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Nuclear Decay Data for Radionuclides used as Calibration Standards

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Abstract

Compilation of evaluated values of half-lives, gamma-ray energies and intensities of radionuclides used as calibration standards in nuclear data measurements.

Decay Data for Radionuclides Used as Calibration Standards

Introduction

This compilation consists of the most current evaluated values of half-lives, gamma-ray energies and intensities of radionuclides used as calibration standards in nuclear data measurements. The tabulated data have been selected from the most recent available evaluations on the basis of their use by individual groups performing decay data measurements. The compilation was reviewed by members of the INDC Standards Subcommittee and of the IAEA Coordinated Research Programme for the Measurement and Evaluation of Transactinium Isotope Nuclear Decay Data. This compilation has also been included in the 1982 Edition of the INDC/NEANDC Nuclear Standards File which is to be published in 1983 in an IAEA Technical Report, titled "Nuclear Data Standards for Nuclear Measurements".

A. Selection of Standards included in File

The radionuclides chosen to be included in this review were selected on the basis of their inclusion in the following compilations:

1. The 1978 INDC/NEANDC Standard File, (see INDC-30, March 1980),
2. The 1979 list of standards for gamma-ray energy calibration recommended by IUPAC (see reference HE7901),
3. The 1980 report by the AECL Radioisotope Standardization Group to the Spectrometry Working Group of the ICRM (see reference RU8001),
4. The list of radionuclides used as standards by groups performing transactinium isotope decay measurements.

B. Selection of Recommended Half-Life Values

The half-life values of the radionuclides chosen to be recommended to be used as standards were selected from the following compilations of evaluated data:

1. The LMRI Table of Radionuclides, including private communications from LMRI in 1981 and 1982,
2. The Nuclear Data Sheets,
3. The report of the AECL Radioisotope Standardization Group to the Spectrometry Working Group of the ICRM (see Reference RU8001),
4. The JAERI-M-8811 report by Y. Yoshizawa et al., "Evaluation of Gamma-Ray Intensities" (April 1980) (see Reference YO8001),

5. The 7th Edition of the Table of Isotopes (see Reference LE7801), and

6. The 1982 edition of the IAEA proposed recommended list of transactinium isotope half-lives. (See Reference TD8201).

The selection of the half-life values to be recommended was made on the basis of the following priorities:

- Most values consist of half-lives evaluated since 1977 as a result of the international nuclear structure and decay data network (NSDD) effort, (published in the Nuclear Data Sheets and compiled in ENDSF), and the more recent evaluations of the LMRI.

- One exception to this was the selection of half-life values for the transactinium isotopes which have been reviewed by the IAEA Coordinated Research Programme on Transactinium Isotope Decay Data Measurement and Evaluation, namely the half-lives of ^{228}Th and ^{241}Am.

- Another exception was the choice of the half-life values for ^{207}Bi, which although published in the Nuclear Data Sheets in 1977 (NDS 22, 4 (1977) 487), has been evaluated independent of the NSDD network effort by Y. Yoshizawa in 1980 (see Ref. Y08001) which takes into consideration the result of a more recent 1978 Japanese measurement.

- For the remaining radionuclides, evaluated by the NSDD network before 1977, half-life values were chosen from more recent compilations as follows:

  a) if the radionuclides in this category were included in the AECL report to ICRM (RU8001) the values recommended by this group were adopted,

  b) for those isotopes which are not included in the AECL report, the half-life values were taken from

     - the LMRI Table of Radionuclides

     - the Table of Isotopes for those radionuclides which have not been evaluated by any of the groups considered in this review, within the last five years.

C. Selection of Recommended Gamma-ray Energies and Intensities

Following the recommendation of the INDC Standards Subcommittee, all gamma-ray energy standards recommended by the IUPAP Commission on Atomic Masses and Fundamental Constants (see Reference HE7901) were adopted for those radionuclides included in this file.

Beyond this initial criterion, the recommended values of $E\gamma$ and $I\gamma$ were selected from the following publications and compilations of evaluated data:

1. Recent evaluations of gamma-ray energies and emission probabilities performed specifically for Ge(Li) spectrometer calibration (see References HE7801, GR7901, DE7902, HE7902, HE8102 and SC8001)

2. The LMRI Table of Radionuclides, including private communication from LMRI in 1981

3. The JAERI-M-8811 report by Y. Yoshizawa et al., "Evaluation of Gamma-Ray Intensities" (see Reference YO8001)

4. The nuclear spectroscopy standards listed in the 7th Edition of the Table of Isotopes (pages 2, 3 and 4 of the Appendices, Reference LE7801)

5. The report of the AECL Radioisotope Standardization Group to the α-, β- and γ-Ray Spectrometry Group of the ICRM (see Reference RU8001)

6. The Nuclear Data Sheets

7. The 7th Edition of the Table of Isotopes

8. The Evaluated Nuclear Structure Data File (ENSDF) as of July 1978 (see Reference DF8001).

The last two references were used primarily in those cases where the isotope had not been evaluated since before 1976.

Comments on the Tabulations

(The numbers in the comment column are to be read individually)

1. Gamma-ray lines of radionuclides included in the 1979 list of standards for gamma-ray energy calibration recommended by IUPAP (HE7901)

2. Radionuclides used as standards by groups performing transactinium isotope decay measurements

3. Radionuclides included in the list of gamma-ray standards submitted to the α-, β- and γ-ray Spectrometry Working Group of the International Committee for Radionuclide Metrology (RU8001)

4. Radionuclides included as gamma-ray standards in the 1978 INDC/NEANDC standards file

5. Radionuclides included in the list of nuclear spectroscopy standards in the 7th Edition of the Table of Isotopes (see pages 2, 3 and 4 of the Appendices in LE7801)

