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Recommended Nuclear Decay Data

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Department for **Innovation, Universities** & **Skills**

Recommended Nuclear Decay Data

Andy Pearce
Division for the Quality of Life

EXECUTIVE SUMMARY

A guide to traceable nuclear decay data for the purposes of radiometric assay is presented. The sources of decay data recommended by NPL are described. Recommended values of half lives and specific activities are provided.

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1. Introduction

This report is intended to represent a guide to traceable nuclear decay data for use in radiometric assay. It contains both a summary of the various data sources available and recommended data collated from these sources.

The first part of this report concerns decay data sources. It describes the sources of decay data which are recommended by NPL. Other sources which may be encountered by users, such as those considered obsolete or unsuitable for use in applications where traceability is required, are also listed.

Sections 4 and 5 contain recommended values. Section 4 contains a list of recommended half lives taken from the decay data source appropriate for that radionuclide. Section 5 contains specific activities for radionuclides with a half life of greater than 10 years calculated using the recommended half lives and most recent atomic mass evaluations.

While the majority of decay data are well-characterised, there remain some areas where the measured data may be insufficient to assign reliable values (see for example the recent work of Collé[30]) or where existing measured data have not yet been incorporated into evaluations. Measurements and evaluations are therefore ongoing and this publication will be reissued periodically reflecting improvements in the evaluated data.

2. Recommended Nuclear Decay Data Sources

The following are the nuclear decay data sources recommended by NPL. These datasources have been selected on the basis of technical quality, traceability of the data to published measured data and the degree to which the datasources are recognised internationally.

2.1. Decay Data Evaluation Project (DDEP)

The Decay Data Evaluation Project was founded in 1995 as an international collaboration to provide high quality evaluated nuclear data for the purposes of applied research and detector calibration[1]. Contributors include Laboratoire Nationale Henri Becquerel (LNHB, France), Physikalisch-Technische Bundesanstalt (PTB, Germany), Idaho National Laboratory (INEEL, USA), Khlopin Radium Institute (KRI, Russia), Lawrence Berkeley National Laboratory (LBNL, USA), National Physical Laboratory (NPL, United Kingdom) and Centro de Investigaciones Energéticas Medioambientales y Tecnológicas (Ciemat, Spain).

Evaluators work on a nuclide-by-nuclide basis according to the needs of their user base. To date, 119 radionuclides have been evaluated. The DDEP data generally represents the best available decay data for the radionuclides which it covers.

The recommended data are maintained on the **nucleide.org** website operated by the Laboratoire Nationale Henri Becquerel (LNHB, France): www.nucleide.org/DDEP_WG/DDEPdata.htm. These data are updated frequently.

A snapshot of the data in time is also published by the Bureau International de Poids et Mesures as **BIPM Monographie 5**[2-3]. The intention of the publication is to promote wider use of the data and to provide a "more permanent" format which can be referenced easily. This data is updated periodically with the publication of additional volumes.

Issues reported concerning these data are that the data does not include specific activities. Deriving specific activities from half lives and atomic masses is trivial compared with other evaluation procedures and this report contains in its appendices specific activities for selected radionuclides. The fact that the data are updated frequently presents a problem for some users, who are advised to maintain their own records of the nuclear data they use through their local document control system. Finally some users have expressed a preference for a datafile format as opposed to PDF. This has to some extent been dealt with by the publication of files in ENSDF format on the DDEP webpages.

2.2. International Atomic Energy Agency Data

IAEA TECDOC-619[4] was the result of an IAEA research programme with the aim of providing an internationally accepted set of nuclear data for use in gamma spectrometer calibration. This programme ran from 1986 to 1990.

IAEA Techical Report 261[6] was the result of another IAEA research programme with the aim of improving the quality and accuracy of heavy element and actinide decay data. This programme ran from 1978 until 1985 with the publication of TECHREP-261 following shortly after in 1986.

In both cases much of this data has been superceded by the work of the DDEP. A Coordinated Research Programme (CRP) to replace TECDOC-619 has recently concluded and the full dataset has been published online at www-nds.iaea.org/xgamma_standards/crp.html. A paper report is planned but not yet published. This data forms a useful alternative for radionuclides such as ^{134}Cs which have not yet been evaluated through the DDEP.

