291	0.4576	0.9799
CM-242	163.2 D	6.1041	0.0	0.0	0.0075	0.0075	0.0017
CM-243	28.5 Y	5.8342	0.0	0.0	0.1227	0.1227	0.1528
CM-244	18.11 Y	5.7965	0.0	0.0	0.0064	0.0064	0.0015
CM-245	8.5E3 Y	5.3606	0.0	0.0	0.0699	0.0699	0.0769
CM-246	4.75E3 Y	5.3756	0.0	0.0	0.0061	0.0061	0.0013
CM-247	1.56E7 Y	4.9467	0.0	0.0	0.0147	0.0147	0.3174
CM-248	3.39E5 Y	4.6521	0.0	0.0	0.0048	0.0048	0.0011
CM-249	64.15 M	0.0	0.2718	0.0	0.0032	0.2750	0.0188
CM-250	6.9E3 Y	1.2975	0.0013	0.0	0.0	0.0013	0.0
BK-249	320 D	0.0	0.0330	0.0	0.0	0.0330	0.0
BK-250	3.222 H	0.0	0.2664	0.0	0.0270	0.2933	0.8867
BK-251	57.0 M	0.0	0.3605	0.0	0.0	0.3605	0.0
CF-248	333.5 D	6.2531	0.0	0.0	0.0044	0.0044	0.0012
CF-249	350.6 Y	5.8323	0.0	0.0	0.0375	0.0375	0.3319
CF-250	13.08 Y	6.0196	0.0	0.0	0.0045	0.0045	0.0012
CF-251	9.0E2 Y	5.6630	0.0	0.0	0.1590	0.1590	0.1220

AVERAGE ENERGIES FOR DIFFERENT RADIATION TYPES IN MEV/DECAY

NUCLIDE	HALF-LIFE	ALPHA PARTICLES	BETA PARTICLES	POSITRONS	DISCRETE ELECTRONS	ALL ELECTRONS	PHOTONS
CF-252	2.639 Y	5.9308	0.0	0.0	0.0042	0.0042	0.0011
CF-253	17.81 D	0.0185	0.0788	0.0	0.0001	0.0789	0.0000
CF-254	60.5 D	0.0181	0.0	0.0	0.0	0.0	0.0000
ES-253	20.467 D	6.6269	0.0	0.0	0.0021	0.0021	0.0010
ES-254	275.7 D	6.3955	0.0	0.0	0.0483	0.0483	0.0179
ES-254M	39.3 H	0.0211	0.1526	0.0	0.0589	0.2015	0.5645
ES-255	39.8 D	0.5035	0.0706	0.0	0.0003	0.0708	0.0001
FM-254	3.240 H	7.1705	0.0	0.0	0.0043	0.0043	0.0013
FM-255	20.07 H	7.0203	0.0	0.0	0.0842	0.0842	0.0112
FM-256	157.6 M	0.5601	0.0	0.0	0.0	0.0	0.0

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