PHOTON ENERGIES AND EMISSION PROBABILITIES FOR RADIONUCLIDES USED AS STANDARDS

NUCLIDE	DECAY MODE	LEVEL	ENERGY (KEV) DATA	ENERGY (KEV) UNCERTAINTY	ENERGY (KEV) PER-CENT	ENERGY (KEV) REFERENCE	EMISSION PROBABILITY DATA	EMISSION PROBABILITY UNCERTAINTY	EMISSION PROBABILITY PER-CENT	EMISSION PROBABILITY REFERENCE	COMMENT
4-BE- 7			(477.605	+- 0.003)	0.001	LM8201	(0.1030	+- 0.0004)	0.388	LM8201	13
11-NA- 22			(1274.542	+- 0.007)	0.001	HE7901	(0.9995	+- 0.0002)	0.020	LM8201	12345
11-NA- 24			(1368.633	+- 0.006)	0.000	HE7901	(0.99994	+- 0.00002)	0.002	LM8201	12345
11-NA- 24			(2754.030	+- 0.014)	0.001	HE7901	(0.99881	+- 0.00008)	0.008	LM8201	12345
19-K - 42			(1524.665	+- 0.020)	0.001	LM8001	(0.179	+- 0.005)	2.793	LM8001	3
21-SC- 46			(889.277	+- 0.003)	0.000	HE7901	(0.999836	+- 0.000016)	0.002	YO8001	134
21-SC- 46			(1120.545	+- 0.004)	0.000	HE7901	(0.999871	+- 0.000012)	0.001	YO8001	134
24-CR- 51			(320.0842	+- 0.0009)	0.000	HE7901	(0.0985	+- 0.0009)	0.914	LM8201	12345
25-MN- 54			(834.843	+- 0.006)	0.001	HE7901	(0.99976	+- 0.00002)	0.002	LM8201	12345
25-MN- 56			(846.754	+- 0.020)	0.002	AU7701	(1.000	+- 0.003)	0.300	AU7701	3
25-MN- 56			(1810.72	+- 0.04)	0.002	AU7701	(0.275	+- 0.008)	2.909	AU7701	3
25-MN- 56			(2113.05	+- 0.04)	0.002	AU7701	(0.145	+- 0.004)	2.759	AU7701	3
25-MN- 56			(2522.88	+- 0.06)	0.002	AU7701	(0.0100	+- 0.0003)	3.000	AU7701	3
25-MN- 56			(2657.45	+- 0.05)	0.002	AU7701	(0.0066	+- 0.0002)	3.030	AU7701	3
25-MN- 56			(2959.77	+- 0.06)	0.002	AU7701	(0.0031	+- 0.0001)	3.226	AU7701	3
25-MN- 56			(3369.60	+- 0.07)	0.002	AU7701	(0.0017	+- 0.0001)	5.882	AU7701	3
26-FE- 59			(142.652	+- 0.002)	0.001	HE7801	(0.0098	+- 0.0004)	4.082	LM7901	1
26-FE- 59			(192.349	+- 0.005)	0.003	HE7801	(0.0295	+- 0.0008)	2.712	LM8101	1
26-FE- 59			(334.99	+- 0.05)	0.015	LM7901	(0.0027	+- 0.0001)	3.704	LM8101	1
26-FE- 59			(382.5	+- 0.2)	0.052	LM7901	(0.00021	+- 0.00003)	14.286	LM7901	1
26-FE- 59			(1099.251	+- 0.004)	0.000	HE7801	(0.561	+- 0.010)	1.783	LM7901	1
26-FE- 59			(1291.596	+- 0.007)	0.001	HE7801	(0.436	+- 0.008)	1.835	LM7901	1
26-FE- 59			(1481.7	+- 0.1)	0.007	LM7901	(0.00061	+- 0.00004)	6.557	LM7901	1
27-CO- 56			(846.764	+- 0.006)	0.001	HE7901	(0.99923	+- 0.00007)	0.007	LM8001	15
27-CO- 56			(1037.844	+- 0.004)	0.000	HE7901	(0.1409	+- 0.0006)	0.426	LM8001	15
27-CO- 56			(1175.099	+- 0.008)	0.001	HE7901	(0.0227	+- 0.0002)	0.881	LM8001	15
27-CO- 56			(1238.287	+- 0.006)	0.000	HE7901	(0.670	+- 0.007)	1.045	LM8001	15
27-CO- 56			(1360.206	+- 0.006)	0.000	HE7901	(0.0426	+- 0.0002)	0.469	LM8001	15
27-CO- 56			(1771.350	+- 0.015)	0.001	HE7901	(0.1549	+- 0.0005)	0.323	LM8001	15
27-CO- 56			(1810.722	+- 0.017)	0.001	HE7901					
27-CO- 56			(1963.714	+- 0.012)	0.001	HE7901					
27-CO- 56			(2015.179	+- 0.011)	0.001	HE7901	(0.0303	+- 0.0004)	1.320	LM8001	15
27-CO- 56			(2034.759	+- 0.011)	0.001	HE7901	(0.0778	+- 0.0012)	1.542	LM8001	15
27-CO- 56			(2112.921	+- 0.010)	0.000	HE7901					
27-CO- 56			(2113.117	+- 0.012)	0.001	HE7901					
27-CO- 56			(2598.460	+- 0.010)	0.000	HE7901	(0.1695	+- 0.0006)	0.354	LM8001	15
27-CO- 56			(3009.596	+- 0.017)	0.001	HE7901					
27-CO- 56			(3201.954	+- 0.014)	0.000	HE7901	(0.0318	+- 0.0008)	2.516	LM8001	15
27-CO- 56			(3253.417	+- 0.014)	0.000	HE7901	(0.0764	+- 0.0020)	2.618	LM8001	15
27-CO- 56			(3272.998	+- 0.014)	0.000	HE7901	(0.018	+- 0.001)	5.556	LM8001	15
27-CO- 56			(3451.154	+- 0.013)	0.000	HE7901	(0.0093	+- 0.0003)	3.226	LM8001	15
27-CO- 56			(3548.18	+- 0.12)	0.003	LM8001	(0.0019	+- 0.0001)	5.263	LM8001	15
27-CO- 57			(122.06135	+- 0.00030)	0.000	HE7901	(0.8568	+- 0.0013)	0.152	LM8201	1245