A second CRP with the aim of replacing Technical Report 261 is in progress. The evaluation procedures adopted are those of the DDEP, and data will be published as and when available through the DDEP as well as in a technical report at the end of the programme. Users with an interest in actinide decay data are therefore recommended to refer to the DDEP in the first instance.

2.3. Evaluated Nuclear Structure Data File (ENSDF) and Nuclear Database (NUDAT)

The ENSDF database is maintained by the National Nuclear Data Center at Brookhaven National Laboratory and contains evaluated nuclear structure and decay data in a standard format. An international network of evaluators contributes to the database, although the bulk of the work is carried out in the US. Most of the recently completed evaluations are published in *Nuclear Data Sheets*.

Raw ENSDF datasets can be downloaded from the US National Nuclear Data Centre at Brookhaven, www.nndc.bnl.gov/ensdf. The format of this data is well-defined[7] and several interpreter codes are available[8]. The data contained in ENSDF are comprehensive, accurate and traceable. NPL recommends and uses nuclear data from ENSDF where radionuclides have not yet been evaluated through the other recommended data sources.

One drawback of the ENSDF database for many applied users is that the focus of the evaluator is on producing nuclear structure data. This results in a large collection of data, only a small subset of which is relevant to the typical radiochemical analyst. For applied users the NUDAT database is a useful abstraction from ENSDF. NUDAT contains nuclide and line search facilities and presents data in a form more accessible than ENSDF. NUDAT can be accessed at www.nndc.bnl.gov/nudat2.

2.4. Joint Evaluated Fission & Fusion (JEFF) project

The Joint Evaluated Fission and Fusion (JEFF) project is a collaboration between the countries participating in the NEA Data Bank. The JEFF library contains large sets of evaluated nuclear data, mainly for fission and fusion applications; it contains a number of different data types, including neutron and proton interaction data, radioactive decay data, fission yield data, thermal scattering law data and photo-atomic interaction data.

JEFF-3.1.1 Decay Data is the most recent dataset published by the JEFF project and was published in 2007[9]. A significant part of the decay data in this publication derives from the DDEP; elsewhere it is taken from UKHEDD-2.2, LNHB evaluations and NUBASE. The JEFF database does not contain unique evaluations of decay data.

The JEFF library can be accessed via the NEA Data Bank's webpages www.nea.fr/html/dbdata. The NEA also provides software to browse the library both online and via CD-ROM, which can be accessed or ordered free-of-charge at www.nea.fr/janis.

Decay data forms a small part of the JEFF library and the JEFF decay data is updated infrequently, with a twelve-year gap between the publication of JEF-2.2.3 and JEFF-3.1. NPL will therefore continue to recommend data from the primary datasources such as the DDEP. However the JEFF library will continue to be the most appropriate source for many users where a very large consistent set of data is required for example in reactor modelling applications. It is also expected many spectrometrists will continue to prefer using the JEFF library and there are no quality issues which should prevent them from doing so.

2.5. UK (Nexia) decay data files

UKPADD-6.7/UKHEDD-2.5 contain evaluations commissioned by BNFL plc and published by Nexia Solutions Ltd with funding from the Nuclear Decomissioning Authority. While these evaluations are recognised as being of a high quality, there is significant overlap with the DDEP data and NPL consider the data from DDEP more likely to be internationally recognised. It should be noted that UKPADD-6.7 and UKHEDD-2.5 are incorporated into release 3.1.1 of the JEFF library.

3. Other data sources

3.1. Useful reference works

The following are useful reference works pertaining to nuclear decay data. These are not recommended as sources of data for use in precise measurements or radiochemical analysis, for which the user is instead referred to the sources in section 3.

Table de Radionucléides[10] is a four-volume book published between 1982 and 1986 by LMRI (now LNHB). This work was the precursor of the DDEP, and has been largely superceded by the DDEP. Indeed, BIPM Monographie 5 is titled 'Table of Radionuclides'.

Karlsruhe Chart of Nuclides[11] is compiled and published by Institute for Transuranium Elements (ITU) in Karlsruhe, Germany, with support from the European Commission. It should be noted there are some significant discrepancies between the data in this publication and that in the recommended data sources. This also applies to the associated database search engine **Nucleonica**.