PHOTON ENERGIES AND EMISSION PROBABILITIES FOR RADIONUCLIDES USED AS STANDARDS

NUCLIDE	DECAY MODE	LEVEL	ENERGY (KEV) DATA	UNCERTAINTY	PER-CENT	REFERENCE	EMISSION PROBABILITY DATA	UNCERTAINTY	PER-CENT	REFERENCE	COMMENT
27-CO- 57			(136.4743	+- 0.0005)	0.000	HE7901	(0.1067	+- 0.0013)	1.218	LM8201	1245
27-CO- 58			(810.775	+- 0.009)	0.001	LM8201	(0.99445	+- 0.00010)	0.010	LM8201	4
27-CO- 58			(863.959	+- 0.009)	0.001	LM8201	(0.0069	+- 0.0002)	2.899	LM8201	4
27-CO- 58			(1674.730	+- 0.009)	0.001	LM8201	(0.00519	+- 0.00004)	0.771	LM8201	4
27-CO- 60			(1173.238	+- 0.004)	0.000	HE7901	(0.9989	+- 0.0002)	0.020	YO8001	12345
27-CO- 60			(1332.502	+- 0.005)	0.000	HE7901	(0.999816	+- 0.000015)	0.002	YO8001	12345
28-NI- 65			1482.			RU8001	(0.235	+- 0.004)	1.702	RU8001	3
29-CU- 64			(1345.77	+- 0.06)	0.004	HA7901	(0.0077	+- 0.0006)	7.792	HA7901	3
30-ZN- 65			(1115.546	+- 0.004)	0.000	HE7901	(0.5075	+- 0.0010)	0.197	LM8001	124
34-SE- 75			(24.38	+- 0.03)	0.123	LM8201	(0.0030	+- 0.0006)	20.000	LM8201	3
34-SE- 75			(66.060	+- 0.0007)	0.001	LM8201	(0.0113	+- 0.0002)	1.770	LM8201	3
34-SE- 75			(80.92	+- 0.02)	0.025	LM8201	(0.00008	+- 0.00002)	25.000	LM8201	3
34-SE- 75			(96.734	+- 0.002)	0.002	LM8201	(0.0349	+- 0.0007)	2.006	LM8201	3
34-SE- 75			(121.119	+- 0.003)	0.002	LM8201	(0.176	+- 0.002)	1.136	LM8201	3
34-SE- 75			(136.002	+- 0.003)	0.002	LM8201	(0.596	+- 0.005)	0.839	LM8201	3
34-SE- 75			(198.596	+- 0.006)	0.003	LM8201	(0.0151	+- 0.0002)	1.325	LM8201	3
34-SE- 75			(264.656	+- 0.004)	0.002	LM8201	(0.596	+- 0.003)	0.503	LM8201	3
34-SE- 75			(279.538	+- 0.003)	0.001	LM8201	(0.253	+- 0.003)	1.186	LM8201	3
34-SE- 75			(303.924	+- 0.003)	0.001	LM8201	(0.0134	+- 0.0002)	1.493	LM8201	3
34-SE- 75			(400.657	+- 0.002)	0.000	LM8201	(0.1160	+- 0.0015)	1.293	LM8201	3
34-SE- 75			(419.0	+- 0.2)	0.048	LM8201	(0.00012	+- 0.00002)	16.667	LM8201	3
34-SE- 75			(469.1	+- 0.2)	0.043	LM8201	(0.000032	+- 0.000006)	18.750	LM8201	3
34-SE- 75			(572.5	+- 0.2)	0.035	LM8201	(0.00038	+- 0.00002)	5.263	LM8201	3
34-SE- 75			(617.6	+- 0.2)	0.032	LM8201	(0.000045	+- 0.000002)	4.444	LM8201	3
34-SE- 75			(821.7	+- 0.2)	0.024	LM8201	(0.000013	+- 0.000002)	15.385	LM8201	3
35-BR- 82			(92.184	+- 0.007)	0.008	LM8201	(0.007?	+- 0.0003)	4.167	LM8201	3
35-BR- 82			(137.23	+- 0.04)	0.029	LM8201	(0.0012	+- 0.0005)	41.667	LM8201	3
35-BR- 82			(221.48	+- 0.03)	0.014	LM8201	(0.0227	+- 0.0005)	2.203	LM8201	3
35-BR- 82			(273.47	+- 0.03)	0.011	LM8201	(0.0081	+- 0.0003)	3.704	LM8201	3
35-BR- 82			(554.348	+- 0.003)	0.001	LM8201	(0.706	+- 0.003)	0.425	LM8201	3
35-BR- 82			(606.33	+- 0.02)	0.003	LM8201	(0.0125	+- 0.0007)	5.600	LM8201	3
35-BR- 82			(619.106	+- 0.004)	0.001	LM8201	(0.433	+- 0.003)	0.693	LM8201	3
35-BR- 82			(698.374	+- 0.005)	0.001	LM8201	(0.284	+- 0.004)	1.408	LM8201	3
35-BR- 82			(776.517	+- 0.003)	0.000	LM8201	(0.834	+- 0.002)	0.240	LM8201	3
35-BR- 82			(827.828	+- 0.006)	0.001	LM8201	(0.241	+- 0.003)	1.245	LM8201	3
35-BR- 82			(951.95	+- 0.04)	0.004	LM8201	(0.0038	+- 0.0002)	5.263	LM8201	3
35-BR- 82			(1007.54	+- 0.03)	0.003	LM8201	(0.0127	+- 0.0006)	4.724	LM8201	3
35-BR- 82			(1044.002	+- 0.007)	0.001	LM8201	(0.275	+- 0.006)	2.182	LM8201	3
35-BR- 82			(1081.3	+- 0.1)	0.009	LM8201	(0.0063	+- 0.0004)	6.349	LM8201	3
35-BR- 82			(1317.476	+- 0.006)	0.000	LM8201	(0.27	+- 0.008)	2.963	LM8201	3
35-BR- 82			1426.			LM8201	(0.0011	+- 0.0005)	45.455	LM8201	3
35-BR- 82			(1474.884	+- 0.006)	0.000	LM8201	(0.164	+- 0.002)	1.220	LM8201	3
35-BR- 82			(1650.339	+- 0.008)	0.000	LM8201	(0.0075	+- 0.0002)	2.667	LM8201	3
35-BR- 82			(1779.58	+- 0.05)	0.003	LM8201	(0.00116	+- 0.00003)	2.586	LM8201	3
36-KR- 85			(514.009	+- 0.012)	0.002	LM8201	(0.00437	+- 0.00011)	2.517	LM8201	3

PHOTON ENERGIES AND EMISSION PROBABILITIES FOR RADIONUCLIDES USED AS STANDARDS

NUCLIDE	DECAY MODE	ENERGY (KEV) LEVEL	DATA	UNCERTAINTY	PER-CENT	REFERENCE	EMISSION PROBABILITY DATA	UNCERTAINTY	PER-CENT	REFERENCE	COMMENT
38-SR- 85		(514.009	+- 0.012)	0.002	LM8201	(0.9929	+- 0.0004)	0.040	LM8201	234
39-Y - 88		(898.042	+- 0.004)	0.000	HE7901	(0.934	+- 0.007)	0.749	LM8201	1243
39-Y - 88		(1836.063	+- 0.013)	0.001	HE7901	(0.9934	+- 0.0007)	0.070	LM8201	1245
39-Y - 88		(2734.087	+- 0.087)	0.003	LE7801	(0.0072	+- 0.0007)	9.722	LM8201	1245
40-ZR- 95		(204.12	+- 0.02)	0.010	LM7701	(0.0003	+- 0.0001)	33.333	LM7701	13
40-ZR- 95		(235.69	+- 0.02)	0.008	LM7701	(0.0029	+- 0.0005)	17.241	LM7701	13
40-ZR- 95		(561.66	+- 0.02)	0.004	LM7701	(0.00010	+- 0.00004)	40.000	LM7701	13
40-ZR- 95		(724.199	+- 0.005)	0.001	HE7901	(0.4425	+- 0.0040)	0.904	LM7701	13
40-ZR- 95		(756.729	+- 0.012)	0.002	HE7801	(0.5444	+- 0.0040)	0.735	LM7701	13
41-NB- 94		(702.645	+- 0.006)	0.001	HE7901	0.998			HE8101	12
41-NB- 94		(871.119	+- 0.004)	0.000	HE7901	0.999			HE8101	12
41-NB- 95		(765.807	+- 0.006)	0.001	GR7901	(0.9980	+- 0.0002)	0.020	YO8001	4
43-TC- 99		(140.511	+- 0.001)	0.001	LM8201	(0.890	+- 0.002)	0.225	LM8201	3
43-TC- 99M1		141.			RU8001	(0.8875	+- 0.0014)	0.158	RU8001	3
47-AG-108M1		(433.936	+- 0.004)	0.001	HE7901	(0.905	+- 0.007)	0.773	YO8001	15
47-AG-108M1		(614.281	+- 0.004)	0.001	HE7901	(0.910	+- 0.007)	0.769	YO8001	15
47-AG-108M1		(722.929	+- 0.004)	0.001	HE7901	(0.907.	+- 0.008)		YO8001	15
47-AG-110M1		(446.811	+- 0.003)	0.001	LM8201	(0.0368	+- 0.0002)	0.543	LM8201	15
47-AG-110M1		(620.360	+- 0.003)	0.000	LM8201	(0.0279	+- 0.0002)	0.717	LM8201	15
47-AG-110M1		(657.7622	+- 0.0020)	0.000	HE7801	(0.9437	+- 0.0010)	0.106	LM8201	15
47-AG-110M1		(677.623	+- 0.002)	0.000	HE7801	(0.1048	+- 0.0010)	0.954	LM8201	15
47-AG-110M1		(687.015	+- 0.003)	0.000	LM8201	(0.0644	+- 0.0003)	0.466	LM8201	15
47-AG-110M1		(706.682	+- 0.003)	0.000	LM8201	(0.162	+- 0.002)	1.235	LM8201	15
47-AG-110M1		(744.277	+- 0.003)	0.000	LM8201	(0.0465	+- 0.0006)	1.290	LM8201	15
47-AG-110M1		(763.944	+- 0.003)	0.000	LM8201	(0.2225	+- 0.0007)	0.315	LM8201	15
47-AG-110M1		(818.031	+- 0.004)	0.000	LM8201	(0.0730	+- 0.0004)	0.548	LM8201	15
47-AG-110M1		(884.685	+- 0.003)	0.000	LM8201	(0.727	+- 0.003)	0.413	LM8201	15
47-AG-110M1		(937.493	+- 0.004)	0.000	LM8201	(0.3426	+- 0.0012)	0.350	LM8201	15
47-AG-110M1		(1384.300	+- 0.004)	0.000	LM8201	(0.258	+- 0.005)	1.938	LM8201	15
47-AG-110M1		(1475.788	+- 0.006)	0.000	LM8201	(0.0398	+- 0.0003)	0.754	LM8201	15
47-AG-110M1		(1505.040	+- 0.005)	0.000	LM8201	(0.1305	+- 0.0006)	0.460	LM8201	15
47-AG-110M1		(1562.302	+- 0.005)	0.000	LM8201	(0.0118	+- 0.0001)	0.847	LM8201	15
48-CD-109		(88.0341	+- 0.0011)	0.001	HE7801	(0.0365	+- 0.0006)	1.644	LM8201	245
49-IN-111		(171.28	+- 0.03)	0.018	HA7903	(0.902	+- 0.003)	0.333	LM8201	4
49-IN-111		(245.35	+- 0.04)	0.016	HA7903	(0.940	+- 0.002)	0.213	LM8201	4
49-IN-111		(537.	+- 1.)	0.186	HA7903	0.87			LM8201	4
49-IN-113M1		(391.702	+- 0.004)	0.001	LM8201	(0.6489	+- 0.0017)	0.262	LM8201	3
49-IN-115M1		336.			RU8001	(0.459	+- 0.003)	0.654	RU8001	3
50-SN-113		(255.115	+- 0.015)	0.006	HE7801	(0.0182	+- 0.0004)	2.198	MA7801	234