Table of Isotopes is a series of publications[13-16] incorporating nuclear structure data taken from the Nuclear Physics and Nuclear Data Sheets journals. These publications are often casually referred to by the names of the authors (Browne and Firestone; Lederer and Shirley). The latest edition was published in 1996. Each publication can be regarded as a snapshot of the ENSDF database, and more up-to-date data can can usually be found by referring direct to ENSDF.

The 16th edition of **Kaye and Laby**[17] is available both in paper form and in electronic form via the NPL website. Part of this publication contains a "Table of Radioactive Elements". It is not recommended that half lives are taken from Kaye and Laby for measurements where traceability is required.

Brookhaven National Laboratories' **Nuclear Wallet Cards**[18] and **Nuclear Wallet Cards for Radioactive Nuclides**[19] are a useful pocketable guide to decay data. The data contained therein are abstracted from the ENSDF database. For the purposes of traceability users are advised to refer instead to the parent databases, NUDAT or ENSDF.

The Radiochemical Manual[20], published in 1998, superceded the 1966 publication of the same name[21]. It is concerned with the measurement, analysis, production and safe use of radionuclides. It contains a chapter on nuclear decay data, and on p82 a table of specific activities.

It is considered the nuclear decay data in chapter 8 of this report have in most cases been superceded by the DDEP data. The specific activities on p82 of the Radiochemical Manual are provided without uncertainties and therefore it is not recommended that these values are used for analysis. It is recommended that users of the nuclear data in the radiochemical manual refer instead to the DDEP. Specific activities based upon the DDEP data and the latest atomic mass evaluations are given in Section 7.

3.2. Obsolete data sources

The following are data sources which have been superceded either by newer editions of the same publication or by newer publications.

JEFF-3.0[22]/**JEF-2.2**[23] are historical versions of the JEFF database described in section 4.4. The decay data are the same in both, having being abstracted from other data sources prior to the publication of JEF-2.2. Users who wish to continue using the JEFF database should migrate to version 3.1.

The **Lund Nuclear Data Server**[24] has gained widespread use through providing a user friendly interface and search facilities. However, the Lund Nuclear Data Server ceased to be maintained in 2004, in addition to which some of the data in Lund may be misleading to the operator as the uncertainty of the gamma emission normalisation factor has not been included. It is recommended users who require search facilities with reliable nuclear decay data consult either the NUDAT2 or JEFF databases.

ICRP Publication 38[25] contains radioactive decay data on radionuclides with radioactive half-lives of more than ten minutes. The tables were designed to facilitate use of the book for dosimetric calculations and in the identification and assay of radionuclides in experimental studies and in monitoring. This publication is now in excess of twenty years old. Users of the radioactive decay data in this publication are advised to refer instead to the sources recommended in section 3.

NPL Report RSA(EXT)53[26] published in 1995 contains tabulated data for half lives, emission probabilities and energies of the major emissions of 53 radionuclides. It has been superceded by the DDEP.

NPL Report CAIR 8[5] was published in 2004 as part of the IAEA project to replace TECDOC-619. As the IAEA data is now available reference should be made directly to the IAEA data. The exceptions are for ^{124}I and ^{147}Pm, which were included in CAIR 8 but have not been adopted into the IAEA data. There is considerable crossover between this publication and the DDEP data, and NPL's preference is for the DDEP data.

IAEA TECDOC-619 and **IAEA Technical Report Series 261** have to an extent been superceded by later publications, and their replacements are described in section 3.2.

4. Recommended Half Lives

4.1. Introduction

Table 1 lists the half lives currently recommended by NPL. These are taken from the following data sources, in order of preference:

- The Decay Data Evaluation Project (DDEP)
- International Atomic Energy Agency data (IAEA)
- ENSDF

The exceptions are for ^{124}I and ^{147}Pm, where the recommended half lives have been taken from NPL Report CAIR 8.

Uncertainties are quoted as standard uncertainties at k=1 and are assumed to be normally distributed. For clarity, where the half life includes an exponent, the same exponent is maintained in the uncertainty.

Note that the values in the table below have been converted to days where necessary, applying the conversion factor 1 year = 365.242198, and rounded where appropriate.

4.2. Changes since previous edition

None – this is the first edition of this report.

4.3. Recommended values

Radionuclide	Half life (days)	Uncertainty of half life (days)	Data source
^{3}H	4497	9	DDEP
^{7}Be	53.22	0.06	DDEP
^{11}C	0.014146	0.000020	DDEP
^{13}N	6.922×10^{-3}	0.003×10^{-3}	DDEP
^{14}C	2.082×10^{6}	0.011×10^{6}	DDEP
^{15}O	1.417×10^{-3}	0.004×10^{-3}	DDEP
^{18}F	0.076200	0.00013	DDEP
^{22}Na	950.6	0.4	DDEP
^{24}Na	0.62323	0.00008	DDEP
^{26}Al	2.62×10^{8}	0.09×10^{8}	DDEP
^{32}P	14.28	0.04	DDEP
^{33}P	25.38	0.04	DDEP
^{35}S	87.32	0.16	DDEP
^{36}Cl	1.099×10^{8}	0.011×10^{8}	DDEP
^{40}K	4.62×10^{11}	0.05×10^{11}	DDEP
^{41}Ar	0.07612	0.00003	ENSDF
^{42}K	0.5150	0.0005	ENSDF
^{43}K	0.929	0.004	ENSDF
^{44}Sc	0.1654	0.0017	DDEP
^{44}Ti	21900	400	DDEP
^{46}Sc	83.788	0.022	DDEP
^{47}Ca	4.536	0.003	ENSDF
^{47}Sc	3.3492	0.0006	ENSDF
^{48}V	15.9735	0.0025	ENSDF
^{51}Cr	27.703	0.003	DDEP
^{54}Mn	312.13	0.03	DDEP
^{55}Fe	1003	3	DDEP
^{56}Co	77.236	0.026	DDEP
^{56}Mn	0.107449	0.000019	DDEP
^{57}Co	271.80	0.05	DDEP
^{57}Ni	1.496	0.013	DDEP

Radionuclide	Half life (days)	Uncertainty of half life (days)	Data source
^{58}Co	70.83	0.10	DDEP
^{59}Fe	44.495	0.008	DDEP
^{60}Co	1925.2	0.3	DDEP
^{63}Ni	36000	900	DDEP
^{64}Cu	0.52921	0.00008	DDEP
^{65}Zn	244.01	0.09	DDEP
^{66}Ga	0.395	0.003	DDEP
^{67}Cu	2.576	0.005	ENSDF
^{67}Ga	3.2613	0.0005	DDEP
^{68}Ga	0.04702	0.00006	DDEP
^{68}Ge	270.95	0.16	DDEP
^{75}Se	119.79	0.04	DDEP
^{79}Se	1.30×10^{8}	0.15×10^{8}	DDEP
^{81m}Kr	1.516×10^{-4}	0.004×10^{-4}	ENSDF
^{82}Br	1.4701	0.0003	ENSDF
^{84}Rb	32.77	0.14	ENSDF
^{85}Kr	3927	8	DDEP
^{85}Sr	64.850	0.007	DDEP
^{86}Rb	18.642	0.018	ENSDF
^{87m}Sr	0.1173	0.0005	ENSDF
^{88}Y	106.626	0.021	DDEP
^{89}Sr	50.57	0.03	DDEP
^{90}Sr	10520	30	DDEP
^{90}Y	2.6684	0.0013	DDEP
^{90m}Y	0.1329	0.0025	DDEP
^{93m}Nb	5890	60	DDEP
^{94}Nb	7.3×10^{6}	0.9×10^{6}	IAEA
^{95}Nb	34.991	0.006	DDEP
^{95m}Nb	3.61	0.03	DDEP
^{95m}Tc	61	2	ENSDF
^{95}Zr	64.032	0.006	DDEP
^{97m}Tc	90.1	1.0	ENSDF