PHOTON ENERGIES AND EMISSION PROBABILITIES FOR RADIONUCLIDES USED AS STANDARDS

NUCLIDE	DECAY MODE	LEVEL	ENERGY (KEV) DATA	ENERGY (KEV) UNCERTAINTY	ENERGY (KEV) PER-CENT	ENERGY (KEV) REFERENCE	EMISSION PROBABILITY DATA	EMISSION PROBABILITY UNCERTAINTY	EMISSION PROBABILITY PER-CENT	EMISSION PROBABILITY REFERENCE	COMMENT
51-SB-124			(602.730	+- 0.003)	0.000	HE7901	(0.9792	+- 0.0029)	0.296	TA8101	15
51-SB-124			(645.855	+- 0.002)	0.000	HE7901	(0.0739	+- 0.0005)	0.677	TA8101	15
51-SB-124			(709.320	+- 0.013)	0.002	LF7801	(0.0135	+- 0.0002)	1.481	TA8101	15
51-SB-124			(713.781	+- 0.005)	0.001	HE7901	(0.0227	+- 0.0003)	1.322	TA8101	15
51-SB-124			(722.786	+- 0.004)	0.001	HE7901	(0.1077	+- 0.0010)	0.929	TA8101	15
51-SB-124			(790.712	+- 0.006)	0.001	HE7901	(0.0074	+- 0.0001)	1.351	TA8101	15
51-SB-124			(968.201	+- 0.004)	0.000	HE7901	(0.0189	+- 0.0002)	1.058	TA8101	15
51-SB-124			(1045.131	+- 0.003)	0.000	HE7901	(0.0184	+- 0.0004)	2.174	TA8101	15
51-SB-124			(1325.512	+- 0.005)	0.000	HE7901	(0.0163	+- 0.0004)	2.454	TA8101	15
51-SB-124			(1355.175	+- 0.022)	0.002	TA8101	(0.0104	+- 0.0004)	3.846	TA8101	15
51-SB-124			(1368.164	+- 0.006)	0.000	HE7901	(0.0262	+- 0.0005)	1.908	TA8101	15
51-SB-124			(1436.563	+- 0.006)	0.000	HE7901	(0.0123	+- 0.0005)	4.065	TA8101	15
51-SB-124			(1690.980	+- 0.004)	0.000	HE7901	(0.474	+- 0.006)	1.266	TA8101	15
51-SB-124			(2090.942	+- 0.007)	0.000	HE7901	(0.056	+- 0.001)	1.786	TA8101	15
53-I -125			(35.4919	+- 0.0005)	0.001	LM8201	(0.0667	+- 0.0013)	1.949	LM8201	4
54-XE-133			(79.623	+- 0.010)	0.013	LM8201	(0.0027	+- 0.0003)	11.111	LM8201	3
54-XE-133			(80.997	+- 0.003)	0.004	HE7801	(0.380	+- 0.007)	1.842	LM8201	3
54-XE-133			(160.613	+- 0.008)	0.005	LM8201	(0.00066	+- 0.00005)	7.576	LM8201	3
54-XE-133			(223.234	+- 0.012)	0.005	LM8201	(0.0000012	+- 0.0000002)	16.667	LM8201	3
54-XE-133			(302.853	+- 0.001)	0.000	LM8201	(0.000048	+- 0.000003)	6.250	LM8201	3
54-XE-133			(383.851	+- 0.003)	0.001	LM8201	(0.000024	+- 0.000002)	8.333	LM8201	3
55-CS-131			(355.	+- 6.)	1.690	LM8201	1.0			LM8201	
55-CS-134			(475.34	+- 0.02)	0.004	LM8201	(0.0150	+- 0.0002)	1.333	LM8201	35
55-CS-134			(563.23	+- 0.02)	0.004	LM8201	(0.0838	+- 0.0003)	0.358	LM8201	35
55-CS-134			(569.32	+- 0.02)	0.004	LM8201	(0.1539	+- 0.0005)	0.325	LM8201	35
55-CS-134			(604.69	+- 0.02)	0.003	LM8201	(0.9763	+- 0.0003)	0.031	LM8201	35
55-CS-134			(795.84	+- 0.01)	0.001	LM8201	(0.8552	+- 0.0003)	0.035	LM8201	35
55-CS-134			(801.93	+- 0.02)	0.002	LM8201	(0.0870	+- 0.0002)	0.230	LM8201	35
55-CS-134			(1038.555	+- 0.020)	0.002	LM8201	(0.00991	+- 0.00004)	0.404	LM8201	35
55-CS-134			(1167.92	+- 0.02)	0.002	LM8201	(0.01792	+- 0.00008)	0.446	LM8201	35
55-CS-134			(1365.16	+- 0.02)	0.001	LM8201	(0.03015	+- 0.00013)	0.431	LM8201	35
55-CS-134M1			(11.28	+- 0.02)	0.177	LM8201	(0.0094	+- 0.0009)	9.574	LM8201	
55-CS-134M1			(127.42	+- 0.06)	0.047	LM8201	(0.126	+- 0.004)	3.175	LM8201	
55-CS-134M1			(138.70	+- 0.03)	0.022	LM8201	(0.00004	+- 0.00001)	25.000	LM8201	
55-CS-137			32.1			LE7801	(0.0557	+- 0.0016)	2.873	LM8201	
55-CS-137			36.4			LE7801	(0.0107	+- 0.0004)	3.738	LM8201	
55-CS-137			37.3			LE7801	(0.0025	+- 0.0001)	4.000	LM8201	
55-CS-137			(661.660	+- 0.003)	0.000	LM8201	(0.847	+- 0.003)	0.354	LM8201	12345
56-BA-133			(53.161	+- 0.001)	0.002	HE8102	(0.0220	+- 0.0006)	2.727	LM8001	235
56-BA-133			(79.623	+- 0.010)	0.013	LM8001	(0.0264	+- 0.0012)	4.545	LM8001	
56-BA-133			(80.997	+- 0.003)	0.004	HE7801	(0.343	+- 0.006)	1.749	LM8001	235
56-BA-133			(160.613	+- 0.008)	0.005	LM8001	(0.0062	+- 0.0002)	3.226	LM8001	235
56-BA-133			(223.234	+- 0.012)	0.005	LM8001	(0.00447	+- 0.00020)	4.474	LM8001	235
56-BA-133			(276.398	+- 0.002)	0.001	HE8102	(0.0712	+- 0.0007)	0.983	LM8001	235
56-BA-133			(302.853	+- 0.001)	0.000	HE8102	(0.183	+- 0.002)	1.093	LM8001	235
56-BA-133			(356.017	+- 0.002)	0.001	HE8102	(0.621	+- 0.007)	1.127	LM8001	235