Radionuclide	Half life (days)	Uncertainty of half life (days)	Data source
^{99}Mo	2.7479	0.0006	DDEP
^{99}Tc	7.8×10^{7}	0.3×10^{7}	DDEP
^{99m}Tc	0.25028	0.00004	DDEP
^{103}Ru	39.247	0.013	IAEA
^{106}Rh	3.48×10^{-4}	0.04×10^{-4}	IAEA
^{106}Ru	371.8	1.8	IAEA
^{108}Ag	1.654×10^{-3}	0.008×10^{-3}	DDEP
^{108m}Ag	160000	4000	DDEP
^{109}Cd	461.4	1.2	DDEP
^{110}Ag	2.843×10^{-4}	0.013×10^{-4}	DDEP
^{110m}Ag	249.78	0.02	DDEP
^{111}In	2.8049	0.0004	DDEP
^{113m}In	0.06908	0.00016	DDEP
^{113}Sn	115.09	0.03	DDEP
^{114m}In	49.51	0.01	ENSDF
^{121}Te	19.16	0.05	ENSDF
^{123}I	0.55098	0.00015	DDEP
^{123m}Te	119.3	0.1	DDEP
^{124}I	4.16	0.06	CAIR 8
^{124}Sb	60.20	0.03	ENSDF
^{125}I	59.407	0.009	DDEP
^{125}Sb	1007.54	0.09	DDEP
^{129}I	5.88×10^{9}	0.26×10^{9}	DDEP
^{131}I	8.0223	0.0019	DDEP
^{131m}Xe	11.930	0.016	DDEP
^{132}I	0.0956	0.0006	ENSDF
^{132}Te	3.204	0.013	ENSDF
^{133}Ba	3849.7	2.2	DDEP
^{133}Xe	5.256	0.009	DDEP
^{133m}Xe	2.198	0.013	DDEP
^{134}Cs	753.5	1.0	IAEA
^{137m}Ba	1.7722×10^{-3}	0.0007×10^{-3}	DDEP

Radionuclide	Half life (days)	Uncertainty of half life (days)	Data source
^{137}Cs	10976	30	DDEP
^{139}Ce	137.641	0.020	DDEP
^{140}Ba	12.753	0.004	DDEP
^{140}La	1.67850	0.00017	DDEP
^{141}Ce	32.508	0.010	DDEP
^{144}Ce	285.1	0.6	IAEA
^{144}Pm	363	14	ENSDF
^{147}Nd	10.98	0.01	ENSDF
^{147}Pm	940	40	CAIR 8
^{152}Eu	4939	6	DDEP
^{153}Gd	240.4	1.0	DDEP
^{153}Sm	1.92855	0.00005	DDEP
^{154}Eu	3141.5	1.4	DDEP
^{155}Eu	1736	5	DDEP
^{159}Gd	0.7700	0.0003	DDEP
^{160}Tb	72.3	0.2	ENSDF
^{166}Ho	1.1165	0.0012	DDEP
^{166m}Ho	4.4×10^5	0.7×10^5	DDEP
^{169}Yb	32.018	0.005	DDEP
^{170}Tm	127.8	0.6	DDEP
^{177}Lu	6.647	0.004	DDEP
^{187}W	0.9883	0.0025	ENSDF
^{186}Re	3.7186	0.0017	DDEP
^{188}Re	0.70854	0.00017	DDEP
^{192}Ir	73.827	0.013	DDEP
^{194}Ir	0.804	0.004	DDEP
^{195}Au	186.10	0.05	ENSDF
^{197}Hg	2.6725	0.0021	ENSDF
^{198}Au	2.6944	0.0008	DDEP
^{199}Au	3.139	0.007	ENSDF
^{200}Tl	1.088	0.004	ENSDF
^{201}Tl	3.0421	0.0017	DDEP

Radionuclide	Half life (days)	Uncertainty of half life (days)	Data source
^{202}Tl	12.23	0.02	ENSDF
^{203}Hg	46.594	0.012	DDEP
^{203}Pb	2.1637	0.0004	DDEP
^{204}Tl	1384	6	DDEP
^{207}Bi	12000	500	DDEP
^{208}Po	1058.5	0.7	ENSDF
^{208}Tl	2.125×10^{-3}	0.006×10^{-3}	DDEP
^{209}Po[1]	37300	1800	ENSDF
^{210}Bi	5.012	0.005	ENSDF
^{210}Pb	8110	80	ENSDF
^{210}Po	138.376	0.002	ENSDF
^{212}Bi	0.04204	0.00004	DDEP
^{212}Pb	0.4433	0.0004	DDEP
^{212}Po	3.472×10^{-12}	0.023×10^{-12}	DDEP
^{214}Bi	0.0138	0.0003	DDEP
^{214}Pb	0.0186	0.0006	DDEP
^{214}Po	1.878×10^{-9}	0.014×10^{-9}	DDEP
^{216}Po	1.74×10^{-6}	0.06×10^{-6}	DDEP
^{218}At	1.62×10^{-5}	0.23×10^{-5}	DDEP
^{218}Po	2.149×10^{-3}	0.004×10^{-3}	DDEP
^{218}Rn	4.17×10^{-7}	0.22×10^{-7}	DDEP
^{220}Rn	6.46×10^{-4}	0.04×10^{-4}	DDEP
^{222}Rn	3.8232	0.0008	DDEP
^{223}Ra	11.43	0.05	DDEP
^{224}Ra	3.627	0.007	DDEP
^{226}Ra[2]	5.844×10^{5}	0.025×10^{5}	DDEP
^{227}Th	18.718	0.005	DDEP
^{228}Ra	2100	11	ENSDF
^{228}Th	698.60	0.23	DDEP
^{228}Th	698.60	0.23	DDEP