PHOTON ENERGIES AND EMISSION PROBABILITIES FOR RADIONUCLIDES USED AS STANDARDS

NUCLIDE	DECAY MODE	LEVEL	ENERGY (KEV) DATA	ENERGY (KEV) UNCERTAINTY	ENERGY (KEV) PER-CENT	ENERGY (KEV) REFERENCE	EMISSION PROBABILITY DATA	EMISSION PROBABILITY UNCERTAINTY	EMISSION PROBABILITY PER-CENT	EMISSION PROBABILITY REFERENCE	COMMENT
56-BA-133			(383.851	+- 0.003)	0.001	HE8102	(0.0892	+- 0.0009)	1.009	LM8001	235
56-BA-137M1			(661.660	+- 0.003)	0.000	LM8201	(0.9007	+- 0.0004)	0.044	LM8201	
58-CE-139			(165.857	+- 0.006)	0.004	LM8201	(0.7999	+- 0.0010)	0.125	LM8201	234
58-CE-141			(145.4442	+- 0.0014)	0.001	HE7801	(0.488	+- 0.004)	0.820	LM8101	234
58-CE-144			(33.622	+- 0.010)	0.030	LM8201	(0.0029	+- 0.0002)	6.897	LM8201	14
58-CE-144			(40.89	+- 0.05)	0.122	LM8201	(0.0039	+- 0.0006)	15.385	LM8201	14
58-CE-144			(53.432	+- 0.010)	0.019	LM8201	(0.00095	+- 0.00005)	5.263	LM8201	14
58-CE-144			(59.03	+- 0.03)	0.051	LM8201	(0.000012	+- 0.000002)	16.667	LM8201	14
58-CE-144			(80.106	+- 0.005)	0.006	LM8201	(0.0112	+- 0.0013)	11.607	LM8201	14
58-CE-144			(99.963	+- 0.020)	0.020	LM8201	(0.00039	+- 0.00003)	7.692	LM8201	14
58-CE-144			(133.544	+- 0.005)	0.004	LM8201	(0.110	+- 0.002)	1.818	LM8201	14
63-EU-152			(121.7824	+- 0.0004)	0.000	HE7901	(0.2837	+- 0.0024)	0.846	DE7902	12345
63-EU-152			(244.6989	+- 0.0010)	0.000	HE7901	(0.0751	+- 0.0005)	0.666	DE7902	12345
63-EU-152			(344.2811	+- 0.0019)	0.001	HE7901	(0.2658	+- 0.0018)	0.677	DE7902	12345
63-EU-152			(411.115	+- 0.005)	0.001	LE7801	(0.02234	+- 0.00013)	0.582	DE7902	12345
63-EU-152			(443.976	+- 0.005)	0.001	LE7801	(0.0312	+- 0.00018)	0.577	DE7902	12345
63-EU-152			(778.903	+- 0.006)	0.001	LE7801	(0.1296	+- 0.0007)	0.540	DE7902	12345
63-EU-152			(964.131	+- 0.009)	0.001	LE7801	(0.1462	+- 0.0006)	0.410	DE7902	12345
63-EU-152			(1085.914	+- 0.013)	0.001	LE7801	(0.1016	+- 0.0005)	0.492	DE7902	12345
63-EU-152			(1112.116	+- 0.017)	0.002	LE7801	(0.1356	+- 0.0006)	0.442	DE7902	12345
63-EU-152			(1408.011	+- 0.014)	0.001	LE7801	(0.2085	+- 0.0008)	0.384	DE7902	12345
64-GD-153			(69.6734	+- 0.0020)	0.003	HE7901	(0.0242	+- 0.0012)	4.959	MA7801	1
64-GD-153			(83.367	+- 0.003)	0.004	MA7801	(0.00206	+- 0.00022)	10.680	MA7801	1
64-GD-153			(97.4316	+- 0.0030)	0.003	HE7901	(0.295	+- 0.009)	3.051	MA7801	1
64-GD-153			(103.1807	+- 0.0030)	0.003	HE7901	(0.211	+- 0.008)	3.791	MA7801	1
69-TM-170			(84.25510	+- 0.00030)	0.000	HE7901	(0.0326	+- 0.0016)	4.908	SC7501	1
70-YB-169			(63.1208	+- 0.0002)	0.000	SH8201	(0.43695	+- 0.01500)	3.433	SH8201	35
70-YB-169			(93.6151	+- 0.0004)	0.000	SH8201	(0.02656	+- 0.00087)	3.276	SH8201	35
70-YB-169			(109.7802	+- 0.0003)	0.000	SH8201	(0.17345	+- 0.00506)	2.917	SH8201	35
70-YB-169			(118.1901	+- 0.0010)	0.001	SH8201	(0.01878	+- 0.00053)	2.822	SH8201	35
70-YB-169			(130.5239	+- 0.0004)	0.000	SH8201	(0.11098	+- 0.00490)	4.415	SH8201	35
70-YB-169			(177.2144	+- 0.0005)	0.000	SH8201	(0.21429	+- 0.00602)	2.809	SH8201	35
70-YB-169			(197.9581	+- 0.0006)	0.000	SH8201	(0.349	+- 0.008)	2.292	SH8201	35
70-YB-169			(261.0788	+- 0.0007)	0.000	SH8201	(0.01895	+- 0.00050)	2.639	SH8201	35
70-YB-169			(307.7382	+- 0.0008)	0.000	SH8201	(0.10784	+- 0.00160)	1.484	SH8201	35
73-TA-182			(31.7378	+- 0.004)	0.013	LE7801	(0.00892	+- 0.00021)	2.354	SC8001	125
73-TA-182			(42.7154	+- 0.006)	0.014	LE7801	(0.00266	+- 0.00008)	3.008	SC8001	125
73-TA-182			57.98			SC8001	(0.2802	+- 0.0052)	1.856	SC8001	
73-TA-182			(65.72247	+- 0.00014)	0.000	LE7801					125
73-TA-182			(67.75001	+- 0.00020)	0.000	HE7901	(0.571	+- 0.013)	2.277	SC8001	125
73-TA-182			(84.6808	+- 0.0003)	0.000	HE7901	(0.0263	+- 0.0010)	3.802	SC8001	125
73-TA-182			(100.10653	+- 0.00030)	0.000	HE7901	(0.1423	+- 0.0042)	2.952	SC8001	125
73-TA-182			(113.6723	+- 0.0004)	0.000	HE7901	(0.0187	+- 0.0006)	3.209	SC8001	125
73-TA-182			(116.4186	+- 0.0007)	0.001	HE7901	(0.00445	+- 0.00015)	3.371	SC8001	125