[1] Note that discrepancies of the order of 25 % have been reported regarding the half life of ^{209}Po [26].
[2] The half life for ^{226}Ra is quoted with more significant figures than in DDEP based upon information in the comments file.

Radionuclide	Half life (days)	Uncertainty of half life (days)	Data source
^{230}Th	2.758×10^{7}	0.018×10^{7}	DDEP
^{231}Pa	1.197×10^{7}	0.004×10^{7}	ENSDF
^{232}Th	5.132×10^{12}	0.022×10^{12}	ENSDF
^{232}U	25170	150	ENSDF
^{233}Pa	26.984	0.018	DDEP
^{233}Th	0.01538	0.00010	DDEP
^{233}U	5.815×10^{7}	0.007×10^{7}	ENSDF
^{234m}Pa	8.05×10^{-4}	0.11×10^{-4}	IAEA
^{234}Th	24.10	0.03	DDEP
^{234}U	8.967×10^{7}	0.022×10^{7}	DDEP
^{235}U	2.5706×10^{11}	0.0018×10^{11}	ENSDF
^{236}Np	5.7×10^{7}	0.3×10^{7}	DDEP
^{236m}Np	0.938	0.017	DDEP
^{236}Pu	1044	3	ENSDF
^{236}U	8.554×10^{9}	0.015×10^{9}	ENSDF
^{237}Np	7.82×10^{8}	0.04×10^{8}	DDEP
^{237}U	6.749	0.016	DDEP
^{238}Np	2.102	0.005	DDEP
^{238}Pu	32046	11	DDEP
^{238}U	1.6319×10^{12}	0.0018×10^{12}	DDEP
^{239}Np	2.356	0.003	DDEP
^{239}Pu	8.806×10^{6}	0.011×10^{6}	ENSDF
^{240}Pu	2.396×10^{6}	0.003×10^{6}	DDEP
^{241}Am	158000	220	DDEP
^{241}Pu	5234	15	DDEP
^{242}Cm	162.86	0.08	DDEP
^{242}Pu	1.362×10^{8}	0.011×10^{8}	DDEP
^{243}Am	2.692×10^{6}	0.006×10^{6}	DDEP
^{244}Cm	6615	11	DDEP
^{250}Cf	4780	40	ENSDF
^{252}Cf	966	3	ENSDF

5. Specific Activities

5.1. Introduction

Table 2 lists specific activities derived from the half lives provided in table 1 and current recommended atomic masses, published by Audi, Wapstra and Thibault[28]. The specific activity is given by:

$$S = \frac{\log_e 2 \, N_A}{86400 \, t_{1/2} \, A}$$

Where $t_{1/2}$ is the radionuclide half-life in days, N_A is Avogadro's constant and A the atomic mass of the radionuclide. Avagadro's constant is taken from the latest CODATA bulletin[29] at 6.02214179(30) × 10^{23} mol^{-1}.

The uncertainty is given by:

$$u(S) = \sqrt{\left(\frac{u(N_A)}{N_A}\right)^2 + \left(\frac{u(t_{1/2})}{t_{1/2}}\right)^2 + \left(\frac{u(A)}{A}\right)^2}$$

The uncertainty associated with Avagadro's number and the atomic mass are generally negligable however are included for completeness. Any correlations between $u(t_{1/2})$ and $u(A)$ are assumed to be negligable.

Uncertainties are quoted as standard uncertainties at *k*=1 and are assumed to be normally distributed. For clarity, where the specific activity includes an exponent, the same exponent is maintained in the uncertainty.