PHOTON ENERGIES AND EMISSION PROBABILITIES FOR RADIONUCLIDES USED AS STANDARDS

NUCLIDE	DECAY MODE	LEVEL	ENERGY (KEV) DATA	UNCERTAINTY	PER-CENT	REFERENCE	EMISSION PROBABILITY DATA	UNCERTAINTY	PER-CENT	REFERENCE	COMMENT
73-TA-182			(152.4308	+- 0.0005)	0.000	HE7901	(0.0695	+- 0.0009)	1.295	SC8001	125
73-TA-182			(156.3874	+- 0.0005)	0.000	HE7901	(0.0263	+- 0.0005)	1.901	SC8001	125
73-TA-182			(179.3948	+- 0.0005)	0.000	HE7901	(0.0309	+- 0.0004)	1.294	SC8001	125
73-TA-182			(198.3530	+- 0.0006)	0.000	HE7901	(0.0144	+- 0.0002)	1.389	SC8001	125
73-TA-182			(222.1099	+- 0.0006)	0.000	HE7901	(0.0750	+- 0.0010)	1.333	SC8001	125
73-TA-182			(229.3220	+- 0.0009)	0.000	HE7901	(0.0364	+- 0.0005)	1.374	SC8001	125
73-TA-182			(264.0755	+- 0.0008)	0.000	HE7901	(0.0362	+- 0.0006)	1.657	SC8001	125
73-TA-182			(1121.301	+- 0.005)	0.000	HE7901	(0.3530	+- 0.0032)	0.907	SC8001	125
73-TA-182			(1189.050	+- 0.005)	0.000	HE7901	(0.1644	+- 0.0015)	0.912	SC8001	125
73-TA-182			(1221.408	+- 0.005)	0.000	HE7901	(0.2717	+- 0.0025)	0.920	SC8001	125
73-TA-182			(1231.016	+- 0.005)	0.000	HE7901	(0.1158	+- 0.0011)	0.950	SC8001	125
73-TA-182			(1257.418	+- 0.005)	0.000	HE7901	(0.0150	+- 0.0002)	1.333	SC8001	125
73-TA-182			(1289.156	+- 0.005)	0.000	HE7901	(0.0136	+- 0.0002)	1.471	SC8001	125
77-IR-192			(136.3434	+- 0.0005)	0.000	HE7901	(0.0018	+- 0.0001)	5.556	LM8101	15
77-IR-192			(205.7955	+- 0.0005)	0.000	HE7901	(0.0331	+- 0.0006)	1.813	LM8101	15
77-IR-192			(295.95821	+- 0.0008)	0.000	HE7901	(0.287	+- 0.002)	0.697	LM8101	15
77-IR-192			(308.45685	+- 0.0008)	0.000	HE7901	(0.297	+- 0.003)	1.010	LM8101	15
77-IR-192			(316.50800	+- 0.0008)	0.000	HE7901	(0.830	+- 0.003)	0.361	LM8101	15
77-IR-192			(468.0715	+- 0.0012)	0.000	LM8001	(0.478	+- 0.003)	0.628	LM8001	15
77-IR-192			(484.5779	+- 0.0013)	0.000	HE7901	(0.0316	+- 0.0003)	0.949	LM8001	15
77-IR-192			(588.5851	+- 0.0016)	0.000	HE7901	(0.0448	+- 0.0004)	0.893	LM8001	15
77-IR-192			(604.41455	+- 0.0016)	0.000	HE7901	(0.0807	+- 0.0006)	0.743	LM8001	15
77-IR-192			(612.46569	+- 0.0016)	0.000	HE7901	(0.0527	+- 0.0005)	0.949	LM8001	15
77-IR-192			(884.5423	+- 0.0020)	0.000	HE7901	(0.0029	+- 0.0001)	3.448	LM8001	15
79-AU-198			(411.8044	+- 0.0011)	0.000	HE7901	(0.9556	+- 0.0007)	0.073	LM8201	12345
79-AU-198			(675.8875	+- 0.0019)	0.000	HE7901	(0.0082	+- 0.0003)	3.659	LM8201	12345
79-AU-198			(1087.6905	+- 0.0029)	0.000	HE7801	(0.00167	+- 0.00009)	5.389	LM8201	12345
80-HG-203			(70.8319	+- 0.0008)	0.001	LM8201	(0.038	+- 0.001)	2.632	LM8201	
80-HG-203			(72.8715	+- 0.0009)	0.001	LM8201	(0.064	+- 0.002)	3.125	LM8201	
80-HG-203			82.4			LM8201	(0.022	+- 0.001)	4.545	LM8201	
80-HG-203			85.2			LM8201	(0.0063	+- 0.0003)	4.762	LM8201	
80-HG-203			(279.1967	+- 0.0012)	0.000	HE7801	(0.816	+- 0.002)	0.245	LM8201	12345
83-BI-207			(569.702	+- 0.002)	0.000	HE7901	(0.9774	+- 0.0003)	0.031	YO8001	1
83-BI-207			(1063.662	+- 0.004)	0.000	HE7901	(0.740	+- 0.003)	0.405	YO8001	1
83-BI-207			(1770.237	+- 0.010)	0.001	HE7901	(0.0687	+- 0.0004)	0.582	YO8001	1
90-TH-228			(84.371	+- 0.003)	0.004	LE7801	(0.0121	+- 0.0006)	4.959	LE7801	
90-TH-228			(131.610	+- 0.004)	0.003	LE7801	(0.00123	+- 0.00006)	4.878	LE7801	1
90-TH-228			(166.407	+- 0.004)	0.002	LE7801	(0.000956	+- 0.000048)	5.021	LE7801	1
90-TH-228			(205.93	+- 0.05)	0.024	LE7801	(0.000184	+- 0.000008)	4.348	LE7801	1
90-TH-228			(215.979	+- 0.005)	0.002	LE7801	(0.00238	+- 0.00013)	5.462	LE7801	1
95-AM-241			(26.345	+- 0.001)	0.004	LE7801	(0.024	+- 0.001)	4.167	LE7801	245
95-AM-241			(33.195	+- 0.011)	0.033	LE7801	(0.00103	+- 0.00011)	10.680	LE7801	245
95-AM-241			(43.423	+- 0.020)	0.046	LE7801	(0.00057	+- 0.00018)	31.579	LE7801	245
95-AM-241			(59.537	+- 0.001)	0.002	LE7801	(0.3582	+- 0.0012)	0.335	HU8101	245

RECOMMENDED HALF LIVES OF RADIONUCLIDES USED AS CALIBRATION STANDARDS

NUCLIDE	DECAY MODE	HALF-LIFE UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY	HALF-LIFE PER-CENT	HALF-LIFE REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY	BRANCHING FRACTION PER-CENT	BRANCHING FRACTION REFERENCE	COMMENT
4-BE- 7	EC	D	(53.29	+- 0.07)	0.131	AJ7901					13
9-F - 18	B+	M	(109.77	+- 0.05)	0.046	AJ7801					3
11-NA- 22	T	Y	(2.602	+- 0.001)	0.038	LM8101					1234
11-NA- 22	B+						(0.9028	+- 0.0006)	0.066	LE7801	
11-NA- 22	EC						(0.0972	+- 0.0006)	0.617	LE7801	
11-NA- 24	B-	H	(14.960	+- 0.006)	0.040	LM8101					1234
19-K - 42	B-	H	(12.359	+- 0.006)	0.049	LM8101					3
21-SC- 46	B-	D	(83.83	+- 0.02)	0.024	AU7801					134
24-CR- 51	EC	D	(27.703	+- 0.004)	0.014	LM8101					1234
25-MN- 54	EC	D	(312.2	+- 0.1)	0.032	LM8101					1234
25-MN- 56	B-	H	(2.5785	+- 0.0006)	0.023	AU7701					3
26-FE- 59	B-	D	(45.54	+- 0.05)	0.110	LM7901					1
27-CO- 56	T	D	(77.12	+- 0.10)	0.130	LM8101					1
27-CO- 56	B+						0.19			LE7801	
27-CO- 56	EC						0.81			LE7801	
27-CO- 57	EC	D	(271.73	+- 0.14)	0.052	LM8101					124
27-CO- 58	T	D	(70.78	+- 0.10)	0.141	LM7401					4
27-CO- 58	B+						(0.1500	+- 0.0005)	0.333	LE7801	
27-CO- 58	EC						(0.8500	+- 0.0005)	0.059	LE7801	
27-CO- 60	B-	Y	(5.271	+- 0.001)	0.019	AU7901					1234
28-NI- 65	B-	H	(2.520	+- 0.001)	0.040	RU8001					3
29-CU- 64	T	H	(12.701	+- 0.002)	0.016	HA7901					3
29-CU- 64	B-						(0.396	+- 0.020)	5.051	LE7801	
29-CU- 64	B+						(0.193	+- 0.007)	3.627	LE7801	
29-CU- 64	EC						0.411			LE7801	
30-ZN- 65	T	D	(244.0	+- 0.2)	0.082	LE7801					124
30-ZN- 65	B+						(0.0146	+- 0.0002)	1.370	LE7801	
30-ZN- 65	EC						(0.9854	+- 0.0002)	0.020	LE7801	
34-SE- 75	EC	D	(119.78	+- 0.01)	0.008	LM8101					3
35-BR- 82	B-	H	(35.30	+- 0.03)	0.085	LM8101					3
36-KR- 85	B-	Y	(10.72	+- 0.02)	0.187	TE8001					3
38-SR- 85	EC	D	(64.85	+- 0.02)	0.031	LM8101					234

RECOMMENDED HALF LIVES OF RADIONUCLIDES USED AS CALIBRATION STANDARDS

NUCLIDE	DECAY MODE	HALF-LIFE UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY	HALF-LIFE PER-CENT	HALF-LIFE REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY	BRANCHING FRACTION PER-CENT	BRANCHING FRACTION REFERENCE	COMMENT
39-Y - 88	EC	D	(106.6	+- 0.2)	0.188	YO8001					124
39-Y - 88	EC	D	(106.60	+- 0.04)	0.038	BU7601					
40-ZR- 95	B-	D	(63.98	+- 0.06)	0.094	LM7701					13
41-NB- 94	B-	Y	(2.03	+- 0.16)E+4	7.882	LE7801					12
41-NB- 95	B-	D	(35.05	+- 0.10)	0.285	LM8101					4
43-TC- 99	B-	Y	(2.14	+- 0.05)E+5	2.336	LE7801					3
43-TC- 99M1	T	H	(6.007	+- 0.002)	0.033	LM8101					3
43-TC- 99M1	B-						9.E-7			LE7801	
43-TC- 99M1	IT						0.9999			LE7801	
47-AG-108M1	T	Y	(127.	+- 21.)	16.535	YO8001					1
47-AG-108M1	IT						(0.081	+- 0.008)	9.877	LE7801	
47-AG-108M1	EC						(0.919	+- 0.008)	0.871	LE7801	
47-AG-110M1	B-	D	(249.8	+- 0.1)	0.040	LM8101					1
48-CD-109	EC	D	(463.1	+- 0.8)	0.173	LM8101					24
49-IN-111	EC	D	(2.802	+- 0.003)	0.107	LM8101					4
49-IN-113M1	IT	M	(99.49	+- 0.06)	0.060	RU8001					3
49-IN-115M1	T	H	(4.486	+- 0.004)	0.089	HA8001					3
49-IN-115M1	B-						(0.050	+- 0.007)	14.000	HA8001	
49-IN-115M1	IT						(0.950	+- 0.007)	0.737	HA8001	
50-SN-113	EC	D	(115.10	+- 0.17)	0.148	LM8101					234
51-SB-124	B-	D	(60.20	+- 0.03)	0.050	TA8101					1
53-I -125	EC	D	(59.90	+- 0.11)	0.184	LM8101					4
54-XE-133	B-	D	(5.244	+- 0.007)	0.133	LM8101					3
55-CS-131	EC	D	(9.68	+- 0.06)	0.620	LM7401					
55-CS-134	B-	Y	(2.066	+- 0.001)	0.048	LM8101					3
55-CS-134M1	IT	H	(2.91	+- 0.02)	0.687	LM7401					
55-CS-137	B-	Y	(30.18	+- 0.05)	0.166	LM7701					1234
56-BA-133	EC	Y	(10.6	+- 0.2)	1.887	LM8001					23
56-BA-137M1	IT	M	(2.554	+- 0.002)	0.078	LM7701					
58-CE-139	EC	D	(137.65	+- 0.03)	0.022	RU8001					234