5.2. Changes since previous edition

None – this is the first edition of this report.

5.3. Recommended values

Radionuclide	Specific Activity ($Bq.g^{-1}$)	Uncertainty of Specific Activity ($Bq.g^{-1}$)
^{3}H	3.562×10^{14}	0.007×10^{14}
^{14}C	1.657×10^{11}	0.009×10^{11}
^{26}Al	7.10×10^{8}	0.24×10^{8}
^{36}Cl	1.222×10^{9}	0.012×10^{9}
^{40}K	2.62×10^{5}	0.03×10^{5}
^{44}Ti	5.02×10^{12}	0.09×10^{12}
^{63}Ni	2.13×10^{12}	0.06×10^{12}
^{79}Se	4.7×10^{8}	0.6×10^{8}
^{85}Kr	1.449×10^{13}	0.003×10^{13}
^{90}Sr	5.108×10^{12}	0.015×10^{12}
^{93m}Nb	8.83×10^{12}	0.09×10^{12}
^{94}Nb	7.05×10^{10}	0.09×10^{10}
^{99}Tc	6.26×10^{8}	0.24×10^{8}
^{108m}Ag	2.80×10^{11}	0.07×10^{11}
^{129}I	6.4×10^{6}	0.3×10^{6}
^{133}Ba	9.4425×10^{12}	0.006×10^{12}
^{137}Cs	3.215×10^{12}	0.009×10^{12}
^{152}Eu	6.439×10^{12}	0.008×10^{9}
^{166m}Ho	6.6×10^{10}	1.1×10^{10}
^{207}Bi	1.95×10^{12}	0.08×10^{12}
^{209}Po[3]	6.2×10^{11}	0.3×10^{11}
^{210}Pb	2.84×10^{12}	0.03×10^{12}
^{226}Ra	3.658×10^{10}	0.016×10^{10}
^{230}Th	7.62×10^{8}	0.05×10^{8}
^{231}Pa	1.747×10^{9}	0.006×10^{9}
^{232}Th	4057	17
^{232}U	8.27×10^{11}	0.05×10^{11}
^{233}U	3.565×10^{8}	0.005×10^{8}
^{234}U	2.302×10^{8}	0.006×10^{8}
^{235}U	79960	60

[3] Note that discrepancies of the order of 25 % have been reported regarding the half life of ^{209}Po, on which this value depends [30].

Radionuclide	Specific Activity ($Bq.g^{-1}$)	Uncertainty of Specific Activity ($Bq.g^{-1}$)
^{236}U	2.393×10^{6}	0.004×10^{6}
^{236}Np	3.59×10^{8}	0.19×10^{8}
^{237}Np	2.606×10^{7}	0.013×10^{7}
^{238}Pu	6.3332×10^{11}	0.0022×10^{11}
^{238}U	12437	14
^{239}Pu	2.295×10^{9}	0.003×10^{9}
^{240}Pu	8.400×10^{9}	0.011×10^{9}
^{241}Am	1.2685×10^{11}	0.0018×10^{11}
^{241}Pu	3.829×10^{12}	0.011×10^{12}
^{242}Pu	1.465×10^{8}	0.012×10^{8}
^{243}Am	7.384×10^{9}	0.016×10^{9}
^{244}Cm	2.992×10^{12}	0.005×10^{12}
^{250}Cf	4.04×10^{12}	0.04×10^{12}

5.4. Specific activity of natural Potassium

Based upon the following molar fractions[31], the specific activity of natural potassium is calculated at 31.3(5) Bq/g ^{40}K.

Isotope	Natural Abundance (molar fraction) %	Atomic Mass
^{39}K	93.2581(44)	38.963706679(204)
^{40}K	0.0117(1)	39.963998475(206)
^{41}K	6.7302(44)	40.961825762(356)

5.5. Specific activity of natural Uranium

Based upon the following molar fractions[31], the specific activity of chemically pure natural Uranium is calculated at 12.2(11) kBq/g ^{234}U, 568.8(7) Bq/g ^{235}U and 12.348(14) kBq/g ^{238}U.

Isotope	Natural Abundance (molar fraction) %	Atomic Mass
^{234}U	0.0054(5)	234.040952088(1960)
^{235}U	0.7204(6)	235.043929918(1957)
^{238}U	99.2742(10)	238.049559894(1968)

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