RECOMMENDED HALF LIVES OF RADIONUCLIDES USED AS CALIBRATION STANDARDS

NUCLIDE	DECAY MODE	UNITS	HALF-LIFE DATA	HALF-LIFE UNCERTAINTY	HALF-LIFE PER-CENT	HALF-LIFE REFERENCE	BRANCHING FRACTION DATA	BRANCHING FRACTION UNCERTAINTY	BRANCHING FRACTION PER-CENT	BRANCHING FRACTION REFERENCE	COMMENT
58-CE-141	B-	D	(32.50	+- 0.01)	0.031	TU7801					234
58-CE-144	B-	D	(284.9	+- 0.2)	0.070	TU7901					14
63-EU-152	T	Y	(13.33	+- 0.04)	0.300	BA8001					1234
63-EU-152	B-						(0.2792	+- 0.0019)	0.681	BA8001	
63-EU-152	B+						0.00019			BA8001	
63-EU-152	EC						(0.7208	+- 0.0019)	0.264	BA8001	
64-GD-153	EC	D	(241.6	+- 0.2)	0.083	LE8101					1
69-TM-170	B-	D	(128.6	+- 0.3)	0.233	LE7801					1
70-YB-169	EC	D	(32.022	+- 0.008)	0.025	SH8201					3
73-TA-182	B-	D	(114.8	+- 0.2)	0.174	DA8101					12
77-IR-192	B-	D	(74.1	+- 0.2)	0.270	DA8101					1
79-AU-198	B-	D	(2.695	+- 0.002)	0.074	LM7702					1234
80-HG-203	B-	D	(46.585	+- 0.008)	0.017	LM8101					1234
83-BI-207	EC	Y	(33.4	+- 0.8)	2.395	YO8001					1
90-TH-228	A	Y	(1.913	+- 0.002)	0.105	TD8201					1
95-AM-241	A	Y	(432.2	+- 0.5)	0.116	TD8201					24

References to the Tabulations of Half-Lives and Gamma-ray Energies and Intensities Used as Calibration Standards

AJ7801 F. Ajzenberg-Selove
Energy Levels of Light Nuclei A = 18-20
Nucl. Phys. A300 (1) (1978) 1-224

AJ7901 F. Ajzenberg-Selove
Energy Levels of Light Nuclei A = 5-10
Nucl. Phys. 320 (1979) 1-224

AU7701 R.L. Auble
Mass Chain Evaluation A = 56
Nuclear Data Sheets 20, (3) (1977) 253

AU7801 R.L. Auble
Mass Chain Evaluation A = 46
Nuclear Data Sheets 24, (1) (1978) 1

AU7901 R.L. Auble
Mass Chain Evaluation A = 60
Nuclear Data Sheets 28, (2) (1979) 103

BA8001 C.M. Baglin
Mass Chain Evaluation A = 152
Nuclear Data Sheets 30, (1) (1980) 1

BU7601 R.L. Bunting, J.J. Kraushaar
Mass Chain Evaluation A=88
Nuclear Data Sheets 18 (2) (1976) 87

DA8101 J. Dairiki
Mass Chain Evaluation A = 182 and 192
Priv. Comm., February 1981
(Work in progress, to be published
in Nuclear Data Sheets)

DE7902 K. Debertin
Nucl. Instr. and Meth. 15 (1979) 465

GR7901 R.C. Greenwood, R.G. Helmer, R.J. Gehrke
Nucl. Instr. and Meth. 159 (1979) 465

HA7901 M.L. Halbert
Mass Chain Evaluation A = 64
Nuclear Data Sheets 28, (2) (1979) 179

HA7903 B. Harmatz
Mass Chain Evaluation A = 111
Nuclear Data Sheets 27, (3) (1979) 453

HA8001 B. Harmatz
Mass Chain Evaluation A = 115
Nuclear Data Sheets 30, (3) (1980) 413

HE7801 R.G. Helmer, R.C. Greenwood, R.J. Gehrke
Nucl. Instr. and Meth. 155 (1978) 189

HE7901 R.G. Helmer, P.H.M. van Asshe, C. van der Leun
Recommended Standards for Gamma-ray Energy Calibration (1979).
(To be published in ADNDT)

HEB101 R.G. Helmer
Private Communication, December 1981

HEB102 R.G. Helmer, A.J. Caffrey, R.J. Gehrke R.C. Greenwood
Nucl. Instr. and Meth 188 (1981) 671

HUB101 J.M.R. Hutchinson, P.A. Manlen
National Bureau of Standards,
September 1981 (unpublished)

LE7801 C.M. Lederer, V.S. Shirley (Edts.)
Table of Isotopes (7th Edition)
John Wiley and Sons (1978)

LEB101 M.A. Lee
Mass Chain Evaluation A = 153
Priv. Comm. Feb. 1981
(Work in progress, to be published in Nuclear Data Sheets)

LM7401 Table of Radionuclides Evaluated by the LMRI
J. Legrand (evaluator), 1974
Laboratoire de Metrologie des Rayonnement Ionisants, CEA, France

LM7701 Table of Radionuclides Evaluated by the LMRI
F. Lagoutine (evaluator), 1977
Laboratoire de Metrologie des Rayonnements Ionisants, CEA, France

LM7702 Table of Radionuclides Evaluated by the LMRI
J.P. Perolat (evaluator), 1977
Laboratoire de Metrologie des Rayonnements Ionisants, CEA, France

LM7901 Table of Radionuclides Evaluated by the LMRI
F. Lagoutine (evaluator), 1974
Laboratoire de Metrologie des Rayonnements Ionisants, CEA, France

LM8001 Table of Radionuclides Evaluated by the LMRI
N. Coursol, F. Lagoutine (evaluators), 1980
Laboratoire de Metrologie des Rayonnements Ionisants, CEA, France

LMB101 Private Communication, June 1981
Laboratoire de Metrologie des Rayonnement Ionisants, CEA, France

LMB201 Private Communication, September 1982
Laboratoire de Metrologie des Rayonnements Ionisants, CEA, France

MA7801 M.J. Martin (Ed.)
Appendix to "Handbook of Radioactivity Measurement Procedures"
NCRP Report 58. U.S. National Committee on Radiation Protection 1978

RUB001 A.R. Rutledge, L.V. Smith and J.S. Merrit
AECL-6692, Decay Data for Radionuclides used for the Calibration of X- and gamma-ray spectrometers (1980)

SC7501 M.R. Schmorak
Mass Chain Evaluation A = 170
Nuclear Data Sheets 15, (3) (1975) 371

SCB001 U. Schoetzig, K. Debertin, K.F. Walz
Nucl. Instr. and Meth. 169 (1980) 43

SH8201 V. Shirley
Mass Chain Evaluation A=169
Nuclear Data Sheets (to be published)

TAB101 T. Tamura
Mass Chain Evaluation A = 124
Priv. Comm., February 1981
(Work in progress, to be published in Nuclear Data Sheets)

TIB201 Proposed Recommended List of Transactinium Isotope Decay Data. Part I. Half-Lives (December 1982 Edition); A. Lorenz (Ed.)
INDC(NDS)-139/NE (1982)

TEB001 J.W. Tepel
Mass Chain Evaluation A = 85
Nuclear Data Sheets 30, (4) (1980) 501

TU7801 J.K. Tuli
Mass Chain Evaluation A = 141
Nuclear Data Sheets 23, (4) (1978) 529

TU7901 J.K. Tuli
Mass Chain Evaluation A = 144
Nuclear Data Sheets 27, 01 (1979) 97

YOB001 Y. Yoshizawa, et al.
Evaluation of Gamma-ray Intensities
Report JAERI-M 8811, also
INDC(JAP)-50/G (1980)